HONG KONG HOUSING AUTHORITY

SPECIFICATION LIBRARY 2022 (BATCH 4) EDITION

(April 2026 version)

README-22

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1. HONG KONG HOUSING AUTHORITY SPECIFICATION LIBRARY

(a) The Hong Kong Housing Authority Specification Library 2022 Edition (SL), which is issued by the Housing Department comprises:

(i) This **README-22** file which describes the structure and features of SL including clause numbering system, clause referencing system and the Worksections arrangement. It also provides a description, the clause numbering system and clause referencing system for Project Specific Specification (PSS).

(ii) Specification clauses which are composed of clause numbers, clause titles, text and associated headings.

(b) The SL is divided into 10 libraries, namely:

(i) Preliminaries Specification,

(ii) Architectural Works Specification,

(iii) Drainage and External Works Specification,

(iv) Structural Engineering Works Specification,

(v) Demolition Works Specification,

(vi) Foundation Works Specification,

(vii) Soft Landscape Works Specification,

(viii) Building Services Installation Specification,

(ix) Civil Engineering Works Specification, &

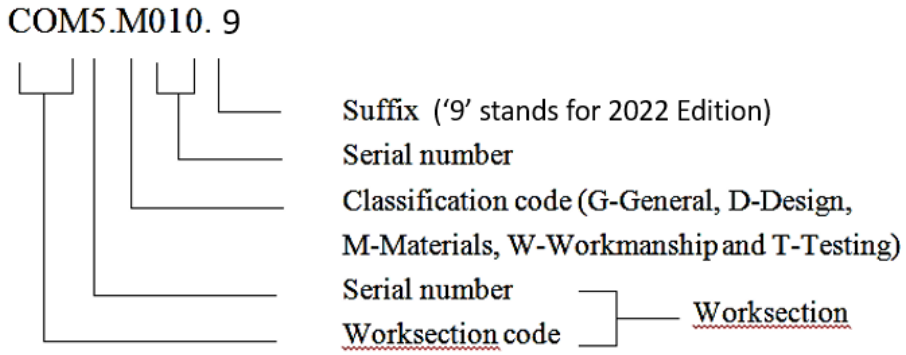
(x) Geotechnical Engineering Works Specification.

(c) The library of 'Preliminaries Specification' is a reference document provided for information only. Specification clauses on Preliminaries for each contract are given in the PSS of the contract documentation.

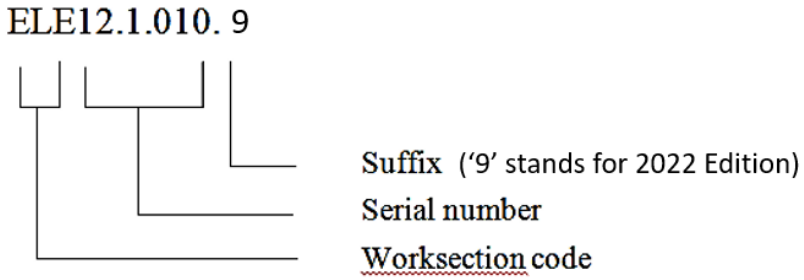
(d) The Tables of Contents which show the content of various libraries of the SL are given in **pages TOC/1 to TOC/12**.

1.1 SL Clause Numbering System

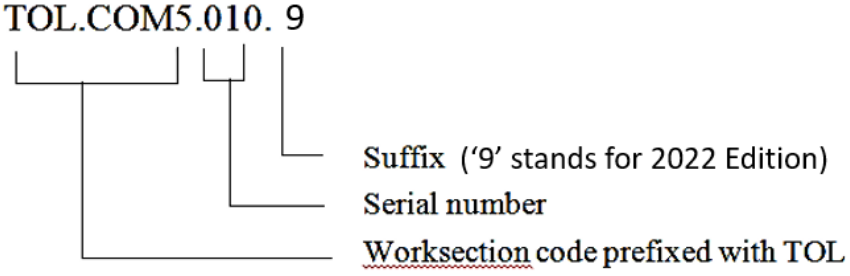
(a) Except for the library of 'Building Services Installation Specification' and Appendix H as contained in the library of 'Structural Engineering Works Specification', the format of the clause number of each specification clause is as follows:



(b) For the library of 'Building Services Installation Specification', the format of the clause number of each specification clause is as follows:



(c) For Appendix H 'Schedule of Tolerances' as contained in the library of 'Structural Engineering Works Specification', the format of the clause number of each specification clause for tolerance is as follows:



2. PROJECT SPECIFIC SPECIFICATION (PSS)

PSS, which comprises PSS clauses, is supplied on a contract basis in the contract documentation. The PSS clauses shall be read in conjunction with the SL. The two documents are to be taken as mutually explanatory to one another subject that PSS shall prevail over SL.

2.1 PSS Clauses

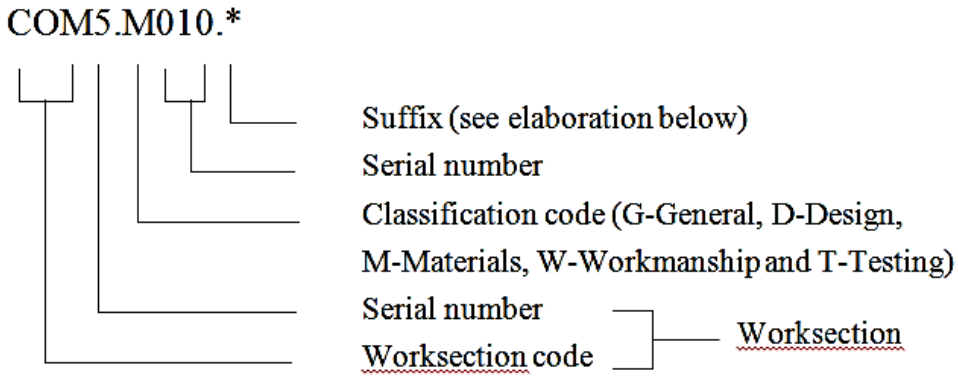
PSS clauses are specification clauses contained in PSS, which are either deletions, omissions, substitutions, alterations or additions to specification clauses contained in SL having identical clause number except the suffix, or additions not specified in SL.

Provided always that where a PSS clause has a clause number which is identical to a clause number in SL, with the exception of the suffix, the PSS clause shall take precedence over and substitute that clause in SL.

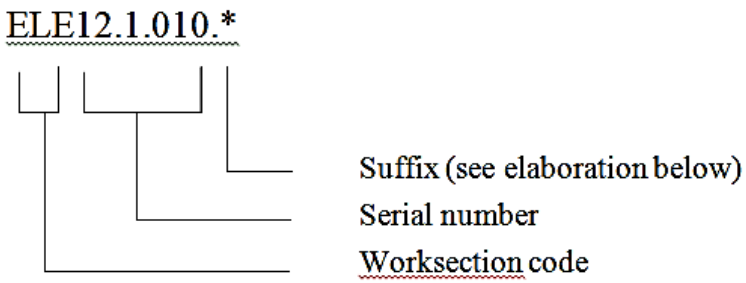
2.2 PSS Clause Numbering System

The format of the clause number for PSS clauses is the same as that for specification clauses in SL except for the suffix:

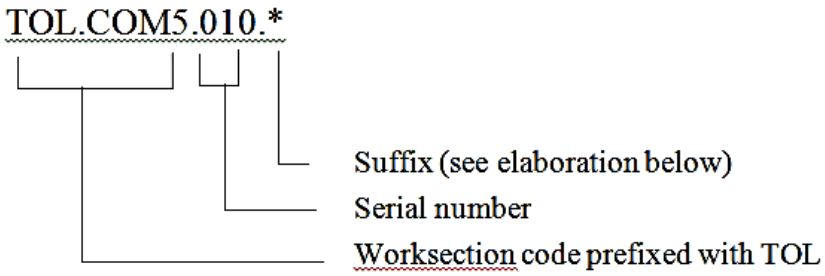
(a) Except for the PSS clauses that are to be read in conjunction with the library of 'Building Services Installation Specification' and Appendix H as contained in the library of 'Structural Engineering Works Specification', the format of the clause number of each PSS clause is as follows:



(b) For PSS clauses that are to be read in conjunction with the library of 'Building Services Installation Specification', the format of the clause number of each PSS clause is as follows:



(c) For PSS clauses that are to be read in conjunction with Appendix H as contained in the library of 'Structural Engineering Works Specification', the format of the clause number of each PSS clause for tolerance is as follows:



(d) Suffix to PSS clause number is designated as follows:

	Suffix
Amendments to SL on contract basis only: – substitutions, alterations, additions or omissions to specification clauses contained in SL.	P
Amendments to SL generally: – addition of new specification clauses to SL. – deletion of specification clauses from SL. – substitutions or alterations to specification clauses contained in SL or to new specification clauses added to SL.	N X A, B, etc

3. REFERENCE TO CLAUSE

When a clause is referred to by another clause in SL and / or PSS, the clause number of the referred clause is to be given without the suffix.

TABLE OF CONTENTS

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LIBRARIES FOR HONG KONG HOUSING AUTHORITY SPECIFICATION LIBRARY

- **Preliminaries Specification**
- **Architectural Works Specification**
- **Drainage and External Works Specification**
- **Structural Engineering Works Specification**
- **Demolition Works Specification**
- **Foundation Works Specification**
- **Soft Landscape Works Specification**
- **Building Services Installation Specification**
- **Civil Engineering Works Specification**
- **Geotechnical Engineering Works Specification**

PRELIMINARIES SPECIFICATION

Table of Contents

PRE.B Preliminaries for Building, Foundation, Demolition and Soft Landscape Contracts

PRE.B1 Project Particulars
PRE.B2 The Works
PRE.B3 The Site
PRE.B4 Possession and Completion
PRE.B5 The Contract Conditions
PRE.B6 Information Required by Conditions of Contract
PRE.B7 Documentation and Records
PRE.B8 Contractor's Obligations
PRE.B9 Quality Standards
PRE.B10 Temporary Works and Facilities
PRE.B11 Work, Materials and Services by Others
PRE.B12 Attendance

PRE.BS Preliminaries for Building Services Sub-Contracts

PRE.BS1 Preliminaries

PRE.C Preliminaries for Civil and Geotechnical Engineering Contracts

PRE.C1 Project Particulars
PRE.C2 The Works
PRE.C3 The Site
PRE.C4 Possession and Completion
PRE.C5 The Contract
PRE.C6 Information Required by Conditions of Contract
PRE.C7 Documentation and Records
PRE.C8 Quality Standards
PRE.C9 Contractor's Obligations
PRE.C10 Traffic Arrangements
PRE.C11 Temporary Works and Facilities
PRE.C12 Attendance
PRE.C13 Appendix 1
PRE.C14 Appendix 2
PRE.C15 Appendix 3

Appendices

APA	***Appendix A -***	***Site/Phase/Estate Boundary Plan***
APB	***Appendix B -***	***List of Contract Drawings***
APC	***Appendix C -***	***Sketches and Details***
APD	***Appendix D -***	***Schedule of Samples to be Provided by the Contractor***
APP	***Appendix P -***	***List of Sub-contract Drawings***
APQ	***Appendix Q -***	***Extracts from the Main Contract***
APR	***Appendix R -***	***Information Required by Conditions of Sub-contract***
APS	***Appendix S -***	***Building Services Material Delivery Inventory Record***
APU	***Appendix U -***	***List of Reference Drawings / Documents***
APV	***Appendix V -***	***List of Sub-contract Reference Drawings / Documents***
APW	***Appendix W -***	***BEAM Plus requirements in building services nominated sub-contracts***
APZ	***Appendix Z -***	***Commissioning Management Plan***

ARCHITECTURAL WORKS SPECIFICATION

Table of Contents

CLA ***Cladding***

CLA1 Profiled Sheet Roofing and Cladding
CLA2 Chinese Tiling
CLA4 Sheet Metal Coverings

COM ***Components***

COM1 Stainless Steel Windows, Doors and Louvres
COM2 Aluminium Windows and Louvres
COM3 uPVC Windows
COM4 Glazing
COM5 Timber Doorsets
COM6 Steel Doors
COM7 Gatesets
COM8 Roller Shutters and Doors
COM9 Cooking Bench/Sink Units
COM10 Glass Panel
COM11 Radio Frequency Identification and Web-based Database System for Building Components
COM12 Plastic Folding Doors

FIN ***Finishings***

FIN1 Plastered and Rendered Finishes
FIN2 Plasterboard
FIN3 Screeds
FIN4 Insitu Wall and Floor Finishes
FIN5 Floor and Wall Tiles and Slabs
FIN6 Flexible Sheet and Tile Finishes
FIN7 Painting
FIN8 Proprietary Suspended Ceilings

IRO ***Ironmongery***

IRO1 Ironmongery

MAS ***Masonry***

MAS1 Brickwork, Blockwork and Panel Partitions
MAS2 Stonework
MAS3 Mortar

MET ***Metalwork***

MET1 General Metalwork

ARCHITECTURAL WORKS SPECIFICATION

Table of Contents (Cont'd)

PLU ***Plumbing and Sanitary Fittings***

PLU1 Water Supply
PLU2 Sanitary Appliances

TIM ***Timber Works***

TIM1 Carpentry and Joinery

WAT ***Waterproofing***

WAT1 Asphalt Work
WAT2 Bitumen Felt Roofing
WAT3 Single Ply Roofing
WAT4 Flashings
WAT5 Sealants
WAT6 Proprietary Waterproofing Systems

AP1.PLU ***APPENDIX 1 - PLU***

DRAINAGE AND EXTERNAL WORKS SPECIFICATION

Table of Contents

DRA ***Drainage***

DRA1 Drainage Above Ground
DRA2 Drainage Below Ground

EXT ***External and Landscape Works***

EXT1 Sub-bases, Bituminous Roadways and Related Footpaths
EXT2 Concrete Carriageways
EXT3 Paths and Paved Areas
EXT4 Route Indicators
EXT5 Kerbs, Edgings and Quadrants
EXT6 Concrete Profile Barriers
EXT7 Untensioned Beam Barriers
EXT8 Road Marking
EXT9 Fencing, Gates and Guardrails
EXT10 Play/Fitness Equipment and Play Surfaces
EXT11 Existing Vegetation Treatment
EXT12 Earthworks
EXT13 Drainage to Planters
EXT14 Hydroseeding
EXT15 Miscellaneous External Works
EXT16 Zero Irrigation System (ZIS) – Insitu Type
EXT17 Automatic Drip Irrigation System

STRUCTURAL ENGINEERING WORKS SPECIFICATION

Table of Contents

CON ***Concrete Works***

CON1 Insitu Concrete
CON2 Formwork
CON3 Reinforcement
CON4 Precast Concrete
CON5 Precast Facade Units (Contractor's Design)
CON6 Movement Joints
CON7 Precast Concrete Components (Engineer's Design)
CON8 Volumetric Precast Concrete Components for Domestic Blocks
CON9 Off-site Steel Reinforcing Bar Prefabrication Yard

EAR ***Earthwork***

EAR1 Excavation and Filling
EAR2 Blasting

STR ***Structural Steelwork***

STR1 Structural Steel

Appendices

APE ***Appendix E - Modification to Design of Domestic Blocks***

APE1 Scope of Appendix
APE2 Terms and Requirements on Permitted Modifications Proposed in Tender Stage
APE3 Terms and Requirements on Proposals for Modifications in Post-contract Stage
APE4 Acceptance Criteria for Proposed Modifications To Design and/or Specification for Domestic Blocks

APH ***Appendix H - Schedule of Tolerances***

DEMOLITION WORKS SPECIFICATION

Table of Contents

DEM ***Demolition***

DEM1 Demolishing Structures
DEM2 Asbestos Removal

FOUNDATION WORKS SPECIFICATION

Table of Contents

PIL ***Piling and Footing***
PIL1 Piling and Footing

SOFT LANDSCAPE WORKS SPECIFICATION

Table of Contents

SLW	***Soft Landscape Works***
SLW1	General Planting Requirements
SLW2	Trees
SLW3	Ground Cover, Shrubs, Climbers and Bamboos
SLW4	Herbaceous Plants
SLW5	Aquatic Plants
SLW6	Indoor Plants
SLW7	Grassing
SLW8	Tree Surgery Works
SLW9	Establishment Works

BUILDING SERVICES INSTALLATION SPECIFICATION

Table of Contents

ELECTRICAL INSTALLATION

ELE1	General Requirements
ELE2	System Requirements
ELE3	Low Voltage Switchgear and Associated Equipment
ELE4	Cubicle Type Switchboards
ELE5	Power Factor Correction Equipment
ELE6	Busbar Chambers and Busbar Trunking Systems
ELE7	Cables
ELE8	Installation of Power Cables
ELE9	Cable Ducts and Cable Trays
ELE11	Wiring System in Steel Conduits
ELE12	Wiring System in Steel Trunking
ELE13	Wiring System in Plastic Conduit or Plastic Trunking
ELE14	Lightning Protection System
ELE16	Miscellaneous Installations
ELE17	Earthing and Protection against Indirect Contact
ELE18	Domestic Appliances
ELE19	Installation of Domestic Appliances
ELE20	Wiring Accessories
ELE21	Lamps, Luminaires, etc. and Lighting Installation
ELE23	Communal Aerial Broadcast Distribution System
ELE24	Security System
ELE25	Public Address System
ELE26	Carpark Control and Management Facilities
ELE28	Miscellaneous Items
ELE29	Standby Diesel Generating Sets
ELE30	Testing and Maintenance
ELE31	Mechanical Ventilation Systems
ELE32	Green Issue
ELE33	Grid-connected Photovoltaic System
ELE34	Grid-backup Solar Powered Lighting
ELE34	Grid-backup Solar Powered Lighting
ELE35	Smart Meter Monitoring and Energy Information Display System for Domestic Blocks
ELE36	Automatic Meter Reading (AMR) Outstation for Water Supplies
ELE37	Electric Vehicle Charging Facilities
AP1	Appendix 1

BUILDING SERVICES INSTALLATION SPECIFICATION

Table of Contents (Cont'd)

FIRE SERVICES & WATER PUMP INSTALLATION

FWP1	General Requirements
FWP2	System Requirements
FWP3	Pipework and Fittings
FWP4	System Control Fittings
FWP5	Water Tanks
FWP6	Pumpsets
FWP7	Hydrant/Hosereel System Equipment and Foam Inlet
FWP8	Automatic Sprinkler System Installations
FWP9	Gas Extinguishing System Installation
FWP10	Fire Alarm and Control System Equipment
FWP11	Electrical Works
FWP12	Portable Equipment
FWP13	Miscellaneous
FWP14	Testing, Commissioning and Maintenance
FWP15	System Components
FWP16	Lift Pit Dewatering System
AP1.FWP	Appendix 1 - FWP
AP2.FWP	Appendix 2 - FWP

LIFT & ESCALATOR INSTALLATION

LTE1	General Requirements
LTE2	Lift Installation
LTE3	Escalator Installation
AP1.LTE	Appendix 1 - LTE

CIVIL ENGINEERING WORKS SPECIFICATION

Table of Contents

BRI ***Bridge Works***

BSW ***Work for Electrical and Mechanical Installations***

CLE ***Site Clearance***

FEN ***Fencing***

FOR ***Formwork***

MAR ***Marine Works***

MEW ***Metalwork***

MRY ***Masonry Walling***

PSC ***Prestressing Concrete***

STW ***Steelwork***

WRS ***Water Retaining Structures***

WSP ***Water Supply Pipework***

N.B. ***APA, APB, APH, CON, DRA, EAR, EXT, FIN, PIL, and WAT*****.....**
Refer to Preliminaries Specification, Architectural Works Specification, Drainage and External Works Specification, Structural Engineering Works Specification and Foundation Works Specification

GEOTECHNICAL ENGINEERING WORKS SPECIFICATION

Table of Contents

GIN ***Ground Investigation, Instrumentation and Soil Testing***

GRO ***Grouting for Geotechnical Works***

GWD ***Ground Water Drainage and Control***

SLO ***Slope Treatment Works***

N.B. ***APA, APB, APH, CON, DRA, EAR, EXT, FIN, PIL, and WAT*****.....**
Refer to Preliminaries Specification, Architectural Works Specification, Drainage and External Works Specification, Structural Engineering Works Specification and Foundation Works Specification

HONG KONG HOUSING AUTHORITY

SPECIFICATION LIBRARY 2022 (BATCH 4) EDITION

Preliminaries Specification

PRE.B PRELIMINARIES FOR BUILDING, FOUNDATION, DEMOLITION, AND SOFT LANDSCAPE CONTRACTS

PRE.B1 PROJECT PARTICULARS 22
PRE.B1.010.9 THE PROJECT 22
PRE.B1.020.9 THE CONTRACT MANAGER 22
PRE.B1.030.9 THE SURVEYOR 22

PRE.B2 THE WORKS 23
PRE.B2.010.C GENERAL DESCRIPTION OF THE WORKS 23
PRE.B2.020.9 WORKS SUBJECT TO EXCISION 26
PRE.B2.030.A PREPARATORY WORKS 26
PRE.B2.040.9 CONCURRENT ADJOINING WORKS 27
PRE.B2.050.9 WORK, MATERIALS AND SERVICES BY OTHERS 27

PRE.B3 THE SITE 28
PRE.B3.010.9 SITE LOCATION 28
PRE.B3.020.A SITE BOUNDARY 28
PRE.B3.030.9 PHASE/ESTATE BOUNDARY 28
PRE.B3.040.9 WORKS SUBJECT TO HIGH WATER LEVELS 28
PRE.B3.050.9 EXISTING BUILDINGS 28
PRE.B3.060.B EXISTING SERVICES 28
PRE.B3.070.B SITE INFORMATION 29
PRE.B3.080.9 ACCURACY OF PREVIOUS WORKS 30
PRE.B3.090.9 LIMITATIONS OF WORKING AREAS 30
PRE.B3.100.9 WORKS IN OCCUPIED PREMISES 31
PRE.B3.110.9 ACCESS TO THE SITE 31

PRE.B4 POSSESSION AND COMPLETION 32
PRE.B4.010.A PHASED POSSESSION OF THE SITE 32
PRE.B4.020.9 NOTIFIED DATE FOR COMMENCEMENT OF THE WORKS 32
PRE.B4.021.9 DATES FOR COMMENCEMENT OF SECTIONS 32
PRE.B4.030.9 PHASED ISSUANCE OF WORKING DRAWINGS AND DETAILS 33
PRE.B4.035.9 PHASED SUBMISSION OF CONTRACTOR'S DESIGN 33
PRE.B4.040.A RESTRICTIONS ON COMMENCEMENT 34
PRE.B4.050.B RESTRICTIONS ON COMMENCEMENT OF PILE INSTALLATION AND / OR FOOTING CONSTRUCTION AND / OR ELSW 36
PRE.B4.060.9 RESTRICTIONS ON COMMENCEMENT OF CONSTRUCTION OF PILE CAPS 38
PRE.B4.065.9 RESTRICTIONS ON COMMENCEMENT OF SITE FORMATION WORKS 39
PRE.B4.070.9 TIME FOR COMPLETION 40
PRE.B4.080.B SECTIONS FOR PHASED COMPLETION 40
PRE.B4.085.9 OCCUPATION OF NEW BUILDING 47
PRE.B4.090.9 TAKING CARE OF THE WORKS AFTER COMPLETION 48

PRE.B5 THE CONTRACT CONDITIONS 49
CONDITIONS OF CONTRACT 49
PRE.B5.010.9 GENERAL CONDITIONS OF CONTRACT 49
PRE.B5.020.9 SPECIAL CONDITIONS OF CONTRACT 49
PRE.B5.030.9 SAID CONDITIONS 49
PRE.B5.040.9 CONDITIONS OF SUB-CONTRACT FOR NOMINATED SUB-CONTRACTS 49
PRE.B5.050.9 INFORMATION REQUIRED BY SAID CONDITIONS 49

CONTRACT TERMINOLOGY 49
PRE.B5.110.9 CONTRACT DEFINITIONS 49
PRE.B5.120.9 EMPLOYER 49
PRE.B5.130.9 DIRECT CONTRACTOR 50
PRE.B5.140.9 DIRECT TESTING CONTRACTOR 50
PRE.B5.150.9 DIRECT CONTRACTOR'S WORKS 50
PRE.B5.160.9 DIRECT TESTING CONTRACTOR'S WORKS 50

PRE.B6 INFORMATION REQUIRED BY CONDITIONS OF CONTRACT 51

GENERAL CONDITIONS OF CONTRACT 51
PRE.B6.010.9 STATUS 51
PRE.B6.020.A LOCATION OF INFORMATION PROVIDED 51
PRE.B6.025.N GCC 2.2 - DUTIES AND POWERS OF THE SURVEYOR AND THE SURVEYOR'S REPRESENTATIVE 53
PRE.B6.030.9 GCC 3.1 - ASSIGNMENT 53
PRE.B6.035.E GCC 3.2 - SUB-CONTRACTING 54
PRE.B6.040.9 GCC 5.3 - ON-DEMAND BOND 63
PRE.B6.050.9 GCC 5.7 - PROGRAMME TO BE FURNISHED 64
PRE.B6.060.F GCC 5.8 - CONTRACTOR'S SUPERINTENDENCE 65
PRE.B6.065.C GCC 5.9 - CONTRACTOR'S EMPLOYEES 87
PRE.B6.070.9 GCC 5.11 - SAFETY, SECURITY AND ENVIRONMENTAL MANAGEMENT OF THE WORKS 91
PRE.B6.080.9 GCC 5.14 - THIRD PARTY INSURANCE 92
PRE.B6.085.A GCC 5.15 - DESIGN RESPONSIBILITY (BUILDING) 92
PRE.B6.090.9 GCC 5.27 - FACILITIES FOR OTHER PERSONS 94
PRE.B6.100.9 GCC 5.33 - CARE OF THE WORKS INSURANCE 94
PRE.B6.150.9 GCC 6.3 - PASSES 94
PRE.B6.170.N GCC 8.4 – EXTENSION OF TIME FOR COMPLETION 94
PRE.B6.200.9 GCC 9.1 - WORKS SUBJECT TO EXCISION 95
PRE.B6.210.9 GCC 10.1 - EXECUTION OF MAINTENANCE WORKS 95
PRE.B6.250.9 GCC 11.1(7) – MEASUREMENT AND VALUATION FOR PROVISIONAL QUANTITIES 98
PRE.B6.260.9 GCC 11.2 - VARIATIONS 98
PRE.B6.265.N GCC 11.6 - ASCERTAINMENT OF CLAIMS 98
PRE.B6.270.9 GCC 11.7 - SURVEYOR'S DETERMINATION AND ASCERTAINMENT 99
PRE.B6.300.9 GCC 14.1 - CONTRACTOR'S INTERIM STATEMENTS 100
PRE.B6.310.9 GCC 14.1 - PAYMENT FOR PRE-DETERMINED AMOUNTS FOR SITE SAFETY, ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE 101
PRE.B6.320.9 GCC 14.2 - INTERIM PAYMENTS, RETENTION MONEY AND INTEREST 101
PRE.B6.325.9 GCC14.2(1) – INTERIM PAYMENTS (FORMWORK TO CONCRETE WALLS OF DOMESTIC BLOCKS) 101
PRE.B6.350.B GCC 17.1 - AVOIDANCE AND RESOLUTION OF DISPUTES 102
PRE.B6.370.9 GCC 20.2(4) SCHEDULE OF PROPORTIONS 104

SPECIAL CONDITIONS OF CONTRACT 105
PRE.B6.500.A STATUS 105
PRE.B6.515.9 SCC5.13 - CARE OF THE WORKS INSURANCE 105
PRE.B6.520.9 SCC5.4 / SCC5.14 - DESIGN RESPONSIBILITY (ADJUSTMENT) 105
PRE.B6.550.9 SCC6.1 - PAYMENT OF WAGES OF SITE PERSONNEL 105
PRE.B6.580.9 SCC7.2 - STRUCTURAL WARRANTY 109

PRE.B6.590.9 SCC7.2 / SCC7.3 - WARRANTY AND DEED OF WARRANTY (ROOFING INSTALLATION, REFUGE FLOOR INSTALLATION AND / OR OTHER WATERPROOFING SYSTEM INSTALLATION) # ... 109
PRE.B6.600.9 SCC8.1 - POSSESSION OF THE SITE (FIXED RATE FOR DELAY) ... 110
PRE.B6.610.9 SCC8.3 - ADDITIONAL LIQUIDATED DAMAGES FOR DELAY ... 110
PRE.B6.612.9 *SCC8.3 / SCC8.5 / SCC8.7 - USE OF THE SITE BY POLICE AND OTHER DISCIPLINED SERVICES ... 110
PRE.B6.620.9 SCC8.3 - TAKING CARE OF THE WORKS AFTER COMPLETION ... 111
PRE.B6.625.9 SCC8.4 - TAKING CARE OF THE WORKS AFTER COMPLETION ... 111
PRE.B6.640.9 SCC8.4 - SECOND LIQUIDATED DAMAGES FOR DELAY (SSF) ... 112
PRE.B6.650.9 SCC8.5 - TAKING CARE OF THE WORKS AFTER COMPLETION ... 113
PRE.B6.660.9 SCC8.6 - EXTENSION OF TIME FOR COMPLETION ... 115
PRE.B6.680.9 SCC9.1 - WORKS SUBJECT TO EXCISION ... 115
PRE.B6.700.9 SCC11.2 / SCC11.3 / SCC11.4 - SCHEDULE OF RATES (FOR PART OF THE WORKS) ... 116
PRE.B6.720.9 SCC14.1 - SPECIALIST SUB-CONTRACTOR ... 116
PRE.B6.730.A SCC14.2 / SCC14.5* – SECURITY OF PAYMENT ... 116
PRE.B6.735.N SCC14.3 – PAYMENTS BY ELECTRONIC METHOD ... 117
PRE.B6.750.A SCC20.1 - CONTRACT PRICE FLUCTUATIONS ... 119
PRE.B6.810.A SCC22.3 - EXCAVATION PERMIT FOR WORKS ... 122
PRE.B6.820.A SCC22.4 - HOUSING CONSTRUCTION MANAGEMENT ENTERPRISE SYSTEM ... 123
PRE.B6.830.X DELETED ... 124
PRE.B6.850.9 SCC22.4 / SCC22.8 – WORKS WITHIN THE RAILWAY PROTECTION AREA ... 124

APPENDIX PRE.B6/I ... 125
SPECIAL CONDITIONS OF CONTRACT ... 125
PRE.B6.APPEND1.B FORMS EPS-F1 TO EPS-F6 ... 125

APPENDIX PRE.B6/II ... 139
SPECIAL CONDITIONS OF CONTRACT ... 139
PRE.B6.APPEND2.D GUIDELINES ON SCOPE AND CONTENTS OF SUB-CONTRACTORS MANAGEMENT PLAN ... 139

APPENDIX PRE.B6/III ... 144
PRE.B6.APPEND3.B HOMES FUNCTIONS AND DETAILS OF IMPLEMENTATION ARRANGEMENT ... 144

APPENDIX PRE.B6/IV ... 146
PRE.B6.APPEND4.9 STANDARD FORM FOR RECORD OF THE 15-MINUTE FLUSHING FOR THE SINK MIXER INSTALLED AT KITCHEN ... 146

APPENDIX PRE.B6/V ... 147
PRE.B6.APPEND5.9 LIST OF DRAWINGS SHOWING THE DESIGN INTENT AND/OR THE EMPLOYER'S REQUIREMENTS FOR WORKS ITEMS TO BE DESIGNED BY THE CONTRACTOR UNDER PRE.B6.085(1)(D) AND PRE.B6.085(1)(E) ... 147

APPENDIX PRE.B6/VI ... 148
PRE.B6.APPEND6.N AUTHORITY FOR PAYMENT TO THE BANK (SAMPLE ONLY) ... 148

PRE.B7 DOCUMENTATION AND RECORDS ... 149
DEFINITIONS AND ABBREVIATIONS ... 149
PRE.B7.010.9 APPROVAL ... 149
PRE.B7.020.9 INSTRUCTED ... 149

PRE.B7.030.9 PROPRIETARY NAMES 149
PRE.B7.040.9 SPECIFIED 149
PRE.B7.050.A MANUFACTURER'S RECOMMENDATIONS 149
PRE.B7.060.9 REGULATIONS 149
PRE.B7.062.9 HOUSING DEPARTMENT 150
PRE.B7.070.C ABBREVIATIONS 150
PRE.B7.080.9 SPECIFICATION 152
PRE.B7.090.A GS CEW 152
PRE.B7.100.9 SITE STAFF 152
PRE.B7.110.9 THE EMPLOYER'S DIRECT CONTRACTOR 152
PRE.B7.120.A INDEPENDENT CHECKING UNIT 152
PRE.B7.130.9 BUILDING WORKS 152
PRE.B7.132.9 NEW BUILDING 152
PRE.B7.135.9 SITE FORMATION WORKS 152
PRE.B7.140.9 DIRECTOR 152
PRE.B7.145.9 TENANT OR OCCUPANT 153

PRE.B8 CONTRACTOR'S OBLIGATIONS 154

AUTHENTICITY OF INFORMATION 154
PRE.B8.005.N CONSENT TO THE EMPLOYER FOR VERIFICATION OF DOCUMENTS SUBMITTED BY THE CONTRACTOR 154

USE OF SITE 155
PRE.B8.010.9 PURPOSE 155
PRE.B8.020.9 ADVERTISING 155
PRE.B8.030.9 WORKERS 155
PRE.B8.040.9 OCCUPANCY AND RENTAL OF PRIVATE LAND OF ECOLOGICAL VALUES 155

SECURITY 155
PRE.B8.110.9 SECURITY MEASURES 155
PRE.B8.120.A SECURITY GUARDS 156
PRE.B8.140.9 PERSONNEL CONTROL 156
PRE.B8.150.9 ENTRANCE WARNING NOTICES 156
PRE.B8.160.9 PARTICULAR REQUIREMENTS FOR EVERY STAIRCASE OF DOMESTIC BLOCKS 156
PRE.B8.162.A SITE SECURITY PLAN 157
PRE.B8.170.9 SECURITY ON COMPLETION 158

SAFETY 159
PRE.B8.210.E COMPLIANCE WITH SAFETY REGULATIONS AND CONTRACT REQUIREMENTS 159
PRE.B8.211.N PROHIBITION OF IMPOSING ADMINISTRATIVE CHARGES FOR REPORTING OF SITE ACCIDENTS AND ELIMINATION OF UNDER-REPORTING OF SITE ACCIDENTS 203
PRE.B8.213.A SITE SAFETY FOR BUILDING SERVICES WORKS 205
PRE.B8.215.N SAFETY IN CONFINED SPACE RELATED TO UNDERGROUND DRAINAGE WORK 216
PRE.B8.220.9 PROVISION OF SAFETY REGULATIONS 221
PRE.B8.225.9 CARING OF NEW WORKERS 221
PRE.B8.230.9 SAFETY POSTERS 221
PRE.B8.235.B SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF OPERATIVES AND SITE SUPERVISORY STAFF 221
PRE.B8.240.A SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF THE CM, HIS REPRESENTATIVES AND VISITORS 226

PRE.B8.241.B INSPECTION AND CERTIFICATION OF OVERHAUL OF MAJOR CONSTRUCTION PLANT ON SITE 227
PRE.B8.242.C USE OF TOWER CRANES 231
PRE.B8.245.D USE OF STATIC AND MOBILE CRANES 239
PRE.B8.248.A SAFE USE OF LORRY-MOUNTED CRANES 243
PRE.B8.250.9 GUARDS TO LIFT WELL OPENINGS 243
PRE.B8.251.D PLATFORMS FOR WORKING AT DIFFERENT HEIGHTS 243
PRE.B8.252.9 PROTECTION OF WORKERS FROM PROTRUDED REINFORCEMENT BARS 246
PRE.B8.255.9 PROTECTIVE STEEL RAILING AT SLABS EDGES 246
PRE.B8.256.9 SAFETY OF REINFORCEMENT BAR BENDING MACHINES 246
PRE.B8.260.9 REQUIREMENTS FOR PRECAST CONCRETE FACADES TO DOMESTIC BLOCKS 247
PRE.B8.262.A REQUIREMENTS FOR LARGE PANEL FORMWORK AND WORKING PLATFORMS TO DOMESTIC BLOCKS 248
PRE.B8.265.A INSTALLATIONS TO REDUCE RISK OF MANUAL HANDLING AND WORKING AT HEIGHT 248
PRE.B8.266.B SAFETY OF ELECTRIC PORTABLE TOOLS 249
PRE.B8.267.E WIRELESS COMMUNICATION TECHNOLOGIES 250
PRE.B8.270.9 TRAFFIC CONTROL 262
PRE.B8.280.9 TEMPORARY TRAFFIC SIGNS 262
PRE.B8.285.A MANAGEMENT AND MAINTENANCE OF DESIGNATED AREAS OPEN TO PUBLIC ACCESS 263
PRE.B8.286.A PROTECTION TO THE PUBLIC AGAINST FALLING OBJECTS 263
PRE.B8.290.C SAFETY OF SITE VEHICLES AND MOBILE PLANT 264
PRE.B8.291.N SAFETY OF AIR HOSE CONNECTED TO AIR COMPRESSOR 264
PRE.B8.295.B DELIVERY OF MATERIALS BY VEHICLES TO SITE 264
PRE.B8.298.9 LOCKOUT AND TAGOUT PROCEDURES FOR ELECTRICAL WORKS 265

HEALTH 266
PRE.B8.300.A HEALTH CARE PLAN 266
PRE.B8.305.A REST AREAS FOR WORKERS 266
PRE.B8.306.9 PROVISION OF AUTOMATED EXTERNAL DEFIBRILLATOR (AED) 267
PRE.B8.307.X DELETED 267

FIRE PRECAUTIONS 267
PRE.B8.310.9 FIRE REGULATIONS 267
PRE.B8.320.9 STREET FIRE HYDRANTS 267
PRE.B8.325.A TEMPORARY FIRE SERVICES WATER TANK 267
PRE.B8.330.9 WATER RELAYING FACILITIES 268
PRE.B8.340.9 DANGEROUS GOODS STORE 268
PRE.B8.345.9 USE OF DANGEROUS SUBSTANCES 268
PRE.B8.350.A PORTABLE FIRE FIGHTING APPLIANCES 268
PRE.B8.360.9 PROHIBITING SMOKING ON SITE 268
PRE.B8.370.N SCREEN FOR WELDING AND FLAME CUTTING 269

GENERAL NUISANCE 269
PRE.B8.410.9 COMPLIANCE WITH REGULATIONS 269
PRE.B8.420.A CONTROL OF LIGHT POLLUTION 269

AIR POLLUTION CONTROL 269
PRE.B8.450.9 BONFIRE RESTRICTION 269
PRE.B8.455.A DUST CONTROL 270
PRE.B8.460.9 DEBRIS CONTROL 271
PRE.B8.465.9 SCREENS GENERALLY 271

PRE.B8.470.9 AIR POLLUTION CONTROL (VOLATILE ORGANIC COMPOUNDS) REGULATION 271
PRE.B8.475.9 USE OF B5 DIESEL OR EURO V DIESEL / ULTRA-LOW-SULPHUR DIESEL 272
PRE.B8.480.9 USE OF NON-ROAD MOBILE MACHINERY APPROVED UNDER THE AIR POLLUTION CONTROL (NON-ROAD MOBILE MACHINERY) (EMISSION) REGULATION 272

CONSTRUCTION DUST MONITORING 273
PRE.B8.510.A BASELINE DUST MONITORING 273
PRE.B8.520.A IMPACT DUST MONITORING 273
PRE.B8.530.9 AIR SENSITIVE RECEIVERS (ASRS) 274
PRE.B8.540.9 ACTIONS AND LIMIT LEVELS 274
PRE.B8.550.9 DUST MONITORING EQUIPMENT 275
PRE.B8.560.9 NON-COMPLIANCE WITH LIMITS 276
PRE.B8.570.A ACTION PLAN 276

MEASUREMENT OF INDOOR AIR QUALITY 277
PRE.B8.610.9 QUALIFIED AGENT FOR INDOOR AIR QUALITY (IAQ) MEASUREMENT 277
PRE.B8.620.9 MEASUREMENT OF AIRBORNE CONTAMINANT(S) 278

CONTROL OF NOISE - STATUTORY REQUIREMENTS 278
PRE.B8.710.9 NOISE CONTROL REGULATIONS 278
PRE.B8.730.9 CONSTRUCTION NOISE PERMIT 279
PRE.B8.740.N CONSTRUCTION NOISE MANAGEMENT PLAN (CNMP) 279

CONTROL OF NOISE - ADDITIONAL REQUIREMENTS 280
PRE.B8.750.9 ADDITIONAL REQUIREMENTS 280
PRE.B8.760.9 PNEUMATICALLY DRIVEN DRILLING RIGS 280
PRE.B8.770.9 OPERATING RESTRICTIONS 280
PRE.B8.773.9 EQUIPMENT NOISE LEVEL LIMITS 280
PRE.B8.775.9 SCHOOL EXAMINATION RESTRICTIONS 280
PRE.B8.777.9 SOUND LEVEL METER 280
PRE.B8.830.9 USE OF PERCUSSIVE PILING RIGS 280
PRE.B8.840.9 EQUIPMENT/ACTIVITY AUTHORISATION 281

NOISE MITIGATION 281
PRE.B8.850.9 NOISE SUPPRESSORS 281
PRE.B8.855.9 SOUND REDUCTION INSTALLATIONS 281
PRE.B8.856.C MOVABLE NOISE BARRIER 281
PRE.B8.860.9 NOISE ABATEMENT MEASURES 282
PRE.B8.865.9 HAND-HELD BREAKERS AND PORTABLE AIR COMPRESSORS 282
PRE.B8.870.A DIESEL GENERATORS FOR SITE'S TEMPORARY ELECTRICITY SUPPLY 283
PRE.B8.875.A SPECIAL SCREENS 283
PRE.B8.880.9 ADMINISTRATIVE NOISE CONTROL MEASURES 283

CONSTRUCTION NOISE MONITORING 283
PRE.B8.890.9 BASELINE NOISE MONITORING 283
PRE.B8.892.A IMPACT NOISE MONITORING 283
PRE.B8.893.A MONITORING STATIONS 284
PRE.B8.894.9 SOUND LEVEL METER 284
PRE.B8.896.9 ACTIONS AND LIMIT LEVELS 285
PRE.B8.898.A NON-COMPLIANCE WITH LIMITS 285

PRESERVATION AND MAINTENANCE OF EXISTING FEATURES 285
PRE.B8.910.9 EXISTING FEATURES 285
PRE.B8.920.A ELECTRICITY SUPPLY HOUSING 285
PRE.B8.930.B EXISTING SLOPES, RETAINING WALLS AND EMBANKMENTS 285

PRE.B8.935.A PROTECTION OF NATURAL STREAMS/RIVERS 286
PRE.B8.960.A PROTECTION OF ROADS AND PAVED AREAS FROM OVERLOADING 286
PRE.B8.970.A LOCATION OF EXISTING SERVICES 286
PRE.B8.980.9 PROTECTION OF EXISTING SERVICES 286
PRE.B8.983.A WORKS IN THE VICINITY OF EXISTING SERVICES 287
PRE.B8.990.A DISCOVERY OF LIVE SERVICES 288
PRE.B8.1000.9 RESPONSIBILITY FOR PUBLIC WORKS 288

PRESERVATION AND PROTECTION OF EXISTING TREES & SHRUBS 288
PRE.B8.1110.B PROTECTION GENERALLY 288
PRE.B8.1112.B DEFINITIONS 289
PRE.B8.1114.B SPECIALIST CONTRACTOR 290
PRE.B8.1115.A COMPETENT MEMBER OF SITE SUPERVISORY STAFF TO OVERSEE TREE WORKS 291
PRE.B8.1116.B PRESERVATION AND PROTECTION OF EXISTING TREES AND VEGETATION GENERALLY 291
PRE.B8.1120.A PROGRAMMING OF PROTECTION WORKS 293
PRE.B8.1130.A EXISTING PROTECTIVE FENCING 293
PRE.B8.1140.A PROTECTIVE BAMBOO FENCING 293
PRE.B8.1150.A PROTECTIVE CHAIN LINK FENCING 293
PRE.B8.1160.A ALIGNMENT OF PROTECTIVE FENCING 294
PRE.B8.1162.A PROTECTION FROM CHANGE IN GROUND LEVEL 294
PRE.B8.1163.B PROTECTION FROM EXCAVATION INCLUDING TRENCHING 294
PRE.B8.1164.A PROTECTION FROM DRILLING 296
PRE.B8.1165.B PROTECTION FROM INSTABILITY 297
PRE.B8.1170.A PRESERVATION AND TREATMENT / REPLACEMENT OF EXISTING TREES AND SHRUBS 298
PRE.B8.1180.B TREE INVENTORY REPORT 298

TREE RISK ASSESSMENT AND INSPECTION 299
PRE.B8.1210.A TREE RISK ASSESSMENT AND ARBORICULTURAL WORKS 299
PRE.B8.1220.B TIMING FOR CARRYING OUT OF TREE RISK ASSESSMENT AND ARBORICULTURAL WORK 299
PRE.B8.1230.C QUALIFICATION AND EXPERIENCE REQUIREMENTS OF THE QUALIFIED ARBORIST 300
PRE.B8.1240.A PRACTICE ON TREE RISK ASSESSMENT AND MANAGEMENT 300
PRE.B8.1250.B INSPECTION AFTER INCLEMENT WEATHER 302
PRE.B8.1260.C ARBORICULTURAL WORKS IN RELATION TO TREE RISK ASSESSMENT AND INSPECTION AFTER INCLEMENT WEATHER AS APPROVED BY THE CM 302

SITE ORGANISATION AND SUPERVISION PLAN 306
PRE.B8.1405.9 SUBMISSIONS OF ORGANISATION CHART AND SP 306

SITE ADMINISTRATION 307
PRE.B8.1407.9 PROBITY AND CODE OF ETHICS 307
PRE.B8.1410.9 SITE MEETINGS 308
PRE.B8.1420.B COORDINATION OF SERVICES 308
PRE.B8.1425.A QUALITY CONTROL SYSTEM 309
PRE.B8.1430.9 PROGRESS AND RECORD PHOTOGRAPHS 310
PRE.B8.1435.A PUBLIC RELATIONS PLAN 311
PRE.B8.1440.A AS-BUILT DRAWINGS AND DOCUMENTATION 311
PRE.B8.1445.9 CONFIRMATION OF VERBAL INSTRUCTION (CVI) 315
PRE.B8.1450.A WAGE BOOKS 315
PRE.B8.1455.N RETURN OF SITE LABOUR DEPLOYMENT AND EMPLOYMENT TO CENSUS AND STATISTICS DEPARTMENT 317

PRE.B8.1460.9 RECORDS OF PLANT AND MATERIALS 317
PRE.B8.1470.9 REMOVAL OF MATERIALS FROM SITE 318
PRE.B8.1480.A CALIBRATION OF EQUIPMENT 318
PRE.B8.1490.B EQUIPMENT CALIBRATION SCHEDULE 318
PRE.B8.1495.F DEVELOPMENT AND CONSTRUCTION SITE MOBILE SYSTEM (DCSMS) 320

TRAINING OF WORKERS 326
PRE.B8.1500.9 CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES 326

PROTECTION 328
PRE.B8.1510.A PROTECTION FROM WEATHER 328
PRE.B8.1520.9 EMERGENCY STANDBY TEAM 328
PRE.B8.1540.9 DRYING THE WORKS 329
PRE.B8.1550.9 PROTECTION FROM OVERLOADING 329
PRE.B8.1560.A PROTECTION TO LIFT LOBBIES 329
PRE.B8.1570.B PROTECTION OF WORKERS FROM HEAT STROKE 329
PRE.B8.1575.9 PROTECTION OF WORKERS WORKING IN COLD WEATHER 331

CLEANLINESS 331
PRE.B8.1610.9 SITE PRESENTATION 331
PRE.B8.1620.9 STORAGE OF NEW MATERIALS AND PLANT 331
PRE.B8.1630.A DISPOSAL OF WASTE MATERIALS 331
PRE.B8.1640.9 CLEANING WORKS ON COMPLETION 332
PRE.B8.1650.9 DISPLAY OF POSTERS - PREVENTION OF MOSQUITO BREEDING 332
PRE.B8.1655.A PREVENTION OF MOSQUITO PROLIFERATION ON SITE 332
PRE.B8.1660.9 REMOVAL AND TREATMENT OF STANDING WATER 333
PRE.B8.1670.9 TREATMENT OF WATER RECEPTACLES 333
PRE.B8.1680.B PESTICIDES AND LARVICIDES 333
PRE.B8.1690.9 PREVENTION OF RODENT INFESTATION ON SITE 333

PROTECTION OF PERSONAL DATA 334
PRE.B8.1710.X DELETED 334

DISPOSAL OF CONSTRUCTION AND DEMOLITION (C&D) MATERIAL 334
PRE.B8.1810.A DISPOSAL OF INERT C&D MATERIALS 334
PRE.B8.1820.A DISPOSAL OF NON-INERT C&D MATERIALS 334
PRE.B8.1830.9 TRIP-TICKET SYSTEM FOR DISPOSAL OF C&D MATERIALS AT PUBLIC FILL RECEPTION FACILITIES/LANDFILLS/OUTLYING ISLANDS TRANSFER FACILITIES 335
PRE.B8.1831.A TRIP-TICKET SYSTEM FOR DISPOSAL OF C&D MATERIALS AT DISPOSAL FACILITIES OTHER THAN PUBLIC FILL RECEPTION FACILITIES/LANDFILLS/OUTLYING ISLANDS TRANSFER FACILITIES 335
PRE.B8.1835.A SITE VIDEO RECORDING SYSTEM 336
PRE.B8.1836.A MONITORING OF WEIGHT OF TRUCKS WITH C&D MATERIALS 336
PRE.B8.1838.9 MECHANICAL COVER SYSTEM FOR DUMP TRUCKS FOR TRANSPORTING C&D MATERIALS 337
PRE.B8.1850.A ALTERNATIVE DISPOSAL GROUND 338
PRE.B8.1860.A REMOVAL OF C&D MATERIALS FROM UNAUTHORIZED DISPOSAL GROUNDS 339

WASTE MANAGEMENT 339
PRE.B8.1910.9 CONSTRUCTION WASTE MANAGEMENT - GENERAL 339
PRE.B8.1920.9 SPECIAL WASTE MANAGEMENT RESPONSIBILITIES 340
PRE.B8.1950.9 HAZARDOUS WASTE 340
PRE.B8.1960.9 PACKAGING MATERIAL 340
PRE.B8.1970.9 STORAGE AND REMOVAL OF WASTE MATERIAL 341

PRE.B8.1975.9 DISPOSAL OF WATER RECEPTACLES 341
PRE.B8.1985.A REMOVAL OF WASTE MATERIALS 341
PRE.B8.1990.A ON-SITE SORTING OF C&D MATERIALS 341
PRE.B8.1995.9 WASTE REDUCTION TARGETS 342
PRE.B8.1997.9 GOOD HOUSEKEEPING PRACTICE FOR WASTE MANAGEMENT 342
PRE.B8.1998.9 CONSTRUCTION & DEMOLITION MATERIALS DISPOSAL TRACKING SYSTEM (CMDTS) 342

DEFECTS RECTIFICATION 343
PRE.B8.2005.A CUSTOMER SERVICE TEAM (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY) 343
PRE.B8.2010.A STANDBY WORKFORCE (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY) 343
PRE.B8.2020.C INTAKE AMBASSADOR (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY) 343

PROTECTION AND DAMAGE MITIGATION 345
PRE.B8.2310.9 DAMAGE BY EROSION 345
PRE.B8.2320.9 MAINTENANCE OF ROADS AND PAVED AREAS 346
PRE.B8.2330.9 ADJOINING PROPERTIES 346
PRE.B8.2340.9 ADJOINING PAVING ETC 346

WATER POLLUTION CONTROL AND WATER CONSERVATION 346
PRE.B8.2410.B REMOVAL OF WATER 346
PRE.B8.2415.A WASTE-WATER RECYCLING FACILITIES 347
PRE.B8.2420.A REUSE OF WATER FROM BORING AND DRILLING 348
PRE.B8.2430.9 REUSE AND DISPOSAL OF BENTONITE SLURRY 348

USE OF TIMBER FOR TEMPORARY WORKS DURING CONSTRUCTION 348
PRE.B8.2450.9 TIMBER FOR TEMPORARY WORKS DURING CONSTRUCTION 348
PRE.B8.2460.9 REUSE OF TIMBER FOR TEMPORARY WORKS DURING CONSTRUCTION 349

CARBON ASSESSMENT TOOL 349
PRE.B8.2480.N CIC CARBON ASSESSMENT TOOL (CAT) 349

ENVIRONMENTAL MANAGEMENT PLAN 350
PRE.B8.2510.A ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES 350
PRE.B8.2515.9 SUBMISSION AND UPDATING OF ENVIRONMENTAL MANAGEMENT PLAN 351
PRE.B8.2520.9 ENVIRONMENTAL MANAGEMENT PLAN 352
PRE.B8.2525.N ENVIRONMENTAL MANAGEMENT PLAN FOR SPECIALIST SUB-CONTRACTORS FOR BUILDING SERVICES WORKS 357
PRE.B8.2530.9 DISTRIBUTION OF ENVIRONMENTAL MANAGEMENT PLAN 359
PRE.B8.2540.9 ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE 359
PRE.B8.2545.A ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE MONITORING AND REPORTING 360
PRE.B8.2546.N ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE AND REPORTING FOR BUILDING SERVICES WORKS BY SPECIALIST SUB-CONTRACTORS 360
PRE.B8.2560.B PROVISION OF ENVIRONMENT AND HYGIENE TRAINING 361
PRE.B8.2570.D PAYMENT FOR PRE-DETERMINED AMOUNTS FOR SITE SAFETY, ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE 361

SITE ACCESS CONTROL OF PERSONNEL 374
PRE.B8.2610.9 SITE ACCESS CONTROL AND RECORDING SYSTEM 374
PRE.B8.2612.9 ARRANGEMENT FOR PRE-OPERATION OF ACRS 374
PRE.B8.2614.9 DESIGN, OPERATION AND SUBMISSION REQUIREMENTS 374
PRE.B8.2620.A SYSTEM REQUIREMENTS 375

PRE.B8.2630.9 ENTRANCE/EXIT CONTROL UNIT 375
PRE.B8.2640.9 CENTRAL DATA COMPUTER UNIT 376
PRE.B8.2650.9 INFORMATION TO BE CAPTURED AND SAVED IN ACRS 376
PRE.B8.2660.A SYSTEM RUNNING AND TERMINATION 377

WORKS ON STREET MAINTAINED BY THE HIGHWAYS DEPARTMENT 378
PRE.B8.2710.A WORKS ON STREET MAINTAINED BY THE HIGHWAYS DEPARTMENT 378
PRE.B8.2720.A EXCAVATION PERMIT APPLICATION 378
PRE.B8.2730.A SAFETY PRECAUTION 379
PRE.B8.2740.9 SITE SUPERVISION 379

BEAM PLUS ASSESSMENT 380
PRE.B8.2810.A BEAM PLUS ASSESSMENT 380
PRE.B8.2820.C BEAM PLUS PREREQUISITES AND CREDITS 380
PRE.B8.2830.9 FILING SYSTEM FOR BEAM PLUS ASSESSMENT 386
PRE.B8.2840.9 MONTHLY BEAM PLUS MONITORING REPORT 386
PRE.B8.2850.9 BEAM PLUS COORDINATION MEETING 387
PRE.B8.2860.9 CONSIDERATE CONSTRUCTION 387

WORKS WITHIN THE RAILWAY PROTECTION AREA 388
PRE.B8.2900.9 GENERAL 388
PRE.B8.2905.9 PROCEDURE FOR POSSESSION 388
PRE.B8.2910.9 WORKING IN THE VICINITY OF THE RAILWAY TRACK 388
PRE.B8.2915.9 TRESPASSING ON RAILWAY PREMISES 388
PRE.B8.2920.9 PREVENTION OF ACCIDENTS 388
PRE.B8.2925.9 WORKS DESIGNED BY CONTRACTOR 388
PRE.B8.2930.A METHOD OF CARRYING OUT THE WORKS AND USE OF PLANT 389
PRE.B8.2935.A INTERFERENCE WITH DRAINS AND SERVICES 391
PRE.B8.2940.9 CROSSING THE TRACK 391
PRE.B8.2945.9 OVERHEAD ELECTRICIAL EQUIPMENT 391
PRE.B8.2950.9 USE OF EXPLOSIVES 392
PRE.B8.2955.9 EMERGENCY CREW 392
PRE.B8.2960.9 STACKING OF MATERIAL 392
PRE.B8.2965.9 SCREENING OF LIGHTS 393
PRE.B8.2970.9 FIRE PREVENTION 393
PRE.B8.2975.9 NOTICE OF ACCIDENTS 393
PRE.B8.2980.9 ADVERTISEMENTS 393
PRE.B8.2985.A CLEARANCE OF LAND AND PROPERTY WITHIN THE RAILWAY PREMISES 393
PRE.B8.2990.A CONDITIONS FOR WORKING WITHIN / IN THE VICINITY OF THE RAILWAY PREMISES 393
PRE.B8.2995.9 RATE OF CHARGE FOR SERVICE / INFORMATION PROVIDED BY MTRCL 393

ROBOTIC CONSTRUCTION 394
PRE.B8.3000.9 ROBOTIC CONSTRUCTION APPLICATION 394
PRE.B8.3005.B SUBMISSION REQUIREMENTS 394
PRE.B8.3010.N OPERATIONAL REQUIREMENTS 395
PRE.B8.3015.N MINIMUM EXTENT OF ROBOTIC CONSTRUCTION APPLICATION FOR INTERNAL WALL AND CEILING PAINTING WORKS 396

BUILDING INFORMATION MODELLING (BIM) 396
PRE.B8.4000.9 DEFINITIONS 396
PRE.B8.4010.9 GENERAL 396
PRE.B8.4020.A BIM TEAM 396
PRE.B8.4030.D BIM DELIVERABLES 396
PRE.B8.4040.B QUALITY ASSURANCE 406

PRE.B8.4050.X DELETED 407
PRE.B8.4060.B HARDWARE AND SOFTWARE REQUIREMENTS 407
PRE.B8.4070.C COMMON DATA ENVIRONMENT (CDE) 407
PRE.B8.4080.B BIM STANDARDS AND GUIDELINES 409
PRE.B8.4090.D CONTRACTOR'S RESPONSIBILITY 409

REALITY CAPTURE 411
PRE.B8.4200.N DEFINITIONS 411
PRE.B8.4210.N GENERAL 411
PRE.B8.4220.N INSTRUMENTS 411
PRE.B8.4230.N EXTENT AND SCOPE OF REALITY CAPTURE TASKS 411
PRE.B8.4240.N REALITY CAPTURE DELIVERABLES 414
PRE.B8.4250.N QUALITY ASSURANCE 416
PRE.B8.4260.N REALITY CAPTURE STANDARDS AND GUIDELINES 417

MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIMEP) 417
PRE.B8.5010.N SCOPE OF WORK 417
PRE.B8.5020.N SITE COORDINATION 417
PRE.B8.5030.N DESIGN REQUIREMENTS 417
PRE.B8.5040.N DELIVERY AND SITE STORAGE 418

APPENDIX PRE.B8/I 419
PRE.B8.APPEND1.9 WASTE FLOW TABLE 419

APPENDIX PRE.B8/II 423
PRE.B8.APPEND2.9 DAILY RECORD SUMMARY 423

APPENDIX PRE.B8/III 424
PRE.B8.APPEND3.9 DISPOSAL DELIVERY FORM 424

APPENDIX PRE.B8/IV 425
PRE.B8.APPEND4.9 MONTHLY RECORDING OF DAILY FLOW RATE OF WASTE WATER DISCHARGED ON SITE 425

APPENDIX PRE.B8/V 426
PRE.B8.APPEND5.9 SUMMARY RECORD OF DELIVERY AND CONSUMPTION OF B5 DIESEL OR EURO V DIESEL / ULTRA LOW SULPHUR DIESEL ON SITE 426

APPENDIX PRE.B8/VI 427
PRE.B8.APPEND6.9 MONTHLY RECORDING OF DETERMINAND OF WASTE WATER DISCHARGED ON SITE 427

APPENDIX PRE.B8/VII 428
PRE.B8.APPEND7.9 RECORD OF CONSTRUCTION DUST MONITORING 428

APPENDIX PRE.B8/VIII 430
PRE.B8.APPEND8.9 RECORD OF CONSTRUCTION NOISE MONITORING 430

APPENDIX PRE.B8/IX 432
PRE.B8.APPEND9.C ENVIRONMENTAL PROTECTION MEASURES 432

APPENDIX PRE.B8/X 444
PRE.B8.APPEND10.9 CERTIFICATE OF OVERHAUL OF MAJOR CONSTRUCTION PLANT ON SITE 444

APPENDIX PRE.B8/XI 456
PRE.B8.APPEND11.9 CHECKLISTS ON CRITICAL PARTS FOR OVERHAUL MAINTENANCE FOR MAJOR CONSTRUCTION PLANT ON SITE 456

APPENDIX PRE.B8/XII 487

PRE.B8.APPEND12.B GUIDELINES ON SCOPE AND CONTENTS OF QUALITY CONTROL SYSTEM 487

APPENDIX PRE.B8/XIII 506
PRE.B8.APPEND13.9 STANDARD TEMPLATE FOR CONFIRMATION OF VERBAL INSTRUCTION 506

APPENDIX PRE.B8/XIV 507
PRE.B8.APPEND14.9 STANDARD TEMPLATE FOR ABORTIVE WORKS RECORD SHEET 507

APPENDIX PRE.B8/XV 509
PRE.B8.APPEND15.9 STANDARD TEMPLATE FOR CVI SUMMARY TABLE FOR MONTHLY SITE MEETINGS 509

APPENDIX PRE.B8/XVI 511
PRE.B8.APPEND16.9 SUMMARY TRAINING STATUS REPORT FOR THE CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES (CICTS) 511

APPENDIX PRE.B8/XVII 513
PRE.B8.APPEND17.9 TECHNICAL NOTES FOR GUIDANCE IN ASSESSING THE EFFECTS OF CIVIL ENGINEERING CONSTRUCTION / BUILDING DEVELOPMENT ON RAILWAY STRUCTURES AND OPERATIONS 513

APPENDIX PRE.B8/XVIII 516
PRE.B8.APPEND18.A KEY INDUSTRIAL SAFETY PRECAUTIONS FOR CONTRACTORS WORKING WITHIN RAILWAY PREMISES 516

APPENDIX PRE.B8/XIX 520
PRE.B8.APPEND19.9 MTRCL'S INDEMNITY FORM 520

APPENDIX PRE.B8/XX 521
PRE.B8.APPEND20.9 LETTER OF UNDERTAKING 521

APPENDIX PRE.B8/XXI 522
PRE.B8.APPEND21.N RECORD OF CALIBRATION OF EQUIPMENT 522

APPENDIX PRE.B8/XXII 523
PRE.B8.APPEND22.N QUARTERLY CARBON EMISSION PERFORMANCE REPORT 523

1. PROJECT INFORMATION 524

2. SITE WORK PROGRESS 525

3. OUTPUT DATA SUMMARY 526

4. SUPPLEMENTARY INFORMATION 527

APPENDIX PRE.B8/XXIII 528
PRE.B8.APPEND23.N FORM OF DECLARATION AND CONSENT TO THE EMPLOYER 528

PRE.B9 QUALITY STANDARDS 529

MATERIALS AND WORKMANSHIP 529
PRE.B9.010.9 GOOD PRACTICE 529
PRE.B9.020.A MATERIALS 529
PRE.B9.030.9 CONSISTENCY OF MATERIALS 529
PRE.B9.040.9 MIX PROPORTIONS 529
PRE.B9.050.9 MANUFACTURER'S RECOMMENDATIONS 529
PRE.B9.060.9 EQUIVALENT MATERIALS AND IMPERIAL SIZES 529

PRE.B9.070.9 BRITISH STANDARDS 529
PRE.B9.080.9 OTHER NATIONAL AND INTERNATIONAL STANDARDS 530
PRE.B9.090.9 EQUIVALENT STANDARDS 530
PRE.B9.095.9 PNAP & PNRC 530

CONSTRUCTION INDUSTRY COUNCIL (CIC) 530
PRE.B9.100.9 CIC GUIDELINES 530

PERFORMANCE ASSESSMENT SCORING SYSTEM (PASS) 530
PRE.B9.106.A PILINGPASS 530
PRE.B9.107.9 DEMOLITIONPASS 531
PRE.B9.110.9 PASS 532

INDEPENDENT CHECKING UNIT (ICU) 533
PRE.B9.112.A GENERAL 533
PRE.B9.113.A SERVICES AND FACILITIES REQUIRED BY ICU 533
PRE.B9.115.9 CHECKING BY ICU ON FOUNDATION WORK 533
PRE.B9.116.A DOCUMENTATION 534
PRE.B9.120.A REQUIREMENTS TO PREPARE ICU SUBMISSIONS AND APPLICATIONS THROUGH ELECTRONIC MEANS FOR ONWARD SUBMISSION TO ICU VIA PUBLIC HOUSING ELECTRONIC PLAN SUBMISSION SYSTEM (PUBLIC HOUSING E-PLAN) 537
PRE.B9.125.9 NEW BUILDING MATERIALS / BUILDING COMPONENTS/ CONSTRUCTION SYSTEMS 539
PRE.B9.127.9 DOCUMENTATION FOR HIGH STRENGTH CONCRETE WORKS 539

CHECKING AND SURVEYING ON FOUNDATION WORKS 539
PRE.B9.130.9 CHECKING AND SURVEYING ON FOUNDATION WORKS 539

APPROVED CONTRACTORS AND SUPPLIERS 540
PRE.B9.210.B LISTS OF APPROVED CONTRACTORS FOR SPECIALIST WORKS 540
PRE.B9.220.9 AVAILABILITY OF CONTRACTORS APPROVED FOR SPECIALIST WORKS 541

BUILDING WORKS 541
PRE.B9.240.N BUILDING WORKS 541

GROUND INVESTIGATION WORKS 541
PRE.B9.250.B GROUND INVESTIGATION WORKS 541

SITE FORMATION WORKS 542
PRE.B9.260.9 SITE FORMATION WORKS 542

TOLERANCES 543
PRE.B9.310.9 TOLERANCES IN GENERAL CONSTRUCTION 543

SAMPLES 543
PRE.B9.410.9 SAMPLES OF MATERIALS - GENERAL REQUIREMENTS 543
PRE.B9.415.9 SAMPLES OF MATERIALS - APPROVAL 543
PRE.B9.420.9 SAMPLES OF MATERIALS - PARTICULAR REQUIREMENTS 544
PRE.B9.430.9 SAMPLES OF FINISHED WORK - GENERAL REQUIREMENTS 544
PRE.B9.440.A SAMPLES AND CONSTRUCTION MOCK-UP OF FINISHED WORK - PARTICULAR REQUIREMENTS 544
PRE.B9.450.9 SAMPLES OF FINISHED WORK - PARTICULAR REQUIREMENTS 545
PRE.B9.460.X DELETED 545

TESTING 545
PRE.B9.510.9 TESTING - COSTS BORNE BY THE CONTRACTOR 545
PRE.B9.520.9 PARTICULAR TESTING FOR DOMESTIC BLOCKS - COSTS BORNE BY THE CONTRACTOR 546
PRE.B9.530.B TESTING - COSTS BORNE BY THE AUTHORITY 546
PRE.B9.540.9 PARTICULAR TESTING FOR DOMESTIC BLOCKS - COSTS BORNE BY THE AUTHORITY 546

PRE.B9.550.9 TEST RECORDS 547
PRE.B9.560.9 WITNESSING TESTING 548
PRE.B9.570.9 TESTING LABORATORIES 548

QUALITY MANAGEMENT SYSTEM 548
PRE.B9.610.9 GENERAL 548
PRE.B9.620.9 ORGANISATION AND RESPONSIBILITY 548
PRE.B9.630.9 DESIGN CONTROL 549
PRE.B9.640.9 PURCHASING OF MATERIALS AND SERVICES 549
PRE.B9.650.9 CONSTRUCTION PROCESS CONTROL 549
PRE.B9.652.9 TEMPORARY WORKS PROCESS CONTROL 549
PRE.B9.653.9 MAINTENANCE WORKS PROCESS CONTROL 549
PRE.B9.660.9 INSPECTION, MEASURING AND TESTING EQUIPMENT 550
PRE.B9.670.9 CONTROL OF NON-CONFORMING MATERIALS AND WORKS 550
PRE.B9.680.9 TRAINING 550
PRE.B9.690.9 QUALITY ASSURANCE PLAN REVIEW 550

PROJECT SPECIFIC PARTNERING 550
PRE.B9.810.B START-UP PARTNERING SESSION */ WORKSHOP* *(*TO DELETE THE INAPPLICABLE WORD)* 550
PRE.B9.820.A REGULAR PARTNERING MEETING 551
PRE.B9.830.A ADDITIONAL SESSION* / WORKSHOP* 551
PRE.B9.840.A CLOSE-OUT MEETING 551
PRE.B9.850.A FACILITATOR FOR THE SESSIONS* / WORKSHOPS* 551
PRE.B9.860.A PARTIES FOR THE PARTNERING SESSION* / WORKSHOP* / MEETING 552
PRE.B9.870.9 HONORARY PLAQUE 552
PRE.B9.890.A COMMUNITY ENGAGEMENT - ACTION SEEDLING ACTIVITIES AND PUBLIC ENGAGEMENT ACTIVITIES* 552

QUALITY CONTROL MEASURES FOR WELDING CONSUMABLES FOR STRUCTURAL STEELWORKS 555
PRE.B9.1000.9 WELDING CONSUMABLES FOR STRUCTURAL STEELWORKS 555

APPENDIX PRE.B9/I 558
PRE.B9.APPEND1.9 CONSTRUCTION MOCK-UP 558

APPENDIX PRE.B9/II 561
PRE.B9.APPEND2.A APPLICATION FORM FOR APPROVAL OF TESTING LABORATORY 561

APPENDIX PRE.B9/III 563
PRE.B9.APPEND3.X DELETED 563

PRE.B10 TEMPORARY WORKS AND FACILITIES 564

TEMPORARY WORKS 564
PRE.B10.010.A TEMPORARY WORKS 564
PRE.B10.015.N TESTING FOR TEMPORARY WORKS 568
PRE.B10.020.A ACCESS AND ROADS 568
PRE.B10.030.A TEMPORARY PASSENGER LIFTS 569
PRE.B10.040.A OTHER LIFTING APPLIANCES 569
PRE.B10.050.9 USE OF LIFTS 571
PRE.B10.060.B TEMPORARY REFUSE CHUTES 571
PRE.B10.065.B FALSEWORK 572
PRE.B10.070.9 MAINTENANCE OF TEMPORARY WORKS 572
PRE.B10.080.9 TEMPORARY STAIRCASES 572
PRE.B10.090.A BUILDING SETTLEMENT AND VERTICALITY MONITORING 573
PRE.B10.091.N HARD PAVED CONSTRUCTION 573

GREENING ON SITE 575
PRE.B10.100.9 TEMPORARY GREENING ON SITE 575
SITE ACCOMMODATION FOR THE CONTRACTOR 575
PRE.B10.110.A ACCOMMODATION GENERALLY 575
PRE.B10.120.A MINIMUM TOILET ACCOMMODATION AND WASHING FACILITIES 575
PRE.B10.125.9 ELECTRICAL/SOLAR WATER HEATER SYSTEM 577
PRE.B10.130.A ADDITIONAL TOILET ACCOMMODATION FOR MULTI-STOREY BUILDING 577
PRE.B10.135.9 FOOD WASTE COMPOSTER 578
PRE.B10.140.A STORAGE SHEDS 578
PRE.B10.150.9 SECURE STOREROOMS 578
SITE ACCOMMODATION FOR BUILDING SERVICES NOMINATED SUB-CONTRACTORS 578
PRE.B10.160.A ACCOMMODATION GENERALLY 578
PRE.B10.170.9 ACCOMMODATION SIZES 578
PRE.B10.180.9 ACCOMMODATION FACILITIES 578
PRE.B10.190.9 ACCOMMODATION SERVICES 578
SITE ACCOMMODATION FOR THE CM AND THE CM'S REPRESENTATIVES 579
PRE.B10.210.A ACCOMMODATION GENERALLY 579
PRE.B10.215.9 SUSTAINABLE PROVISIONS OF SITE ACCOMMODATION 579
PRE.B10.220.9 ACCOMMODATION SIZES 579
PRE.B10.230.9 ACCOMMODATION FACILITIES 580
PRE.B10.240.9 ACCOMMODATION FURNITURE AND FITTINGS 580
PRE.B10.250.9 ACCOMMODATION SERVICES 580
PRE.B10.255.9 BURGLAR ALARM SYSTEM FOR SITE ACCOMMODATION 581
PRE.B10.260.9 ACCOMMODATION CLERICAL SERVICES 582
PRE.B10.270.9 ACCOMMODATION MAINTENANCE 583
PRE.B10.280.A VEHICLE ACCOMMODATION 583
PRE.B10.290.9 TEMPORARY ACCOMMODATION FOR THE CM AND HIS REPRESENTATIVES DURING MAINTENANCE PERIOD 583
SITE ACCOMMODATION FOR THE CM'S LAND SURVEY TEAM 586
PRE.B10.300.A ACCOMMODATION GENERALLY FOR THE CM'S LAND SURVEY TEAM 586
PRE.B10.303.9 ACCOMMODATION FURNITURE AND FITTINGS FOR THE CM'S LAND SURVEY TEAM 586
PRE.B10.306.9 ACCOMMODATION SERVICES FOR THE CM'S LAND SURVEY TEAM 586
SITE ACCOMMODATION ASSOCIATED WITH IN-SITU CONCRETING WORK 586
PRE.B10.310.9 SITE TESTING LABORATORY 586
PRE.B10.320.9 CONTAINER OFFICE 587
PRE.B10.322.B CONTAINER STOREROOMS 587
PRE.B10.324.9 TAKING OVER OF CONTAINER STOREROOMS 588
PRE.B10.330.9 CONTAINER CURING ROOMS AND TANKS 588
PRE.B10.335.9 STEEL CONTAINERS FOR TEST SAMPLES OF BAR REINFORCEMENT/FABRIC REINFORCEMENT 588
PRE.B10.340.9 STEEL CONTAINER ROOM SPECIFICATION 588
PRE.B10.350.9 STEEL CURING TANK 588
PRE.B10.360.9 CURING TANK MAINTENANCE 589
PRE.B10.370.9 CURING RECORDS 589
PRE.B10.380.9 ACCESS BY DIRECT TESTING CONTRACTOR 589
PRE.B10.390.9 ACCOMMODATION MAINTENANCE 589

SITE EQUIPMENT FOR THE CM AND CM'S REPRESENTATIVES 589
PRE.B10.410.9 EQUIPMENT GENERALLY 589
PRE.B10.420.A BASIC OFFICE EQUIPMENT 590
PRE.B10.430.X DELETED 591
PRE.B10.450.9 PASS EQUIPMENT 591
PRE.B10.465.D EQUIPMENT FOR DEVELOPMENT AND CONSTRUCTION SITE MOBILE SYSTEM (DCSMS) AND HOUSING SMART INTAKE (HOST) SYSTEM 592
PRE.B10.470.9 UNINTERRUPTIBLE POWER SUPPLY 594
PRE.B10.480.9 CAMERAS 595
PRE.B10.485.9 BROADBAND LINE AND NETWORKING 595
PRE.B10.490.9 COVER METER 595
PRE.B10.500.9 REBOUND HAMMER AND ACCESSORIES 595
PRE.B10.520.9 EQUIPMENT MAINTENANCE 596
SITE EQUIPMENT FOR THE CM'S LAND SURVEY TEAM 596
PRE.B10.530.A PROVISION OF SURVEY EQUIPMENT 596
PRE.B10.540.9 COMMUNICATION SYSTEM 598
SERVICES FOR THE CM AND CM'S REPRESENTATIVES 598
PRE.B10.580.A CONTRACT TECHNICAL ASSISTANTS 598
PRE.B10.581.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (STRUCTURAL) 603
PRE.B10.582.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (ARCHITECTURAL) 603
PRE.B10.583.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (BUILDING SERVICES) 604
PRE.B10.584.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (BUILDING WORKS) 605
PRE.B10.585.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (BUILDING SERVICES SITE) 605
PRE.B10.586.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (WORKS SUPERVISOR) 606
SERVICES FOR THE CM AND CM'S LAND SURVEY TEAM 607
PRE.B10.590.9 SURVEY SUPPORT 607
TRANSPORT FACILITIES FOR THE CM, THE CM'S REPRESENTATIVES AND SITE STAFF 607
PRE.B10.610.B VEHICLE AND DRIVER 607
PRE.B10.620.9 BOAT AND BOATMAN 610
PRE.B10.630.9 SHUTTLE BUS AND DRIVER 611
HOARDINGS AND GANTRIES 612
PRE.B10.710.B HOARDINGS AND GANTRIES GENERALLY 612
PRE.B10.720.9 TAKING OVER EXISTING HOARDINGS 615
PRE.B10.730.A NEWLY ERECTED HOARDINGS 615
PRE.B10.740.9 GATES AT VEHICULAR INGRESS / EGRESS FOR TRAFFIC CONTROL 616
PRE.B10.750.9 TAKING OVER EXISTING GATES AT VEHICULAR INGRESS / EGRESS FOR TRAFFIC CONTROL 618
SCAFFOLDING (BAMBOO AND METAL) AND SCREENS 618
PRE.B10.810.A SAFETY REGULATIONS AND REQUIREMENTS FOR SCAFFOLDING ETC 618
PRE.B10.820.A DESIGN OF SCAFFOLDING SYSTEM 618
PRE.B10.830.A ERECTION / ADDITION / ALTERATION / DISMANTLING OF BAMBOO SCAFFOLDING 619

PRE.B10.835.B ERECTION / ADDITION / ALTERATION / DISMANTLING OF METAL SCAFFOLDING 622
PRE.B10.840.9 SUPPORTS TO SCAFFOLDING 624
PRE.B10.850.9 ACCESS TO/EGRESS FROM SCAFFOLDING 624
PRE.B10.860.B PROTECTIVE CANOPY 624
PRE.B10.870.9 OVERHEAD PROTECTION 625
PRE.B10.880.9 WALKWAY/WORKING PLATFORM AND COVER FOR FINISHING WORKS 625
PRE.B10.890.9 ACCESS/PROTECTION FOR THE CM AND HIS REPRESENTATIVES 626
PRE.B10.900.9 GUARD RAILS 626
PRE.B10.910.B PROTECTIVE MATERIALS INSTALLED ON THE SCAFFOLDING 626
PRE.B10.920.9 OBSTRUCTION OF WALKWAY/WORKING PLATFORM AND GANGWAY 626
PRE.B10.930.9 CLEARANCE OF DEBRIS 626
PRE.B10.940.9 SLOPING CATCH FAN 626
PRE.B10.945.9 INSPECTION AND MAINTENANCE 627
PRE.B10.950.9 RETENTION OF PROTECTIVE MEASURES 627
PRE.B10.980.9 DISMANTLING 627

TEMPORARY SAFETY FENCES, RAILS AND BARRIERS 628
PRE.B10.1010.9 EXTERNAL OPENINGS AND FLOOR OPENINGS 628
PRE.B10.1015.9 OPEN EXCAVATIONS 628
PRE.B10.1020.9 TEMPORARY PROTECTION TO LIFT WELL OPENINGS 628
PRE.B10.1021.B TEMPORARY PROTECTION ABOVE STEEL BENDING YARD 629
PRE.B10.1030.9 PERMANENT STAIRCASES 629
PRE.B10.1040.9 OPENINGS AT TOWER CRANES 630

SIGNBOARDS 630
PRE.B10.1110.9 SIGNBOARDS 630
PRE.B10.1130.9 PAINTING AND SIGNWRITING 630
PRE.B10.1140.9 DISPLAY SIGNS FOR SLOPE/RETAINING WALL REGISTRATION NUMBERS 630

SERVICES FOR THE EXECUTION OF THE WORKS 630
PRE.B10.1210.9 WATER SUPPLY 630
PRE.B10.1220.9 WATER SUPPLY RESTRICTIONS 631
PRE.B10.1230.A TESTING WATER SUPPLY 631
PRE.B10.1240.9 WATER DISTRIBUTION 631
PRE.B10.1250.9 PROVISION OF WATER DISTRIBUTION DETAILS 631
PRE.B10.1260.9 TESTING WATER DISTRIBUTION 631
PRE.B10.1270.A ELECTRICITY SUPPLY 631
PRE.B10.1280.9 PROVISION OF ELECTRICITY SUPPLY INFORMATION 632
PRE.B10.1290.A USE OF TEMPORARY ELECTRICITY SUPPLY FACILITIES 632
PRE.B10.1300.9 TELEPHONE 633
PRE.B10.1310.9 TEMPORARY ELECTRICAL INSTALLATION 633

REMOTE SITE MONITORING SYSTEM (RSMS) 634
PRE.B10.1410.A MOUNTING POST FOR RSMS 634
PRE.B10.1430.9 RSMS TO BE MOUNTED ON WALLS OR OTHER SUPPORTING STRUCTURES 635

CONSTRUCTION & DEMOLITION MATERIALS DISPOSAL TRACKING SYSTEM (CMDTS) 636
PRE.B10.1510.A MOUNTING POST FOR CMDTS 636
PRE.B10.1520.9 TAKING OVER EXISTING MOUNTING POST FOR CMDTS 636

APPENDIX PRE.B10/I 638

CONTRACT TECHNICAL ASSISTANTS (CTA) 638
PRE.B10.APPEND1.9 CODE OF CONDUCT FOR CONTRACT TECHNICAL ASSISTANTS WORKING FOR HOUSING AUTHORITY / HOUSING DEPARTMENT . 638

APPENDIX PRE.B10/II 642
CONTRACT TECHNICAL ASSISTANTS (CTA) 642
PRE.B10.APPEND2.9 DECLARATION FORMS 642

APPENDIX PRE.B10/IV 643
CONTRACT TECHNICAL ASSISTANTS (CTA) 643
PRE.B10.APPEND4.9 REPORT ON CONFLICT OF INTEREST 643

APPENDIX PRE.B10/V 645
CONTRACT TECHNICAL ASSISTANTS (CTA) 645
PRE.B10.APPEND5.9 CONFIDENTIALITY UNDERTAKING 645

APPENDIX PRE.B10/VI 647
CONTRACT TECHNICAL ASSISTANTS (CTA) 647
PRE.B10.APPEND6.9 INSURANCE REQUIREMENT 647

APPENDIX PRE.B10/VII 649
CONTRACT TECHNICAL ASSISTANTS (CTA) 649
PRE.B10.APPEND7.9 INDEMNITY TO PRINCIPAL CLAUSE AND INDEMNITY TO PRINCIPAL CONTRACTOR CLAUSE UNDER EMPLOYEES' COMPENSATION INSURANCE 649

APPENDIX PRE.B10/VIII 651
CONTRACT TECHNICAL ASSISTANTS (CTA) 651
PRE.B10.APPEND8.9 SAMPLE CONFIRMATION LETTER 651

APPENDIX PRE.B10/IX 655
CONTRACT TECHNICAL ASSISTANTS (CTA) 655
PRE.B10.APPEND9.A SAMPLE MONTHLY STATEMENT 655

APPENDIX PRE.B10/X 657
CONTRACT TECHNICAL ASSISTANTS (CTA) 657
PRE.B10.APPEND10.9 SAMPLE DECLARATION FORM 657

APPENDIX PRE.B10/XI 659
PRE.B10.APPEND11.N (ANNUAL*) SAFETY CERTIFICATE FOR TEMPORARY WORKS 659

PRE.B11 WORK, MATERIALS AND SERVICES BY OTHERS 660
PRE.B11.010.C WORKS BY GOVERNMENT DEPARTMENTS, UTILITY UNDERTAKINGS, DIRECT CONTRACTORS AND / OR DIRECT TESTING CONTRACTORS 660
PRE.B11.030.9 WORKS BY NOMINATED SUB-CONTRACTORS 662
PRE.B11.040.9 SUPPLY ONLY OF MATERIALS BY NOMINATED SUB-CONTRACTORS 662
PRE.B11.050.9 SUB-CONTRACTING 662
PRE.B11.070.9 CONCURRENT ADJOINING WORKS 662

PRE.B12 ATTENDANCE 663
GENERAL ATTENDANCE ON ALL TRADES 663
PRE.B12.010.9 GENERAL ATTENDANCE ON ALL TRADES 663
GENERAL ATTENDANCE ON TENDERING CONTRACTORS 663
PRE.B12.110.A FACILITIES FOR TENDERING CONTRACTORS 663

PRE.B12.120.9 INFORMATION FOR TENDERING CONTRACTORS 663
PRE.B12.130.9 REMEDIAL WORKS OR EXPENSES 663

GENERAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS, DIRECT CONTRACTORS, GOVERNMENT DEPARTMENTS AND UTILITY UNDERTAKING . 663
PRE.B12.210.9 PROVISION FOR ATTENDANCE 663
PRE.B12.220.9 PLANNING AND PROGRAMMING 663
PRE.B12.230.A BUILDER'S WORK 664
PRE.B12.235.9 GENERAL ATTENDANCE FOR BUILDING SERVICES INSTALLATIONS 665
PRE.B12.240.9 RESOLUTION OF CONFLICTING BUILDER'S WORK REQUIREMENTS 666
PRE.B12.250.9 ROUTING OF SERVICES 666
PRE.B12.260.9 PROVISION OF DETAILS OF METHOD OF CONSTRUCTION 666
PRE.B12.270.9 INSPECTION AND CERTIFICATION 666
PRE.B12.280.9 ENDORSEMENT OF CONFORMITY 666
PRE.B12.290.9 REVIEW OF SITE SECURITY PLAN 666

GENERAL ATTENDANCE ON MATERIALS SUPPLIED BY THE AUTHORITY 666
PRE.B12.310.9 GENERAL ATTENDANCE ON MATERIALS SUPPLIED BY THE AUTHORITY 666

SPECIAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS 667
PRE.B12.410.9 ELECTRICAL INSTALLATION 667
PRE.B12.430.A LIFT AND ESCALATOR INSTALLATION 667
PRE.B12.431.N PROTECTION OF LIFT ARCHITRAVE 668

SPECIAL ATTENDANCE 668
PRE.B12.510.9 TESTING CONCRETE AND CONSTITUENT MATERIALS 668
PRE.B12.511.9 TESTING DRILLED-IN ANCHORS AND GROUTED BOLTS/ DOWELS/ REINFORCING BARS 669
PRE.B12.515.9 ATTENDANCE ON DIRECT TESTING CONTRACTORS OF PILING WORKS 669
PRE.B12.516.9 ATTENDANCE ON DIRECT TESTING CONTRACTOR FOR AIR MONITORING TESTS 669
PRE.B12.520.9 NON-DESTRUCTIVE TESTS ON PILES & ULTRASONIC ECHO SOUNDER TEST FOR TYPE 3 PILE 669
PRE.B12.530.9 CONCRETE CORING AND TESTING EXCLUDING CORE TESTING OF TYPE 1(C) & TYPE 3 PILES 670
PRE.B12.532.9 CORE TESTING OF TYPE 1(C) & TYPE 3 PILES 670
PRE.B12.534.9 CONFIRMATORY CORE TESTING OF FOUNDING STRATA OF TYPE 3 PILES 670
PRE.B12.536.9 NON-DESTRUCTIVE TESTS ON WELDS OF PILES 671
PRE.B12.537.9 LOADING TESTS OF WORKING PILES 671
PRE.B12.538.9 PROVING BEDROCK AFTER INSTALLATION - TYPES 5 & 6 PILES .. 671
PRE.B12.540.9 GAS WATER HEATER INSTALLATION / FITTING OUT GAS PIPEWORK 672
PRE.B12.560.9 TURFING AND PLANTING WORKS 672
PRE.B12.565.9 ATTENDANCE ON THE ENVIRONMENTAL PROTECTION DEPARTMENT'S DIRECT CONTRACTOR 672
PRE.B12.570.9 ATTENDANCE ON THE EMPLOYER'S DIRECT CONTRACTOR 672
PRE.B12.580.9 REMOTE SITE MONITORING SYSTEM (RSMS) 673
PRE.B12.590.9 CONSTRUCTION & DEMOLITION MATERIALS DISPOSAL TRACKING SYSTEM (CMDTS) 673

SPECIAL ATTENDANCE ON UTILITY UNDERTAKING 673
PRE.B12.620.9 FIXED TELECOMMUNICATION NETWORK SERVICES INSTALLATION 673

PRE.B12.630.9 ELECTRICITY SUPPLY COMPANY 673
PRE.B12.640.X DELETED 674

SPECIAL REQUIREMENTS FOR PHASING THE WORKS 674

PRE.B12.710.A NOMINATED SUB-CONTRACTORS 674
PRE.B12.720.9 DIRECT CONTRACTORS 676
PRE.B12.730.A UTILITY UNDERTAKING 677
PRE.B12.740.9 GOVERNMENT DEPARTMENTS 678

FACILITIES FOR NOMINATED SUB-CONTRACTORS, DIRECT CONTRACTORS AND UTILITY UNDERTAKING 678

PRE.B12.810.9 FREEDOM OF MOVEMENT 678
PRE.B12.820.9 ACCESS ROAD FOR ELECTRICITY SUPPLY INSTALLATION 678
PRE.B12.830.9 USE OF AVAILABLE PLANT 678
PRE.B12.840.9 WORK AND STORAGE AREAS 678
PRE.B12.850.9 TEMPORARY SERVICES 679
PRE.B12.860.9 SITE CONVENIENCES 679
PRE.B12.870.9 UNLOADING ETC 679
PRE.B12.880.9 WATCHMAN/SECURITY GUARDS 679
PRE.B12.890.9 CLEARING AWAY RUBBISH 679
PRE.B12.900.9 MAKING GOOD 680
PRE.B12.910.9 SPECIAL BONDING 680
PRE.B12.920.A TEMPORARY ELECTRICAL SUPPLY REQUIRED FOR TESTING 680
PRE.B12.930.9 PROVISION OF SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF OPERATIVES AND SITE SUPERVISORY STAFF OF NOMINATED SUB-CONTRACTORS 681

DELETED

PRE.B1 PROJECT PARTICULARS

PRE.B1.010.9 THE PROJECT

Option 1

The Project is the Construction of Phase ……..…….. of a Public Housing Estate at ..... for the Hong Kong Housing Authority.

Option 2

The Project is the demolition of ..... existing domestic blocks (Block Nos. ..... and .....), one existing school and one existing electrical substation in ..... Estate at ..... for the redevelopment of ..... Estate Phase ..... for the Hong Kong Housing Authority.

Option 3

1. The Project is the execution of piling to foundations for the construction of ..... for the Hong Kong Housing Authority.
2. The Project is the design and execution of piling, to foundations for the construction of ..... for the Hong Kong Housing Authority.

Option 4

1. The Project is the execution of piling (and pilecaps) to foundations and the execution of certain substructure works for the construction of ..... for the Hong Kong Housing Authority.
2. The Project is the design and execution of piling (and pilecaps) to foundations and the execution of certain substructure works for the construction of ..... for the Hong Kong Housing Authority.

Option 5

The Project is the Soft Landscape Works at ..... for the Hong Kong Housing Authority.

PRE.B1.020.9 THE CONTRACT MANAGER

Option 1

The Contract Manager is the Chief Architect/..... of the Development and Construction Division, Housing Department.

Option 2

The Contract Manager is Messrs .....

Option 3

The Contract Manager is the Chief Structural Engineer/ ..... of the Development and Construction Division, Housing Department.

Option 4

The Contract Manager is Messrs .....

PRE.B1.030.9 THE SURVEYOR

Option 1

The Surveyor is the Chief Quantity Surveyor/……. of the Development and Construction Division, Housing Department.

Option 2

The Surveyor is Messrs .....

PRE.B2 THE WORKS

PRE.B2.010.C GENERAL DESCRIPTION OF THE WORKS

Option 1

The Works to be executed under this Contract include the construction of the following major items:

1. ..... - storey domestic blocks (Blocks ..... and .....), each block approximately ..... x ..... m overall on plan and approximately ..... m high from ground floor to main roof level. The long wing of each block is linked to its two short wings with a 90º angle link core approximately ..... x ..... m overall on plan.

   The blocks contain ..... No. Type A, ... No. Type B, ... No. Type C and ..... No. Type D rental domestic units in ..... domestic upper floors. The ground floors fitted out;
2. The external facades of the domestic units to Blocks ..... and ..... are to be constructed in precast concrete panels by the Contractor in accordance with the Drawings and Specification; particular attention is drawn to Worksections CON5 and CON7;
3. Precast concrete components *(including semi-precast slabs, precast balconies, precast staircases, precast structural walls, precast partition walls and precast refuse chutes) to domestic block are to be constructed in accordance with the Drawings and Specification; particular attention is drawn to Worksections CON4 and CON7;
4. Volumetric precast concrete components *(including volumetric precast bathrooms (VPB), volumetric precast kitchens (VPK), volumetric precast lift lobbies, volumetric precast lift shafts, volumetric precast lift machine rooms, volumetric precast roof water tanks and volumetric precast ground floor water tanks) to domestic block, completed with fixtures, fittings and finishes, are to be constructed in accordance with the Drawings and Specification; particular attention is drawn to Worksection CON8;
5. Precast manholes are to be designed and constructed by the Contractor in accordance with the Specification; particular attention is drawn to Worksections CON1 and DRA2;
6. One-seven-storey Flexi Primary School approximately ..... x ..... m overall on plan and approximately ..... m high from ground floor to main roof level with associated single storey Menial Staff Quarters:
   a. In accordance with PRE.B6.680 and GCC Clause 9.1, this part of the Works is “Works Subject to Excision”.
7. ..... storey non-standard commercial centre links with one ..... storey carpark building;
8. One multi-storey carpark building of ..... plus ..... split levels of carpark spaces and a top storey of ....., approximately ..... x ..... m overall on plan and approximately ..... m high from ground floor to roof garden level;
9. One ..... storey carport of ..... parking spaces, approximately ..... x ..... m overall on plan and ..... m high from ground level to carport podium with .....;
10. One District Park with .....;
11. One pedestrian footbridge approximately ..... x ..... m overall on plan, spanning .....;
12. One Pedestrian Spine composed of .....;
13. Conduct community engagement activities as described in PRE.B9.890;
14. The use of off-site prefabricated steel reinforcing bars produced by a Type 1 Yard in accordance with Worksection CON9 for at least 70% in weight of the steel reinforcing bars in all cast in-situ concrete elements excluding piles;

15. All associated drainage and external works, including lorry parking areas, slopes, road, emergency and service access, play areas, ball courts, covered walkways, service mains, ducts and pits, and refuse storage area etc.;
16. Protection and preservation of existing trees and shrubs within and outside the Site boundary and treatment and management of yard waste in accordance with PRE.B8.1110 and Worksection EXT18. When Instructed, the transplanting of certain trees will be carried out by a Direct Contractor employed direct by the Authority;
17. All such works and / or services in relation to the taking care of the Works after completion in accordance with Clause SCC8.5.

    Note: Special requirements for works and / or services are given in PRE.B6 to this Specification;
18. Work outside the boundary of the Site, including:
    a. Soil and surface water drainage connection works. Area ..... refers;
    b. Water supply connection works. Area ..... refers;
    c. Road run-in and footpath works. Area ..... refers;
    d. Utilities investigation survey. Area ..... refers (such survey shall be carried out both within the Site and outside the boundary of the Site; see also PRE.B3.060);
    e. Protection and preservation of the existing trees and shrubs as per PRE.B8.1116. Area ..... refers;
    f. ..... Area ..... refers.
19. All such other work as indicated on the Drawings or described in this Specification or may otherwise be ordered in accordance with the Conditions of Contract.

Option 2

The Works to be executed under this Contract comprise the following major items:

1. The demolition of the following buildings and all existing structures annexed thereto, including grubbing up ground slabs, pavings, footings, pile caps, tie beams, strap beams etc., and all blinding, hardcore and mass concrete filling thereunder. Demolition to a level 1 m below the underside of the existing pile caps including cutting off concrete piles and dowel bars:
    a. .....-storey reinforced concrete blocks (Blocks .....). Each block approximately ..... x ..... m overall on plan and approximately ..... m high from ground floor to main roof level;
    b. One 6-storey high reinforced concrete school (School No. .....) approximately ..... x ..... m overall on plan and approximately ..... m high from ground floor to main roof level;
    c. One 1-storey high reinforced concrete electrical substation approximately ..... x ..... m overall on plan and approximately ..... m high.
2. The survey, removal, storage, salvage and disposition of the reusable and recyclable materials specified in DEM1.D140;
3. The survey and removal of asbestos in the above buildings;
4. The erection and maintenance of permanent site hoardings;
5. The breaking up of all existing railings, fencing, barriers, concrete curbs, flower beds and pots, sitting benches, tree protective cages, chess tables and chairs, lamp poles (except for lamp posts belonging to Utility Undertakings), telephone poles, vehicle barriers, bollards, surface water channels, external pavings and hardcore under, and all other structures including grubbing up their foundations;
6. Sealing off disused drains and manholes but maintaining the flow of live drains, etc.;
7. The backfilling of all voids resulting from demolition;

8. Protection and preservation of existing trees and shrubs within and outside the Site boundary and treatment and management of yard waste in accordance with PRE.B8.1110 and Worksection EXT18. When Instructed, the transplanting of certain trees will be carried out by a Direct Contractor employed direct by the Authority;
9. The protection and preservation of all slopes and embankments;
10. The removal from Site of all materials, debris, etc., arising from the Works. (See DEM1.M010 and DEM1.M020);
11. The preparation and submission of a record plan showing levels and details at completion of the Works in a form agreed by the CM;
12. All such works and / or services in relation to the taking care of the Works after completion in accordance with Clause SCC8.4 and PRE.B8.170;
13. All such other work as indicated on the Drawings or described in this Specification or may otherwise be ordered in accordance with the Conditions of Contract.

Option 3

The Works to be executed under this Contract for piling (and pilecaps) comprise the following major items:

1. *The execution of piling (and pile caps) to foundations as shown on the Drawings and in accordance with this Specification to the following: / The design and execution of piling (and pile caps) to foundations to sustain the dead, superimposed, earth and wind loads and all other loads as shown on the Drawings and in accordance with this Specification to the following:
   a. ..... -storey domestic blocks (Blocks ..... and .....);
   b. One ..... -storey commercial complex;
   c. One ..... -storey carpark;
   d. One pedestrian footbridge;
   e. .....;
   f. .....
2. The design only of pilecaps for items ..... to sub-clause (1) above and Specification thereto as may be necessary to ensure that the construction of such pilecaps satisfies the assumptions made in their design;
3. Excavation, filling and disposal in connection with construction of pilecaps;
4. Execution of starter bars for walls and columns of a future superstructure contract as referred to on the Drawings;
5. Preliminary additional piles;
6. The construction for use by subsequent contractors of a transformer compound / transformer and switch room compound comprising single storey building size ..... x ..... x ..... m and associated external works;
7. All testing in connection with the above works as required by this Specification and/or as Instructed;
8. The erection, relocation and maintenance of permanent site hoardings;
9. The use of off-site prefabricated steel reinforcing bars produced by a Type 1 Yard in accordance with Worksection CON9 for at least 40% in weight of the steel reinforcing bars in all cast in-situ concrete elements;
10. Protection and preservation of existing trees and shrubs within and outside the Site boundary and treatment and management of yard waste in accordance with PRE.B8.1110 and Worksection EXT18. When Instructed, the transplanting of certain trees will be carried out by a Direct Contractor employed direct by the Authority;
11. All such works and / or services in relation to the taking care of the Works after completion in accordance with Clause SCC8.3 and PRE.B8.170;

12. All such other work as indicated on the Drawings or described in this Specification or may otherwise be ordered in accordance with the Conditions of Contract.

Option 4

The Works to be executed under this Contract include:

1. Section A - Planting Works:
   a. Existing vegetation treatment, including but not limited to arboricultural works, transplanting and felling of existing trees;
   b. Soil excavation, filling and grading to plant beds;
   c. Supplying and applying soil, soil conditioners, compost, drainage materials, and mulches;
   d. Supplying and placing boulders;
   e. Supplying and spreading fertilizer;
   f. Supplying and sowing grass, laying turf and sprigs, including for use in grass paving system;
   g. Supplying and planting climbing plants, ground cover plants, herbaceous plants, shrubs, trees and other plant materials;
   h. Supplying and placing artificial plants;
   i. Supplying and planting aquatic plants;
   j. Supplying and placing indoor plants;
   k. Hydroseeding;
   l. Tree surgery works;
   m. Ancillary works including provision of protective fencing, daily hiring of plants etc.;
   n. Processing and delivering suitable yard waste to the Y • PARK in accordance with EXT18.W020;
   o. When Instructed, collect and deliver compost and mulch from Y • PARK to the Site.
2. Section B - Establishment Works:

   Establishment Works including maintaining the new and existing planted and grassed areas, and tending and replacing plants as necessary for the period defined in PRE.B4.080.

   These works shall include the following:
   a. Those trees and palms transplanted to the Site by the Employer's Direct Contractor;
   b. Any tree surgery, transplanting or felling works for the existing trees;
   c. Conducting annual tree risk assessment and management (TRAM) exercise in accordance with PRE.B8.1210 for new and existing trees as instructed by the CM;
   d. Providing a full set of tree inventory survey report in accordance with SLW9.W100;
   e. Processing and delivering suitable yard waste to Y • PARK in accordance with EXT18.W020.

PRE.B2.020.9 WORKS SUBJECT TO EXCISION

Parts of the Works which are ”Works Subject to Excision” in accordance with GCC Clause 9.1 are listed in PRE.B6.680.

PRE.B2.030.A PREPARATORY WORKS

Option 1

There are no previous contracts for this project.

Option 2

1. The following preparatory work has been (is being) executed under previous separate contract(s):
   a. Ground investigation;
   b. Demolition;
   c. Site formation, the levels having generally been formed to .....;
   d. Substructures;
   e. Piling;
   f. Pilecaps;
   g. Temporary transformer compound / transformer and switch room compound;
   h. Temporary works as described in PRE.B10.010 .....
2. Drawings for the above works may be seen by prior appointment at the Hong Kong Housing Authority Headquarters' office during normal office hours. The above information is given in good faith without limiting the Contractor's obligations and liabilities under the Contract. The Contractor is also advised to inspect the relevant works on and in the vicinity of the Site.

Option 3

1. The following preparatory work has been (is being) executed under previous separate contract(s):
   a. The construction of ..... (Building Contract);
   b. The construction of ground level and / or raised planting beds;
   c. Spreading and levelling soil in certain planting areas;
   d. Tree removal works, including transplanting and felling of existing trees, shrubs and survey of existing trees within and outside the Site boundary.
2. Drawings for the above works may be seen by prior appointment at the Hong Kong Housing Authority Headquarters' office during normal office hours.

PRE.B2.040.9 CONCURRENT ADJOINING WORKS

1. Other contracts are being or will be carried out concurrently on adjoining sites as follows:

   .....
2. In accordance with GCC Clause 5.27, liaise with and coordinate the sequence of the Works with the contractors for these separate contracts and with the Direct Contractors, Government Departments and Utility Undertaking engaged in the development of the adjoining sites. In particular attention is drawn to the following requirements:
   a. The (demolition of) external works in this Phase ..... contract connect directly with the external works for the separate Phase ..... contract. Allow, in the time for completion of the Works, for all time taken in liaison and coordination with the separate contractors;
   b. Works by others may be carried out on and/or in the vicinity of the Site boundary. Allow for providing access for such works and for temporary shifting and reinstatement of fencing and site hoardings to suit the requirements of separate contracts;
   c. .....

PRE.B2.050.9 WORK, MATERIALS AND SERVICES BY OTHERS

Refer to Worksection PRE.B11 of this Specification.

PRE.B3 THE SITE

PRE.B3.010.9 SITE LOCATION

Option 1

The Site of the Works is at.....

Option 2

The Site of the Works is the various planting beds, grassed areas etc at

.....

PRE.B3.020.A SITE BOUNDARY

The boundary of the Site is delineated on Drawing No: .....

PRE.B3.030.9 PHASE/ESTATE BOUNDARY

The Phase/Estate boundary is delineated on plan at Appendix A of this Specification

PRE.B3.040.9 WORKS SUBJECT TO HIGH WATER LEVELS

This Site is close to the sea waterfront and works for some pile caps and some drainage works will be required to be carried out below high water levels. Obtain a copy of the times and heights of high and low water for Hong Kong, adjusted as necessary for ..... Notwithstanding the published tide tables, which indicate a maximum high water level of not exceeding + ...m PD, take account of and accept responsibility for any consequences of the abnormal high tide build up above these levels that can occur in this area due to extreme weather conditions.

PRE.B3.050.9 EXISTING BUILDINGS

Attention is drawn to the following buildings adjacent or abutting the Site:

.....

PRE.B3.060.B EXISTING SERVICES

Option 1

1. The following utility services, drains etc are known to be within the Site (see also PRE.B8.970)

   .....
2. A plan indicating known existing underground services may be viewed by prior appointment at the Hong Kong Housing Authority Headquarters' office during normal office hours;
3. The Contractor shall at his own cost and time mentioned in sub-clause (5) carry out and complete utilities investigation survey to:
   a. Verify the alignments, extent and invert levels of any existing utilities and services within the Site and outside the boundary of the Site;
   b. Identify the locations and alignments of existing utilities and services that may have potential clashes with the Works, in particular the drainage works, and demonstrate any clashes with sufficient information for the CM's consideration;
   c. Take necessary precautionary measures to avoid causing disturbances and damage to existing utilities and services during the utilities investigation survey.
4. Submit the methodology, arrangement, programme and details of the utilities investigation survey to the CM for comments. The survey methodology may include but not be limited to all or combination of the following:

a. Obtain the latest information of existing underground utilities and services installation from Utility Undertakings and Government departments immediately at commencement of the Works;

b. Locate existing underground utilities and services by visual inspection of surface features such as manhole and utility pit covers, etc.;

c. Carry out survey using methods such as 'electromagnetic detection methods' and 'ground probing radar' in areas where non-destructive means are needed to investigate potential clashes of existing utilities and services with the Works, or as instructed by the CM;

d. Excavate trial pits and trenches to locate the existing utilities and services;

e. Verify and agree with Government departments and utilities undertakings on the alignment and extent of the existing underground utilities and services.

5. Within …….. months from the notified date for commencement of the Works, the Contractor shall complete utilities investigation survey including the submission of the reports, record drawings, photographs of the survey findings and reinstate the affected areas of the Site to the CM's satisfaction;

6. Ensure the existing utilities and services incidental to utilities investigation survey works are not damaged. Alter and adapt the utilities investigation survey works to suit the existing utilities and services if necessary. No claim whatsoever will be considered for the consequence due to any difference between the existing utilities and services shown on the drawings and those actually found on Site;

7. Render all necessary assistance to the Employer in application for an Excavation Permit or any extension in respect thereof in accordance with PRE.B8.2710, PRE.B8.2720, PRE.B8.2730 and PRE.B8.2740 when the utilities investigation survey is to be carried out on Street Maintained by the Highways Department;

8. Attention is drawn that the extent and locations of the existing utilities and services may render conventional trench excavation impracticable and require unconventional method such as hand-dug tunnelling to suit the actual site conditions in construction of the drainage works. Allow sufficient time in the programme for implementing the required temporary works and construction sequence for the Works. Hand-dug tunnelling shall comply with the latest Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department. The following terms used in the Guidance Notes shall be construed as follows for the purpose of the Specification:

Term used in the Guidance Notes	Terms in the Specification
the proprietor	Direct Contractor
project engineer	Qualified Engineer
contractor	Contractor

Option 2

1. The following utility services, drains etc are known to be within the Site (see also PRE.B8.970)

   .....

2. A plan indicating known existing underground services may be viewed by prior appointment at the Hong Kong Housing Authority Headquarters' office during normal office hours.

PRE.B3.070.B SITE INFORMATION

1. Attention is drawn to the following Site information:

a. According to ground water monitoring data, construction of ..... may be carried out below ground water level;

.....;

2. A number of boreholes and trial pits have been made on and near the Site and the logs and cores may be inspected by prior arrangement with the CM;
3. Ground water monitoring have been carried out on or near the Site and the ground water monitoring data may be inspected by prior arrangement with the CM;
4. A copy of compact disc containing part or whole of the information about the logs and / or cores of the boreholes and trial pits and the ground water monitoring data as mentioned above may be obtained from the CM by prior arrangement with the CM;
5. Accept responsibility for ascertaining the ground conditions including the nature of the soil and rock and the ground water levels;
6. The above information is given in good faith for reference only and is not meant to be exhaustive or to be representative of the whole or any part of the Site or in any way limiting the obligations and liabilities of the Contractor under the Contract. No guarantee can be given nor responsibility be taken by the Employer or the CM for their accuracy, consistency or sufficiency, and no claim whatsoever will be entertained on account of any errors, discrepancies and insufficiency in relation to the information given.

PRE.B3.080.9 ACCURACY OF PREVIOUS WORKS

Option 1

1. Carry out a survey to record the site topography, the setting out and levels of piles, pilecaps, the position, number, size and length of starter bars of the piles, etc. which are to be taken over from the previous piling contractor. Bear all cost in connection with the survey including preparation of survey drawings. Immediately inform the CM of any discrepancies or faults otherwise no claim will be considered for costs incurred in respect of such discrepancies or faults;
2. At a time to be determined by the CM:
   a. Carry out sub-clause (1) above by a joint survey with the previous piling contractor shortly after award of the Contract in the presence of the CM or his representatives;
   b. Prepare, submit and re-submit after reconciliation as necessary the draft survey drawings produced from the joint survey to the CM or his representatives and the previous piling contractor for checking;
   c. Prepare and submit the finalized survey drawings signed by both the Contractor and the previous piling contractor for endorsement by the CM or his representatives within 14 days after commencement of the joint survey;
   d. Bear all cost in connection with the joint survey including preparation of survey drawing.

Option 2

Establish the correctness of the setting out, levels etc; immediately inform the CM of any discrepancies or faults, otherwise no claim will be considered for costs incurred in respect of such discrepancies or faults.

PRE.B3.090.9 LIMITATIONS OF WORKING AREAS

Option 1

1. Limitations of working areas and storage spaces are as shown on Drawing No. ..... included at Appendix C to this Specification/temporary works described in PRE.B10.010;
2. Make allowance in the programme and construction sequence to cater for such limitations;

3. Additional works area and/or borrow area(s) as delineated on Drawing No. ..... will be made available to the Contractor, if required, free of charge. Make good and reinstate areas to former condition before handing back to the Authority;
4. Parts of the site required to be taken over by the Contractor for temporary works areas for designated periods are as shown in ..... Make good and reinstate areas to former condition before handing back to the Authority when directed.

Option 2

Subject to prior agreement with the CM, the Contractor is permitted to make use of the paved areas within the Phase/Estate boundary, as working area. The CM may withdraw the agreement or impose additional restrictions at any time subsequent to the agreement. Keep the working area clean, tidy, and maintain and keep clear all drains, U channels, gulleys and the like, at all times.

PRE.B3.100.9 WORKS IN OCCUPIED PREMISES

Take note that the domestic units on the Estate are, or shortly will be, inhabited and that the inhabitants may cause obstructions and hindrances to the Contractor in the execution of the Works. Provide necessary measures to protect the inhabitants from injury and their property from damage, etc in the carrying out of the Works.

PRE.B3.110.9 ACCESS TO THE SITE

1. Accept responsibility for providing own access routes, access points and entry on to the Site. Requirement for temporary access and roads are given in PRE.B10.020. Restrictions on the number of entrances and exits to the Site are stated in PRE.B10.710;
2. Charges may be applied for the parking of vehicles within the estate car park which are used during the period of the contract. The Contractor is to make due allowance for such charges;
3. Other restrictions apply as follows: .....

PRE.B4 POSSESSION AND COMPLETION

PRE.B4.010.A PHASED POSSESSION OF THE SITE

Option 1

There are no special requirements for phased possession of the Site in Portions for this Contract.

Option 2

In accordance with GCC Clause 8.2, the extent of Portions to which the Contractor will be given possession from time to time, and the order in which such Portions will be made available, are as follows:

1. Area …… for Blocks ..... and ..... - available at the notified date for commencement of the Works;
2. Area …… for Blocks ..... and ..... - available within ..... months after the notified date for commencement of the Works;
3. Area(s) ..... available at the commencement date specified in the Excavation Permit issued by Highways Department or other duly constituted authority.

Option 3

In accordance with GCC Clause 8.2 the extent of Portions of the Site to which the Contractor will be given possession from time to time are as follows:

No less than 80% of the various areas which comprise the Site will be handed over to the Contractor on the notified date for commencement of the Works; the remainder of the areas may be handed over progressively with the last area being handed over no later than half way between the notified date for commencement and the date for completion, or extended date for completion of Section A - Planting Works.

PRE.B4.020.9 NOTIFIED DATE FOR COMMENCEMENT OF THE WORKS

The period of time within which the notified date for commencement shall occur will be within 28 days after the date of the Letter of Acceptance. Provided that if the date of the Letter of Acceptance is subsequent to the first day of August of the same year as, and before the first day of February of the following year of the Tender submission, the period of time within which the notified date for commencement of the Works shall occur as stated in the Appendix to the Form of Tender will be deemed to be deleted and substituted by the following related to the month in which the tender is accepted.

Month of Acceptance		Period of Time for Commencement in the Appendix to the Form of Tender
August	(of year of tender)	220 days
September	(of year of tender)	190 days
October	(of year of tender)	160 days
November	(of year of tender)	130 days
December	(of year of tender)	100 days
January	(of the year following the year of tender)	65 days

PRE.B4.021.9 DATES FOR COMMENCEMENT OF SECTIONS

Option 1

There are no special requirements for phased commencement of the Works in Sections for this Contract.

Option 2

In accordance with GCC Clause 8.1, the dates for commencement of the following Sections are not the same as the notified date for commencement of the Works. The dates for commencement of such Sections shall fall within the periods as specified below and shall be notified in writing by the CM:

1. Section ……. for Blocks ..... and ..... shall have a date for commencement within …….months of the notified date for commencement of the Works;
2. Section ……. for Blocks ..... and ..... shall have a date for commencement within …….months of the notified date for commencement of the Works.

PRE.B4.030.9 PHASED ISSUANCE OF WORKING DRAWINGS AND DETAILS

1. The following working drawings and details will be available for issue to the Contractor for construction purposes as follows:

   (Specify works affected)

   Available within ..... months after the notified date for commencement of the Works;
2. Programme the Works to suit and allow for any additional costs in connection with the above restrictions and timing for issue of drawings. Any of the above works executed by the Contractor before the receipt of the drawings/information from the CM will be at his own risk.

PRE.B4.035.9 PHASED SUBMISSION OF CONTRACTOR'S DESIGN

1. Phase the submission of Contractor's design in the following Stages:
   a. Submission for major works:

Phased Submission	Time for Submission
Stage 1 Type of major works ("Type Ma"): i. ii. iii. iv.	Not later than .... months from the notified date for commencement of the Works or at least ..... days before the commencement of the specified works of Stage 1 of Type Ma, whichever is the earlier.
The number of Stage 1 submission for each type of works shall be limited to not more than ONE first submission and ONE amendment.	
Stage 2 Type Ma: i. ii. iii.	Not later than ..... months from the notified date for commencement of the Works or at least ..... days before the commencement of the specified works of Stage 2 of Type Ma, whichever is the earlier.

The number of Stage 2 submission for each type of works shall be limited to not more than ONE first submission and ONE amendment.	

Phased Submission	Time for Submission

b. Submission for minor works:

Phased Submission	Time for Submission
Type of minor works ("Type Mi"): i. ii. iii.	Not later than ..... months from the notified date for commencement of the Works or at least ..... days before the commencement of the specified works of Type Mi, whichever is the earlier. The Type Mi submission shall be grouped by the Contractor and submit to the CM for approval on monthly basis, i.e. only ONE submission per month is allowed, including any first submission or amendment of previous submission.

2. The final amendment for all Contractor's design submissions, including Type Ma and Type Mi submissions, shall be grouped into ONE submission and shall not be more than ONE;
3. Submit four copies of drawings, calculations and any other relevant documents related to Contractor's design items mentioned in sub-clause (1) for Approval. Any submission not to the satisfaction of the CM shall be re-submitted. Allow 45 days for each submission and re-submission for the checking by the CM.

PRE.B4.040.A RESTRICTIONS ON COMMENCEMENT

Option 1

Attention is drawn to the following restrictions on commencement of parts of the Works:

1. Commencement of those Sections of the Works which are "Works Subject to Excision" in accordance with GCC Clause 9.1 are listed in PRE.B6.680 (see also PRE.B2.020);
2. Do not commence the laying of pipes in the open area / roads in the first 12 months after the notified date for commencement of the Works;
3. Commencement of the Building Works (except pile installation, pile cap and footing construction) is subject to the CM's written permission which shall be obtained as follows:
   a. Submit SP in accordance with PRE.B8.1405;

b. Apply for the CM's written permission to commence the Building Works before the commencement of the Building Works. The CM's written permission will not be given before:
   i. The SP as per sub-clause (a) has been submitted;
   ii. The hoarding and gantries works specified in PRE.B10.710, PRE.B10.720 and PRE.B10.730 have been completed.
c. Within three days after the date of the Letter of Acceptance, complete and submit Form ICU 10 to the CM for commencing the Building Works.

4. Commencement of the ELSW is subject to the CM's written permission which shall be obtained as follows:
   a. Submit ELSP in accordance with EAR1.D030;
   b. Submit SP in accordance with PRE.B8.1405;
   c. After obtaining Approval of the ELSP as per sub-clause (a) above, apply to the CM for the permission to commence ELSW and allow at least 22 days for the CM's written permission which will not be given before:
      i. The conditions imposed by the CM in the approval of the ELSP have been fulfilled;
      ii. The SP as per sub-clause (b) has been submitted;
      iii. The hoarding and gantries works specified in PRE.B10.710, PRE.B10.720 and PRE.B10.730 have been completed;
      iv. "Pre-construction Condition Survey" report, with reference to PNAP APP-137, of area covering at least 50m from the perimeter of the Site or to the extent agreed by the CM has been submitted;
      v. "Public Relations Plan" as specified in PRE.B8.1435 has been submitted.
   d. Complete and submit Form ICU 10 for commencing ELSW to the CM at least 14 days prior to the commencement of the ELSW.
5. Commencement of curtain walling works is subject to the CM's written permission which shall be obtained as follows:
   a. Submit design calculations and details in accordance with PRE.B6.085 to the CM at least 45 days before the commencement of curtain walling works. Allow a further 45 days for each re-submission;
   b. Apply for the CM's written permission to commence the curtain walling works at least 22 days before the commencement of the curtain walling works. The CM's written permission will not be given before the submission as per sub-clause (a) has been Approved;
   c. Complete and submit Form ICU 10 for commencing the curtain walling works to the CM at least 14 days prior to the commencement of the curtain walling works.
6. Programme the Works by taking into account of the submissions and any re-submission as may be required under the above sub-clauses.

Option 2

Attention is drawn to the following restrictions on commencement of parts of the Works:

1. Do not commence the demolition works in general before all the precautionary measures as described in DEM1.W210 have been completed to the satisfaction of the CM.

Option 3

Attention is drawn to the following restrictions on commencement of parts of the Works:

1. Commencement of those Sections of the Works which are "Works Subject to Excision" in accordance with GCC Clause 9.1 are listed in PRE.B6.680 (see also PRE.B2.020).

PRE.B4.050.B RESTRICTIONS ON COMMENCEMENT OF PILE INSTALLATION AND / OR FOOTING CONSTRUCTION AND / OR ELSW

Option 1

1. Commencement of pile installation and / or footing construction is subject to the CM's written permission which shall be obtained as follows:
   a. Submit the piling and / or footing design in accordance with PIL1.D210;
   b. Submit SP in accordance with PRE.B8.1405;
   c. Submit information for the hard paved construction as required in PRE.B10.091;
   d. After obtaining Approval of the piling and / or footing design as per sub-clause (a) above, apply to the CM for the permission to commence pile installation and / or footing construction work and allow at least 22 days for the CM's written permission which will not be given before:
      i. The conditions imposed by the CM in the approval of the piling and / or footing design have been fulfilled;
      ii. The SP as per sub-clause (b) has been submitted;
      iii. The hoarding …….. and gantries works specified in Drawings provided in PRE.B10.710, PRE.B10.720 and PRE.B10.730 have been completed;
      iv. The proposal for hard paved construction to the storage areas, main haul road, the respective blocks with the impending Type 3 pile installation and the branch haul road(s) leading to the respective blocks impending pile installation and / or footing construction have been approved by the CM as specified in PRE.B10.020 and PRE.B10.091;
      v. "Pre-construction Condition Survey" report, with reference to PNAP APP-137, of area covering at least 50m from the perimeter of the Site or to the extent agreed by the CM has been submitted;
      vi. "Public Relations Plan" as specified in PRE.B8.1435 has been submitted.
   e. Complete and submit Form ICU 10 for commencing the pile installation and / or footing construction to the CM at least 14 days prior to the commencement of the pile installation and / or footing construction.
2. Commencement of pile installation and / or footing construction is subject to the CM's written permission which shall be obtained as follows:
   a. Submit SP in accordance with PRE.B8.1405;
   b. Submit information for the hard paved construction as required in PRE.B10.091;
   c. Submit method statement for pile installation and / or footing construction for Approval;
   d. After obtaining Approval of the method statement as per in sub-clause (b) above, apply to the CM for the permission to commence pile installation and / or footing construction work and allow at least 22 days for the CM's written permission which will not be given before:
      i. The SP as per sub-clause (a) has been submitted;
      ii. The hoarding …….. and gantries works specified in Drawings provided in PRE.B10.710, PRE.B10.720 and PRE.B10.730 have been completed;
      iii. The proposal for hard paved construction to the storage areas, main haul road, the respective blocks with the impending Type 3 pile installation and the branch haul road(s) leading to the respective blocks impending pile installation and / or footing construction have been approved by the CM as specified in PRE.B10.020 and PRE.B10.091;

iv. "Pre-construction Condition Survey" report, with reference to PNAP APP-137, of area covering at least 50m from the perimeter of the Site or to the extent agreed by the CM has been submitted;

v. Public Relations Plan as specified in PRE.B8.1435 has been submitted.

d. Complete and submit Form ICU 10 for commencing the pile installation and / or footing construction to the CM at least 14 days prior to the commencement of the pile installation and / or footing construction.

3. Commencement of the part(s) of piling and / or footing work(s) affected by amendment of piling and / or footing design is subject to the CM's written permission which shall be obtained as follows:

a. Submit the amendment of piling and / or footing design in accordance with PIL1.D220;

b. After obtaining Approval of the amendment of piling and / or footing design as per sub-clause (a) above, apply to the CM for the permission to commence work and allow at least 22 days for the CM's written permission to commence the part(s) of piling and / or footing work(s) affected by amendment of piling and / or footing design.

4. Commencement of the ELSW is subject to the CM's written permission which shall be obtained as follows:

a. Submit ELSP in accordance with EAR1.D030;

b. Submit SP in accordance with PRE.B8.1405;

c. After obtaining Approval of the ELSP as per sub-clause (a) above, apply to the CM for the permission to commence ELSW and allow at least 22 days for the CM's written permission which will not be given before:

i. The conditions imposed by the CM in the approval of the ELSP have been fulfilled;

ii. The SP as per sub-clause (b) has been submitted;

iii. The hoarding and gantries works specified in PRE.B10.710, PRE.B10.720 and PRE.B10.730 have been completed;

iv. "Pre-construction Condition Survey" report, with reference to PNAP APP-137, of area covering at least 50m from the perimeter of the Site or to the extent agreed by the CM has been submitted;

v. "Public Relations Plan" as specified in PRE.B8.1435 has been submitted.

d. Complete and submit Form ICU 10 for commencing ELSW to the CM at least 14 days prior to the commencement of the ELSW.

5. Programme the Works by taking into account of the submissions that may be required under the above sub-clauses.

Option 2

1. Commencement of footing construction is subject to the CM's written permission which shall be obtained as follows:

a. Submit the footing design in accordance with PIL1.D210;

b. Submit SP in accordance with PRE.B8.1405;

c. After obtaining Approval of the footing design as per sub-clause (a) above, apply to the CM for the permission to commence footing construction work and allow at least 22 days for the CM's written permission which will not be given before:

i. The conditions imposed by the CM in the approval of the footing design have been fulfilled;

ii. The SP as per sub-clause (b) has been submitted;

iii. The hoarding …….. and gantries works specified in Drawings provided in PRE.B10.710, PRE.B10.720 and PRE.B10.730 have been completed.

d. Complete and submit Form ICU 10 for commencing the footing construction to the CM within three days after the date of the Letter of Acceptance.

2. Commencement of footing construction is subject to the CM's written permission which shall be obtained as follows:
   a. Submit SP in accordance with PRE.B8.1405;
   b. Submit proposal of method statement for footing construction for Approval;
   c. Apply for the CM's written permission to commence footing construction within three days after the date of the Letter of Acceptance. The CM's written permission will not be given before:
      i. The SP as per sub-clause (a) has been submitted;
      ii. The proposed method statement as per sub-clause (b) has been Approved;
      iii. The hoarding …….. and gantries works specified in Drawings provided in PRE.B10.710, PRE.B10.720 and PRE.B10.730 have been completed.
   d. Complete and submit Form ICU 10 for commencing the footing construction to the CM within three days after the date of the Letter of Acceptance.
3. Commencement of the part(s) of footing work(s) affected by amendment of footing design is subject to the CM's written permission which shall be obtained as follows:
   a. Submit the amendment of footing design in accordance with PIL1.D220;
   b. After obtaining Approval of the amendment of footing design as per sub-clause (a) above, apply to the CM for the permission to commence the part(s) of footing work(s) and allow at least 22 days for the CM's written permission.
4. Commencement of the ELSW is subject to the CM's written permission which shall be obtained as follows:
   a. Submit ELSP in accordance with EAR1.D030;
   b. Submit SP in accordance with PRE.B8.1405;
   c. After obtaining Approval of the ELSP as per sub-clause (a) above, apply to the CM for the permission to commence ELSW and allow at least 22 days for the CM's written permission which will not be given before:
      i. The conditions imposed by the CM in the approval of the ELSP have been fulfilled;
      ii. The SP as per sub-clause (b) has been submitted;
      iii. The hoarding and gantries works specified in PRE.B10.710, PRE.B10.720 and PRE.B10.730 have been completed;
      iv. "Pre-construction Condition Survey" report, with reference to PNAP APP-137, of area covering at least 50m from the perimeter of the Site or to the extent agreed by the CM has been submitted;
      v. "Public Relations Plan" as specified in PRE.B8.1435 has been submitted.
   d. Complete and submit Form ICU 10 for commencing ELSW to the CM at least 14 days prior to the commencement of the ELSW.
5. Programme the Works by taking into account of the submissions that may be required under the above sub-clauses.

PRE.B4.060.9 RESTRICTIONS ON COMMENCEMENT OF CONSTRUCTION OF PILE CAPS

1. Commencement of pile caps construction is subject to CM's written permission which shall be obtained as follows:

a. Make all necessary submissions in accordance with …….. including Form ICU14;

b. Submit the pile cap design in accordance with PIL1.D830;

c. Submit SP in accordance with PRE.B8.1405;

d. Apply for CM's written permission to commence pile caps construction at least 22 days before the commencement of pile caps construction. CM's written permission will not be given before:

i. The submissions as per sub-clause (a) have been made and the proof test results comply with the Specification's requirements;

ii. The pile cap design as per sub-clause (b) has been Approved;

iii. The conditions imposed by the CM in the approval of the pile cap design have been fulfilled;

iv. The SP as per sub-clause (c) has been submitted.

e. Obtain CM's written permission to proceed with the construction of pile caps on a block by block basis unless otherwise agreed by the CM.

2. Commencement of the part(s) of pile cap works affected by amendment of pile cap design is subject to CM's written permission which shall be obtained as follows:

a. Submit the amendment of pile caps design to the CM at least 42 days before the commencement of the part(s) of pile cap works affected by amendment of pile cap design. Allow a further 42 days for each re-submission;

b. Apply for CM's written permission to commence the part(s) of pile cap works affected by amendment of pile cap design at least 22 days before the commencement of such works. CM's written permission will not be given before the amendment of pile caps design as per sub-clause (a) has been Approved;

3. Programme the Works by taking into account the submissions and any re-submissions as may be required under the above sub-clauses.

PRE.B4.065.9 RESTRICTIONS ON COMMENCEMENT OF SITE FORMATION WORKS

Option 1

Attention is drawn to the following restrictions on commencement of Site Formation Works:

1. Commencement of the Site Formation Works is subject to the CM's written permission, which shall be obtained as follows:

a. Submit SP for the Site Formation Works in accordance with PRE.B8.1405;

b. Apply for the CM's written permission to commence the Site Formation Works at least 22 days before the commencement of the Site Formation Works. CM's written permission will not be granted before the SP as per sub-clause (a) has been submitted;

c. Complete and submit Form ICU 10 for commencing the Site Formation Works to the CM at least 14 days prior to the commencement of the Site Formation Works.

2. Programme the Works by taking into account of the submissions required under the above sub-clauses.

Option 2

Attention is drawn to the following restrictions on commencement of Site Formation Works:

1. Commencement of the Site Formation Works is subject to the CM's written permission, which shall be obtained as follows:

a. Submit SP for the Site Formation Works in accordance with PRE.B8.1405;

b. Apply for the CM's written permission to commence the Site Formation Works within three days after the date of the Letter of Acceptance. CM's written permission will not be granted before the SP as per sub-clause (a) has been submitted;

c. Complete and submit Form ICU 10 for commencing the Site Formation Works to the CM within three days after the date of the Letter of Acceptance.

2. Programme the Works by taking into account of the submissions required under the above sub-clauses.

PRE.B4.070.9 TIME FOR COMPLETION

Option 1

In accordance with GCC Clause 8.3, the time for completion of the whole of the Works, but excluding any works and / or services in relation to taking care of the Works after completion, is ..... months.

Option 2

In accordance with GCC Clause 8.3, the time for completion of the whole of the Works, but excluding any works and / or services in relation to taking care of the Works after completion is:

Tender 'A' - ..... months;

Tender 'B' - to be proposed by the tenderer and to be less than the time for completion in Tender 'A' but not less than ..... months.

Option 3

In accordance with GCC Clause 8.3 the time for completion of the whole of the Works is ..... months.

Option 4

In accordance with GCC Clause 8.3 the time for completion of the whole of the Works is ..... months or such period as stipulated by the Contractor in his Tender 'B' or alternative tender, as appropriate.

Option 5

In accordance with GCC Clause 8.3 the time for completion of the whole of the Works, but excluding any works and / or services in relation to taking care of the Works after completion is ..... months.

PRE.B4.080.B SECTIONS FOR PHASED COMPLETION

Option 1

1. There are no special requirements for phased completion of the Works in Sections for this Contract;
2. As stated in PRE.B2.010 sub-clause ..... complete the placement of fill in the open area / roads to the required finished levels within six months from the notified date for commencement of the Works;
3. Provide timber mock up for the external and internal walls of kitchen and bathroom with gas, plumbing and drainage pipeworks, reinforcement bars and building services fittings such as conduits and switch boxes for the following typical domestic flats no later than commencement of concreting works for the first typical floor.

   Flats: ……;

   Conform with the following requirements for the timber mock-up:

   a. Install gas, plumbing and drainage pipeworks, reinforcement bars and building services fittings as shown on Drawings on both sides of the timber walls to show that the alignments and openings of the pipeworks, reinforcement bars and building services fittings do not encroach upon each other at the external and internal sides of the kitchen and bathroom;

b. Agree with the CM on the alignment of all items before the commencement of concreting works of the first domestic floor;

c. Submit as-fitted drawings for the coordinated alignments and openings of the pipeworks, reinforcement bars and building services fittings in the timber mock-up;

d. Maintain the Approved timber mock-up until the completion of sample wing and sample flats;

e. Obtain the CM's Approval for the removal of the timber mock-up.

4. Provide the following sample wing, sample flats and construction mock-up on the location of the typical floor at 3rd floor or above of the appropriate blocks to be proposed by the Contractor and agreed with the CM, no later than two months after completion of the tenth floor concrete frame including the eleventh floor slab:

Block ..... entire wing of .....

Block .... floor 1 No. flat type.

Block .... floor 1 No. construction mock-up as described in PRE.B9.440.

Conform with the following requirements for the sample wing, sample flats and construction mock-up:

a. Completion to include all finishes and fittings including all utility connections and building services item, and passing all relevant tests including:

i. Equipotential bonding tests;

ii. Verification Repetitive Flushing Test (RFT) for common W-trap system as per DRA1.T220;

iii. Watertightness test to pipe sleeves at external walls as per WAT6.T020.

b. Externally, complete with external finishes, services pipes, windows with glazing and drying racks;

c. Internally, complete with finishes for the floor of the sample wing;

d. Facilitate the CM to carry out a trial run of wheelchair in sample wing to manoeuvre in the common circulation areas;

e. Facilitate the CM to carry out a trial run of wheelchair in sample flats to verify that wheelchair user can gain access to and use the fittings in living / bed area, kitchen and bathroom;

f. If brazing or soldering alloy is used in the connection between water pipes, set up mock-up for internal and external brazing and soldering joint including those at external wall. The mock up jointing, once approved, shall serve as benchmark standard of workmanship for plumbing installation;

g. Keep clean and clear access to sample wing, sample flats and construction mock-up at all times and allow for access by parties authorized by the CM;

h. Provide security and maintain the Approved sample wing and sample flats until completion of the Works, including provision of all necessary temporary lighting inside the flats and at corridors and provide lockable gates at strategic locations to prevent unauthorized entry but not obstructing fire escape routes;

i. Provide security and maintain the Approved construction mock-up including provision of all necessary temporary lighting inside the flats and at corridors and provide lockable gates at strategic locations to prevent unauthorized entry but not obstructing fire escape routes;

j. Obtain the CM's Approval for the removal of the installed finishes and fittings at the construction mock-up and to complete the Works in accordance with GCC Clause 8.3.

Option 2

1. Phase the completion of the Works in the following Sections:

Section	Time for completion (from and including the notified date for commencement of the Works unless otherwise stated)
a. Section 1: Block	..... months (..... days);
b. Section 2: Block	..... months (..... days);
c. Section 3: ..... at Area	..... months from and including the date of possession of Area .....;
d. Section 4: Primary School	..... months (..... days);
e. Section 5: ..... at Area	..... months (..... days) from and including the notified date for commencement of Section 5.;
f. Section 6: ..... at Area(s)	* From and including the date of possession of Area ..... and for the validity period specified in the Excavation Permit;
g. Section 7: Remaining Works	..... months; (..... days).

Completion of each Section shall be deemed to include completion of all associated services, emergency vehicular access roads, drainage, external works and the like.

* Completion of the Section shall be conditional upon the passing of final tests and inspections prescribed by the Specification and the completion of any remedial work arising from such tests and inspections.

2. As stated in PRE.B2.010 sub-clause ..... complete the placement of fill in the open area / roads to the required finished levels within six months from the notified date for commencement of the Works;
3. Special requirements for phasing the Works to suit Nominated Sub-contractors and Direct Contractors, Utility Undertakings and Government departments are given in PRE.B12.710 to PRE.B12.740 inclusive;
4. Provide timber mock up for the external and internal walls of kitchen and bathroom with gas, plumbing and drainage pipeworks, reinforcement bars and building services fittings such as conduits and switch boxes for the following typical domestic flats no later than commencement of concreting works for the first typical floor.

   Flats: ……;

Conform with the following requirements for the timber mock-up:

a. Install gas, plumbing and drainage pipeworks, reinforcement bars and building services fittings as shown on Drawings on both sides of the timber walls to show that the alignments and openings of the pipeworks, reinforcement bars and building services fittings do not encroach upon each other at the external and internal sides of the kitchen and bathroom;
b. Agree with the CM on the alignment of all items before the commencement of concreting works of the first domestic floor;
c. Submit as-fitted drawings for the coordinated alignments and openings of the pipeworks, reinforcement bars and building services fittings in the timber mock-up;
d. Maintain the Approved timber mock-up until the completion of sample wing and sample flats;
e. Obtain the CM's Approval for the removal of the timber mock-up.

5. Provide the following sample wing, sample flats and construction mock-up on the location of the typical floor at 3rd floor or above of the appropriate blocks to be proposed by the Contractor and agreed with the CM, no later than two months after completion of the tenth floor concrete frame including the eleventh floor slab:

   Block ..... entire wing of .....

   Block .... floor 1 No. flat type.

   Block .... floor 1 No. construction mock-up as described in PRE.B9.440.

   Conform with the following requirements for the sample wing, sample flats and construction mock-up:

   a. Completion to include all finishes and fittings, including all utility connections and building services items, and passing all relevant tests including:
      i. Equipotential bonding tests;
      ii. Verification Repetitive Flushing Test (RFT) for common W-trap system as per DRA1.T220;
      iii. Watertightness test to pipe sleeves at external walls as per WAT6.T020.
   b. Externally, complete with external finishes, services pipes, windows with glazing and drying racks;
   c. Internally, complete with finishes for the floor of the sample wing;
   d. Facilitate the CM to carry out a trial run of wheelchair in sample wing to manoeuvre in the common circulation areas;
   e. Facilitate the CM to carry out a trial run of wheelchair in sample flats to verify that wheelchair user can gain access to and use the fittings in living / bed area, kitchen and bathroom;
   f. If brazing or soldering alloy is used in the connection between water pipes, set up mock-up for internal and external brazing and soldering joint including those at external wall. The mock up jointing, once approved, shall serve as benchmark standard of workmanship for plumbing installation;
   g. Keep clean and clear access to sample wing, sample flats and construction mock-up at all times and allow for access by parties authorized by the CM;
   h. Provide security and maintain the Approved sample wing and sample flats until completion of the Works, including provision of all necessary temporary lighting inside the flats and at corridors and provide lockable gates at strategic locations to prevent unauthorized entry but not obstructing fire escape routes;
   i. Provide security and maintain the Approved construction mock-up including provision of all necessary temporary lighting inside the flats and at corridors and provide lockable gates at strategic locations to prevent unauthorized entry but not obstructing fire escape routes;
   j. Obtain the CM's Approval for the removal of the installed finishes and fittings at the construction mock-up and to complete the Works in accordance with GCC Clause 8.3.

Option 3

1. Phase the completion of the Works in the following Sections:

Section	Time for completion (from and including the notified date for commencement of the Works unless otherwise stated)	
	Tender 'A'	Tender 'B'
a. Section 1: Block	..... months (..... days);	Same as the time for completion of the whole of the Works;

b. Section 2: Block	..... months (..... days);	* ..... months (..... days);
c. Section 3: ..... at Area	..... months (..... days) from and including the date of possession of Area .....,	** ..... months (..... days) from and including the date of possession of Area .....;
d. Section 4: Primary School	..... months (..... days);	* ..... months (..... days);
e. Section 5: ..... at Area	..... months (..... days) from and including the notified date for commencement of Section 5.;	..... months (..... days) from and including the notified date for commencement of Section 5.;
f. Section 6: ..... at Area(s)	*** From and including the date of possession of Area ..... and for the validity period specified in the Excavation Permit.	*** From and including the date of possession of Area ..... and for the validity period specified in the Excavation Permit.
g. Section 7: Transformer and Switch Room Compound		One month earlier than the time for completion of the whole of the Works;
h. Section 8: Remaining Works	..... months (..... days);	* ..... months (..... days);

Completion of each Section shall be deemed to include completion of all associated services, emergency vehicular access roads, drainage, external works and the like.

* To be proposed by the tenderer, but not greater than the time for completion of the Section in Tender 'A' and in any event not more than the time for completion of the whole of the Works for Tender 'B' and not less than ..... months and (..... days if applicable).

** To be proposed by the tenderer, but not greater than the time for completion of the Section in Tender 'A', and in any event the total of the time for completion of the Section (Tender 'B') plus the maximum period stated in PRE.B4.010 is not to be greater than the time for completion of the whole of the Works for Tender 'B'.

*** Completion of the Section shall be conditional upon the passing of final tests and inspections prescribed by the Specification and the completion of any remedial work arising from such tests and inspections.

2. As stated in PRE.B2.010 sub-clause ..... complete the placement of fill in the open area / roads to the required finished levels within six months from the notified date for commencement of the Works;

3. Special requirements for phasing the Works to suit Nominated Sub-contractors and Direct Contractors, Utility Undertakings and Government departments are given in PRE.B12.710 to PRE.B12.740 inclusive;
4. Provide timber mock up for the external and internal walls of kitchen and bathroom with gas, plumbing and drainage pipeworks, reinforcement bars and building services fittings such as conduits and switch boxes for the following typical domestic flats no later than commencement of concreting works for the first typical floor.

   Flats: ……;

   Conform with the following requirements for the timber mock-up:

   a. Install gas, plumbing and drainage pipeworks, reinforcement bars and building services fittings as shown on Drawings on both sides of the timber walls to show that the alignments and openings of the pipeworks, reinforcement bars and building services fittings do not encroach upon each other at the external and internal sides of the kitchen and bathroom;
   b. Agree with the CM on the alignment of all items before the commencement of concreting works of the first domestic floor;
   c. Submit as-fitted drawings for the coordinated alignments and openings of the pipeworks, reinforcement bars and building services fittings in the timber mock-up;
   d. Maintain the Approved timber mock-up until the completion of sample wing and sample flats;
   e. Obtain the CM's Approval for the removal of the timber mock-up.
5. Provide the following sample wing, sample flats and construction mock-up on the location of the typical floor at 3rd floor or above of the appropriate blocks to be proposed by the Contractor and agreed with the CM, no later than two months after completion of the tenth floor concrete frame including the eleventh floor slab:

   Block ..... entire wing of .....

   Block .... floor 1 No. flat type.

   Block .... floor 1 No. construction mock-up as described in PRE.B9.440.

   Conform with the following requirements for the sample wing, sample flats and construction mock-up:

   a. Completion to include all finishes and fittings, including all utility connections and building services items, and passing all relevant tests including:
      i. Equipotential bonding tests;
      ii. Verification Repetitive Flushing Test (RFT) for common W-trap system as per DRA1.T220;
      iii. Watertightness test to pipe sleeves at external walls as per WAT6.T020.
   b. Externally, complete with external finishes, services pipes, windows with glazing and drying racks;
   c. Internally, complete with finishes for the floor of the sample wing;
   d. Facilitate the CM to carry out a trial run of wheelchair in sample wing to manoeuvre in the common circulation areas;
   e. Facilitate the CM to carry out a trial run of wheelchair in sample flats to verify that wheelchair user can gain access to and use the fittings in living/bed area, kitchen and bathroom;
   f. If brazing or soldering alloy is used in the connection between water pipes, set up mock-up for internal and external brazing and soldering joint including those at external wall. The mock up jointing, once approved, shall serve as benchmark standard of workmanship for plumbing installation;
   g. Keep clean and clear access to sample wing, sample flats and construction mock-up at all times and allow for access by parties authorized by the CM;

h. Provide security and maintain the Approved sample wing and sample flats until completion of the Works, including provision of all necessary temporary lighting inside the flats and at corridors and provide lockable gates at strategic locations to prevent unauthorized entry but not obstructing fire escape routes;

i. Provide security and maintain the Approved construction mock-up including provision of all necessary temporary lighting inside the flats and at corridors and provide lockable gates at strategic locations to prevent unauthorized entry but not obstructing fire escape routes;

j. Obtain the CM's Approval for the removal of the installed finishes and fittings at the construction mock-up and to complete the Works in accordance with GCC Clause 8.3.

Option 4

Phase the completion of the Works in the following Sections:

Section	Time for completion (from and including the notified date for commencement of the Works unless otherwise stated)
a. Section 1: Demolition of Blocks	..... months;
b. Section 2: Demolition of Blocks	..... months;
c. Section 3: Demolition of School No	..... months;
d. Section 4: Demolition of Electrical Substation	..... months from and including the notified date for commencement of Section 4;
e. Section 5: Remaining works	..... months;
f. Section 6: Taking care of the works after the completion of the preceding Sections	..... months.

Option 5

In accordance with GCC Clause 8.3 the time for completion of each Section of the Works is as follows:

Section	Time for Completion
Section A: Planting Works	..... weeks from and including the notified date for commencement of the Works.
Section B: Establishment Works	24 months commencing from and including the day after the date of completion of Section A certified under GCC Clause 8.7.

Option 6

Phase the completion of the Works in the following Sections:

Section	Time for completion (from and including the notified date for commencement of the Works unless otherwise stated)
a. Section 1: Block	..... months;
b. Section 2: Block	..... months;
c. Section 3: School	..... months from and including the notified date for commencement of Section 3;

d. Section 4: Remaining Works	..... months.

Completion of each Section shall be deemed to include completion of all associated services, drainage, external works and the like which are necessary for the proper functioning of the Section.

Option 7

Phase the completion of the Works in the following Sections:

Section	Time for completion (from and including the notified date for commencement of the Works unless otherwise stated)	
	Tender 'A'	Tender 'B'
a. Section 1: Block	..... months;	*..... months;
b. Section 2: Block	..... months;	*..... months;
c. Section 3: Primary School	..... months from and including the notified date for commencement of Section 3;	*..... months from and including the notified date for commencement of Section 3;
d. Section 4: Remaining works	..... months.	*..... months.

Completion of each Section shall be deemed to include completion of all associated services, drainage, external works and the like which are necessary for the proper functioning of the Section.

* To be proposed by the tenderer, but not greater than the time for completion of the Section in Tender 'A' and in any event not more than the time for completion of the whole of the Works for Tender 'B'.

PRE.B4.085.9 OCCUPATION OF NEW BUILDING

1. The occupation of a New Building is subject to ICU's control and CM has to obtain from ICU an occupation permit (OP) in respect of a New Building before such New Building can be occupied. Comply with the following for OP application by CM:
   a. Programme and complete the works including building services installations in accordance with Specification, Drawings and CM's instructions for obtaining OP by CM;
   b. At least 45 days prior to the completion of the Works, provide information and drawings to CM which include but are not limited to the following for assisting CM to prepare the record plans for building, structural and drainage works (including drainage in external works) as required for OP application:
      i. Record plans for works designed by the Contractor;
      ii. Record plans for drainage in external works.
   c. At least 30 days prior to the completion of the Works, provide information to CM which includes but is not limited to the following for assisting CM to obtain the certificates as required for OP application:

Certificate	Information Required
i. Certificate of Accepted Building Materials Products (Form ICU 202)	Test reports, assessment reports or supporting documents with name of laboratory, report no., validity date & name of laboratory accreditation body.

Ii Use Permit issued by the Electrical and Mechanical Services Department	Application form for inspection duly completed with all information as required in LTE1.8.010.
iii. Fire Services Certificate	Application form for inspection duly completed with all information as required in PLU1.T060 and FWP1.6.020.
iv. Certificate of water supply connection (including FS installation) issued by WSD	Application form for inspection duly completed with all information as required in PLU1.W1120.

d. Submit Form ICU 13 to CM for processing the OP application;

e. Provide attendance on Site for inspection by ICU in accordance with PRE.B9.113.

2. When a part of a New Building has to be occupied, CM has to obtain from ICU a temporary occupation permit (TOP) in respect of that part of a New Building before such part of the New Building can be occupied. Comply with the following for TOP application by CM:

a. Programme and complete the works in accordance with CM's instructions for obtaining TOP by CM;

b. Provide information and drawings in accordance with sub-clause (1)(b) at least 45 days prior to the completion of the part of the New Building that will be occupied;

c. Provide information and drawings in accordance with sub-clause (1)(c) at least 30 days prior to the completion of the part of the New Building that will be occupied;

d. Submit Form ICU 12 to CM for processing TOP application;

e. Provide attendance on Site for inspection by ICU in accordance with PRE.B9.113.

PRE.B4.090.9 TAKING CARE OF THE WORKS AFTER COMPLETION

Execute and/or provide works and/or services in relation to the taking care of the Works after completion during such times after certified completion as instructed by the CM under the Conditions of Contract.

PRE.B5 THE CONTRACT CONDITIONS

CONDITIONS OF CONTRACT

PRE.B5.010.9 GENERAL CONDITIONS OF CONTRACT

Option 1

The General Conditions of Contract are the "Hong Kong Housing Authority General Conditions of Contract for Building Works 2013 Edition (version 1.1)".

Option 2

The General Conditions of Contract are the "Hong Kong Housing Authority General Conditions of Contract for Foundation Works 2013 Edition (version 1.1)".

Option 3

The General Conditions of Contract are the "Hong Kong Housing Authority General Conditions of Contract for Miscellaneous Works 2013 Edition, (version 1.1)".

PRE.B5.020.9 SPECIAL CONDITIONS OF CONTRACT

The Special Conditions of Contract are as scheduled and detailed in the Contract "booklet" for this Contract.

PRE.B5.030.9 SAID CONDITIONS

1. The General Conditions of Contract, the Special Conditions of Contract and the Articles of Agreement are referred to elsewhere in this Specification as the "said Conditions";
2. The "said Conditions" include clauses dealing specifically with the provision of plant, equipment, labour and the quality of workmanship and samples and testing. This Specification is written for use in conjunction with the "said Conditions" and the Contractor is deemed to have knowledge of all relevant clauses in the "said Conditions".

PRE.B5.040.9 CONDITIONS OF SUB-CONTRACT FOR NOMINATED SUB-CONTRACTS

The form of sub-contract referred to in GCC Clause 12.1(2) is the “Hong Kong Housing Authority Articles of Agreement and General Conditions of Nominated Sub-contract to Building Works Contracts 2013 Edition (version1.1)” (To be used in conjunction with the Hong Kong Housing Authority General Conditions of Contract for Building Works 2013 Edition (version 1.1)).

PRE.B5.050.9 INFORMATION REQUIRED BY SAID CONDITIONS

Information required by the Conditions of Contract is scheduled in Worksection PRE.B6 and other Worksections as appropriate of this Specification.

CONTRACT TERMINOLOGY

PRE.B5.110.9 CONTRACT DEFINITIONS

All definitions in the "said Conditions" are deemed also to apply to this Specification.

PRE.B5.120.9 EMPLOYER

The Employer is the Hong Kong Housing Authority, as defined in the "said Conditions", and referred to in this Specification as "The Authority".

PRE.B5.130.9 DIRECT CONTRACTOR

"Direct Contractor" is a "Specialist Contractor" as defined in GCC Clause 1.1.

PRE.B5.140.9 DIRECT TESTING CONTRACTOR

"Direct Testing Contractor" is a "Specialist Contractor" as defined in GCC Clause 1.1.

PRE.B5.150.9 DIRECT CONTRACTOR'S WORKS

"Direct Contractor's Works" is a type of "Specialist Works" as defined in GCC Clause 1.1.

PRE.B5.160.9 DIRECT TESTING CONTRACTOR'S WORKS

"Direct Testing Contractor's Works" is a type of "Specialist Works" as defined in GCC Clause 1.1.

PRE.B6 INFORMATION REQUIRED BY CONDITIONS OF CONTRACT

GENERAL CONDITIONS OF CONTRACT

PRE.B6.010.9 STATUS

The information given in clause PRE.B6.020 to PRE.B6.370 is to be read in conjunction with the General Conditions of Contract and is to form part of the Contract.

PRE.B6.020.A LOCATION OF INFORMATION PROVIDED

Option 1

Quick reference of key information detailed elsewhere in the Contract is as indicated below:

GCC Clause No.	Information Detailed
1.1 Maintenance Period	Form of Tender *
5.3 Amount of Bond (On-demand Bond)	Form of Tender *
5.15 Permanent work to be designed by the Contractor	PRE.B6.085
8.1 Period of time after the date of the Letter of Acceptance within which the notified date for commencement shall occur	Form of Tender *
8.2 Extent of Portions for possession	PRE.B4.010
8.1 Dates for commencement of Sections	PRE.B4.021
8.3 Time for completion of the Works	Form of Tender *
8.3 Time for completion of required Sections (Refer to PRE.B4.080)	Form of Tender *
8.6 Amount of liquidated damages for the Works	Form of Tender *
8.6 Amount of liquidated damages for each Section	Form of Tender *
11.1(7) Period of Final Measurement	Form of Tender *
12.1(2) Standard form of sub-contract	PRE.B5.040
12.1 (3) Design or specification requirements for Nominated Sub-contractors	PRE.B6.085
14.1(1) Period of interim certificates	Form of Tender *
14.2(1) Percentage of certified value retained	Form of Tender *
14.2(1) Limit of Retention Money	Form of Tender *
20.2(4) Schedule of Proportions	PRE.B6.370

* Appendix to Form of Tender

Option 2

Quick reference of key information detailed elsewhere in the Contract is as indicated below:

GCC Clause No.	Information Detailed
1.1 Maintenance Period	Form of Tender *
5.3 Amount of Bond (On-demand Bond)	Form of Tender *
5.15 Permanent work to be designed by the Contractor	SCC7.1/7.2 and PRE.B2.010
8.1 Period of time after the date of the Letter of Acceptance within which the notified date for commencement shall occur	Form of Tender *
8.2 Extent of Portions for possession	PRE.B4.010
8.1 Dates for commencement of Sections	PRE.B4.021
8.3 Time for completion of the Works	Form of Tender *
8.3 Time for completion of required Sections (Refer to PRE.B4.080)	Form of Tender *
8.6 Amount of liquidated damages for the Works	Form of Tender *
8.6 Amount of liquidated damages for each Section	Form of Tender *
11.1(7) Period of Final Measurement	Form of Tender *
14.1(1) Period of interim certificates	Form of Tender *
14.2(1) Percentage of certified value retained	Form of Tender *
14.2(1) Limit of Retention Money	Form of Tender *

* Appendix to Form of Tender

Option 3

Quick reference of key information detailed elsewhere in the Contract is as indicated below:

GCC Clause No.	Information Detailed
1.1 Maintenance Period	Form of Tender *
5.3 Amount of Bond (On-demand Bond)	Form of Tender *
8.1 Period of time after the date of the Letter of Acceptance within which the notified date for commencement shall occur	Form of Tender *
8.2 Extent of Portions for possession	PRE.B4.010
8.1 Dates for commencement of Sections	PRE.B4.021
8.3 Time for completion of the Works	Form of Tender *
8.3 Time for completion of required Sections (Refer to PRE.B4.080)	Form of Tender *
8.6 Amount of liquidated damages for the Works	Form of Tender *
8.6 Amount of liquidated damages for each Section	Form of Tender *
11.1(7) Period of Final Measurement	Form of Tender *
14.1(1) Period of interim certificates	Form of Tender *
14.2(1) Percentage of certified value retained	Form of Tender *
14.2(1) Limit of Retention Money	Form of Tender *

* Appendix to Form of Tender

Option 4

Quick reference of key information detailed elsewhere in the Contract is as indicated below:

GCC Clause No.	Information Detailed
1.1 Maintenance Period	Form of Tender *
5.15 Permanent work to be designed by the Contractor	PRE.B6.310
8.1 Period of time after the date of the Letter of Acceptance within which the notified date for commencement shall occur	Form of Tender *
8.2 Extent of Portions for possession	PRE.B4.010
8.1 Dates for commencement of Sections	PRE.B4.020 and PRE.B4.021
8.3 Time for completion of the Works	Form of Tender *
8.3 Time for completion of required Sections (Refer to PRE.B4.080)	Form of Tender *
8.6 Amount of liquidated damages for the Works	Form of Tender *
8.6 Amount of liquidated damages for each Section	Form of Tender *
11.1(7) Period of Final Measurement	Form of Tender *
14.1(1) Period of interim certificates	Form of Tender *
14.2(1) Percentage of certified value retained	Form of Tender *
14.2(1) Limit of Retention Money	Form of Tender *

* Appendix to Form of Tender

PRE.B6.025.N GCC 2.2 - DUTIES AND POWERS OF THE SURVEYOR AND THE SURVEYOR'S REPRESENTATIVE

The information as referred to in GCC Clause 2.2(6) that the Surveyor shall have the power to order the Contractor to provide which in the opinion of the Surveyor is relevant to the Surveyor's execution of his duties under the Contract may include but not be limited to the types of information and records as specified in Worksection PRE.B6.

PRE.B6.030.9 GCC 3.1 - ASSIGNMENT

Submit details to support an application for the assignment of the Contractor's financial benefit in the Contract in accordance with GCC Clause 3.1(2) as follows:

1. Written confirmation that the assignment is for financing the execution and completion of the Works under the Contract;
2. Written confirmation from the financial institution to which the benefit is to be assigned that it is a bank with a Full Banking Licence in Hong Kong under the Banking Ordinance and its Full Banking Licence number;
3. Written confirmation that the Contractor and the financial institution will enter into a Deed of Assignment in the terms and conditions approved by the Employer.

PRE.B6.035.E GCC 3.2 - SUB-CONTRACTING

1. The trade contractors registration scheme referred to in GCC Clause 3.2(9)(a) means the Registered Specialist Trade Contractors Scheme administered by CIC. The latest version of the Registered Specialist Trade Contractors Scheme as may be revised and promulgated by CIC from time to time throughout the course of the Contract shall apply to the Contract;

1. The trade contractors registration scheme referred to in GCC Clause 3.2(8)(a) means the Registered Specialist Trade Contractors Scheme administered by CIC. The latest version of the Registered Specialist Trade Contractors Scheme as may be revised and promulgated by CIC from time to time throughout the course of the Contract shall apply to the Contract;

2. For the purpose of GCC Clause 3.2(9), if a sub-contractor is registered under a trade as a Group 1 contractor in the Register of Specialist Trade Contractors and if the value of the relevant sub-contract exceeds the tender limit of Group 1 contractors of the trade under the Registered Specialist Trade Contractors Scheme, the sub-contractor shall have been admitted into Group 1 (Advanced) or Group 2 before the commencement of the works under the relevant sub-contract; and if a sub-contractor is registered under a trade as a Group 1 (Advanced) contractor in the Register of Specialist Trade Contractors and if the value of the relevant subcontract exceeds the tender limit of Group 1 (Advanced) contractors of the trade under the Registered Specialist Trade Contractors Scheme, the sub-contractor shall have been admitted into Group 2, before the commencement of the work under the relevant sub-contract;

3. The Contractor shall submit a Sub-contractors Management Plan to the CM within 30 days of the date of the Letter of Acceptance. Update such Sub-contractors Management Plan on a quarterly basis during the currency of the Works until the date of issue of the maintenance certificate, or where applicable the date of issue of the last partial maintenance certificate, whichever is the later. The first quarter shall commence from the expiry of the month in which such Sub-contractors Management Plan was submitted to the CM. Submit any updated Sub-contractors Management Plan within one month from the expiry of the quarter;

3. The Contractor shall submit a Sub-contractors Management Plan to the CM within 30 days of the date of the Letter of Acceptance. Update such Sub-contractors Management Plan on a quarterly basis during the currency of the Works until the date of certified completion of the Works. The first quarter shall commence from the expiry of the month in which such Sub-contractors Management Plan was submitted to the CM. Submit any updated Sub-contractors Management Plan within one month from the expiry of the quarter;

4. Should there be any changes in the sub-contracting arrangements at any time before the next quarterly submission is due, notify the CM forthwith of such changes in writing. Such notification shall not affect the obligation to submit an updated Sub-contractors Management Plan under sub-clause (3) above. In the event that there are no changes to the sub-contracting arrangements in any one quarter, notify the CM of the same and no updated submission for such quarter will be required to be made;

5. Any Sub-contractors Management Plan or updated Sub-contractors Management Plan submitted under sub-clause (3) above shall contain such detailed information as required by the “Guidelines on Scope and Contents of the Sub-contractors Management Plan” in APPENDIX PRE.B6/II to this Worksection, and the latest “Contractor's Guideline on Wage Monitoring System” published by HA;

6. The CM may, upon receipt of any Sub-contractors Management Plan or updated Sub-contractors Management Plan, provide his comments on such plan. Amend or revise forthwith such Sub-contractors Management Plan or updated Sub-contractors Management Plan upon receipt of such the CM’s comments, to the satisfaction of the CM. The CM shall have no obligation to comment or approve any Sub-contractors Management Plan or updated Sub-contractors Management Plan;

7. The Contractor shall, upon written request by the CM, produce to the CM documentary proof to demonstrate to the satisfaction of the CM that the Contractor has complied with all the provisions in the latest Sub-contractors Management Plan. Such documentary proof shall include, but is not limited to, documents of sub-contracts, reports from sub-contractors on their further sub-contracting arrangement and daily attendance records of site workers. For the purpose of determining the extent of documentary proof, the CM may make reference to the "Guidelines on Documentary Proof to Demonstrate the Compliance of the Provisions in the Sub-contractors Management Plan" in Annex 2 to APPENDIX PRE.B6/II to this Worksection. The CM may make as many separate written requests as he thinks fit. The provisions of this sub-clause shall be without prejudice to other provisions under this Clause;
8. For the purpose of sub-clauses (3) to (7), the term "Sub-contractors" in Sub-contractors Management Plan means all types of sub-contractors irrespective of the tiers and including but not limited to Specialist Sub-contractors and Nominated Sub-contractors;

Option 1

9. The following prohibition on sub-contracting the Works or any part thereof shall apply:
   a. Do not sub-contract the provision of management / site supervision team as specified in the Contract;
   b. Do not sub-contract to a single sub-contractor for the provision of labour and materials or labour only to the Works after excepting the works undertaken by the Nominated Sub-contractors and the provision of management / site supervision team. For the purpose of this clause, separate sub-contracting of works on a piece-work basis to the same sub-contractor will be considered as a whole.
10. The following parts of the Works are to be executed by contractors included on the relevant list given or referred to in the Specification. If the Contractor is not on the relevant list, then he shall select contractors from the relevant list to execute that part of the Works:

a.	Ground investigation works and works required to be carried out by RSC(GIFW) under the Contract:	refer to PRE.B9.210, PRE.B9.250 & PIL1.G460;
b.	Footbridge bearings:	refer to PRE.B9.210;
c.	Play equipment:	refer to PRE.B9.210;
d.	Fresh and flush water supply installations and above-ground drainage works excepting the works undertaken by Nominated Sub-contractors:	refer to PRE.B9.210, PLU1.G012 & DRA1.W002;
e.	Off-site prefabrication of steel reinforcing bars to be produced by Type 1 Yard:	refer to CON9.G020;
f.	Road run-in, footpath repair and drainage works outside the boundary of the Site:	refer to PRE.B9.210;
g.	Water supply connection works outside of the boundary of the Site:	refer to PRE.B9.210;
h.	Construction of footing:	refer to PIL1.G520;

i. Piling activities as stated in sub-clause (1) of PIL1.G515. refer to PIL1.G515;

j. Site Formation Works: refer to PRE.B9.260;

k. Arboricultural work: refer to PRE.B8.1114.

11. In the event that any part of the Works is to be sub-contracted, the sub-contracting of any part of the Works by the Contractor shall be limited as follows:
    a. sub-contracting of any part of the Works requiring entry of human beings into confined space, the same meaning adopted in the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE), that forms part of a sewerage or drainage system *or any part of the Works involving …... shall be limited to the first tier of sub-contracting;
    b. sub-contracting of any part of the Works involving site formation works shall be limited to the first tier of sub-contracting;
    c. sub-contracting of any part of the Works not falling under sub-clauses (11)(a) and (11)(b) above shall be limited to two tiers (i.e. the first tier and second tier) of sub-contracting except for Nominated Sub-contract Works where PRE.BS1.520 shall be followed.
12. For the purpose of sub-clause (11) where any part of the Works is to be sub-contracted, the first tier of sub-contracting means the sub-contracts between the Contractor and his sub-contractors and the first tier sub-contractor refers to the sub-contractor of the first tier of sub-contracting. The second tier of sub-contracting means the sub-contracts between the first tier sub-contractor and his sub-contractor;
13. Further to sub-clause (11),
    a. The Contractor may submit a proposal to the CM for an extra tier of sub-contracting for any part of the Works which has been sub-contracted in compliance with the limit in sub-clauses (11)(a), (11)(b) or (11)(c), whichever is applicable;
    b. The CM shall not be obliged to consider the Contractor's proposal for an extra tier of sub-contracting unless the proposal is submitted in writing to the CM at least 14 days before the sub-contractor of the relevant tier of sub-contracting enters into any sub-contract for the extra tier of sub-contracting and the proposal is accompanied by an explanation with supporting evidence on the need for the extra tier of sub-contracting;
    c. The rejection or acceptance of the Contractor's proposal for any reason by the CM shall not entitle the Contractor to any extension of time or additional payment nor does it relieve the Contractor from any liability or obligation under the Contract.
14. Further to sub-clause (11), in the event that any part of the demolition works is to be sub-contracted, demolition works mean any work carried out on any building or structure to be demolished, comply with the following:

Option "A"

a. The Contractor shall select a Demolition Sub-contractor who shall be registered on the Housing Authority List of Demolition Contractors and the Buildings Department List of Registered Specialist Contractors (Demolition Works) in the first tier of sub-contracting to carry out the demolition works. In the event that the Demolition Sub-contractor further sub-contract the demolition works, the second tier sub-contractor shall be registered on the Housing Authority List of Demolition Contractors or the Buildings Department List of Registered Specialist Contractors (Demolition Works). Submit information regarding the subcontracting works in accordance with DEM1.G010 and DEM1.G020.

a. The Contractor shall select a Demolition Sub-contractor who shall be registered on the Housing Authority List of Demolition Contractors or the Buildings Department List of Registered Specialist Contractors (Demolition Works). Submit information regarding the subcontracting works in accordance with DEM1.G010 and DEM1.G020.

15. The following parts of the Works are to be executed by contractors included in the Register of Asbestos Contractors kept by Environmental Protection Department:
    a. Asbestos removal.
16. The following parts of the Works are to be executed by independent asbestos laboratory registered under Air Pollution Control Ordinance:
    a. Air monitoring test.
17. In the event that the piling activities stated in sub-clause (1) of PIL1.G515 are to be further sub-contracted, comply with the requirements stated in the relevant clauses given under the heading of 'Approved Contractors and Subcontractors' of the PIL Worksection (PIL1.G510 to PIL1.G630);
18. Provide particulars of the sub-contractors of all tiers employed or to be employed on the Works complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time. Submit these particulars to the CM and Labour Relations Officer (LRO) within 14 days from the date for commencement of the Works, and thereafter within 2 days of any change thereon or within the time frames as stated in the aforesaid Contractor's Guideline until the date of issue of the maintenance certificate, or the date of issue of the last partial maintenance certificate, whichever is the later. Submission of these particulars to the CM shall be in both printed and electronic copies while those to LRO in electronic copies;
19. When the CM has instructed the replacement of the sub-contractor in the event of non-performance of the sub-contractor, or any of his staff who is not performing to the entire satisfaction of the CM, comply with the following:
    a. Submit particulars of another sub-contractor or replacement staff of the sub-contractor for the CM's approval within two weeks after receipt of the CM's instruction;
    b. Bear all associated costs and the extra time required.
20. The Contractor shall submit for the approval of the CM, the names, experience, company profiles and all other details of the Piling Subcontractor and Piling Sub-subcontractor. Approval by the CM on engaging the Piling Subcontractor and Piling Sub-subcontractor shall under no circumstances relieve the Contractor's responsibility whatsoever under the Contract;

21. In the event of non-performance of the Piling Subcontractor or Piling Sub-subcontractor, or any of their staff who is not performing to the entire satisfaction of the CM, he may instruct the replacement of the Piling Subcontractor and Piling Sub-subcontractor, or any of their staff. In this event, the Contractor shall submit within two weeks of receipt of the CM's instruction another Piling Subcontractor and Piling Sub-subcontractor or replacement staff of the Piling Subcontractor and Piling Sub-subcontractor for the approval of the CM. The Contractor is deemed to have made provision for all associated costs and the extra time required in this respect;
22. The erection, dismantling and height alteration of tower cranes are to be executed by contractor(s) selected by the Contractor from the register on the specialty of "erection, dismantling and climbing" of the Tower Crane trade under the Registered Specialist Trade Contractors Scheme specified in sub-clause (1).

Option 2

9. The following prohibition on sub-contracting the Works or any part thereof shall apply:
    a. Do not sub-contract the provision of management / site supervision team as specified in the Contract;
    b. Do not sub-contract to a single sub-contractor for the provision of labour and materials or labour only to the Works after excepting the provision of management / site supervision team. For the purpose of this clause, separate sub-contracting of works on a piece-work basis to the same sub-contractor will be considered as a whole.
10. The following parts of the Works are to be executed by contractors included on the relevant list given or referred to in the Specification. If the Contractor is not on the relevant list, then he shall select contractors from the relevant list to execute that part of the Works:

a.	Ground investigation works and works required to be carried out by RSC(GIFW) under the Contract:	refer to PRE.B9.210, PRE.B9.250 & PIL1.G460;
b.	Off-site prefabrication of steel reinforcing bars to be produced by Type 1 Yard:	refer to CON9.G020;
c.	Site Formation Works:	refer to PRE.B9.260.

11. In the event that any part of the Works is to be sub-contracted, the sub-contracting of any part of the Works by the Contractor shall be limited as follows:
    a. sub-contracting of any part of the Works requiring entry of human beings into confined space, the same meaning adopted in the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE), that forms part of a sewerage or drainage system *or any part of the Works involving …... shall be limited to the first tier of sub-contracting;
    b. sub-contracting of any part of the Works involving site formation works shall be limited to the first tier of sub-contracting;
    c. sub-contracting of any part of the Works not falling under sub-clause (11)(a) and (11)(b) above shall be limited to two tiers (i.e. the first tier and second tier) of sub-contracting.
12. For the purpose of sub-clause (11) where any part of the Works is to be sub-contracted, the first tier of sub-contracting means the sub-contracts between the Contractor and his sub-contractors and the first tier sub-contractor refers to the sub-contractor of the first tier of sub-contracting. The second tier of sub-contracting means the sub-contracts between the first tier sub-contractor and his sub-contractor;

13. Further to sub-clause (11),
    a. The Contractor may submit a proposal to the CM for an extra tier of sub-contracting for any part of the Works which has been sub-contracted in compliance with the limit in sub-clauses (11)(a), (11)(b) or (11)(c), whichever is applicable;
    b. The CM shall not be obliged to consider the Contractor's proposal for an extra tier of sub-contracting unless the proposal is submitted in writing to the CM at least 14 days before the sub-contractor of the relevant tier of sub-contracting enters into any sub-contract for the extra tier of sub-contracting and the proposal is accompanied by an explanation with supporting evidence on the need for the extra tier of sub-contracting;
    c. The rejection or acceptance of the Contractor's proposal for any reason by the CM shall not entitle the Contractor to any extension of time or additional payment nor does it relieve the Contractor from any liability or obligation under the Contract.
14. Further to sub-clause (11), in the event that any part of the demolition works is to be sub-contracted, demolition works mean any work carried out on any building or structure to be demolished, comply with the following:

Option "A"

    a. The Contractor shall select a Demolition Sub-contractor who shall be registered on the Housing Authority List of Demolition Contractors and the Buildings Department List of Registered Specialist Contractors (Demolition Works) in the first tier of sub-contracting to carry out the demolition works. In the event that the Demolition Sub-contractor further sub-contract the demolition works, the second tier sub-contractor shall be registered on the Housing Authority List of Demolition Contractors or the Buildings Department List of Registered Specialist Contractors (Demolition Works). Submit information regarding the subcontracting works in accordance with DEM1.G010 and DEM1.G020.

Option "B"

    a. The Contractor shall select a Demolition Sub-contractor who shall be registered on the Housing Authority List of Demolition Contractors or the Buildings Department List of Registered Specialist Contractors (Demolition Works). Submit information regarding the subcontracting works in accordance with DEM1.G010 and DEM1.G020.

15. The following parts of the Works are to be executed by contractors included in the Register of Asbestos Contractors kept by Environmental Protection Department:
    a. Asbestos removal.
16. The following parts of the Works are to be executed by independent asbestos laboratory registered under Air Pollution Control Ordinance:
    a. Air monitoring test.
17. In the event that the piling activities stated in sub-clause (1) of PIL1.G510 are to be sub-contracted, comply with the requirements stated in the relevant clauses given under the heading of 'Approved Contractors and Subcontractors' of the PIL Worksection (PIL1.G510 to PIL1.G630);
18. Provide particulars of the sub-contractors of all tiers employed or to be employed on the Works complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time. Submit these particulars to the CM and Labour Relations Officer (LRO) within 14 days from the date for commencement of the Works, and thereafter within 2 days of any change thereon or within the time frames as stated in the aforesaid Contractor's Guideline until the date of issue of the maintenance certificate. Submission of these particulars to the CM shall be in both printed and electronic copies while those to LRO in electronic copies;

19. When the CM has instructed the replacement of the sub-contractor in the event of non-performance of the sub-contractor, or any of his staff who is not performing to the entire satisfaction of the CM, comply with the following:
    a. Submit particulars of another sub-contractor or replacement staff of the sub-contractor for the CM's approval within two weeks after receipt of the CM's instruction;
    b. Bear all associated costs and the extra time required.
20. The Contractor shall submit for the approval of the CM, the names, experience, company profiles and all other details of the Piling Subcontractor and RSC(GIFW). Approval by the CM on engaging the Piling Subcontractor and RSC(GIFW) shall under no circumstances relieve the Contractor's responsibility whatsoever under the Contract;
21. In the event of non-performance of the Piling Subcontractor, RSC(GIFW) or any of their staff being not to the entire satisfaction of the CM, he may instruct the replacement of the Piling Subcontractor, RSC(GIFW) or any of their staff. In this event, the Contractor shall submit within two weeks of receipt of the CM's instruction another Piling Subcontractor, RSC(GIFW) or replacement staff of the Piling Subcontractor or RSC(GIFW) for the approval of the CM. The Contractor is deemed to have made provision for all associated costs and the extra time required in this respect;
22. The erection, dismantling and height alteration of tower cranes are to be executed by contractor(s) selected by the Contractor from the register on the specialty of "erection, dismantling and climbing" of the Tower Crane trade under the Registered Specialist Trade Contractors Scheme specified in sub-clause (1).

Option 3

9. The following prohibition on sub-contracting the Works or any part thereof shall apply:
    a. Do not sub-contract the provision of management / site supervision team as specified in the Contract;
    b. Do not sub-contract to a single sub-contractor for the provision of labour and materials or labour only to the Works after excepting the provision of management / site supervision team. For the purpose of this clause, separate sub-contracting of works on a piece-work basis to the same sub-contractor will be considered as a whole.
10. The following parts of the Works are to be executed by contractors included on the relevant list given or referred to in the Specification. If the Contractor is not on the relevant list, then he shall select contractors from the relevant list to execute that part of the Works:
    a. Ground investigation works: refer to PRE.B9.210 & PRE.B9.250;
    b. Site Formation Works: refer to PRE.B9.260.
11. In the event that any part of the Works is to be sub-contracted, the sub-contracting of any part of the Works by the Contractor shall be limited as follows:
    a. sub-contracting of any part of the Works requiring entry of human beings into confined space, the same meaning adopted in the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE), that forms part of a sewerage or drainage system *or any part of the Works involving ….. shall be limited to the first tier of sub-contracting;
    b. sub-contracting of any part of the Works involving demolition works or site formation works shall be limited to the first tier of sub-contracting;

c. sub-contracting of any part of the Works not falling under sub-clause (11)(a) and (11)(b) above shall be limited to two tiers (i.e. the first tier and second tier) of sub-contracting.

12. For the purpose of sub-clause (11) where any part of the Works is to be sub-contracted, the first tier of sub-contracting means the sub-contracts between the Contractor and his sub-contractors and the first tier sub-contractor refers to the sub-contractor of the first tier of sub-contracting. The second tier of sub-contracting means the sub-contracts between the first tier sub-contractor and his sub-contractor;
13. Further to sub-clause (11),
    a. The Contractor may submit a proposal to the CM for an extra tier of sub-contracting for any part of the Works which has been sub-contracted in compliance with the limit in sub-clauses (11)(a), (11)(b) or (11)(c), whichever is applicable;
    b. The CM shall not be obliged to consider the Contractor's proposal for an extra tier of sub-contracting unless the proposal is submitted in writing to the CM at least 14 days before the sub-contractor of the relevant tier of sub-contracting enters into any sub-contract for the extra tier of sub-contracting and the proposal is accompanied by an explanation with supporting evidence on the need for the extra tier of sub-contracting;
    c. The rejection or acceptance of the Contractor's proposal for any reason by the CM shall not entitle the Contractor to any extension of time or additional payment nor does it relieve the Contractor from any liability or obligation under the Contract.
14. Further to sub-clause (11), in the event that any part of the demolition works is to be sub-contracted, comply with the following:
    a. The Contractor shall select a Demolition Sub-contractor who shall be registered on the Housing Authority List of Demolition Contractors or the Buildings Department List of Registered Specialist Contractors (Demolition Works). Submit information regarding the subcontracting works in accordance with DEM1.G010 and DEM1.G020.
15. The following parts of the Works are to be executed by contractors included in the Register of Asbestos Contractors kept by Environmental Protection Department:
    a. Asbestos removal.
16. The following parts of the Works are to be executed by independent asbestos laboratory registered under Air Pollution Control Ordinance:
    a. Air monitoring test.
17. Provide particulars of the sub-contractors of all tiers employed or to be employed on the Works complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time. Submit these particulars to the CM and Labour Relations Officer (LRO) within 14 days from the date for commencement of the Works, and thereafter within 2 days of any change thereon or within the time frames as stated in the aforesaid Contractor's Guideline. Submission of these particulars to the CM shall be in both printed and electronic copies while those to LRO in electronic copies;
18. In the event of non-performance of the Demolition Sub-contractor, or any of their staff not to the entire satisfaction of the CM, he may instruct the replacement of the Demolition Sub-contractor or any of their staff. In this event, comply with the following:
    a. Submit particulars of another sub-contractor or replacement staff of the sub-contractor for the CM's approval within two weeks after receipt of the CM's instruction;
    b. Bear all associated costs and the extra time required.

19. The erection, dismantling and height alteration of tower cranes are to be executed by contractor(s) selected by the Contractor from the register on the specialty of "erection, dismantling and climbing" of the Tower Crane trade under the Registered Specialist Trade Contractors Scheme specified in sub-clause (1).

Option 4

9. The following prohibition on sub-contracting the Works or any part thereof shall apply:
    a. Do not sub-contract the provision of management / site supervision team as specified in the Contract;
    b. Do not sub-contract to a single sub-contractor for the provision of labour and materials or labour only to the Works after excepting the provision of management / site supervision team. For the purpose of this clause, separate sub-contracting of works on a piece-work basis to the same sub-contractor will be considered as a whole.
10. In the event that any part of the Works is to be sub-contracted, the sub-contracting of any part of the Works by the Contractor shall be limited as follows:
    a. sub-contracting of any part of the Works requiring entry of human beings into confined space, the same meaning adopted in the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE), that forms part of a sewerage or drainage system *or any part of the Works involving …... shall be limited to the first tier of sub-contracting;
    b. sub-contracting of any part of the Works involving site formation works shall be limited to the first tier of sub-contracting;
    c. sub-contracting of any part of the Works not falling under sub-clause (10)(a) and (10)(b) above shall be limited to two tiers (i.e. the first tier and second tier) of sub-contracting.
11. For the purpose of sub-clause (10) where any part of the Works is to be sub-contracted, the first tier of sub-contracting means the sub-contracts between the Contractor and his sub-contractors and the first tier sub-contractor refers to the sub-contractor of the first tier of sub-contracting. The second tier of sub-contracting means the sub-contracts between the first tier sub-contractor and his sub-contractor;
12. Further to sub-clause (10),
    a. The Contractor may submit a proposal to the CM for an extra tier of sub-contracting for any part of the Works which has been sub-contracted in compliance with the limit in sub-clauses (10)(a), (10)(b) or (10)(c), whichever is applicable;
    b. The CM shall not be obliged to consider the Contractor's proposal for an extra tier of sub-contracting unless the proposal is submitted in writing to the CM at least 14 days before the sub-contractor of the relevant tier of sub-contracting enters into any sub-contract for the extra tier of sub-contracting and the proposal is accompanied by an explanation with supporting evidence on the need for the extra tier of sub-contracting;
    c. The rejection or acceptance of the Contractor's proposal for any reason by the CM shall not entitle the Contractor to any extension of time or additional payment nor does it relieve the Contractor from any liability or obligation under the Contract.
13. When the CM has instructed the replacement of the sub-contractor in the event of non-performance of the sub-contractor, or any of his staff who is not performing to the entire satisfaction of the CM, comply with the following:
    a. Submit particulars of another sub-contractor or replacement staff of the sub-contractor for the CM's approval within two weeks after receipt of the CM's instruction;
    b. Bear all associated costs and the extra time required.

PRE.B6.040.9 GCC 5.3 - ON-DEMAND BOND

Option 1

1. Procure an on-demand bond in favour of the Employer with the bonded sum as follows:
   a. The bonded sum shall initially be 3 per cent of the Contract Sum excluding the Prime Cost Sums for works by Nominated Sub-contractors; and
   b. The bonded sum shall be subsequently decreased to 0.25 per cent of the Contract Sum excluding the Prime Cost Sums for works by Nominated Sub-contractors upon expiry of six months after the date of completion as stated in:
      i. The certificate of completion issued by the Contract Manager in respect of the Works; or
      ii. The last certificate of completion issued by the Contract Manager if different certificates of completion are issued for different Sections or parts of the Works.
2. Submit the on-demand bond referred to in sub-clause (1) above to the Employer through the Surveyor within 21 days of the date of the Letter of Acceptance. The on-demand bond shall remain in full force and effect unless and until such time as stated in the form as provided in the Appendix to Conditions of Contract;
3. Obtain from each Nominated Sub-contractor an on-demand bond in favour of the Employer in an amount as stated in and to the requirements of the sub-contract between the Contractor and the Nominated Sub-contractor. Submit the on-demand bond to the Employer through the Surveyor within 42 days of the acceptance of the Nominated Sub-contractor's tender by the Contractor.

Option 2

1. Procure an on-demand bond in favour of the Employer with the bonded sum as follows:
   a. The bonded sum for the period of 12 months from and including the effect date of the on-demand bond shall initially be one percent of the Contract Sum excluding Prime Cost Sums for works by Nominated Sub-contractors;
   b. From the expiry of the period referred to in sub-clause (1)(a) above up to expiry of six months after the date of completion as stated in:
      i. The certificate of completion issued by the Contract Manager in respect of the Works; or
      ii. The last certificate of completion issued by the Contract Manager if different certificates of completion are issued for different Sections or parts of the Works,

      the bonded sum shall be increased to 3 per cent of the Contract Sum excluding the Prime Cost Sums for works by Nominated Sub-contractors; and
   c. From the expiry of the period referred to in sub-clause (1)(b) above, the bonded sum shall be subsequently decreased to 0.25 per cent of the Contract Sum excluding the Prime Cost Sums for works by Nominated Sub-contractors.
2. Submit the on-demand bond referred to in sub-clause (1) above to the Employer through the Surveyor within 21 days of the date of the Letter of Acceptance. The on-demand bond shall remain in full force and effect unless and until such time as stated in the form as provided in the Appendix to Conditions of Contract;
3. Obtain from each Nominated Sub-contractor an on-demand bond in favour of the Employer in an amount as stated in and to the requirements of the sub-contract between the Contractor and the Nominated Sub-contractor. Submit the on-demand bond to the Employer through the Surveyor within 42 days of the acceptance of the Nominated Sub-contractor's tender by the Contractor.

PRE.B6.050.9 GCC 5.7 - PROGRAMME TO BE FURNISHED

Option 1

1. Submit programme to the CM. Incorporate into the programme the dates of the key activities including but not limited to the following:
   a. Commencement and completion of the Works;
   b. Commencement and completion of the utilities investigation survey works within and outside the Site boundary in compliance with PRE.B3.060;
   c. Concreting Works on monthly basis;
   d. Submission of SP;
   e. Completion of sample wing, sample flats and construction mock-up;
   f. Commencement and completion of works to be executed by Nominated Sub-contractors;
   g. Handing over of the lift well and machine rooms by the Contractor to the Nominated Sub-contractor for lift installation in accordance with the Contract;
   h. Completion of the works for OP or TOP application.
2. Supply Nominated Sub-contractors with details of any revisions to programme as soon as possible;
3. Submit to the CM a separate detailed programme for piling works to be carried out by the Piling Sub-contractor(s). The Contractor shall demonstrate to the CM that the separate detailed programme has been agreed with the Piling Sub-contractor(s). Incorporate into the programme the dates of key piling activities including but not limited to the following, as applicable:
   a. Commencement and completion of each section of the Works;
   b. Predrilling;
   c. Installation of trial piles;
   d. Testing boring;
   e. Construction of piles;
   f. Testing;
   g. Post construction proof drilling.
4. Submit to the CM a separate detailed programme for demolition works to be carried out by the Demolition Sub-contractor(s). The Contractor shall demonstrate to the CM that the separate detailed programme has been agreed with the Demolition Sub-contractor(s). Incorporate into the programme the dates of key demolition activities including but not limited to the following, as applicable:
   a. Commencement and completion of each section of the Works;
   b. Asbestos investigation and / or abatement work;
   c. Erection of props;
   d. Installation of safety protection measures;
   e. Demolition works.
5. Submit programmes in the form of: .....;
6. Allow in the programme the time required for the CM's approval to the submissions and re-submissions, if so required.

Option 2

1. Submit programmes for Section B - Establishment Works as and when required by the CM;
2. Allow in the programme the time required for the CM's approval to the submissions and re-submissions, if so required.

Option 3

1. Submit programmes in the form of: .....;

2. Incorporate into the programme the dates of the key activities including but not limited to the following:
   a. Commencement and completion of the Works;
   b. Concreting Works on monthly basis;
   c. Approval for ELSP;
   d. Submission of SP.
3. If the Contract has piling sub-contractor(s), submit to the CM a separate detailed programme for piling works to be carried out by the Piling Sub-contractor(s). The Contractor shall demonstrate to the CM that the separate detailed programme has been agreed with the Piling Sub-contractor(s). Incorporate into the programme the dates of key piling activities including but not limited to the following, as applicable:
   a. Commencement and completion of each section of the Works;
   b. Predrilling;
   c. Installation of trial piles;
   d. Testing boring;
   e. Construction of piles;
   f. Testing;
   g. Post construction proof drilling.
4. Submit to the CM a separate detailed programme for demolition works to be carried out by the Demolition Sub-contractor(s). The Contractor shall demonstrate to the CM that the separate detailed programme has been agreed with the Demolition Sub-contractor(s). Incorporate into the programme the dates of key demolition activities including but not limited to the following, as applicable:
   a. Commencement and completion of each section of the Works;
   b. Asbestos investigation and / or abatement work;
   c. Erection of props;
   d. Installation of safety protection measures;
   e. Demolition works.
5. Allow in the programme the time required for the CM's approval to the submissions and re-submissions, if so required.

Option 4

1. Submit programmes in the form of: .....;
2. Incorporate into the programme the dates of the key activities including but not limited to the following, if applicable:
   a. Commencement and completion of each section of the Works;
   b. Approval for ELSP;
   c. Submission of SP;
   d. Asbestos investigation works and / or abatement works;
   e. Erection of props;
   f. Installation of safety protection measures;
   g. Demolition works.
3. Allow in the programme the time required for the CM's approval to the submissions and re-submissions, if so required.

PRE.B6.060.F GCC 5.8 - CONTRACTOR'S SUPERINTENDENCE

Option 1

There are no specific requirements on the provision of superintendence.

Option 2

Set up Contractor's Management Team as in sub-clause (1) of this clause and provide the services of the superintendents as in the other sub-clauses of this clause. Ensure that safety training requirements of respective superintendents as specified are complied with. Superintendents with relevant qualifications can take up one or more of the posts subject to the CM's prior approval. Submit the names, qualifications, experience and documentary proof of employment status of the superintendents for approval of the CM. Such superintendents shall be approved by the CM before in service, or shall be deemed to be approved if not expressly disapproved by the CM in writing within 14 days of the submission for approval.

1. Contractor's Management Team

   Within 14 days from the notified date for commencement of the Works, submit to the CM with all necessary details a list of sufficient number of staff in the following disciplines for the management / site supervision team:

   a. Project Manager (PM);
   b. Quantity Surveyors;
   c. Quality Control Manager (QCM);
   d. Architectural Quality Control Coordinator (AQCC);
   e. Structural Quality Control Coordinator (SQCC);
   f. Environmental Manager (EM);
   g. Environmental Supervisor (ES);
   h. Site Agent;
   i. General Foremen;
   j. Block Foremen;
   k. Art Curator (AC).

Option 1

Except for the following personnel, all members of the management / site supervision team shall be full time on Site when they are deployed to the Site:

a. Project Manager (PM);
b. Quantity Surveyor;
c. Environmental Manager;
d. Art Curator (AC).

Option 2

Except for the following personnel, all members of the management / site supervision team shall be full time on Site when they are deployed to the Site:

a. Project Manager (PM);
b. Quantity Surveyor;
c. Art Curator (AC).

2. Project Manager (PM):
   a. The PM must hold the following qualifications:
      i. Project Manager involved in contract with Modular Integrated Construction (MiC) must have satisfactorily completed the Master Class on MiC Project Implementation (Project Managers) offered by the CIC.
3. Quality Control Manager (QCM):
   a. The QCM must hold the following qualifications:
      i. Qualification and relevant experience equivalent to Technically Competent Person (TCP) Grade T4 of Registered Contractor's Stream for ……. Works as stated in Table 8.7 of CoPSS;
      ii. ……..

b. The QCM shall be full time on Site. The duties and responsibilities of the QCM are as follows:
   i. Organize, plan and supervise Quality Control Coordinators (QCCs) in checking, endorsing and inspecting works in their relevant disciplines;
   ii. Carry out further inspection, checking and endorse on work as specified in sub-clauses (4) to (5) below;
   iii. Ensure works were inspected by the respective QCCs in accordance with the Quality Control System, and are in accordance with the Specification and Drawings before seeking approval from the CM to covering up under GCC Clause 7.3;
   iv. Certify photocopies of the ISO certificates for materials or components as true copies of the original certificates when circumstances warranted;
   v. Submit relevant forms to the CM within 14 days of completion of the works;
   vi. Develop and oversee the control measures to ensure material compliance at all stages in the progress of the Works including purchase, delivery, storage and use of materials;
   vii. Any other duties as required in the Specification.

4. Architectural Quality Control Coordinator (AQCC):
   a. AQCC must hold qualifications equivalent to higher certificate or higher diploma in:
      i. Building studies, building surveying or architectural studies awarded by universities funded by the University Grants Committee, or the Institutes of Vocational Education or the previous Technical Institutes operated under the Vocational Training Council plus at least 3 years of relevant working experience to the satisfaction of Building Authority; or
      ii. Civil engineering awarded by universities funded by the University Grants Committee, or the Institutes of Vocational Education or the previous Technical Institutes operated under the Vocational Training Council plus at least 5 years of relevant working experience to the satisfaction of Building Authority.
   b. The role of AQCC can be taken up by superintendents with relevant qualifications;
   c. The AQCC shall be deployed on Site for a period of …… months commencing …… months after the notified date for commencement of the Works. AQCC shall assist QCM in inspecting and checking of the works, responding to queries and endorsing all relevant documents as assigned;
   d. The duties and responsibilities of the AQCC for material control for the Works are listed below:
      i. Review with QCM on control measures and checking mechanism for material compliance of architectural and building materials in accordance with the Guidelines on Scope and Contents of Quality Control System in APPENDIX PRE.B8/XII;
      ii. Coordinate with all sub-contractors and suppliers and record the established Quality Control System for material compliance of architectural and building materials at all stages in the progress of the Works including material purchase, delivery, storage and use;
      iii. Review with Site Staff on material control measures for the Works throughout the progress of the Works;

iv. Keep all architectural and building materials purchase forms for Site Staff's curtail checking when required;

v. Report to QCM on the status on material delivery, storage and use of architectural and building materials on weekly basis;

vi. Compile and maintain the material delivery schedule and record of architectural and building materials;

vii. Coordinate with SQCC and Building Services Engineer for checking of all delivery notes of materials in accordance with the information shown on the Approved sample submission forms;

viii. Submit weekly architectural and building materials delivery schedules to Site Staff;

ix. Check and record all architectural and building materials delivered to Site and report to QCM and Site Staff any non-compliance with Contract requirements or any deviation from the Approved samples;

x. Maintain records of material checking, delivery notes and Certificate of Origin, etc. for architectural and building materials;

xi. Provide attendance for random checking on material storage by Site Staff;

xii. Plan and update storage plan for architectural and building materials. Check and maintain record of architectural and building materials storage and checking;

xiii. Report on materials compliance at monthly site meetings;

xiv. Any other duties as required in the "Guidelines on Scope and Contents of Quality Control System" in APPENDIX PRE.B8/XII related to material compliance checking and monitoring, etc.;

xv. ……

e. The AQCC shall check and endorse the following items for architectural and building materials and QCM shall further inspect and endorse the forms and documents relevant to items (i) to (viii) below:

i. Architectural shop drawings, associated design and method statement;

ii. Remedial works proposal;

iii. Sample submission for materials and components;

iv. Material delivered on Site against Approved samples;

v. Testing reports for materials and components;

vi. Request for inspection and tests;

vii. Delivery vouchers, certificate of origin, etc.;

viii. …….

5. Structural Quality Control Coordinator (SQCC):

a. SQCC must hold qualifications and relevant experience as follows:

i. Higher certificate or higher diploma in civil or structural engineering with 5-year relevant experience or Degree in civil or structural engineering with 2-year relevant experience;

ii. The qualifications stated in sub-clause (a)(i) above shall comply with the requirements of clause 8.19 of the CoPSS;

iii. The relevant experience stated in sub-clause (a)(i) above shall comply with the requirements of clauses 8.22 and 8.23 of CoPSS for TCP Grade T3.

b. The role of SQCC can be taken up by superintendents with relevant qualifications;

c. The SQCC shall be deployed on Site for a period of ……. months commencing …… months after the notified date for commencement of the Works. SQCC shall assist QCM in inspecting and checking of the works, responding to queries and endorsing on all relevant documents as assigned, and take up the role of temporary works coordinator;

d. The duties and responsibilities of the SQCC for material control for the Works are listed below:

   i. Review with QCM on the control measures and checking mechanism for material compliance of structural materials in accordance with the Guidelines on Scope and Contents of Quality Control System in APPENDIX PRE.B8/XII;

   ii. Coordinate with all sub-contractors and suppliers and record the established Quality Control System for material compliance of structural materials at all stages in the progress of the Works including material purchase, delivery, storage and use;

   iii. Review with Site Staff on structural material control measures for the Works throughout the progress of the Works;

   iv. Keep all structural material purchase forms for Site Staff's curtail checking when required;

   v. Report to QCM on the status on material delivery, storage and use of structural materials on weekly basis;

   vi. Compile and maintain the material delivery schedule and record of structural materials;

   vii. Coordinate with AQCC for checking of all delivery notes of materials in accordance with the information shown on the Approved sample submission forms and of structural materials approved by the CM including materials for use in temporary works;

   viii. Submit weekly structural materials delivery schedules to Site Staff;

   ix. Check and record all structural materials delivered to Site, including materials for use in temporary works, and report to QCM and Site Staff any non-compliance with Contract requirements or any deviation from the Approved samples;

   x. Maintain records of material checking, delivery notes and Certificate of Origin, etc. for structural materials;

   xi. Provide attendance for random checking on material storage by Site Staff;

   xii. Plan and update storage plan for structural materials. Check and maintain record of structural material storage and checking;

   xiii. Report on materials compliance at monthly site meetings;

   xiv. Any other duties required in the "Guidelines on Scope and Contents of Quality Control System" in APPENDIX PRE.B8/XII related to material compliance checking and monitoring, etc.;

   xv. ……

e. The SQCC shall check and endorse the following items:

   i. Structural engineering shop drawings, associated design and method statement;

   ii. Design and erection for formwork and falsework;

   iii. Concreting of critical structures;

   iv. Remedial works proposal;

v. Erection of steel structures;

vi. Reinforcement fixing, including mechanical splice works where appropriate;

vii. Core tests, pile tests and tests on critical structural elements carried out on or off-site;

viii. Construction of cantilever structures;

ix. Sample submission for materials and components;

x. Material delivered on Site against Approved samples;

xi. Other testing reports for materials and components, and summary of test results;

xii. Request for inspection and tests;

xiii. Delivery vouchers;

xiv. ……..

f. The SQCC shall be full time on Site for checking and endorsement of the high strength concrete works (concrete of grade strength higher than 60 MPa), including sampling of concrete and steel reinforcing bars, making and curing of concrete test cubes and drilling of insitu concrete core samples;

g. The items listed in sub-clauses (e)(i) to (e)(vi) above shall be further inspected and endorsed by a Contractor's superintendent who must hold qualification and relevant experience as follows:

i. Degree in civil or structural engineering with 4-year relevant experience or Registered Professional Engineer (civil or structural);

ii. The qualifications stated in sub-clause (g)(i) above shall comply with the requirements of clause 8.19 of the CoPSS;

iii. The relevant experience stated in sub-clause (g)(i) above shall comply with the requirements of clauses 8.22 and 8.23 of CoPSS for TCP Grade T4.

6. Building Services Engineer (BSE):

a. Provide the services of a full time competent English speaking BSE. Within seven days from the date for commencement of the Works as notified by the CM in accordance with GCC Clause 8.1, submit for the CM's approval the name, qualifications and experience of the BSE;

b. The BSE must hold qualifications and relevant experience as follows:

i. Preferably corporate membership of the Hong Kong Institution of Engineers (Building Services, Electrical or Mechanical Discipline) elected after 5.12.1975, or equivalent, with 1 year of relevant post qualification experience in supervising construction of building services installations in new developments; or

ii. Degree in Building Services, Electrical or Mechanical Engineering with 4 years of relevant post qualification experience in supervising construction of building services installations in new developments.

c. The duties of the BSE are:

i. Obligations defined in PRE.B8.1410, PRE.B8.1420, PRE.B8.1430, PRE.B8.1440 and generally as PRE.B12;

ii. Obligations defined in GCC Clause 5.25(3);

iii. Liaise with the Safety Officers / Safety Supervisors on all Site operations in respect of building services Nominated Sub-contractors.

d. The duties and responsibilities of the Building Services Engineer for material control for the Works are listed below:

i. Review with QCM on the control measures and checking mechanism for material compliance of building services materials in accordance with the Guidelines on Scope and Contents of Quality Control System in APPENDIX PRE.B8/XII;

ii. Coordinate with all suppliers and Sub-contractors including Nominated Sub-contractors and record the established Quality Control System for material compliance of building services materials at all stages in the progress of the Works including material purchasing, delivery, storage and use;

iii. Review with Site Staff on building services material control measures for the Works throughout the progress of the Works;

iv. Coordinate with sub-contractors including Nominated Sub-contractors in keeping all building services materials purchase forms for Site Staff's curtail checking when required;

v. Report to QCM on the status on material delivery, storage and use of building services materials on weekly basis;

vi. Consolidate the material delivery schedule and record of building services materials;

vii. Coordinate with AQCC for checking of all delivery notes of materials in accordance with the information shown on the Approved sample submission forms;

viii. Submit weekly building services materials delivery schedules to Site Staff;

ix. Check and record all building services materials delivered to Site, and report to QCM and Site Staff any non-compliance with the Contract requirements or any deviation from the Approved samples;

x. Maintain record of material checking, delivery notes and Certificate of Origin, etc. for building services materials;

xi. Provide attendance for random checking on building services material storage by Site Staff;

xii. Plan and update storage plan for building services materials based on the latest delivery schedules and work plan for review with Site Agent / QCM. Check and maintain record of building services material storage and checking;

xiii. Report on materials compliance at monthly site meetings;

xiv. Any other duties as required in the "Guidelines on Scope and Contents of Quality Control System" in APPENDIX PRE.B8/XII related to material compliance checking and monitoring, etc..

7. Blasting Control Engineer (BCE):
   a. Provide the services of a competent English-speaking BCE full time on Site during blasting operations. Within seven days from the notified date for commencement of the Works, submit for the CM's approval the name, qualifications and experience of the BCE;
   b. The BCE must be:
      i. Suitably qualified to the satisfaction of the CM;
      ii. Experienced in bulk and controlled blasting;
      iii. From an Approved independent agency.
   c. The duties of the BCE will include:

i. Notify the CM of the Contractor's blasting proposals in accordance with the Contract requirements and certify in writing to the Contractor's representative that all the requirements have been complied with prior to each blast. Copy this certification to the CM at least 1 hour before each blast;

ii. Act as an intermediary with the Mines and Quarries Division, Geotechnical Engineering Office;

iii. Advise the Contractor on and vet the techniques for controlled blasting, such as pre-splitting, smooth blasting etc., with particular reference to the preservation of high quality rockslope faces and the minimizing of necessary protection works;

iv. Advise on all aspects of blasting safety in particular prevention of fly rock;

v. Monitor effects of blasting on adjacent property and where necessary recommend improvements to the blasting techniques used;

vi. Prepare a Blasting Assessment for comment by the Geotechnical Engineering Office before commencement of any rock blasting works.

d. Compliance with this sub-clause shall not relieve the Contractor of his general obligations regarding blasting given elsewhere in this Specification.

8. Registered Structural Engineer (RSE):

a. Employ a RSE registered with Building Authority to comply with the requirements of the Specification;

b. The RSE shall utilise standard forms (EPS-F1 and EPS-F2 in APPENDIX PRE.B6/I to this Worksection) when submitting all items requiring his certification, approval and calculation as detailed in the relevant Work sections of the Specification and including, but not limited to, the following sub-clauses:

i. All temporary works classified as Case 1 under the CoPSS clause 4.9 and all temporary works stipulated in PRE.B10.010 sub-clauses (5), (8) and (9) or as directed by the CM. For certifying completion of temporary works, RSE shall submit Form EPS-F2 along with the as-built record plans and photos after inspection. For certifying completion of temporary works providing support to a tower crane, RSE shall submit Form EPS-F5 along with the as-built record plans and photos after inspection;

ii. All submissions to ICU other than those submissions signed by the Design Certifying Consultant as required under sub-clause (12) below;

iii. All submissions to ICU.

c. The RSE shall submit the safety certificate for the existing Case 1, Case 2 and Case 3 Temporary Works in sub-clauses (5), (8) and (9) of PRE.B10.010 within 14 days of the notified date for commencement of the Works as stipulated in sub-clause (3) of PRE.B10.010 using the form provided at APPENDIX.PRE.B10/XI;

d. The RSE shall carry out the responsibility stipulated in DEM1.D050;

e. The RSE shall possess the experience stipulated in EAR1.D010 and shall carry out the responsibility detailed in EAR1.D050;

f. The RSE shall take up the role of Responsible Engineer as stipulated in the Code of Practice for the Structural use of Steel 2011 and in STR1.G030;

g. Where off-site fabrication of structural steelworks is proposed by the Contractor, the RSE shall carry out the responsibility detailed in STR1.W1430;

h. The RSE shall carry out the responsibility stipulated in COM4.M060 and PNAP APP-37;

i. The RSE shall carry out the responsibility stipulated in COM4.M485 and PNAP APP-37.

9. Asbestos Removal Site Supervisor:

   The qualifications, experience and duties of the Asbestos Removal Site Supervisor are stated in the Specification;

10. Registered Asbestos Consultant:

    The Registered Asbestos Consultant registered with EPD is to carry out duties under Air Pollution Control Ordinance;

11. Defect Rectification Coordinator (DRC) for domestic portion of domestic blocks only:
    a. Provide the services of one full time DRC during the first six months of the Maintenance Period or where Sections are applicable to the Contract the first six months of the individual Maintenance Period for each Section with domestic block(s);
    b. The DRC shall be an authorised English speaking agent of the Contractor competent for the discharge of the duties as DRC. The minimum requirements of the DRC shall include the following:
       i. At least five years' works experience in a capacity equivalent to a Block Foreman as specified in sub-clause (13) on building works contracts;
       ii. Of which two years shall be on Housing Department's public housing construction;
       iii. Capable of English and Chinese writing and Cantonese speaking.
    c. The DRC shall take up the following roles and duties related to defect rectification:
       i. Liaise with all parties concerned, coordinate, programme and ensure that the execution of Maintenance Works including any works of repair or rectification, or making good any defect, imperfection, shrinkage, settlement or other fault identified within the Maintenance Period for all works including building services works shall be in accordance with the provisions of the Contract;
       ii. Attend meetings and to be a member of the Customer Service Team organised and chaired by the site representative of the CM in accordance with PRE.B8.2005;
       iii. Work in a collaborative manner with the site representative(s) of the CM and the property management agent's representative(s) under the Customer Service Team;
       iv. Be accessible by other team members in the Customer Service Team at all times through a designated mobile phone in particular for urgent repairs.
    d. Notwithstanding the minimum requirements stipulated for a DRC in sub-clause (11)(b) above, the Site Agent or General Foreman as specified in sub-clause (13) can act as the DRC.

12. Design Certifying Consultant (DCC):
    a. Select a consultant on the Architectural and Associated Consultants Selection Board's (AACSB) List of Structural Engineering Category for the CM's approval as the DCC;
    b. DCC shall certify all layouts, details and calculations submitted to the CM for * foundation works designed by the Contractor as stated in Clauses PIL1.D040, PIL1.W055, PIL1.W070, PIL1.W2010 and PIL1.W2030 as appropriate and * permanent works designed by the Contractor as stated in PRE.B6.085. The submissions must be signed by a Director of the DCC, who must be a registered structural engineer registered with the Building Authority;

c. The DCC shall utilise standard forms (EPS-F1 and EPS-F2 in APPENDIX PRE.B6/I to this Worksection) when submitting all items requiring his certification.

13. Site Agent, General Foreman & Block Foreman:
    a. For building works, appoint the following minimum number of site supervisory staff constantly on Site who should possess the minimum qualification and experience as specified:
        i. One Site Agent who must hold a diploma or higher certificate in building studies / civil / structural engineering from a Government approved educational institute or equivalent, plus 8-year site experience of which 5 years must have been spent in building construction as a site supervisory staff;
        ii. One General Foreman who must hold an ordinary certificate in building studies / civil / structural engineering from a Government approved educational institute or equivalent, plus 8-year site experience of which 6 years must have been spent in building construction as a site supervisory staff.

            If the General Foreman does not possess the specified minimum qualification, he must have at least 17-year site experience of which 10 years must have been spent in building construction as a site supervisory staff;
        iii. One Block Foreman per domestic block who must hold a CIC certificate in construction supervisory role or trade test certificate in levelling & setting out, plus 6-year site experience of which 4 years must have been spent in building construction as a site supervisory staff.

            If the Block Foreman does not possess the specified minimum qualification, he must have at least 10-year site experience of which 6 years must have been spent in building construction as a site supervisory staff;
        iv. Site Agent involved in contract with Modular Integrated Construction (MiC) must have satisfactorily completed the Master Class on MiC Project Implementation (Project Managers) offered by the CIC. General Foreman and Block Foreman involved in contract with MiC must have held a Certificate in Modular Integrated Construction (MiC) for Foreman issued by the CIC.
    b. To underpin implementation of the Safety Plan, the Site Agent, General Foreman and Block Foreman are at duty to assist in promoting the safety and health of personnel employed on Site, which shall include but not limited to the following:
        i. Supervise the observance of safety standards by the workers;
        ii. Carry out daily safety inspection;
        iii. Promote safety-at-work in carrying out work on Site;
        iv. Attend Site Safety Committee meetings;
        v. Conduct tool box talks as necessary.
    c. Site Agent, General Foreman and Block Foreman are to be directly employed by the Contractor on a monthly wage basis;
    d. Submit for the CM's approval within seven days from the notified date for commencement of the Works the name(s), qualifications and experience of the Site Agent, General Foreman and Block Foreman.
14. Site Agent:
    a. The Site Agent must hold qualifications and relevant experience as follows:
        i. Higher certificate or higher diploma in civil or structural engineering with 5 years relevant experience, or Degree in civil or structural engineering with 2 years relevant experience;

ii. The qualifications stated in sub-clauses (a)(i) above shall comply with the requirements of clause 8.19 of the CoPSS;

iii. The relevant experience stated in sub-clauses (a)(i) above shall comply with the requirements of clauses 8.22 and 8.23 of CoPSS for TCP Grade T3;

iv. If the Site Agent does not possess the specified minimum qualification stated in sub-clause (a)(i) above, he must have completed the top-up training course "Top-up Course for Construction Supervision on Foundation Works" organised by the former Construction Industry Training Authority with 12 years relevant working experience (counted in full). The relevant experience must have been gained within the previous 15 years and at least 1 year must be local site experience.

b. To underpin implementation of the Safety Plan, the Site Agent is at duty to assist in promoting the safety and health of personnel employed on Site, which shall include but not limited to the following:

i. Supervise the observance of safety standards by the workers;

ii. Carry out daily safety inspection;

iii. Promote safety-at-work in carrying out work on Site;

iv. Attend Site Safety Committee meetings;

v. Conduct tool box talks as necessary.

c. The Site Agent is to be directly employed by the Contractor on a monthly wage basis;

d. Submit for the CM's approval within seven days from the notified date for commencement of the Works the name(s), qualifications and experience of the Site Agent.

15. Qualified Engineer (QE):

a. The qualifications and experience of the QE shall be as follows:

i. A Registered Professional Engineer in Civil or Structural discipline registered under the Engineers Registration Ordinance in an appropriate discipline plus at least 5 years of relevant experience.

a. The qualifications and experience of the QE shall be as follows:

i. A Registered Professional Engineer in Geotechnical or Civil discipline (and also in the Structural discipline if structural works are required) registered under the Engineers Registration Ordinance plus at least 5 years of relevant experience in site investigation, design and construction of trenchless or underground excavation works to play the role of competent engineer under the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department;

ii. ……;

b. Utilise standard forms (EPS-F1 and EPS-F2 in APPENDIX PRE.B6/I to this Worksection) when submitting the items requiring QE's certification including temporary works as detailed in PRE.B10.010 sub-clauses (6) and (7). For certifying completion of temporary works, QE shall submit Form EPS-F2 along with the as-built record plans and photos after inspection;

c. QE shall submit the safety certificate for the existing Case 2 and Case 3 Temporary Works in sub-clauses (6) and (7) of PRE.B10.010 within 14 days of the notified date for commencement of the Works as stipulated in sub-clause (3) of PRE.B10.010 using the form provided at APPENDIX.PRE.B10/XI;

d. Allow sufficient time in the construction programme for such checking and certification by the QE and submission to the CM for written consent;

16. Authorized Signatory (AS):
    a. The qualification and experience of the AS shall be as required under the Buildings Ordinance in particular, the requirements stated in the PNRC No. 38, the CoPSS and other relevant PNRCs issued by the BD;
    b. The AS shall carry out the duties in the Supervision Plan (SP) stated in clause PRE.B8.1405 and other relevant requirements.
17. Technically Competent Person (TCP) for SP:
    a. Appoint one or more TCP of the grade and with qualification and relevant experience specified in the TMSP and CoPSS for various types of works as required under the SP, to carry out the duties as specified in the SP, and to act as and perform the duties of the "Safety Supervision Personnel" as referred to in the CoP for Safe Use of Tower Cranes issued by LD and the Guidelines on Safety of Tower Cranes issued by CIC;
    b. Appoint a TCP who must hold qualifications and relevant experience equivalent to TCP Grade T4 of Registered Contractor's Stream for building works with significant geotechnical content as stated in Table 8.7 of the CoPSS to carry out the following duties:
        i. Supervise and control the quality of all slope filling and compaction works to ensure their compliance with the requirements of the Contract;
        ii. Supervise all testing associated with the filling and compaction works;
        iii. Prepare the monthly reports, covering assessment, "as-built" plans and sections and testing records specified in EAR1.W2410;
        iv. Prepare geological logs of drillholes, exploratory pits, excavation faces of rock and soil faces; keep photographic records of same; prepare geological sections and report to the CM, as directed by the CM;
        v. Monitor behaviour of rock and soil slopes by means of geotechnical instrumentation; collect and present data to the CM, as directed by the CM;
        vi. Observe and record the geological characteristics of the excavated material, as directed by the CM;
        vii. Monitor behaviour of groundwater on the Site by observing and recording surface flows, piezometers, and flows from any raking drains; collect and present data to the CM, as directed by the CM;
        viii. Observe and record rock mass characteristics by means of discontinuity surveys; select samples for testing; carry out rock and soil slope stability and stabilisation works analyses; present data and report to the CM as directed by the CM;
        ix. Design and sketch stabilisation works using personal computers and Approved computer software, as directed by the CM;
        x. Collect and analyse data relating to effects of blasting procedures on condition of rock berms and faces and report to the CM, as directed by the CM;
        xi. Ensure adequate field supervision and procedural correctness of rock and soil slope protection and stabilisation works, as directed by the CM. Assess the stability of boulders and recommend the types of stabilisation works to the CM;
        xii. Liaise with the CM on all aspects of the engineering geology and geotechnical works;
        xiii. Certify the accuracy, correctness, and completeness, of all geotechnical information supplied to the CM by the Contractor;

xiv. Keep a detailed record of all aspects of the geotechnical works carried out on Site and report to the CM weekly.

c. Appoint a TCP who must hold qualifications and relevant experience equivalent to TCP Grade T1 of Registered Contractor's Stream, and to act as a quality control co-ordinator to supervise the off-site steel reinforcement bar prefabrication works in a prefabrication yard;

d. Subject to the CM's approval, one TCP may be assigned to cover the duties and responsibilities of more than one role provided that:

i. The TCP who is appointed satisfies the requirements of the highest grade of TCP specified;

ii. The TCP undertakes inspections at a frequency no less than the frequency derived in accordance with the documents stated in sub-clause (17)(a).

e. Notify the CM immediately if there is any subsequent change of the TCP during the course of services.

18. Technical Director (TD):

a. The qualification and experience of the TD shall be as required under the Buildings Ordinance in particular, the requirements stated in the PNRC No.38, and other relevant PNRCs issued by the BD;

b. The TD shall be authorized by the Contractor to:

i. Have access to plant and resources;

ii. Provide technical and financial support for the execution of the Works;

iii. Make decisions for the company and supervise the AS and other personnel.

c. The TD should not be the same person as the AS in sub-clause (16).

19. Registered Geotechnical Engineer (RGE):

a. Employ a RGE registered with Building Authority to prepare and sign the geotechnical report and supporting documentation to support the Contractor's submissions made by the Design Certifying Consultant / Registered Structural Engineer employed for the following works:

i. Excavation and Lateral Support Works as stated in EAR1.D030;

ii. Foundation works as stated in the Worksection PIL;

iii. Demolition works as stated in the Worksection DEM;

iv. Temporary works with significant geotechnical content as defined in Paragraph 7 of CoPSS to be designed by the Contractor;

v. Temporary works that may affect or be affected by slopes or retaining walls except for temporary slopes formed by the Contractor which should be certified together with the associated temporary works;

vi. Any other temporary works as required under the Drawings, the Specification and / or directed by the CM

b. The RGE shall utilise standard forms (EPS-F1 and EPS-F2 in APPENDIX PRE.B6/I to this Worksection) when submitting all items requiring his certification, approval and calculation as detailed in the above sub-clauses;

c. The RGE shall submit the safety certificate using the form provided at APPENDIX.PRE.B10/XI where necessary for existing temporary works in accordance with sub-clause (3) of PRE.B10.010;

d. The RGE shall verify that the conditions on Site are consistent with assumptions made in the geotechnical report and supporting documentation prepared by him;

e. Comply with PNAP APP-141 for the division of responsibilities between RSE and RGE.

20. Certified Supervisor (CS) for Application of Tile Adhesive and / or Cement Sand Mortar with Latex:
    a. The CS must be certified for supervision on the application of tile adhesive and / or cement sand mortar with latex on Site and at the factory of precast concrete components by the manufacturer who will provide the tile adhesive and / or the latex;
    b. The CS shall be full time on Site and at the factory of precast concrete components during the application of tile adhesive and / or cement sand mortar with latex. The duties and responsibilities of the CS are as follows:
        i. Have thorough understanding on mixing, application and limitations of the tile adhesive and / or the cement sand mortar with latex to be used;
        ii. Ensure that the trade tested workers on tiling works have attended the technical briefing provided by the tile adhesive and / or the latex manufacturer;
        iii. Supervise the application of tile adhesive and / or cement sand mortar with latex to ensure proper procedures, in particular the open time requirement, have been followed;
        iv. Maintain records of supervision including any rectification works carried out for inspection by the CM if required.
    c. The role of the CS can be taken up by superintendents with relevant certification as sub-clause (20)(a).
21. Piling Sub-contractor's Superintendents:

    Require the Piling Sub-contractor to deploy the following staff full time on Site during the construction period of the foundation works:
    a. A superintendent with qualification and relevant experience equivalent to TCP Grade T4 of Registered Contractor's Stream for Foundation Works as stated in table 8.7 of CoPSS to take up the duties and responsibilities of the QCM for works relating to construction of foundations;
    b. A superintendent with qualification and relevant experience same as those required of the SQCC to take up the duties and responsibilities of the SQCC for works relating to construction of foundations.
22. Supervising Engineer (Tower Crane):
    a. The qualification and experience of the Supervising Engineer (Tower Crane) shall be same as those required for the supervising engineer in Paragraph 10.2 under the CoP for Safe Use of Tower Cranes issued by LD and Section F(i) under the Guidelines on Safety of Tower Cranes issued by CIC;
    b. The Supervising Engineer (Tower Crane) shall carry out the duties of the supervising engineer same as those required in Paragraph 10.2 under the CoP for Safe Use of Tower Cranes issued by LD and Section F in the Guidelines on Safety of Tower Cranes issued by CIC.
23. Competent Engineer for Utilities Investigation Survey Works:
    a. The Competent Engineer shall be competent, able to communicate in both English and Chinese and qualified in accordance with the following requirements and appropriately experienced to carry out the duties specified in the Contract;
    b. The Competent Engineer shall have a minimum of 4-year working experience on construction sites of which 2 years must be spent in building construction works, and hold one of the following qualifications:
        i. MICE or MIStructE or MCIBSE or MIEE or MIME or HKIE or MCIOB or MHKICM; or

ii. A degree / higher diploma in civil or structural or building services or electronic or electrical or mechanical engineering or building studies or building surveying or architectural studies from a Hong Kong or British University or Government recognised tertiary educational institution.

c. The Competent Engineer shall have hands-on experience in carrying out and supervision of the utilities investigation survey specified in PRE.B3.060 involved;

d. The Competent Engineer shall be in full time attendance to supervise the carrying out of the utilities investigation survey works, and shall certify the accuracy, correctness and completeness of all relevant survey information supplied to the CM by the Contractor;

e. The Contractor shall submit the name and particulars of the Competent Engineer for the CM's approval 2 weeks prior to the commencement of the utilities investigation survey works.

24. Environmental Manager (EM):

Option 1

a. Appoint a person as the EM working part time on Site to provide professional advice to the Contractor and overseeing all Environmental Management and Site Hygiene matters of the Works and include but not limited to the duties in sub-clause (c) below;

Option 2

a. Appoint a person as the EM working full time on Site to provide professional advice to the Contractor and overseeing all Environmental Management and Site Hygiene matters of the Works and include but not limited to the duties in sub-clause (c) below;

b. The minimum qualification of the EM or the person providing the services of an EM under sub-clause (a) above shall be as follows:

i. Degree in Environmental Discipline (Environmental Science, Environmental Engineering, Environmental Studies or Environmental Management); or

ii. Degree in construction related discipline and having satisfactorily completed a certificate course in environmental management by a local or overseas tertiary education institute; or

iii. A corporate member of the Hong Kong Institution of Engineers (HKIE) in Environmental Discipline or equivalent; or

iv. A full member of the Hong Kong Chartered Institute of Water and Environmental Management; or

v. A professional member of the Hong Kong Institute of Qualified Environmental Professionals; or

vi. A corporate member of a professional institution other than those as mentioned in (iii) to (v) above and EITHER having at least 3-year working experience in construction / project management with environmental management content OR in possession of a diploma or above in environmental studies or environmental engineering awarded by a local or overseas tertiary educational institution.

b. The minimum qualification of the EM or the person providing the services of an EM under sub-clause (a) above shall be as follows:

i. A corporate member of the Hong Kong Institution of Engineers (HKIE) in Environmental Discipline or equivalent; or

ii. A full member of the Hong Kong Chartered Institute of Water and Environmental Management; or

iii. A professional member of the Hong Kong Institute of Qualified Environmental Professionals; or

iv. A corporate member of a professional institution other than those as mentioned in (i) to (iii) above and EITHER having at least 3 years working experience in construction / project management with environmental management content OR in possession of a diploma or above in environmental studies or environmental engineering awarded by a local or overseas tertiary educational institution.

c. The EM's duties include but not limited to the following:

i. Prepare, implement and update the Environmental Management Plan;

ii. Advise on measures to be taken to comply with legislative and contractual obligations under environmental protection, waste management and site hygiene and implement such measures;

iii. Liaise on all matters relating to environmental and site hygiene monitoring;

iv. Conduct periodic inspections of the Site for identifying potential hazards to the environment and deficiencies in site hygiene, and recommend corrective actions as necessary;

v. Attend to enforcement actions taken by the Environmental Protection Department, Food and Environmental Hygiene Department, and other enforcing departments on matters relating to site environment and hygiene;

vi. Attend to public complaints and coordinate remedial actions;

vii. Oversee all the environmental performance on the Site and ensure that any polluting or potentially polluting situation is promptly rectified;

viii. Organize and attend Environmental Management and Site Hygiene meetings;

ix. Compile monthly environmental report for submission to the CM at least five working days before such meetings and produce monitoring records, in prescribed format, to meet BEAM Plus standards where applicable;

x. Advise on the implementation of an environmental management system; waste disposal, trip ticketing and other enhancement measures;

xi. Arrange and provide environmental training including site specific induction training and toolbox talks for all Site Personnel, and organize environmental promotional activities;

xii. Prepare the documentation to support submissions under the Housing Authority's incentive schemes in respect of environmental and site hygiene items;

xiii. Monitor the maintenance of cleanliness and tidiness on the Site;

xiv. Oversee the proper maintenance of amenity facilities by dedicated workers stated in PRE.B8.2520 on the Site.

xv. Oversee the implementation of the Construction Noise Management Plan (CNMP) / updated CNMP stated in PRE.B8.740.

25. Environmental Supervisor (ES):

Option 1

a. Appoint an ES working full time on Site to assist EM for the inspection, supervision and monitoring of the environmental and hygiene performance of the Works;

Option 2

a. Appoint two ES working full time on Site to assist EM for the inspection, supervision and monitoring of the environmental and hygiene performance of the Works;

b. The qualification and experience of ES shall be as follows:

i. A person in possession of a higher diploma or a higher certificate in construction related discipline or environmental studies or environmental engineering awarded by a local or overseas tertiary educational institution, plus 3-year working experience with a minimum of one-year working experience in environmental related work; or

ii. A person in possession of a higher diploma or a higher certificate in construction related discipline and has satisfactorily completed the "Environmental Protection Course for Environmental Supervisors" organised by CIC, IVE or equivalent.

c. The ES's duties include but not limited to the following:

i. Assist the EM in carrying out his duties;

ii. Carry out routine inspections of the Site for identifying potential hazards to the environment and deficiencies in site hygiene, report findings with recommendations for corrective actions, and ensure that follow up action is taken promptly to rectify defects;

iii. Supervise and monitor all the environmental performance on the Site; check and ensure that any polluting or potentially polluting situation is promptly rectified and assist EM in preparing the monitoring records, in prescribed format to meet BEAM Plus standards where applicable;

iv. Advise EM on the upkeeping of environmental performance and hygiene standards of the Site;

v. Supervise and promote the execution of environmental protection and hygiene works by workers on the Site;

vi. Organize site based environmental protection and hygiene promotion awards and promotional activities as prescribed under the Integrated Pay for Safety, Environment and Hygiene Scheme (IPSEHS);

vii. Supervise the dedicated workers stated in PRE.B8.2520 in the proper maintenance of amenity facilities on the Site.

26. Contractor's Labour Officer (CLO):

a. The qualifications and experience of the CLO shall be as follows:

i. Completed Secondary 5 or equivalent;

ii. Well versed in Hong Kong Employment Ordinance & relevant labour legislation;

iii. Good command of both oral and written English and Chinese;

iv. Good knowledge and experience of the operation and practices of the construction industry is preferable;

v. Good computer knowledge preferably with past experience on the operation of a computerized smart card system;

vi. 2-year full time working experience on personnel management or human resources related duties; or Post-secondary qualification in Human Resources or Personnel Management is preferable.

b. Within 7 days from the notified date for commencement of the Works, the Contractor shall nominate at least ..... numbers of Contractor's Labour Officer (CLO) for the CM's approval. The nominated CLO(s) when approved shall work on Site and responsible for monitoring the payment of wages and MPF contributions. The CLO(s) shall provide all necessary assistance to the Labour Relations Officer in the monitoring process and in the handling of complaints on arrears of wages and MPF contributions raised by any Site Personnel;

c. The provision of CLO shall be maintained until at least 2 months after the month in which the access control device of the entrance / exit control unit in ACRS is removed as stipulated in PRE.B8.2660. Thereafter, subject to the CM's approval, the Contractor may assign a staff to perform CLO's duties as stipulated in sub-clause (b) above during the period when the Contractor is required to keep the wage books as stipulated in PRE.B8.1450;

d. The CM shall have the power to withdraw his approval of the CLO at any time. If such approval shall be withdrawn the Contractor shall, after receiving notice in writing of such withdrawal, remove the CLO from the Site forthwith and shall replace him by another CLO approved by the CM.

27. Building Information Modelling (BIM) Manager:

a. Appoint one BIM Manager for the overall BIM management and process control. The BIM Manager shall direct BIM Coordinator(s) and Modeller(s) to handle BIM tasks such as BIM modelling and collaborating information exchange amongst stakeholders of the Works;

b. The BIM Manager shall hold qualifications and relevant experience as follows:

i. Construction Industry Council (CIC) Certified BIM Manager (CCBM);

ii. able to communicate in both English and Chinese.

c. The Contractor shall submit the name, qualifications and experience of the proposed BIM Manager for the CM's approval within 14 days from the notified date for commencement of the Works;

d. If in the opinion of the CM, the BIM Manager does not perform to the satisfaction of the CM, the CM may instruct the Contractor to appoint a replacement. The Contractor shall submit a CV of the replacement with qualifications and experience for the CM's approval within 14 days after receipt of the CM's instruction. The Contractor shall bear all associated costs and the extra time required;

e. For any proposed changes to the BIM Manager, the Contractor shall submit a CV of the replacement staff together with evidence of qualifications and experience to the CM at least 14 days in advance for the CM's approval;

f. Other superintendents may also act as the BIM Manager provided that he / she holds the required qualifications and experience.

28. BIM Coordinator / Modeller:

a. Manpower resources

The Contractor shall provide the minimum number of BIM Coordinator(s) and Modeller(s) as detailed in the below table to assist the BIM Manager in modelling and collaboration works. Notwithstanding the specified minimum number of BIM Coordinator(s) and Modeller(s), the Contractor shall at his own discretion and expenses deploy any additional resources as may be required for performing BIM tasks (i.e. complying with the requirements under PRE.B8.4000 to PRE.B8.4090) to the satisfaction of the CM;

	BIM Coordinator (No.)	BIM Modeller (No.)
*Part time / Full time	*(fill in the required no.)*	*(fill in the required no.)*

**delete as appropriate*

b. Qualifications and Experience

The BIM Coordinator(s) and Modeller(s) shall hold qualifications and relevant experience as follows:

Option 1

BIM Coordinator

i. CIC-Certified BIM Coordinator (CCBC);

ii. able to communicate in both English and Chinese.

BIM Modeller

i. a diploma (or equivalent) in relation to architectural, engineering, surveying or construction-related discipline;

ii. minimum of one year's practical experience in BIM projects;

iii. able to communicate in both English and Chinese.

Option 2

BIM Coordinator

Either

i. CIC-Certified BIM Coordinator (CCBC);

ii. able to communicate in both English and Chinese.

or

i. CIC Certified BIM Coordinator (Associate) (CCBC(A)) and with at least half of the BIM Coordinators attaining the qualification of CCBC;

ii. able to communicate in both English and Chinese.

BIM Modeller

i. a diploma (or equivalent) in relation to architectural, engineering, surveying or construction-related discipline;

ii. minimum of one year's practical experience in BIM projects;

iii. able to communicate in both English and Chinese.

c. The Contractor shall submit the names, qualifications and experience of the proposed BIM Coordinator(s) and Modeller(s) for the CM's approval within 14 days from the notified date for commencement of the Works;

d. If in the opinion of the CM, any of the BIM Coordinator(s) or Modeller(s) does not perform to the satisfaction of the CM, the CM may instruct the Contractor to appoint a replacement. The Contractor shall submit a CV of the replacement staff together with evidence of qualifications and experience for the CM's approval within 14 days after receipt of the CM's instruction. The Contractor shall bear all associated costs and the extra time required;

e. For any proposed changes to the BIM Coordinator(s) or Modeller(s), the Contractor shall submit a CV of the replacement staff together with evidence of qualifications and experience to the CM at least 14 days in advance for the CM's approval;

f. Other superintendents may also act as the BIM Coordinator or Modeller provided that he / she holds the required qualifications and experience.

29. Independent Checking Consultant (ICC):

a. Select a consultant on the Architectural and Associated Consultants Selection Board's (AACSB) List of Structural Engineering Category for the CM's approval as the ICC;

b. ICC shall ensure that the design submission is in compliance with the Buildings Ordinance, and certify the design and completion of Case 2 and Case 3 Temporary Works as specified in PRE.B10.010 sub-clause (9). The submissions must be signed by a Director of the ICC, who must be a registered structural engineer registered with the Building Authority. ICC shall also have or employ a registered geotechnical engineer registered with the Building Authority to review and certify the geotechnical report and supporting documentation of temporary works. The registered geotechnical engineer of ICC shall not be the same RGE as defined in sub-clause (19) of PRE.B6.060;

c. The ICC shall utilise standard forms (EPS-F1 to EPS-F6 in APPENDIX PRE.B6/I to this Worksection) when submitting all items requiring its confirmation and / or certification. For certifying completion of temporary works, ICC shall submit Form EPS-F2 along with the as-built record plans and photos after inspection. For certifying completion of temporary works providing support to a tower crane, ICC shall submit Form EPS-F5 along with the as-built record plans and photos after inspection. For free-standing tower crane, ICC shall submit EPS-F6 to ICU with copy to the CM to confirm the completeness of submitted documents including certified plans and construction drawings with design justifications and duly signed forms EPS-F3 to EPS-F5 for record within 14 days after the completion of temporary works;

d. The RSE in sub-clause (8) / RGE in sub-clause (9) and ICC should be independent from each other and have no holding, subsidiary, employer / employee or any other relationship.

30. Competent person for Hand-dug Tunnelling Work:

a. The qualifications and experience of the competent person shall be as follows:

i. Safety officer registered under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations; or

ii. a person certified by Labour Department as competent to prepare risk assessment reports;

iii. possessing at least one year's relevant experience, after obtaining the registration or certificate from Labour Department, in assessing risk to the safety and health of workers working in confined space;

b. The competent person shall carry out the responsibility stipulated in the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department.

31. Competent Engineer for Hand-dug Tunnelling Work:

a. The qualifications and experience of the Competent Engineer shall be as follows:

i. Registered Professional Engineer under the Engineers Registration Ordinance in the Geotechnical or Civil discipline (and also in the Structural discipline if structural works are required) plus at least 5 years of relevant experience in site investigation, design and construction of trenchless or underground excavation works;

ii. ……;

b. Utilise standard forms (EPS-F1 and EPS-F2 in APPENDIX PRE.B6/I to this Worksection) when submitting the items requiring Competent Engineer's certification as detailed in sub-clauses (31)(d) to (31)(g) below;

c. Allow sufficient time in the construction programme for such checking and certification by the Competent Engineer and submission to the CM for written consent;

d. Certification by the Competent Engineer is required for the design and construction of the following Temporary Works in relation to hand-dug tunnelling works:

i. ……;

ii. ……

e. Submit Competent Engineer certificate for construction of the Temporary Works listed in sub-clause (31)(d) above to the CM for consent before the Temporary Work is put in use;

f. Submit Competent Engineer certificate for construction of the Temporary Works listed in sub-clause (31)(d) above to the CM for consent before the staged Temporary Work is put in use in the order of the following schedule:

	Temporary Works	Schedule of stages for Competent Engineer certificate submission
i.	.....	.....;
ii.	.....	.....;
iii.	.....	.....

g. Checking and certification by Competent Engineer are required for design only on the following Temporary Works:

i. .....;

ii. .....

32. Independent Checking Engineer (ICE) for Hand-dug Tunnelling Work:

a. The qualifications and experience of the ICE shall be as follows:

i. Registered Professional Engineer under the Engineers Registration Ordinance in the Geotechnical or Civil discipline (and also in the Structural discipline if structural works are required) plus at least 5 years of relevant experience in site investigation, design and construction of trenchless or underground excavation works.

b. The ICE shall utilise standard forms (EPS-F1 and EPS-F2 in APPENDIX PRE.B6/I to this Worksection) when submitting all items requiring his verification as detailed in the relevant sections of the Specification and including the following:

i. All temporary works in relation to hand-dug tunnelling works classified as Case 1 under the CoPSS clause 4.9;

ii. All substantial temporary works in relation to hand-dug tunnelling works stipulated in PRE.B10.010, as directed by the CM;

iii. Temporary works in relation to hand-dug tunnelling works erected on slopes or retaining walls, as directed by the CM;

c. The ICE shall carry out the responsibility stipulated in the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department;

d. The ICE shall possess the experience stipulated in EAR1.D010 and shall carry out the responsibility detailed in EAR1.D050.

33. Art Curator:

a. The Art Curator shall hold relevant experience as follows:

i. Knowledge on art and the range of art media;

ii. Active on the art scene, being a good art critic and have good network with local artists or organisation;

iii. Have experience in art curating and direction;

iv. Good communicative and interpersonal skills to liaise with the artists, contractors and engineers etc..

b. The duties of the Art Curator shall include but not limited to the followings:

i. Formulate art strategy and provide artistic direction in conceptualizing the overall ambience and theme with appropriate artworks at suitable locations, in liaison with the CM;

ii. Monitor artists from procurement through to completion, and carry out supervision to ensure the artworks are fabricated on time and completed in sound construction to the required quality, with the provision of maintenance guides as stated in EXT19.M010 to EXT19.M080 inclusive;

iii. Coordinate design interface with and not limited to external façade, glazed wall, architectural works, external works, engineering works, building services works, landscaping works;

iv. Provide input to the CM on changes to the Works induced by the artworks, if necessary;

v. Prepare and make all necessary submissions to the CM. This includes coopting technical and professional support, to realize artistic concepts into structurally adequate physical artworks, support necessary statutory submissions such as structural calculations to Government departments and carrying out site supervision when required;

vi. Liaise with the artists, contractors, engineers, sub-contractor(s), personnel and etc. for the safe installation of artworks on Site;

vii. Organise, coordinate and hold Public Engagement Activities as described in PRE.B9.890.

c. The Contractor shall submit the name(s), qualification(s), experience and documentary proof of employment status of the Art Curator for approval of the CM. Such Art Curator shall be approved by the CM at least six (6) months before the submission of proposal and plan of the Public Engagement Activities.

34. Appointed superintendents, namely, Quality Control Manager (QCM), Building Services Engineer, Blasting Control Engineer, Registered Asbestos Consultant, Site Agent, Authorized Signatory (AS), Technically Competent Person (TCP) Grade T4 to T5 for SP, Qualified Engineer, Supervising Engineer (Tower Crane), Competent Engineer, Environmental Manager (EM) and Independent Checking Engineer shall have attained the following mandatory safety training qualification:

a. Safety Training Course for Site Management Staff (nominal course duration 27 hours) provided by the CIC or the OSHC or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

b. Those appointed superintendents having completed a Safety Training Course for Site Management Staff provided by the CIC or the OSHC or equivalent training organization for 5 years or above shall complete the Safety Training Refresher Course for Site Management Staff (nominal course duration 7 hours) provided by the CIC or the Safety Training Course for Site Management Staff (Refresher) (nominal course duration 7 hours) by the OSHC or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard.

35. Superintendents can be exempted from certain modules of the Safety Training Course for Site Management Staff by fulfilling the exemption criteria laid down by the CIC or OSHC;

36. Appointed superintendents, namely, Architectural Quality Control Coordinator (AQCC), Structural Quality Control Coordinator (SQCC), Asbestos Removal Site Supervisor, General Foreman, Block Foreman, DRC, Technically Competent Person (TCP) Grade T1 to T3 for SP, Certified Supervisor (CS) for Application of Tile Adhesive, Piling Sub-contractor's Superintendents and Environmental Supervisor (ES) shall have attained the following mandatory safety training qualification:
    a. Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by the OSHC or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by the CIC or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;
    b. Those appointed superintendents having completed the mandatory safety training for 4 years or above shall complete the Enhancement Course for Construction Safety Supervisors (nominal course duration 12 hours) provided by CIC or the Enhancement Course for Safety Supervisors (Construction) (nominal course duration 12 hours) by the OSHC or equivalent training by other organisations subject to verification that the equivalent training is based on course contents of equivalent or higher standard.
37. The appointed superintendents referred to in sub-clauses (34) and (37) above who have attained or once attain the stipulated training qualification shall participate and give advice in Induction Training and Tool Box Talks to enrich the knowledge of personnel of particular trades.

PRE.B6.065.C GCC 5.9 - CONTRACTOR'S EMPLOYEES

1. The Contractor and his sub-contractors shall comply with the Construction Workers Registration Ordinance (Cap. 583), in particular with respect to the requirements that only registered skilled / semi-skilled workers are employed to carry out construction works of those designated trade divisions set out in the Ordinance (as may be revised from time to time throughout the course of the Contract) unless under the conditions specified in the Ordinance which exempt the above requirements;
2. Further to GCC Clause 5.9(1), the following qualified workers shall have acquired the respective qualifications:
    a. "Skilled Worker" is a registered skilled worker or registered skilled worker (provisional) as respectively defined in section 2(1) of the Construction Workers Registration Ordinance (Cap. 583);
    b. "Semi-skilled Worker" is a registered semi-skilled worker or registered semi-skilled worker (provisional) as respectively defined in section 2(1) of the Construction Workers Registration Ordinance (Cap 583).
3. For complying with GCC Clause 5.9(1)(c), the Contractor or his sub-contractors shall employ the minimum number of Skilled and Semi-skilled Workers calculated in accordance with the stated percentages of the total workforce on Site at any one time in each of the following scheduled trade divisions. For the purpose of this sub-clause, the term "total workforce" means the total number of workers of the relevant trade division but excluding Workers under Instruction as provided for under sub-clause (4) below, workers working across designated trade divisions pursuant to section 3A of the Construction Workers Registration Ordinance (Cap. 583), workers carrying out exempted construction work pursuant to section 63A of the Construction Workers Registration Ordinance (Cap. 583), CICTS Trainees under training in accordance with PRE.B8.1500 and ITCTS Trainees who completed training under this Contract in accordance with PRE.B8.1500 (11):
    a. For piling works:

	Trade division	Requirement of combined percentage for Skilled and Semi-skilled Workers	Max. permissible percentage of Semi-skilled Workers
i.	Ground Investigation Operator	100%	0%
ii.	Piling Operative (Percussive Pile)	100%	0%
iii.	Piling Operative (Bored Pile)	100%	0%
iv.	Plant Equipment Operator (Percussive Pile)	100%	0%
v.	Plant Equipment Operator (Bored Pile)	100%	0%

b. For building works:

	Trade division	Requirement of combined percentage for Skilled and Semi-skilled Workers	Max. permissible percentage of Semi-skilled Workers
i.	Bricklayer	100%	15%
ii.	Tiler	100%	15%
iii.	Plasterer	100%	15%
iv.	Joiner	100%	15%
v.	Carpenter (Formwork - Building Construction)	100%	15%
vi.	Painter and Decorator	100%	15%
vii.	Painter (Texture-spray)	100%	0%*
viii.	Plumber	100%	15%
ix.	General welder	100%	15%
x.	Concretor	100%	15%
xi.	Leveller	100%	15%
xii.	Metal Worker	100%	15%
xiii.	Bar Bender & Fixer	100%	15%
xiv.	Bamboo Scaffolder	100%	15%
xv.	Marble Worker	100%	15%
xvi.	Drainlayer	100%	15%
xvii.	Ground Investigation Operator	100%	0%
xviii.	Metal Scaffolder	100%	15%
xix.	Waterproofing Worker	100%	0%

xx.	Piling Operative (Percussive Pile)	100%	0%
xxi.	Piling Operative (Bored Pile)	100%	0%
xxii.	Plant & Equipment Operator (Percussive Pile)	100%	0%
xxiii.	Plant & Equipment Operator (Bored Pile)	100%	0%
xxiv.	Pipelayer	100%	0%*
xxv.	Construction Plant Mechanic	100%	15%
xxvi.	Window Frame Installer	100%	15%
xxvii.	Rigger / Metal Formwork Erector	100%	15%
xxviii.	Paving Block Layer	100%	0%*
xxix.	Curtain Wall Installer	100%	0%
xxx.	Floor Layer (PVC Flooring)	100%	15%
xxxi.	Floor Layer (Timber Flooring)	100%	15%
xxxii.	Glazier	100%	15%

* Semi-skilled worker is not available in this trade division.

c. For demolition works:

	Trade division	Requirement of combined percentage for Skilled and Semi-skilled Workers	Max. permissible percentage of Semi-skilled Workers
i.	Bamboo Scaffolder	100%	15%
ii.	Asbestos Abatement Worker	100%	0%*
iii.	Demolition Worker (Building)	100%	0%*

* Semi-skilled worker is not available in this trade division.

4. The Contractor and his sub-contractors shall follow the latest "Guidelines on Arrangement of Instruction and Supervision and Code of Practice for Reasonable Measures of Instruction and Supervision" published by CIC and implement reasonable measures regarding the arrangement for workers not registered under the relevant trade division (i.e. "Workers under Instruction") to carry out construction work of such trade division under instruction and supervision pursuant to section 4 of the Construction Workers Registration Ordinance (Cap. 583);

Option 1

5. Complete a return for workers for each trade division prescribed under sub-clause (3) above, giving details of the personal particulars of each of such workers employed, and deliver it together with the returns submitted by the Nominated Sub-contractors to the CM in accordance with GCC Clause 5.25(3):

a. Obtain the format of the return from the CM;
b. A return is to be completed in respect of:
    i. The workers which include Skilled Workers, Semi-skilled Workers, Workers under Instruction, workers working across designated trade divisions and workers carrying out exempted construction work for each trade division employed on the fifteenth (15) day of each month, or in the event of the fifteenth (15) day being a General Holiday on the day immediately following the General Holiday;
    ii. The average number of workers which include Skilled Workers, Semi-skilled Workers, Workers under Instruction, workers working across designated trade divisions and workers carrying out exempted construction work for each trade division per day employed in each month.

Option 2

5. Complete a return for workers for each trade division prescribed under sub-clause (3) above, giving details of the personal particulars of each of such workers employed, and deliver it to the CM in accordance with GCC Clause 5.25(3):
    a. Obtain the format of the return from the CM;
    b. A return is to be completed in respect of:
        i. The workers which include Skilled Workers, Semi-skilled Workers, Workers under Instruction, workers working across designated trade divisions and workers carrying out exempted construction work for each trade division employed on the fifteenth (15) day of each month, or in the event of the fifteenth (15) day being a General Holiday on the day immediately following the General Holiday;
        ii. The average number workers which include Skilled Workers, Semi-skilled Workers, Workers under Instruction, workers working across designated trade divisions and workers carrying out exempted construction work for each trade division per day employed in each month.
6. Arrange and release workers to attend either the 2-day or 5-day course including examination organised by the Construction Industry Council (CIC) for attaining the status of registered skilled worker in the trade of Demolition Worker (Building) under the Workers Registration-Secretariat of CIC as appropriate. Submit evidence to the CM for substantiating the fulfilment of all of the following conditions, which shall be provided to the CM for ascertaining Contractor's entitlement to the designated payment as provided and detailed in the Bills of Quantities or schedule of rates in respect of the arrangement and release of workers to attend the aforesaid course, and attainment of the status of registered skilled worker:
    a. Each worker is counted only once;
    b. The worker passed the examination of CIC after the tender-out date of the concerned demolition contract;
    c. Submission of the original payment receipt of course and examination fees issued by CIC;
    d. The worker has provided proof of registration as registered skilled worker in the trade of Demolition Worker (Building) under Workers Registration-Secretariat of CIC;
    e. The worker has worked for the Contract as a demolition worker for at least 60 working days after the registration with Workers Registration-Secretariat of CIC;
    f. The worker has been reimbursed of one of the following:

i. The designated payment with workers' signed acknowledgement of receipt available in the event that the course and examination fees were paid by the worker;

ii. The designated payment net of the course and examination fees with workers' signed acknowledgement of receipt available in the event that the course and examination fees were paid by the Contractor.

7. Arrange and release workers to sit for the examination organised by CIC for attaining the status of registered skilled worker in the trade of Asbestos Abatement Worker under Workers Registration-Secretariat of CIC as appropriate. Submit evidence to the CM for substantiating the fulfilment of all of the following conditions, which shall be provided to the CM for ascertaining Contractor's entitlement to the designated payment as provided and detailed in the Bills of Quantities or schedule of rates in respect of the arrangement and release of workers to sit for the aforesaid examination, and attainment of the status of registered skilled worker:
   a. Each worker is counted only once;
   b. The worker passed the examination of CIC after the tender-out date of the concerned demolition contract;
   c. Submission of the original payment receipt of examination fee issued by CIC;
   d. The worker has provided proof of registration as registered skilled worker in the trade of Asbestos Abatement Worker under Workers Registration-Secretariat of CIC;
   e. The worker has worked for the Contract as an asbestos abatement worker for at least 30 working days after the registration with Workers Registration-Secretariat of CIC;
   f. The worker has been reimbursed of one of the following:
      i. The designated payment with workers' signed acknowledgement of receipt available in the event that the examination fee was paid by the worker;
      ii. The designated payment net of the examination fee with workers' signed acknowledgement of receipt available in the event that the examination fee was paid by the Contractor.
8. Keep record of payment for the course fee / examination fee of CIC and payment of wages to workers with workers' signed acknowledgement of receipt;
9. The total amount of designated payment payable in accordance with sub-clauses (6) and (7) above shall not exceed the ceiling sum calculated as 0.1% of the Contract Sum;
10. The total amount of designated payment payable in accordance with sub-clauses (6) and (7) above shall not exceed the ceiling sum calculated as 0.1% of the total sum for the demolition works within the Contract Sum;
11. Welder for Electric Arc Welding and Flame Cutting:
   a. The general welder shall have at least attained the level of intermediate tradesman and registered as Registered Semi-skilled Worker under the Construction Workers Registration Ordinance;
   b. The general welder undertaking flame cutting and gas welding work shall have attained the training qualification of a gas welding safety training course approved by Labour Department and holds a valid training certificate.

PRE.B6.070.9 GCC 5.11 - SAFETY, SECURITY AND ENVIRONMENTAL MANAGEMENT OF THE WORKS

Option 1

1. The safety and security requirements in respect of the Works and all operations on the Site are specified in PRE.B8.110 to PRE.B8.360 and elsewhere in Worksection PRE.B8.
2. The environmental management and site hygiene requirements in respect of the Works and all operations on the Site are specified in PRE.B8.410 to PRE.B8.2850 and elsewhere in Worksection PRE.B8.
3. Pursuant to GCC Clause 5.11, the Contractor shall submit the Safety Plan and the Environmental Management Plan and their subsequent revisions or updates to the CM in accordance with the requirements as specified in PRE.B8.210 and PRE.B8.2515 respectively.

Option 2

1. The safety and security requirements in respect of the Works and all operations on the Site are specified in PRE.B8.110 to PRE.B8.360 and elsewhere in Worksection PRE.B8.

PRE.B6.080.9 GCC 5.14 - THIRD PARTY INSURANCE

1. The list of insurers approved by the Employer will be the Register of Authorized Insurers maintained by the Insurance Authority. Any insurer not on this list or not authorized by the Insurance Authority will not be approved. The Insurer must provide, together with the insurance policy, a covering letter undertaking to inform the Employer of any cessation of the insurance policy due to any reason whatsoever. No insurance shall be approved without such a covering letter;
2. The minimum amount of third party insurance is stated in the Appendix to the Form of Tender. The amount stated is deemed to be in respect of any one accident and unlimited in the aggregate amount for the period of insurance.

   The expression 'accident' meaning any one accident or series of accidents arising out of any one event irrespective of the number of claims that may arise therefrom but unlimited in number for the period of insurance.

PRE.B6.085.A GCC 5.15 - DESIGN RESPONSIBILITY (BUILDING)

1. Accept liability for:
   a. The suitability of purpose of the materials and equipment incorporated in the Works by any Nominated Sub-contractor;
   b. All design responsibilities included in Nominated Sub-contracts. The design requirements for each of the Nominated Sub-contractors are generally set out in the typical Sub-contract documents, available for inspection at the Housing Department Office, and the Contractor must satisfy himself of these responsibilities.

      The Nominated Sub-contracts which carry a design responsibility and for which the Contractor is responsible are:

      i. .....;

      ii. .....;

      iii. .....

   c. Design responsibility for all modifications in design and / or Specification proposed by the Contractor (refer to Appendix E to this Specification);
   d. Design responsibility of the following permanent works which are designed by the Contractor but certification by the Design Certifying Consultant is not required:

Reference no.	Description of works	Specification	Drawings

i.	Design mixes of concrete	CON1.M1110	Refer APPENDIX PRE.B6/V to this Worksection
ii.	Play / fitness equipment	EXT10.M010	
iii.	uPVC windows	COM3.D010 - COM3.D230	
iv.	Impact Absorbing Surfacing Materials (IASM)	EXT10.M310 & EXT10.M320	
v.	External furniture	EXT15.D020	
vi.	Precast manholes	DRA2.M010, DRA2.M610, DRA2.W1210 and DRA2.T310	

e. Design responsibility of the following permanent works which are designed by the Contractor and require certification by the Design Certifying Consultant:

Reference no.	Description of works	Specification	Drawings
i.	Curtain wall	……	Refer APPENDIX PRE.B6/V to this Worksection
ii.	Roof lights	……	
iii.	Precast facades	CON5.D010 - CON5.D1040 inclusive	
vi.	Metal doors	COM6.D010 - COM6.D110 inclusive	
v.	Roller shutter and doors	COM8.D010 - COM8.D320 inclusive	
vi.	Aluminium windows and louvres	COM2.D010 - COM2.D320 inclusive	
vii.	Stainless steel windows, doors and louvres complete with glazing for domestic blocks	COM1.D010 - COM1.D240 inclusive	
viii.	Structural steelwork	STR1.D010 - STR1.D780 inclusive	
ix.	Bridge bearing	……	
x.	Artworks	EXT19.M010 - EXT19.M080 inclusive	
xi	……	……	

2. Submit to the CM certificate signed by the Design Certifying Consultant as specified in PRE.B6.060 certifying that the permanent works listed in sub-clause (1)(e) which are designed by the Contractor are structurally safe;
3. Submit the following to the CM for approval:
   a. Design calculations and details for the following items of work:
      i. Curtain wall: ……...;
      ii. ……;
      iii. ……..

b. Supporting documents in relation to the works items given in sub-clause (3)(a) above:

i. ……;

ii. ……

c. Allow for at least 45 days for processing of first submission and at least 45 days for each re-submission to the CM for approval.

4. List of Drawings showing the design intent and/or the Employer's requirements for works items in sub-clauses (1)(d) and (1)(e) above is included in APPENDIX PRE.B6/V to this Worksection. The aforesaid list of Drawings is not meant to be exhaustive and the Contractor is deemed to have examined all Drawings listed in the Appendices to the Specification;
5. The principles of design will be as set out in the Contract documents and the Contractor shall not vary these without first obtaining the written permission of the CM;
6. Any design for which the Contractor is responsible shall be submitted to the CM prior to execution of any work in accordance with the design for CM's written confirmation that the requirements of the Employer appear to have been met, and after CM's confirmation the Contractor shall not vary such design without the written consent of the CM. The submission to the CM of such design and CM's confirmation shall not relieve the Contractor of any duty or responsibility under the Contract.

PRE.B6.090.9 GCC 5.27 - FACILITIES FOR OTHER PERSONS

Facilities required to be provided to others under the Contract are specified in Worksection PRE.B12.

PRE.B6.100.9 GCC 5.33 - CARE OF THE WORKS INSURANCE

The list of insurers approved by the Employer will be the Register of Authorized Insurers maintained by the Insurance Authority. Any insurer not authorized by the Insurance Authority will not be approved. The Insurer must provide together with the insurance policy a covering letter undertaking to inform the Employer of any cessation of the insurance policy due to any reason whatsoever. No insurance policy shall be approved without such a covering letter. In the event that a Nominated Sub-contractor or a Direct Contractor submits a claim under the insurance policies required to be maintained by the Contractor under GCC Clause 5.33 for any loss or damage from whatsoever cause arising, other than the "excepted risks", he will be entitled to be reimbursed the amount paid to the Contractor by the insurer for that claim. The Nominated Sub-contractor or the Direct Contractor will also be entitled to be reimbursed from the Contractor 30% of the amount of any policy excesses deducted.

PRE.B6.150.9 GCC 6.3 - PASSES

1. Ensure everyone entering the Site has a Pass. The requirements of Passes shall conform to the smart cards as stipulated in PRE.B8.2620 and PRE.B8.2650.
2. Issue Passes to, including but not limited to, all staff and sub-contractors, Nominated Sub-contractors, Specialist Contractors, Utility Undertaking staff and contractors, workers or contractors employed by the Employer, the Surveyor and his representatives, the CM and his representatives and anyone authorised by him, and the authorised representatives of the Employer.

PRE.B6.170.N GCC 8.4 – EXTENSION OF TIME FOR COMPLETION

Without prejudice to GCC Clause 8.4(2)(a) and Clause 8.4(2)(h)(i), the Contractor shall submit the following to the CM at the same time when serving the written notice of claim for extension of time (EOT) as referred to in GCC Clause 8.4(2)(a) in order for the CM to decide whether the Contractor is fairly entitled to an EOT for the completion of the Works or relevant Section(s) according to GCC Clause 8.4(2)(d):

1. Relevant contract clause(s) for the EOT claim with justification;
2. Date of cause of delay to the progress of the Works or any Section became apparent;
3. Cause of delay and summary of the event;
4. Affected period (including the start and end dates, and number of working days involved);
5. Analysis of the actual delay caused to the completion of works;
6. Critical path analysis justifying the delay was critical to the completion of works;
7. Concurrent delay analysis accompanied with programme;
8. Calendar chart(s) (for the Works / each relevant Section) illustrating:
   a. The counting of number of working days claimed for the delaying event;
   b. The working of number of working days and calendar days of EOT submitted under the claim.
9. Estimated amount of claim for expenditure / additional payment in relation to the EOT claim (if any);
10. Plans / photos / drawings and any other documents or materials to substantiate the EOT claim.

PRE.B6.200.9 GCC 9.1 - WORKS SUBJECT TO EXCISION

There are no parts of the Works subject to excision.

PRE.B6.210.9 GCC 10.1 - EXECUTION OF MAINTENANCE WORKS

1. Carry out and complete such Maintenance Works within the respective times for completion as set out in Schedule A and Schedule B below, which stipulate the times for completion of the various categories of Maintenance Works;
2. The periods of time set out in the legends of Schedule A and Schedule B shall commence from the date when the Contractor is in receipt of the instruction;
3. Defects that are commonly identified as incurring maximum inconvenience to tenants once found are classified as urgent Maintenance Works and they are not listed in the schedules. These urgent Maintenance Works require different completion time and the schedules will no longer apply. Instead, the Contract Team shall issue an instruction to the Contractor for immediate rectification or completion in a shorter time;
4. In situation where it becomes apparent that the progress of the execution of Maintenance Works is likely to be delayed, notify the CM of the cause and probable effect and extent of such delay. If the CM considers that the delay is due to occurrence of a special circumstance and the Contractor is fairly entitled to a longer duration for completion, CM shall notify the Contractor of such extended time accordingly;
5. When the Maintenance Works have been completed, notify the CM, who shall issue confirmation of the date of completion of such works.

SCHEDULE A DOMESTIC FLAT

TRADE / LOCATION		Plaster & Tiling (a)	(b)	(c)	(d)	(e)	(f)		Metal Work (g)	(h)	(j)	Iron-mongery (k)	(l)	(m)	(n)	(o)		Plumbing (p)	(q)	(r)	(s)	(t)	(u)
	Ceiling (i)		3	3	2	1	3	Gate (v)	3	2		1	1		3								
(A)	Wall (ii)		3	3	2	1	3	Window (vi)	3	2		1	1	1									
LIVING	Floor (iii)	3	3	3	2			Door (vii)	3	2	2	1	1		3								
BEDROOMS	Drywall (iv)				2	1	3	Door Frame (viii)	3	2	2				3								
								Parquet/Skirting (ix)			2				3								
	Ceiling (i)		3	3	2	1	3	Window (iv)	3	2		1	1	1			Pipework (ix)	1	1	1	1	3	
(B)	Wall (ii)	3	3	3	2	1	3	S. S. Rail (v)	3	2						2	Basin (x)	1	1	1	1		
BATHROOM	Floor (iii)	3	3	3	2			Door (vi)	3	2	2	1	1	1	3		Tub (xi)	1	1	1	1	3	
								Door Frame (vii)	3	2	2				3		Shower (xii)	1	1	1	1		
								Bath panel (viii)	3	2	2				3		W.C. (xii)	1	1	1	1		
																	Cistern (xiv)		1	1	1		
																	Floor Drain (xv)	1	1	1	1		
																	Vent Pipe (xvi)				1		
	Ceiling (i)		3	3	2	1	3	Window (iv)	3	2		1	1	1			Pipework (viii)	1	1	1	1	3	
(C)	Wall (ii)	3	3	3	2	1	3	Door (v)	3	2	2	1	1	1	3		Sink (ix)	1	1	1	1		
KITCHEN	Floor (iii)	3	3	3	2			Door Frame (vi)	3	2	2				3								
								Cooking Bench (vii)	3	2													
	Ceiling (i)		3	3	2	1	3	Metal Door (iv)	3	2		1	1	1			Pipework (viii)	1	1	1	1	3	
(D)	Wall (ii)	3	3	3	2	1	3	Burglar Bar (v)	2	1		1	1		3		Floor Drain (ix)	1	1	1	1		
BALCONY	Floor (iii)	3	3	3	2			Pipeduct Panel (vi)	3	2	2	2	2		3								
								Louvre (vii)	3	2			2	2									
Others : Specify								Letter Box (i)	3	2	2	2	2										

Legends:

(a) Damaged tile
(b) Hollow Spot
(c) Plaster/Screed Crack
(d) Concrete/Drywall Crack
(e) Seepage
(f) Painting
(g) Major: Needs Replacing
(h) Minor: Needs adjusting etc.
(j) Joinery
(k) Lock
(l) Hinge
(m) Glazing
(n) Painting
(o) Other (e.g. Fixing)
(p) Blocked Drain/Tap
(q) Leaking Pipe/Trap
(r) Leaking Tap/Valve
(s) Loosely Fixed
(t) Painting
(u) Others: Specify

	Socket/Connector	(i)	1
(F)	Lighting Point	(ii)	1
B.S.	MCB/MCB Board	(iii)	1
ITEMS	CABD	(iv)	1
	Door Phone /Bell	(v)	1
	Others : Specify under Remarks	(vi)	

Legends

1 Rectification completed within 1 week
2 Rectification completed within 2 week
3 Rectification completed within 3 week
4 Rectification completed within 4 week
Not applicable

SCHEDULE B COMMON AREA

TRADE		Plaster & Tiling							Metal Work			Iron-mongery						Plumbing					
LOCATION		(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(j)	(k)	(l)	(m)	(n)	(o)		(p)	(q)	(r)	(s)	(t)	(u)
	Ceiling (i)		4	4	2		2	Water Meter Cpd (iv)	4	4		4	4		4		Pipework (ix)	1	1	1	1	4	
(G)	Wall (ii)	4	4	4	2		2	Grilles (v)	2	2		2	2		4		Floor Drain (x)	1	1		1	4	
STAIR	Floor (iii)	4	4	4	2	4		Window/Louvre (vi)	2	2		2	2	2									
								Railing (vii)	2	1					4								
								Exit Door (viii)	4	1	1	1	1	1	4								
	Ceiling (i)		4	4	2		2	Water Meter Cpd (i)	4	4	4	4	4	4	4		Pipework (viii)	1	1	1	1	4	
(H)	Wall (ii)	4	4	4	2		2	Hose Reel Cpd (ii)	4	4	4	4	4	4	4		Floor Drain (ix)	1	1	1	1	4	
CORRIDOR	Floor (iii)	4	4	4	2	4		Signage (vi)	4	4	4	4	4	4	4		HR/FSI (x)	1	1	1	1	4	
								Service Rm Door (vii)	4	4	4	4	4	4	4								
	Ceiling (i)		4	4	2		2	Window/Louvre (iv)	2	1		2	2	2	4		Pipework (vi)	1	1	1	1	4	
(J)	Wall (ii)	4	4	4	2		2	False Ceiling (v)	4	4	4						Floor Drain (vii)	1	1	1	1	4	
LIFT	Floor (iii)	4	4	4	2	4																	
LOBBY																							
	Electric Meter Rm (i)		4	4	4		1										PRV (viii)		1	1	1		
	Water Meter Rm (ii)		4	4	4	4	1																
	Pipeduct (iii)		4	4	4	4	1																
(K)	Refuse Rm (iv)	4	4	4	4	4	2																
	Service/Telecom Rm (v)		4	4	4		1																
	Others : Specify (vi)																						
	External Wall (vii)	4	4	4	4		2																

Legends

(a) Damaged tile
(b) Hollow Spot
(c) Plaster/Screed Crack
(d) Concrete/Drywall Crack
(e) Inadequate Fail
(f) Seepage
(g) Major: Needs Replacing
(h) Minor: Needs adjusting etc.
(j) Joinery
(k) Lock
(l) Hinge
(m) Glazing
(n) Painting
(o) Others: Specify
(p) Blocked Drain/Tap
(q) Leaking Pipe/Trap
(r) Leaking Tap/Valve
(s) Loosely Fixed
(t) Painting
(u) Others: Specify

		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(j)	(k)
	DESCRIPTION										
(L)	Equipment Burnt/Break Down (i)	1	2	2	2	2	2	1	2	2	
B.S.	Broken Wire (ii)	1	1	1	1	1	1	1	1	1	
ITEMS	Inadequate Illumination (ii)	4	2	2	2	2	2	4	4	4	
	Defective/Outstanding Builder's Work (iv)	4	4	4	4	4	4	4	4	4	
	Others : Specify under Remarks (v)										

Legends

1 Rectification completed within 1 week
2 Rectification completed within 2 week
3 Rectification completed within 3 week
4 Rectification completed within 4 week
Not applicable

Legends

(a) Lift Machine Room
(b) Lift Car
(c) Lift Landings
(d) Pump /rooms
(e) Corridor
(f) Staircase
(g) Meter Rooms
(h) Refuse Rooms
(j) Service Rooms
(k) Others: Specify

PRE.B6.250.9 GCC 11.1(7) – MEASUREMENT AND VALUATION FOR PROVISIONAL QUANTITIES

Option 1

Pursuant to GCC Clause 11.1(7)(b) relating to the time frame for providing the Surveyor's determination for provisional quantities, and pursuant to GCC Clause 11.7(2) relating to issuing an assessment prior to Surveyor's determination, the Surveyor shall provide the Contractor with the assessment for provisional quantities within 12 months after the date of commencement of the Period of Final Measurement, and shall provide the Surveyor's determination within the time and in such manner as provided in GCC Clause 11.7(2).

Option 2

Pursuant to GCC Clause 11.1(7)(b) relating to the measurement and valuation for provisional quantities, the Surveyor shall issue the Surveyor's determination for provisional quantities within 6 months after the date of commencement of the Period of Final Measurement.

PRE.B6.260.9 GCC 11.2 - VARIATIONS

For the avoidance of doubt, the words "position", "dimension", "level" and "line" in GCC Clause 11.2 (1)(a) shall be deemed to include the actual founding level of each pile and the actual rockhead levels (where appropriate for individual pile types) for those piles as designed by the Contract Manager.

PRE.B6.265.N GCC 11.6 - ASCERTAINMENT OF CLAIMS

1. The contemporary records that may reasonably be required from the Contractor to support or substantiate any claim for expenditure or additional payment, with the details to be submitted to or inspected by the Surveyor for the purpose of the Surveyor's ascertainment of the claim as referred to in GCC Clause 11.6(1), shall include but not be limited to the following types wherever applicable to the compilation of the claim:
   a. Records of site superintendents' engagement;
   b. Records of labour force and/or sub-contractor usage;
   c. Records of Constructional Plant deployed (self-owned and/or rented);
   d. Records of on-site and/or off-site logistics;
   e. Records of items of site overheads;
   f. Records of items of head office overheads;
   g. Records of idling time or reduced productivity of resources;
   h. Records for verification of build-up for depreciation of plant or other assets.
2. The above records (other than sub-clauses (1)(f) and (1)(h) above), as well as other contemporary records reasonably required by the Surveyor, have to be verified and endorsed by the Site Staff, CM or his representatives whenever possible on submission to or inspection by the Surveyor.
3. The Contractor shall accept the responsibility that any failure of him to submit or produce for inspection the records in sub-clause (1) above or other contemporary records as required by the Surveyor within the time prescribed by GCC Clause 11.6, without reasonable justifications acceptable to the Surveyor, may jeopardise the outcome of the ascertainment of the claim by the Surveyor. The Contractor shall bear any loss of or shortfall in cost recovery or payment entitlement of the claim arising from his failure in this connection irrespective of whether there will be any further submissions of better or supplementary records by him beyond the prescribed time. The Surveyor is also entitled not to take into account the further submissions of records, if any, by the Contractor in ascertaining the Cost or additional payment for the claim pursuant to GCC Clause 11.6(5).

PRE.B6.270.9 GCC 11.7 - SURVEYOR'S DETERMINATION AND ASCERTAINMENT

Option 1

Pursuant to GCC Clause 11.7(2)(a) and prior to issuing Surveyor's determination relating to the measurement and valuation of a variation ordered by the CM, the Surveyor shall assess the sum which in his opinion shall be added to or deducted from the Contract Sum and provide the Contractor with such assessment progressively in accordance with the following time frames:

Table A

Variation (other than variation for structural works (see Table B)) ordered by the CM * (From the notified date for commencement of the Works unless otherwise stated)	Surveyor to provide his assessment to the Contractor (From the notified date for commencement of the Works unless otherwise stated)
Within the first 6 months	Within the 1st to the 9th month
Within the 7th to the 12th month	Within the 7th to the 15th month
Within the 13th to 18th month	Within the 13th to the 21st month
Within the 19th to 24th month	Within the 19th to 27th month
Within the 25th month to the date of completion certified by the CM in the certificate of completion **	Within the 25th month to 9 months after the date of completion certified by the CM in the certificate of completion **
After date of completion certified by the CM in the certificate of completion **	To be agreed by the Surveyor and the Contractor

Table B

Variation for structural works ordered by the CM *	Surveyor to provide his assessment to the Contractor
On or before date of completion certified by the CM in the certificate of completion **	Within 12 months after the date of commencement of the Period of Final Measurement
After date of completion certified by the CM in the certificate of completion **	To be agreed by the Surveyor and the Contractor

* For verbal instruction subsequently confirmed in writing by the CM, the relevant date for the purpose of the time frames is the date on which the CM confirms in writing the verbal instruction and not the date on which the verbal instruction is given to the Contractor.

**In the event that different certificates of completion have been issued for different Sections or parts of the Works, the date of completion shall mean the last date of completion certified amongst the certificates of completion.

Option 2

Pursuant to GCC Clause 11.7(2)(a) and prior to issuing a Surveyor's determination under the Contract relating to the measurement and valuation of a variation ordered by the CM, the Surveyor shall assess the sum which in his opinion shall be added to or deducted from the Contract Sum and provide the Contractor with such assessment progressively in accordance with the following time frames:

Variation ordered by the CM * (from the notified date for commencement of the Works unless otherwise stated)	Surveyor to provide his assessment to the Contractor (from the notified date for commencement of the Works unless otherwise stated)
Within the first 4 months	Within the 1st to the 7th month
Within the 5th to the 8th month	Within the 5th to the 11th month
Within the 9th month to the date of completion certified by the CM in the certificate of completion **	Within the 9th month to 6 months after the date of completion certified by the CM in the certificate of completion **
After date of completion certified by the CM in the certificate of completion **	To be agreed by the Surveyor and the Contractor

* For verbal instruction subsequently confirmed in writing by the CM, the relevant date for the purpose of the time frames is the date on which the CM confirms in writing the verbal instruction and not the date on which the verbal instruction is given to the Contractor.

** In the event that different certificates of completion have been issued for different Sections or parts of the Works, the date of completion shall mean the last date of completion certified amongst the certificates of completion.

PRE.B6.300.9 GCC 14.1 - CONTRACTOR'S INTERIM STATEMENTS

In accordance with GCC Clause 14.1, the list of materials shall be the following:

1. For domestic block:
   a. Bar reinforcement of any diameter;
   b. Precast concrete components and volumetric precast concrete components as specified in Worksections CON7 and CON8 respectively;
   c. Panel wall partition;
   d. Doorset;
   e. Metal door;
   f. Kitchen cupboard / cabinet / cooking bench and sink units;
   g. Window and composite window;
   h. Metal gateset;
   i. Floor and wall tile;
   j. Sanitary fitting.
2. For other building including ……..:
   a. ……;
   b. ……;
   c. ……;
   d. …….
3. For external works:
   a. Drain pipe;
   b. Flexible connector;
   c. Paving block;
   d. Play mat surface;
   e. Play equipment;
   f. Proprietary roof system for covered walkway;
   g. Pavilion and similar element;

h. Ductile iron underground water pipe;

i. Cover for manhole, cable pit and u-channel.

4. For Nominated Sub-contractors' works:

a. All materials for the respective Nominated Sub-contract works.

PRE.B6.310.9 GCC 14.1 - PAYMENT FOR PRE-DETERMINED AMOUNTS FOR SITE SAFETY, ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE

The payment for pre-determined amounts for site safety, environmental management and site hygiene is specified in PRE.B8.2570.

PRE.B6.320.9 GCC 14.2 - INTERIM PAYMENTS, RETENTION MONEY AND INTEREST

1. The percentage of certified value retained and the limit of Retention Money Held in respect of the Contractor are stated in the Appendix to the Form of Tender;
2. In accordance with GCC Clause 14.2(5)(a), the Retention Money Held in respect of the Nominated Sub-contractor shall be released in accordance with the following proportions:

Maintenance Works stage	Portion to be released for each Maintenance Works stage
1	25%
2	25%
3	50%
Total	100%

3. In accordance with GCC Clause 14.2 (5)(b), the Retention Money Held in respect of the Contractor shall be released in accordance with the following proportions:

Maintenance Works stage	Portion to be released for each Maintenance Works stage
1	25%
2	25%
3	50%
Total	100%

PRE.B6.325.9 GCC14.2(1) – INTERIM PAYMENTS (FORMWORK TO CONCRETE WALLS OF DOMESTIC BLOCKS)

1. This clause shall only apply where prefabricated metal panel formwork is designed and procured by the Contractor for the casting of concrete walls of typical floors of domestic block(s);
2. Notwithstanding that interim payments for formwork are generally valued and certified based on the estimated value of work done, the Surveyor shall value and certify in interim payments the initial cost for the design, procurement and delivery to Site of the prefabricated metal panel formwork for each domestic block subject to the following:

a. The Contractor has applied for payment of such initial cost in a statement in accordance with GCC Clause 14.1(1);

b. The Contractor has submitted to the Surveyor proof of the Contractor’s ownership of the prefabricated metal panel formwork for concrete walls of typical floors of the domestic block and payment receipts of the Contractor’s expenditure incurred for the design, procurement and delivery to Site of such prefabricated metal panel formwork;

c. The Surveyor's valuation of the initial cost is to be based on the Contractor's submitted payment receipts and capped at 30% of the total value of the formwork to concrete walls of typical floors of the domestic block (the "Relevant Formwork") measured and priced in the Bills of Quantities;

d. The initial cost is payable to the Contractor after satisfactory completion of the concrete casting and metal panel formwork striking for all the concrete walls of the first typical floor of the domestic block.

3. Where the initial cost is valued and payable as per sub-clause (2) above and for the purpose of interim payments, the remaining value of the Relevant Formwork in the Bills of Quantities (i.e. after deducting the aforesaid initial cost) shall be valued and certified in interim payments based on the progress of work done on Site of the Relevant Formwork.

PRE.B6.350.B GCC 17.1 - AVOIDANCE AND RESOLUTION OF DISPUTES

Option 1

1. The DARA system set forth in GCC Clause 17.1 is for the following purposes:
   a. Foster co-operation among the Employer, the Contractor and the Nominated Sub-contractors and Specialist Sub-contractors who may be engaged for the execution of any part of the Works;
   b. Minimize the volume of claims, disputes and disruptions to the Works;
   c. Ensure the cost-effective and expeditious resolution of disputes.
2. With respect to GCC Clause 17.1(3), engage the DARA in accordance with the following:
   a. Selection of a DARA:

      The Employer and the Contractor shall jointly select a DARA by agreement through a ranking system and procedures as set out in DCMP-A12 of the Master Process Manual of the Housing Department, which may be inspected at the office of the Contract Officer of the Housing Department.

   b. Appointment of the DARA:
      i. Appoint the DARA within 63 days commencing from the award of the Contract;
      ii. If the Employer and the Contractor fail to agree on a suitable DARA within 63 days commencing from the award of the Contract and there is no agreement between the Employer and the Contractor on extending the 63 day period, then the DARA shall be appointed by the Hong Kong International Arbitration Centre upon the written application of either the Employer or the Contractor;
      iii. The Employer and the Contractor shall enter into a written agreement with the DARA which is, inter alia, to give effect to the obligations of the DARA under the Contract;
      iv. The Contractor, by the Nominated Sub-contract conditions, is authorised to appoint the DARA and to execute the DARA Agreement for and on behalf of each of the Nominated Sub-contractors.
   c. Termination of the DARA's services:

      If the DARA resigns from the position, or is discharged by the Employer and / or the Contractor, or is otherwise unable to fulfil his obligations, then for the purposes of GCC Clause 17.1 the Employer and the Contractor shall, unless otherwise agreed, appoint a replacement DARA pursuant to sub-clause (2)(a) above;

   d. Experience and requirements of the DARA:

i. The DARA shall be an individual person possessing general construction experience and knowledge, and dispute resolution skills;

ii. The DARA shall be neutral and independent of the Employer and the Contractor;

iii. The DARA cannot be an employee of the Employer, the Contractor, any Nominated Sub-contractor or any Specialist Sub-contractor, and must not have any actual, potential or perceived conflict of interest with the Employer, the Contractor, any Nominated Sub-contractor or any Specialist Sub-contractor. The DARA shall observe the latest guidelines in DCMP-F761 as referred to in DCMP-A12 ("Rules on Conflict of Interest in DARA Employment") promulgated by the Housing Department from time to time.

e. To facilitate the carrying out of dispute avoidance and dispute resolution duties, the DARA shall take steps which shall include but not be limited to the following:

i. Spend a sufficient amount of time at the beginning of each section of the Works on the Site to become familiar with the relevant personnel, including the CM and his representatives, the Surveyor and his representatives, the liaison from the end-user's administration (where appropriate), and the representatives of the Contractor and some or all of the Nominated Sub-contractors and Specialist Sub-contractors;

ii. Familiarize with the construction, design and programme of each section of the Works, including all plans for the coordination of building services.

Option 2

1. The DARA system set forth in GCC Clause 17.1 is for the following purposes:
   a. Foster co-operation between the Employer and the Contractor;
   b. Minimize the volume of claims, disputes and disruptions to the Works;
   c. Ensure the cost-effective and expeditious resolution of disputes.
2. With respect to GCC Clause 17.1(3), engage the DARA in accordance with the following:
   a. Selection of a DARA:

      The Employer and the Contractor shall jointly select a DARA by agreement through a ranking system and procedures as set out in DCMP-A13 of the Master Process Manual of the Housing Department, which may be inspected at the office of the Contract Officer of the Housing Department;
   b. Appointment of the DARA:
      i. Appoint the DARA within 63 days commencing from the award of the Contract;
      ii. If the Employer and the Contractor fail to agree on a suitable DARA within 63 days commencing from the award of the Contract and there is no agreement between the Employer and the Contractor on extending the 63 days period, then the DARA is to be appointed by the Hong Kong International Arbitration Centre upon the written application of either the Employer or the Contractor;
      iii. The Employer and the Contractor shall enter into a written agreement with the DARA which is, inter alia, to give effect to the obligations of the DARA under the Contract.
   c. Termination of the DARA's services:

If the DARA resigns from the position, or is discharged by the Employer and / or the Contractor, or is otherwise unable to fulfil his obligations, then for the purposes of GCC Clause 17.1 the Employer and the Contractor shall, unless otherwise agreed, appoint a replacement DARA pursuant to sub-clause (2)(a) above.

d. Experience and requirements of the DARA:
   i. The DARA shall be an individual person possessing general construction experience and knowledge, and dispute resolution skills;
   ii. The DARA shall be neutral and independent of the Employer and the Contractor;
   iii. The DARA cannot be an employee of either the Employer or the Contractor and must not have any actual, potential or perceived conflict of interest with the Employer or the Contractor. The DARA shall observe the latest guidelines in DCMP-F761 as referred to in DCMP-A13 ("Rules on Conflict of Interest in DARA Employment") promulgated by the Housing Department from time to time.

e. To facilitate the carrying out of dispute avoidance and dispute resolution duties, the DARA shall take steps which shall include but not be limited to the following:
   i. Spend a sufficient amount of time at the beginning of each section of the Works on the Site to become familiar with the relevant personnel, including the CM and his representatives, the Surveyor and his representatives, the liaison from the end-user's administration (where appropriate), and the representatives of the Contractor;
   ii. Familiarize with the construction, design and programme of each section of the Works.

PRE.B6.370.9 GCC 20.2(4) SCHEDULE OF PROPORTIONS

1. The "Schedule of Proportions" to be used in calculating the "Price Fluctuation Factor" is included at Schedule I to the Form of Tender;
2. The list of items of labour and selected materials included in the "Schedule of Proportions" is pre-determined and shall not be changed during the currency of the Contract;
3. The "Schedule of Proportions" shall be completed in accordance with the instructions contained in the Schedule I;
4. The "Price Fluctuation Factor" for each payment certificate shall be calculated by the Surveyor. The following applies to such calculations:
   a. The figure of 0.1500 given in the column (4) of the "Schedule of Proportions" represents 15% of the "Effective Value" that will not be subject to fluctuation adjustment. The figure of 0.1500 will therefore not be used in the calculation of the "Price Fluctuation Factor";
   b. The products obtained by multiplying each of the calculated proportions given in column (4) of the "Schedule of Proportions" by the (index) fractions shall be to eight decimal places. Decimal places in excess of eight shall be rounded up or down to the nearest eighth decimal place;
   c. The final calculated "Price Fluctuation Factor" shall be to six decimal places. Decimal places in excess of six shall be rounded up or down to the nearest sixth decimal place.

SPECIAL CONDITIONS OF CONTRACT

PRE.B6.500.A STATUS

The information given in clauses PRE.B6.515 to PRE.B6.850 is to be read in conjunction with the Special Conditions of Contract and is to form part of the Contract.

PRE.B6.515.9 SCC5.13 - CARE OF THE WORKS INSURANCE

The list of insurers approved by the Employer will be the List of Authorized Insurers published by the Insurance Authority. Any insurer not on this list or not authorized by the Insurance Authority will not be approved. The Insurer must provide together with the insurance policy a covering letter undertaking to inform the Employer of any cessation of the insurance policy due to any reason whatsoever. No insurance policy shall be approved without such a covering letter. In the event that a Direct Contractor submits a claim under the insurance policies required to be maintained by the Contractor under SCC Clause SCC5.13 for any loss or damage from whatsoever cause arising, other than the "excepted risks", he will be entitled to be reimbursed the amount paid to the Contractor by the insurer for that claim. The Direct Contractor will also be entitled to be reimbursed from the Contractor 30% of the amount of any policy excesses deducted.

PRE.B6.520.9 SCC5.4 / SCC5.14 - DESIGN RESPONSIBILITY (ADJUSTMENT)

The Contractor shall design and be responsible for the design of the following part(s) of the Works:

1. Piling;
2. Pilecaps;
3. Shallow foundations including footings raft;
4. .....

The Contractor shall design and be responsible for the design of the following part(s) of the Works:

1. .....;
2. .....

PRE.B6.550.9 SCC6.1 - PAYMENT OF WAGES OF SITE PERSONNEL

1. Labour Relations Officer (LRO):
   a. One LRO shall be authorized by the Employer and notified to the Contractor by the CM to work on Site. The LRO shall be responsible to the CM and accommodated in the office of the CM's representatives. After the date of certified completion of the Works, the LRO may be accommodated and work at locations outside the Site as notified by the CM;
   b. The duties and responsibilities of the LRO shall include but not necessarily be limited to the following:
      i. Check and verify the proper operation of the ACRS;
      ii. Conduct checking of the records as required in PRE.B8.1450;
      iii. Prepare and submit directly to the CM a monthly report on the payment of the wages and MPF contribution, and the daily records of ACRS based on the wage books prepared by the Contractor;
      iv. Conduct random inspection on Site to verify the identity of the Site Personnel and to promote effective communication with the Site Personnel;
      v. Be responsible for receiving complaints from the Site Personnel on any matters relating to the payment of wages and other employment conditions;
      vi. Check the validity of the complaints based on the compiled records;

vii. Provide all necessary assistance to the Site Personnel for referring the complaint cases to the Labour Department if necessary and work in collaboration with the Labour Department to investigate and verify the validity of the complaints;

viii. Inform the CM of anomalies and to refer the same to the Contractor for investigation and appropriate follow-up actions;

ix. Witness the surveys of Site Personnel on behalf of the CM pursuant to sub-clause 2(d) below.

c. Provide all necessary facilities including direct telephone lines, office accommodation and furniture for the use of LRO working on Site to carry out his/her duties;

d. Provide all necessary assistance to the LRO for carrying out his/her duties on Site.

2. Comply with the following for monitoring the payment of wages and Mandatory Provident Fund (MPF) contribution to Site Personnel:

a. Employment contract:

i. Keep a copy of the complete set of the executed employment contracts of all Site Personnel in the wage books as required in PRE.B8.1450. Each copy of the executed employment contracts together with an updated register of the employment contracts shall be kept in the wage books within two days from the date that the Site Personnel commences to work on Site;

ii. Deliver the original executed employment contracts of any Site Personnel to the office of the CM's representatives for inspection by the CM within one day when requested by the CM;

iii. Seek written approval from the CM before a Site Personnel without an executed employment contract executes any work on the Site;

iv. The terms of the employment contract shall not be less favourable to the terms provided in the "Specimen Employment Contract" in the latest "Guidelines on Wage Payment Monitoring and Reimbursement of Contractor's and Sub-contractors' Contributions to the Mandatory Provident Fund for their Site Personnel" published by Development Bureau of HKSAR from time to time.

b. Wage payment and mandatory provident fund ("MPF") arrangement for Site Personnel:

i. Ensure that sufficient funds have been reserved in the designated bank account for the payment of all wages and MPF contribution to all Site Personnel employed or engaged by the Contractor. Instruct promptly the designated bank to effect the timely payment to the respective wage payment accounts, employee MPF contribution accounts and the employer MPF contribution accounts of all Site Personnel employed or engaged by the Contractor according to the schedule as prepared in sub-clause (c)(ii);

ii. Ensure that sub-contractors of all tiers have sufficient funds available in the designated bank accounts for the payment of all wages and MPF contribution to all Site Personnel employed or engaged by them. Also ensure that sub-contractors of all tiers shall promptly instruct the designated banks to effect the timely payment to the respective wage payment accounts, employee MPF contribution accounts and the employer MPF contribution accounts of all Site Personnel employed or engaged by them according to the schedule as prepared in sub-clause (c)(ii);

iii. Pay, and require the sub-contractors of all tiers to pay the wages to all the Site Personnel by bank's autopay service and make the MPF contribution as stipulated in sub-clause (c);

iv. Require each of the Site Personnel to provide a bank account and an employee MPF contribution account via which wage payment will be paid by bank's autopay service.

c. Wage payment and MPF contribution records:

i. Within 14 days from the notified date for commencement of the Works, submit to the CM the name of the designated bank and all related arrangement details for the payment of wages and MPF contribution to all the Site Personnel;

ii. Prepare schedules of wages and the corresponding MPF contribution of all the Site Personnel employed or engaged by the Contractor based on the verified daily record as required in PRE.B8.2610. Keep a copy of such schedules in the wage books as required in PRE.B8.1450 within 14 days from the end of the corresponding wages period;

iii. Require the sub-contractors of all tiers to prepare the respective schedules of wages and the corresponding MPF contribution of all the Site Personnel employed or engaged by them based on the verified data from the ACRS as required in PRE.B8.2610. Keep a copy of such schedules in the wage books as required in PRE.B8.1450 within 14 days from the end of the corresponding wages period;

iv. Keep a copy of the records of transactions in the wage books as required in PRE.B8.1450 within 21 days from the end of the corresponding wages period;

v. Submit and require sub-contractors of all tiers to submit to the CM for each worker's payment cycle a written declaration that all wages of the Site Personnel have been paid and all MPF contribution have been made. For the records of payment of wages and MPF contribution of the Site Personnel in the managerial grade as stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time, it is optional to keep them in the wage books as required in PRE.B8.1450 provided that they are directly employed by the Contractor and the CM has no objection to this arrangement.

d. Wage payment status survey:

Assign designated staff (not less than 2 persons and one of them shall be at Site Foreman grade or above) to conduct surveys with Site Personnel on Site under the witness of the LRO for checking their status of wage payment at least at monthly interval commencing from the second month from the notified date for commencement of the Works up to and including the month in which the maintenance certificate or where applicable the last partial maintenance certificate (whichever is the latest) is issued, or up to an earlier date as otherwise agreed by the CM. For Contracts with more than one Portion of the Site, the survey on each Portion of the Site shall be conducted at least at monthly interval commencing from the second month from the commencement of the works of that particular Portion of the Site up to and including the month in which the maintenance certificate or where applicable the last partial maintenance certificate (whichever is the latest) is issued or up to an earlier date as otherwise agreed by the CM. The number of Site Personnel to be surveyed in each month shall not be less than the percentage agreed with the CM of the total number of Site Personnel who have or had worked on Site without exemption of wage payment record submission, irrespective of duration, for the monthly period preceding the date of commencement of the survey, or otherwise a smaller number if agreed by the CM. The outcome of these surveys shall be submitted to the CM and LRO for record no later than 1 week from the first day of each monthly survey exercise. Prior agreement on detailed arrangement of the surveys is required from the CM.

d. Wage payment status survey:

Assign designated staff (not less than 2 persons and one of them shall be at Site Foreman grade or above) to conduct surveys with Site Personnel on Site under the witness of the LRO for checking their status of wage payment at least at monthly interval commencing from the second month from the notified date for commencement of the Works up to and including the month in which the operation of ACRS is terminated as stipulated in PRE.B8.2660. For Contracts with more than one Portion of the Site, the survey on each Portion of the Site shall be conducted at least at monthly interval commencing from the second month from the commencement of the works of that particular Portion of the Site up to and including the month in which the operation of ACRS is terminated as stipulated in PRE.B8.2660. The number of Site Personnel to be surveyed in each month shall not be less than the percentage agreed with the CM of the total number of Site Personnel who have or had worked on Site without exemption of wage payment record submission, irrespective of duration, for the monthly period preceding the date of commencement of the survey, or otherwise a smaller number if agreed by the CM. The outcome of these surveys shall be submitted to the CM and LRO for record no later than 1 week from the first day of each monthly survey exercise. Prior agreement on detailed arrangement of the surveys is required from the CM.

3. Provide all necessary assistance in the handling of complaints on arrears of wages raised by all Site Personnel:

   a. Provide site office telephone lines or other off-Site contact telephone lines installed with voice mail system solely for receiving workers' enquiries or complaints about wages arrears and provide the telephone numbers to the LRO;

   b. Assign designated staff (not less than 2 persons) to receive the calls. Record workers' enquiries or complaints and report the same to the CM, LRO and other relevant parties as instructed by the CM;

   c. Display the posters provided by the LRO at workstations for reminding workers about the hotlines for enquiring or complaining arrears of workers' wages;

   d. Display notices on Site at prominent locations notifying the Site Personnel to seek assistance from the LRO on matters concerning wages arrears and disputes, and showing the contact details of the LRO;

e. Assign a designated staff to respond to issues raised by the LRO in connection with the discharge of his duties;

f. Provide to a Site Personnel free of charge a copy of his daily attendance records whenever his written request for same is received. The daily attendance records shall be verified by the Contractor or employer of the Site Personnel;

g. Address immediately the enquiries and/or complaints lodged by Site Personnel to the Contractor, the CM or LRO and reply to them the outcome or the follow-up actions taken or to be taken within two days upon receipt of the enquiries and/or complaints.

4. The requirements stipulated in sub-clauses (2) and (3) above may be exempted subject to the compliance with all relevant criteria and procedures stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time or as Approved by the CM on individual case basis.

PRE.B6.580.9 SCC7.2 - STRUCTURAL WARRANTY

Pursuant to Clause SCC7.2, structural warranty is required for the following Building Structures:

1. ……
2. ……

PRE.B6.590.9 SCC7.2 / SCC7.3 - WARRANTY AND DEED OF WARRANTY (ROOFING INSTALLATION, REFUGE FLOOR INSTALLATION AND / OR OTHER WATERPROOFING SYSTEM INSTALLATION) #

Option 1

Pursuant to Clause SCC7.3, warrant the Waterproofing System Installation in the following areas:

1. Kitchens;
2. Bathrooms, toilets, lavatories;
3. Refuse storage and material recovery rooms;
4. Lift pits;
5. External tankings;
6. …….

Option 2

Pursuant to Clause SCC7.3, warrant the Waterproofing System Installation to the following areas:

1. External tankings of basement;
2. …….;
3. ……..

Option 3

Pursuant to Clause SCC7.2, warrant the Waterproofing System Installation to the following areas:

1. External tankings;
2. …….;
3. ……..

PRE.B6.600.9 SCC8.1 - POSSESSION OF THE SITE (FIXED RATE FOR DELAY)

The specified rate inserted by the Contractor related to SCC8.1 of the Special Conditions of Contract is deemed to have included any costs and expenditure incurred by the Contractor as a result of delay in giving possession of Portions of the Site and such costs and expenditure shall include, inter alia, the cost of any prolonged obligations on the part of the Contractor under the Contract including any prolonged maintenance, protection and insurance etc of the completed parts of the Works; any uneconomical use of labour, plant and materials; disruption to progress of the Works; and fluctuations in the cost of labour and materials for the remaining works.

PRE.B6.610.9 SCC8.3 - ADDITIONAL LIQUIDATED DAMAGES FOR DELAY

1. In accordance with SCC8.3(1) the Specified Section(s) and the respective relevant Section(s) is / are:

Specified Section(s)		relevant Section(s)
a.	Section ……....	Section ……....
b.	Section ……....	Section ……....

2. In accordance with SCC8.3(1) the rate per day for Additional Liquidated Damages (ALD) shall be as follows:

relevant Section	ALD rate* ($ per day)	ALD rate** ($ per day)
Section	(Insert rate)	Insert rate
Section	(Insert rate)	Insert rate

* ALD rate in brackets applies to the period up to the date 90 days from the prescribed date for completion or any extension thereof of the relevant Section with SSF domestic blocks.

**ALD rate not in brackets is either for the relevant Section with rental buildings, or applies to the period beyond the date 90 days from the prescribed date for completion or any extension thereof of the relevant Section with SSF domestic blocks.

PRE.B6.612.9 *SCC8.3 / SCC8.5 / SCC8.7 - USE OF THE SITE BY POLICE AND OTHER DISCIPLINED SERVICES

1. When Instructed, allow the Hong Kong Police Force or other disciplined services of the Government to use part(s) or area(s) of the Site (where demolition works are to be carried out by the Contractor) for the purpose of training(s) for a period not more than five days or for periods not more than five days in total provided that such training(s) shall be carried out within one month of the Contractor's taking possession of such part(s) or area(s) of the Site;
2. Such training(s) will include but not be limited to tactical movement through the building block(s) and the use of mechanical breaking equipment and methods to practise entry and operational techniques;
3. Immediately upon receiving the CM's written instruction, liaise and coordinate with the representatives of the Hong Kong Police Force or such other disciplined services regarding such training(s) and, taking into account the planning and progress of the Works, determine the part(s) or area(s) of the Site where there is no likelihood of asbestos containing materials being disturbed, affected or exposed and the period(s) of time in accordance with sub-clause (1) above for such training(s);

4. Provide all necessary assistance and support as requested by the Hong Kong Police Force or such other disciplined services of the Government in connection with such training(s);
5. Should the CM issue a written instruction in respect of use of the Site for such training(s) and the Site or any part(s) or area(s) thereof be used for such training(s) by the Hong Kong Police Force or other disciplined services of the Government, the Contractor shall be paid in accordance with the tendered daily rate set out in the Contract (which rate shall be deemed to be inclusive of all costs of the Contractor in fulfilling all his obligations and the requirements under the Contract for the provision or use of the Site or any part(s) or area(s) thereof in connection with or in respect of such training(s)) and the Contractor shall be deemed to have made sufficient pricing and allowance in terms of both costs and time in the said tendered daily rate and the programme of the Works respectively.

PRE.B6.620.9 SCC8.3 - TAKING CARE OF THE WORKS AFTER COMPLETION

In accordance with Clause SCC8.3 and where instructed by the CM, execute the following works and/or provide the following services for the purpose of the taking care of the Works after completion:

1. The Site Security Services which shall include, in respect of the parts of the Works and the Site specified in CM's instruction (hereinafter referred to as the Property), the following:
   a. Take full responsibility for the care of the Property. In case of any damage, loss or any injury from any cause whatsoever, except the "excepted risks" as defined in GCC Clause 5.12, the Contractor shall at his own expense and with all possible speed make good or at the option of the Employer shall pay to the Employer the cost of making good any damage to the Property;
   b. Indemnify and keep indemnified the Employer against all losses and claims for injury or damage to any person including any employee of the Employer or property including the Property or any other property of the Employer whatsoever which may arise from any incident occurring on, in, or arising from the Property;
   c. Take out and maintain an insurance policy with an insurer approved by the Employer to cover the risks described in sub-clause (1)(b) above. The insurance shall be in the joint names of the Contractor and the Employer and shall contain a Cross-Liability clause as between the Contractor and the Employer;
   d. Take all legally valid available means of preventing trespassers entering the Site;
   e. Supply, on Site at all times, at least one security guard;
   f. Operate (including provision of electricity supply), at any time whenever it is dark, lighting associated with walkways, hoardings, and accesses;
   g. Keep the Site closed with all accesses locked;
   h. Do not permit visitors to enter the Site unless approved by the CM.

   For each day of the Site Security Services Period, the Contractor shall be paid at the respective tendered daily rates included in the Contract in respect of the Works and the Site or part thereof as appropriate. Such payments shall be included in the statement to be delivered under GCC Clause 14.1 and certified under GCC Clause 14.2.

PRE.B6.625.9 SCC8.4 - TAKING CARE OF THE WORKS AFTER COMPLETION

In accordance with Clause SCC8.4 and where instructed by the CM, execute the following works and/or provide the following services for the purpose of the taking care of the Works after completion:

1. The Site Security Services which shall include, in respect of the parts of the Works and the Site specified in CM's instruction (hereinafter referred to as the Property), the following:
   a. Take full responsibility for the care of the Property. In case of any damage, loss or any injury from any cause whatsoever, except the "excepted risks" as defined in GCC Clause 5.12, the Contractor shall at his own expense and with all possible speed make good or at the option of the Employer shall pay to the Employer the cost of making good any damage to the Property;
   b. Indemnify and keep indemnified the Employer against all losses and claims for injury or damage to any person including any employee of the Employer or property including the Property or any other property of the Employer whatsoever which may arise from any incident occurring on, in, or arising from the Property;
   c. Take out and maintain an insurance policy with an insurer approved by the Employer to cover the risks described in sub-clause (1)(b) above. The insurance shall be in the joint names of the Contractor and the Employer and shall contain a Cross-Liability clause as between the Contractor and the Employer;
   d. Take all legally valid available means of preventing trespassers entering the Site;
   e. Supply, on Site at all times, at least one security guard;
   f. Operate (including provision of electricity supply), at any time whenever it is dark, lighting associated with walkways, hoardings, and accesses;
   g. Keep the Site closed with all accesses locked;
   h. Do not permit visitors to enter the Site unless approved by the CM.

   For each day of the Site Security Services Period, the Contractor shall be paid at the respective tendered daily rates included in the Contract in respect of the Works and the Site or part thereof as appropriate. Such payments shall be included in the statement to be delivered under GCC Clause 14.1 and certified under GCC Clause 14.2.

PRE.B6.640.9 SCC8.4 - SECOND LIQUIDATED DAMAGES FOR DELAY (SSF)

1. In accordance with SCC8.4(1) the rate per day for Second Liquidated Damages (Second LD) shall be as follows:

Section	Second LD rate ($ per day)
Section 1 (i.e. *SSF* block)	(insert rate)
Section 2 (i.e. Rental)	Nil
(Include all other Sections)	(as appropriate)
Total Second LD rate for the Works	(insert total)

1. In accordance with SCC8.4(1) the rate per day for Second Liquidated Damages (Second LD) shall be as follows:

The Works	Second LD rate ($ per day)
(*SSF* part - Insert description)	(insert rate)
Remainder of the Works	Nil
Total Second LD rate for the Works	(insert total)

1. In accordance with SCC8.4(1) the rate per day for Second Liquidated Damages (Second LD) shall be as follows:

Section	Part of the Section	Second LD rate ($ per day)	Total Second LD rate ($ per day)
Section 1 (*SSF*)	(*SSF* part - Insert description)	(insert rate)	(insert total for Section 1)
	Remainder of the Section	Nil	
Section 2 (Rental)	------	Nil	Nil
(Include all other Sections)		(as appropriate)	(as appropriate)
Total Second LD rate for the Works			(insert total)

PRE.B6.650.9 SCC8.5 - TAKING CARE OF THE WORKS AFTER COMPLETION

In accordance with Clause SCC8.5 and where instructed by the CM, execute the following works and / or provide the following services for the purpose of the taking care of the Works after completion:

1. The Site Security Services which shall include, in respect of the parts of the Works and the Site specified in CM's instruction (hereinafter referred to as the Property), the following:
   a. Take full responsibility for the care of the Property. In case of any damage, loss or any injury from any cause whatsoever, except the "excepted risks" as defined in GCC Clause 5.12, the Contractor shall at his own expense and with all possible speed make good or at the option of the Employer shall pay to the Employer the cost of making good any damage to the Property;
   b. Indemnify and keep indemnified the Employer against all losses and claims for injury or damage to any person including any employee of the Employer or property including the Property or any other property of the Employer whatsoever which may arise from any incident occurring on, in, or arising from the Property;
   c. Take out and maintain an insurance policy with an insurer approved by the Employer to cover the risks described in sub-clause (1)(b) above. The insurance shall be in the joint names of the Contractor and the Employer and shall contain a Cross-Liability clause as between the Contractor and the Employer;
   d. Take all legally valid available means of preventing trespassers entering the Site;
   e. Supply, on Site at all times, at least one security guard;
   f. Operate (including provision of electricity supply), at any time whenever it is dark, lighting associated with walkways, hoardings, and accesses;
   g. Keep the Site closed with all accesses locked;
   h. Do not permit visitors to enter the Site unless approved by the CM.

   For each day of the Site Security Services Period, the Contractor shall be paid at the respective tendered daily rates included in the Contract in respect of the Works and the Site or part thereof as appropriate. Such payments including any fluctuation adjustment shall be included in the statement to be delivered under GCC Clause 14.1 and certified under GCC Clause 14.2.
2. The maintenance of the protections to lifts and G/F lift lobbies which shall include the following:

a. Maintain the plywood protective linings to the frames and architraves of lift openings on each and every floor, to the internal walls, floors and ceilings of lift cars, and to the walls and floors of the lift lobbies on ground floor, including repairs and replacement, to the satisfaction of the CM, and keep the same in good working condition;

b. Dismantle, remove and clear away the whole protective linings, including cleaning and making good of the protected works to the satisfaction of the CM, on the date before the issue of Maintenance Certificate and as determined by an instruction from the CM.

Alternatively, the CM shall have the option to instruct the Contractor, prior to the issue of the Maintenance Certificate, to pass the property in the plywood protective linings to the Employer on the date as determined by an instruction, in which case the Contractor is not required to dismantle, remove or clear away the same;

c. For each day of the maintenance of the said protective lining, the Contractor shall be paid at the tendered daily rate which rate shall include any repair and replacement where necessary to keep the same in good working conditions. Furthermore, the Contractor shall be paid the respective tendered amount either for the dismantling and removal of the protective lining, or for the Employer to take over the same, as the case may be. Such payments including any fluctuation adjustment shall be included in the statement to be delivered under GCC Clause 14.1 and certified under GCC Clause 14.2.

3. When Instructed by the CM during the 6-month period from the date of occupation of a domestic block or a part of a domestic block (i.e. the date of the occupation permit (OP) in respect of a domestic block, or the temporary occupation permit (TOP) in respect of that part of a domestic block issued by ICU under PRE.B4.085), adjust the level of cooking bench to one of the fixing levels for stainless steel supporting frames for occupied domestic flats as follows:

a. On the date of appointment as requested by tenants and arranged by the CM for carrying out the level adjustment work, liaise with the Intake Ambassador who shall coordinate with the tenants for access to their flats for the works;

b. With the presence of tenants, carry out the adjustment of level of the polymer resin cooking bench to one of the fixing levels for stainless steel supporting frame as requested by the tenants and instructed by the CM;

c. Ensure that the existing equipotential bonding connection for stainless steel supporting frames of cooking bench remains intact and connected;

d. In the event of disconnected equipotential bonding, employ a registered electrical contractor to reinstate the equipotential bonding connection for stainless steel supporting frames of cooking bench according to the requirement of the CoP for the Electricity (Wiring) Regulation and a completion certification (WR1) shall be submitted to the CM for record;

e. Seal joints between cooking bench and wall and between cooking bench and supporting leg for sink unit with silicon sealant; make good, restore or reinstate any finishes that are damaged, disturbed or affected to their prior conditions;

f. In the event that the tenants have failed to keep their appointment for the level adjustment work, notify the Intake Ambassador and carry out the adjustment work at other time to be arranged and informed by the Intake Ambassador. Allow for maximum three repeated visits to occupied flats to complete the level adjustment work and bear all associated costs.

4. When Instructed by the CM within a period of 13 months commencing from the date of occupation permit (OP), or temporary occupation permit (TOP) as the case may be, in respect of the domestic blocks issued by ICU under PRE.B4.085, carry out 15-minute flushing for the sink mixer installed at kitchen of designated individual domestic flats as follows:

a. With a minimum of one day advance notice of the CM (after having coordinated with the estate management of the public rental estate or the management agency of the subsidized sale flats development before the individual prospective tenants / flat owners complete the intake formalities), complete the 15-minute flushing for the sink mixer installed at kitchen of the designated domestic flats according to the following steps:
   i. Remove the strainer / aerator installed at sink mixer;
   ii. Flush the sink mixer with the strainer / aerator removed for 15 minutes;
   iii. Thoroughly cleanse the strainer / aerator removed from the sink mixer and flush clean water through the same to remove any accumulated substances that may be present;
   iv. Reinstall the strainer / aerator after the cleansing and flushing.

b. Record the water meter readings before and after the 15-minute flushing of sink mixer for the designated flat using a prescribed format at PRE.B6.APPEND4. Certify and submit the record for CM's retention;

c. Allow sufficient workers for carrying out the 15-minute flushing of sink mixers as per sub-clauses (4)(a) and (4)(b) above, which shall be completed on time before the individual tenants / flat owners carry out flat inspection during the intake process in accordance with the programme of the estate management of the public rental estate or the management agency of the subsidized sale flats development.

PRE.B6.660.9 SCC8.6 - EXTENSION OF TIME FOR COMPLETION

Refer to the Appendix to the Form of Tender for Sections of the Works which are subject to Extensions of Time for Inclement Weather.

PRE.B6.680.9 SCC9.1 - WORKS SUBJECT TO EXCISION

Option 1

1. The following Sections of the Works are "Works Subject to Excision":
   a. Primary School. The written instruction to proceed pertaining to the Section shall be given within ..... months from the notified date for commencement of the Works;
   b. .....
2. In the event of any work being excised in respect of this clause there will not be any adjustment to the prices in Bill No. 1 – Preliminaries.

Option 2

1. The following parts of the Works are "Works Subject to Excision":
   a. Primary School. The written instruction to proceed pertaining to such parts shall be given within ..... months from the notified date for commencement of the Works;
   b. .....
2. In accordance with Clause SCC9.1 the following adjustment shall apply. In the event of the "Works Subject to Excision" being excised in respect of this clause, the prices of Preliminaries shall be reduced and adjusted in the calculation of the Final Contract Sum and the payment of Preliminaries will duly reflect the adjustment as follows:

   ……
   ……
   ……
   ……

PRE.B6.700.9 SCC11.2 / SCC11.3 / SCC11.4 - SCHEDULE OF RATES (FOR PART OF THE WORKS)

Schedule of Rates for the following part(s) of the Works are provided in the Contract:

1. .....;
2. .....

PRE.B6.720.9 SCC14.1 - SPECIALIST SUB-CONTRACTOR

1. In accordance with GCC Clause 3.2(6), the following part(s) of the Works are to be executed by Specialist Sub-contractors selected by the Contractor from the relevant list given or referred to in the Specification:
   a. .....
   b. .....
2. In accordance with Clause SCC14.1(7)(b), the limit of the total amount of retention monies held for the following Specialist Sub-contract is:

	Limit of Retention Money (HK$)
a.	.....
b.	.....

PRE.B6.730.A SCC14.2 / SCC14.5* – SECURITY OF PAYMENT

In respect of the Construction Industry Security of Payment Ordinance (Cap. 652) (the "SOP Ordinance"), the following provisions shall apply to the Contract as part of the Specification:

1. The adjudication documents and / or other documents (other than a payment claim) relating to the SOP Ordinance's implementation which have to be served by the Contractor on the Employer shall be served to an officer representing the Employer as advised by the CM in writing no later than the initial contract meeting for the Contract. Such documents shall be served by leaving them at, or sending them by registered post to the officer's normal place of business as advised by the CM on the same occasion, or by hand to the officer in person, except otherwise specified in section 68 of the SOP Ordinance. Where the Contractor serves such documents on the Employer, he shall also serve a copy of the same on the CM and the Surveyor on the same day on which it is served on the Employer in a manner to be notified to the Contractor in the initial contract meeting for the Contract. On the other hand, the Contractor shall advise the CM and the Surveyor no later than the initial contract meeting for the Contract the superintendent designated for receiving the adjudication documents and / or other documents relating to the SOP Ordinance on behalf of the Contractor as well as his normal place of business for delivery or posting purpose;
2. A payment claim to be served by the Contractor on the Employer under the SOP Ordinance shall be served to the officer as advised by the CM under sub-clause (1) above, with a copy to the Surveyor served on the same day, in the same manner as specified in sub-clause (1) above;
3. Where the Contractor wishes to exercise his rights to delay work or supply of the Contract under the SOP Ordinance, he shall state his intended starting date of such delay in the notice of intention to be served to the Employer in addition to other details as required by the SOP Ordinance;
4. For any sub-contractor of any tier of sub-contracting who may wish to exercise his rights to delay work or supply for his sub-contract under the SOP Ordinance, the Contractor shall sustain effective communication channels to the CM's satisfaction by which the sub-contractor can notify:
   a. The Employer (as the owner of the Site), through the CM's representative as advised by the CM in writing no later than the initial contract meeting for the Contract;

b. The Contractor, through a designated superintendent as his representative; about the sub-contractor's imminent exercise of such rights within the time limit prescribed by the SOP Ordinance. In this regard, the Contractor shall ensure that each of his sub-contractors, irrespective of tiers, acknowledges the above communication channels in the first month of his execution of sub-contract works on Site or supply of goods and services to the Contract. The Contractor shall also collect relevant data about the status of any adjudication proceedings of his sub-contractors at all tiers for reporting to the CM at monthly site meetings in a format to be agreed with the CM.

PRE.B6.735.N SCC14.3 – PAYMENTS BY ELECTRONIC METHOD

1. The Contractor shall select from one of the following electronic payment methods and notify the Contract Manager within 14 days of the date of the Letter of Acceptance in accordance with Clause SCC14.3(2) of the Special Conditions of Contract:
   a. bank transfer into the designated bank account;
   b. telegraphic transfer into the designated bank account; or
   c. payment through the Faster Payment System (FPS) proxy,

   provided that for an overseas Contractor without any bank account or FPS proxy in Hong Kong, the Contractor shall always select the electronic payment method prescribed in item (b) above;

2. Depending on the method selected under sub-clause (1) above, the Contractor shall provide the details of the designated bank account (if the method prescribed in sub-clause (1)(a) or (1)(b) above is selected) or the details of the FPS proxy (if the method prescribed in sub-clause (1)(c) above is selected) by filling in all required details in the prevailing form of "Authority for Payment to the Bank" (i.e. "Annex 5b", a sample of which is attached in Appendix PRE.B6/VI for reference only), and shall submit the duly completed "Annex 5b" together with all supporting documents as required in "Annex 5b" within 14 days of the date of the Letter of Acceptance in accordance with Clause SCC14.3(2) of the Special Conditions of Contract. A copy of the prevailing "Annex 5b" will be enclosed with the Letter of Acceptance for the Contractor's return;

3. The Employer shall not be held responsible or liable for any delay in payment of any sums due or payable under the Contract or in respect of the Works if such delay is caused by or arises from any failure (in whatever way) of bank transfer or telegraphic transfer of payment into the designated bank account, or of the FPS proxy (as the case may be) for whatever reason, including any default of the Contractor or any third party (save and except for any fault on the part of the Employer), and no claims for any interest, charges or damages (in whatever description or form) shall be entitled by the Contractor for any late payment caused by or arising from any such failure or default;

4. In the event of any payment(s) to be made into a designated bank account or through the FPS proxy, whether under Clause SCC14.3 of the Special Conditions of Contract or otherwise or whether the designated bank account or the FPS proxy is in Hong Kong or overseas, any charges, fees or sums imposed for such payment(s) by any bank(s) or stored value facility operator(s), including but not limited to the Contractor's bank(s), the Employer's bank(s) and any other bank(s) which process, make or deal with (in whatever way) such payment(s) or transfer(s), shall all be borne by the Contractor. Regardless of the applicable payment method, any charges, fees or sums imposed by a bank or a stored value facility operator in Hong Kong or an

overseas bank for refusing or rejecting any payment even when the payment is made in accordance with the payment instruction provided by the Contractor in "Annex 5b" or for carrying out any special request(s) by the Contractor shall also be borne by the Contractor. In the circumstances where any charges, fees or sums shall be borne by the Contractor under the foregoing provisions, the Contractor shall reimburse the Employer for the same immediately upon the Employer having settled such charges, fees or sums (as the case may be) with the bank or the stored value facility operator. Without prejudice to the Employer's entitlement to immediate reimbursement from the Contractor as aforesaid, the Employer may, in addition thereto, set off any amounts payable under the Contract against such charges, fees or sums (as the case may be), and the Contractor hereby agrees and confirms that the Employer shall be entitled to such right of set-off;

5. To avoid any unnecessary delay in payment or any charges, fees or sums imposed by banks or otherwise as stated in sub-clause (4) above, the Contractor shall pay extra care to find out the transaction and stored value limits for receiving payment via FPS from its own bank or stored value facility operator before selecting and notifying the Employer of the electronic payment method selected in accordance with Clause SCC14.3 of the Special Conditions of Contract;

6. Where any change(s) are to be made to the payment instruction provided by the Contractor in "Annex 5b", the Contractor shall obtain a copy of prevailing "Annex 5b" from the Contract Manager as soon as possible and shall serve at least one month's written notice on the Contract Manager before such changes shall take effect, and shall, at the time of the service of the said notice, resubmit to the Contract Manager a revised duly completed "Annex 5b" with all relevant details, including such change(s), provided therein together with the relevant supporting documents as mentioned in sub-clause (2) above. Where the Contractor has failed to comply with the foregoing provisions, the Employer shall be entitled to make payment according to the payment instruction set out in the "Annex 5b" as previously provided by the Contractor in accordance with Clause SCC14.3(2) of the Special Conditions of Contract and sub-clause (2) above until any change(s) to the payment instruction has/have been made and taken effect as aforesaid, and the Employer shall not be liable for any delay in payment, or any charges, fees, sums or damages (in whatever form) arising from refusal of any bank or stored value facility operator or any third party to accept payment made by the Employer to the Contractor as a result of the Contractor's failure to comply with this sub-clause (6) including but not limited to any late notification of changes to the payment instruction, submission of an incomplete "Annex 5b" and failure to provide relevant supporting documents required;

7. For the purpose of this clause:
   a. "designated bank account" means the bank account the details of which shall be provided by the Contractor in accordance with Clause SCC14.3(2) of the Special Conditions of Contract and sub-clause (2) above;
   b. "Faster Payment System" or "FPS" means the Faster Payment System operated by the Hong Kong Interbank Clearing Limited;
   c. "FPS proxy" means the Hong Kong Identity Card number or FPS identifier registered with the FPS and linked with a bank or a stored value facility to be provided by the Contractor in accordance with Clause SCC14.3(2) of the Special Conditions of Contract and sub-clause (2) above for receiving payment via FPS;
   d. "stored value facility" has the meaning as set out in section 2A of the Payment Systems and Stored Value Facilities Ordinance (Cap. 584).

PRE.B6.750.A SCC20.1 - CONTRACT PRICE FLUCTUATIONS

1. The increases or decreases in the sums payable in an interim or final payment certificate pursuant to GCC Clause 20.2 shall be the net total of the material fluctuations (F) calculated from the following formula:

$$F = MCf \times EVf \times \frac{CIf - BIf}{BIf} + MCr \times EVr \times \frac{CIr - BIr}{BIr} + MCs \times EVs \times \frac{CIs - BIs}{BIs}$$

2. The definitions for the variables of the formula specified in sub-clause (1) above are stipulated in the following sub-clauses (3) to (18);
3. MCf represents the percentage of "Material Content of Diesel Fuel", which shall be ……;
4. MCr represents the percentage of "Material Content of Steel Reinforcement", which shall be 70%;
5. MCs represents the percentage of "Material Content of Steel H-piles", which shall be 80%;
6. EVf represents "Effective Value of Diesel Fuel in respect of the Whole or any Section of the Works", which shall be the difference between the sums specified in sub-clauses (6)(a) and (6)(b):
   a. The sum, exclusive of any increases or decreases made in accordance with this clause, as computed for the items in the Schedule of Effective Items for Fluctuation Adjustments in respect of Diesel Fuel as given in sub-clause (19), which in the opinion of the Surveyor is due to the Contractor under GCC Clause 14.2, before deducting retention and before deducting previous payments on account, less all sums for piling work items based on actual cost or current prices;
   b. The sum calculated in accordance with sub-clause (6)(a) above and included in the last preceding interim payment certificate issued by the Surveyor.
7. EVr represents "Effective Value of Steel Reinforcement in respect of the Whole or any Section of the Works", which shall be the difference between the sums specified in sub-clauses (7)(a) and (7)(b):
   a. The sum of steel reinforcement, exclusive of any increases or decreases made in accordance with this clause, as computed for the items in the Schedule of Effective Items for Fluctuation Adjustments in respect of steel reinforcement as given in sub-clause (19), which in the opinion of the Surveyor is due to the Contractor under GCC Clause 14.2, before deducting retention and before deducting previous payments on account, less all sums for steel reinforcement items based on actual cost or current prices;
   b. The sum calculated in accordance with sub-clause (7)(a) above and included in the last preceding interim payment certificate issued by the Surveyor.
8. EVs represents "Effective Value of Steel H-piles in respect of the Whole or any Section of the Works", which shall be the difference between the sums specified in sub-clauses (8)(a) and (8)(b):
   a. The sum for the supply only of steel H-piles, exclusive of any increases or decreases made in accordance with this clause, as computed for the items in the Schedule of Effective Items for Fluctuation Adjustments in respect of steel H-piles as given in sub-clause (19), which in the opinion of the Surveyor is due to the Contractor under GCC Clause 14.2, before deducting retention and before deducting previous payments on account, less all sums for the supply only of steel H-piles items based on actual cost or current prices;

b. The sum calculated in accordance with sub-clause (8)(a) above and included in the last preceding interim payment certificate issued by the Surveyor.

9. BIf represents "Base Material Index for Diesel Fuel", which shall be the Index Number of "Diesel fuel" listed in the "Index Numbers of the Costs of Labour and Materials used in Public Sector Construction Projects (April 2021 = 100)" published monthly by the Census and Statistics Department of the Government of the Hong Kong Special Administrative Region (C&SD) and applicable to the date 42 days prior to the date for the return of tenders;
10. BIr represents "Base Material Index for Steel Reinforcement", which shall be the Index Number of "Steel reinforcement" listed in the "Index Numbers of the Costs of Labour and Materials used in Public Sector Construction Projects (April 2021 = 100)" published monthly by the C&SD and applicable to the date 42 days prior to the date for the return of tenders;
11. BIs represents "Base Material Index for Steel H-piles", which shall be the Index Number of "Galvanised mild steel" listed in the "Index Numbers of the Costs of Labour and Materials used in Public Sector Construction Projects (April 2021 = 100)" published monthly by the C&SD and applicable to the date 42 days prior to the date for the return of tenders;
12. CIf represents "Current Material Index for Diesel Fuel", which shall be the Index Number of "Diesel fuel" listed in the "Index Numbers of the Costs of Labour and Materials used in Public Sector Construction Projects (April 2021 = 100)" published monthly by the C&SD and applicable to the date 42 days prior to the "date" stipulated below in either sub-clause (15) or (16) as appropriate;
13. CIr represents "Current Material Index for Steel Reinforcement", which shall be the Index Number of "Steel reinforcement" listed in the "Index Numbers of the Costs of Labour and Materials used in Public Sector Construction Projects (April 2021 = 100)" published monthly by the C&SD and applicable to the date 42 days prior to the "date" stipulated below in either sub-clause (15) or (16) as appropriate;
14. CIs represents "Current Material Index for Steel H-piles", which shall be the Index Number of "Galvanised mild steel" listed in the "Index Numbers of the Costs of Labour and Materials used in Public Sector Construction Projects (April 2021 = 100)" published monthly by the C&SD and applicable to the date 42 days prior to the "date" stipulated below in either sub-clause (15) or (16) as appropriate;
15. In the event that the Works are not phased for completion in Sections in the Contract, the "date" mentioned in sub-clauses (12) to (14) above shall be determined as follows:
    a. Where the whole of the Works is certified complete pursuant to GCC Clause 8.7, the "date" shall be the earliest date of the following dates:
        i. The due date, but in the event of the time for completion having been extended, then the extended date, for completion of the Works; or
        ii. The date of completion of the Works certified pursuant to GCC Clause 8.7; or
        iii. The date of the last day of the period to which the Surveyor's certificate relates.
    b. Where a part of the Works is certified complete pursuant to GCC Clause 8.7, the "date" applicable to such completed part of the Works shall be the earliest date of the following dates:
        i. The due date, but in the event of the time for completion having been extended, then the extended date, for completion of the Works; or
        ii. The date of completion of such part of the Works certified pursuant to GCC Clause 8.7; or
        iii. The date of the last day of the period to which the Surveyor's certificate relates.

c. Where a part of the Works is certified complete pursuant to GCC Clause 8.7, the "date" applicable to the remainder of the Works shall be the earliest date of the following dates:

i. The due date, but in the event of the time for completion having been extended, then the extended date, for completion of the remainder of the Works; or

ii. The date of completion of the remainder of the Works certified pursuant to GCC Clause 8.7; or

iii. The date of the last day of the period to which the Surveyor's certificate relates.

16. In the event that the Works are phased for completion in Sections in the Contract, the "date" mentioned in sub-clauses (12) to (14) above shall be determined as follows:

a. Where the whole of the Section is certified complete pursuant to GCC Clause 8.7, the "date" shall be the earliest date of the following dates:

i. The due date, but in the event of the time for completion having been extended, then the extended date, for completion of the Section; or

ii. The date of completion of the Section certified pursuant to GCC Clause 8.7; or

iii. The date of the last day of the period to which the Surveyor's certificate relates.

b. Where a part of the Section is certified complete pursuant to GCC Clause 8.7, the "date" applicable to such completed part of the Section shall be the earliest date of the following dates:

i. The due date, but in the event of the time for completion having been extended, then the extended date, for completion of the Section; or

ii. The date of completion of such part of the Section certified pursuant to GCC Clause 8.7; or

iii. The date of the last day of the period to which the Surveyor's certificate relates.

c. Where a part of the Section is certified complete pursuant to GCC Clause 8.7, the "date" applicable to the remainder of the Section shall be the earliest date of the following dates:

i. The due date, but in the event of the time for completion having been extended, then the extended date, for completion of the remainder of the Section; or

ii. The date of completion of the remainder of the Section certified pursuant to GCC Clause 8.7; or

iii. The date of the last day of the period to which the Surveyor's certificate relates.

17. For the purpose of sub-clause (18), “Index Number” shall mean any Index Number appropriate to sub-clauses (12) to (14);

18. In the event of any change(s) to the base period, composition, compilation method or availability of the Index Number or any statistical figures used for compiling an Index Number, as adopted by C&SD in the published Index Number on or after the date for the return of tenders, and

a. Where a conversion factor and/or the associated conversion method for the change in the Index Number is available from C&SD, the relevant current Index Number upon and after the discontinuation of the Index Number with the original base period, composition and/or compilation method shall be calculated by using such conversion factor on the corresponding Index Number; or

b. Where the Index Number remains available but a conversion factor and/or the associated conversion method is not available from C&SD, the relevant current Index Number upon and after the discontinuation of the Index Number with the original base period, composition and/or compilation method shall be calculated by multiplying the new Index Number by a contract conversion factor which is a fraction, the numerator of which is the sum of the Index Number with the original base period, composition and/or compilation method over the 12 months immediately before the first reference month whereby the Index Number is discontinued ("month of the discontinuation"), and the denominator of which is the sum of the Index Number with the new base period, composition and/or compilation method over the 12 months immediately before the month of the discontinuation (i.e.

$$\text{Contract Conversion Factor C} = \frac{OIN_{k-1} + OIN_{k-2} + \cdots + OIN_{k-12}}{NIN_{k-1} + NIN_{k-2} + \cdots + NIN_{k-12}}$$

where

k is the month of the discontinuation of the old Index Number

NIN_{k-x} is the new Index Number applicable for x month(s) before month k

OIN_{k-x} is the old Index Number applicable for x month(s) before month k).

19. The effective items which are subject to fluctuation adjustment are listed as follows:

a. Schedule of Effective Items for Fluctuation Adjustments:

Diesel Fuel	Steel Reinforcement	Steel H-Piles
All items in the Bill(s) for Execution of Piling to Foundations and item(s) assessed based on the rate(s) of any of the above scheduled items	The BQ items representing the sum of steel reinforcement in piling and pile cap works and item(s) assessed based on the rate(s) of any of the above scheduled items	The BQ items representing the sum for the supply only of steel H-piles and item(s) assessed based on the rate(s) of any of the above scheduled items

b. Other items not listed in the schedule given in sub-clause (19)(a) above, which shall include but not be limited to the following, will not be included in the calculation of the effective value for fluctuation adjustment:

i. Preliminaries items;

ii. Site safety items;

iii. Environmental management and site hygiene items;

iv. Taking care of the works after completion;

v. Provision of Labour Relations Officer, Contract Technical Assistants and the like.

PRE.B6.810.A SCC22.3 - EXCAVATION PERMIT FOR WORKS

1. Without limiting the areas subject to Clause SCC22.3(11) possession of the actual area for the following Portion(s) of the Site are to be given by the Designated Authority and are subject to the conditions of Excavation Permits to be applied for by the Employer:

a. Area .....;

b. Area .....

2. Render all necessary assistance to the Employer in processing any application for an Excavation Permit for works on Street Maintained by the Highways Department with reference to PRE.B8.2710 - PRE.B8.2740;

3. For works on land other than Street Maintained by the Highways Department that require an Excavation Permit, apply the Excavation Permit in accordance with Clauses SCC22.3(1)(b) and SCC22.3(5).

PRE.B6.820.A SCC22.4 - HOUSING CONSTRUCTION MANAGEMENT ENTERPRISE SYSTEM

1. Follow the HOMES accounts creation procedures, which will be provided to the Contractor when the CM informs the Start Date, for obtaining the authorized main contractor submission account (AMCSA) and the associated security token for HOMES before the Start Date, and the quality control account (QCA) and main contractor data operation account (MCDOA) upon approval to the appointment of QCM;

2. Ensure the availability of computer systems that can fulfill the minimum requirement as specified in the Guide for HOMES, and bear all costs for the computer systems and the connection of the computer systems to the HOMES through web browser (internet connection);

3. Use the HOMES as the electronic communication media for the Contract from the Start Date onward. In the event the Contract stipulates that a specified personnel except QCM, AQCC and SQCC is responsible for the submission of the specified documents or certification of specified activities, such personnel should sign on the required documents as proper record. The signed documents shall be scanned in 'pdf' format and submitted to the CM through HOMES via the AMCSA. Keep the original of the signed documents as proper record or submit to the CM when instructed;

4. The QCM and QCCs shall use QCA for submissions in HOMES. The QCM shall assume overall responsibility in all the submissions using QCA in HOMES;

5. Upon issue of the maintenance certificate of the Works, only AMCSA will remain active for access to HOMES until the End Date unless otherwise determined by the CM;

6. Train staff for operating the computer system to input and submit the required information through HOMES. While self-learning training kit CD is distributed to the Contractor free of charge at the Start Date, the Employer will be organizing training courses for HOMES from time to time and the Contractor may arrange their staff to attend the training course where considered appropriate on payment of the relevant cost and fees;

7. Follow the 'Guide for Housing Construction Management Enterprise System (HOMES) for Hong Kong Housing Authority (for Contractors' use only)' for any necessary process available / required by the HOMES;

8. Coordinate with Nominated Sub-contractors and other contractors directly appointed by the Employer who are HOMES users for proper and timely execution of the functions in HOMES;

9. Further to the provisions in Clauses SCC22.4(1) and SCC22.4(2) of the Special Conditions of Contract, while the Contract Manager shall have the full power to determine and adjust the extent of the application of HOMES in contract administration before the End Date and to order the adoption of communications in hardcopy form which shall be deemed to be formal and authentic copy of the communication, hardcopy communication shall be adopted, further to those specified under Clause SCC22.4(6), for use in at least the following areas unless otherwise instructed by the Contract Manager:

a. Provision of Drawings and Specification (GCC Clause 4.2);
b. Commencement, Completion and Delays (GCC Clause 8);
c. Works Subject to Excision (GCC Clause 9.1);
d. Notice of Claims (GCC Clause 11.5);
e. Ascertainment of Claims (GCC Clause 11.6);
f. Surveyor's Determination and Ascertainment (GCC Clause 11.7);
g. Requested Variation (GCC Clause 11.8);
h. Payments to Nominated Sub-contractors (GCC Clause 12.5);
i. Avoidance and Resolution of Disputes (GCC Clause 17).

10. Further to the provisions in Clause SCC22.4 of the Special Conditions of Contract, the HOMES functions are in place on the Start Date of HOMES (excluding those mentioned in sub-clause (9) above) and the details of their implementation arrangement shall be as required in APPENDIX PRE.B6/III to this Worksection.

PRE.B6.830.X DELETED

PRE.B6.850.9 SCC22.4 / SCC22.8 – WORKS WITHIN THE RAILWAY PROTECTION AREA

1. The area of the Site deemed to be within the Railway Protection Area is shown on Drawing No. ..... in Appendix A to this Specification;
2. MTRCL has notified periods of Restriction, Possession and / or Isolation during which relevant part(s) of the Works may be allowed to be carried out and details of the periods are as follows:

   …….

   ……..

APPENDIX PRE.B6/I

SPECIAL CONDITIONS OF CONTRACT

PRE.B6.APPEND1.B FORMS EPS-F1 TO EPS-F6

FORM EPS-F1 (SHEET 1 OF 2)

Contract Title : _____

Contract No. : _____

Notice of Appointment : Registered Structural Engineer (RSE)* / Registered Geotechnical Engineer (RGE)* / Qualified Engineer (QE)* / Competent Engineer (CE)* / Design Certifying Consultant (DCC)*/ Independent Checking Engineer (ICE) for Hand-dug Tunnelling Work*/ Independent Checking Consultant (ICC)*

To: Hong Kong Housing Authority

Attention: Contract Manager

In accordance with the provisions of the General Condition of Contract Clause 5.8 and the Specification Clause PRE.B6.060, I / we* hereby give you notice that I / we* have appointed (full name of the RSE / RGE / QE / CE / DCC / ICE / ICC *)

(English) _____ (Chinese) _____ of

(address) _____

_____

Telephone No. _____, Fax No. _____, as RSE / RGE / QE / CE / DCC/ ICE / ICC * for the purpose of the General Conditions of Contract Clause 5.8 of the captioned Contract.

Date: _____

_____
Signature of Project Manager

_____
Name in full

_____
Name of Contractor

* Delete whichever is inapplicable

FORM EPS-F1 (SHEET 2 OF 2)

Confirmation of Appointment

I (name in full) _____ (Chinese) _____ confirm that I have been appointed as the RSE / RGE / QE / CE / DCC / ICE / ICC * for the purpose of the General Conditions of Contract Clause 5.8 and the Specification Clause PRE.B6.060 of the above Contract.

Date: _____

_____
Signature of RSE / RGE / QE / CE / ICE / Authorized Representative of DCC[1] / Authorized Representative of ICC[1] *

Certificate of Registration No. of RSE / RGE* : _____

Date of Expiry of Registration *[2] : _____

Company Name[#] of RSE / RGE / QE / CE / ICE / DCC / ICC* : _____

Business Registration Certificate No.[#] _____

* Delete whichever is inapplicable

Notes :-

1. The Authorized Representative should sign with the company chop.
2. Date of Expiry of Registration are applicable to the appointment of RSE / RGE only.

FORM EPS-F2 (SHEET 1 OF 2)

Contract Title : _____

Contract No. : _____

Works / Certificate* Submission by **Registered Structural Engineer (RSE)* / Registered Geotechnical Engineer (RGE)* / Qualified Engineer (QE)* / Competent Engineer (CE) * / Design Certifying Consultant (DCC)*/ Independent Checking Engineer (ICE) for Hand-dug Tunnelling Work*/ Independent Checking Consultant (ICC)***

To: Hong Kong Housing Authority

Attention: Contract Manager

In accordance with the provisions of the Contract for demolition / foundation / building* works as detailed in Specification clause / Drawing no.* _____

I / we* hereby submit the (here specify the type of plans) _____ plans / geotechnical report / supporting documentation / structural details / calculations / method statement / Temporary Works design / completion certificate of Temporary Works* for your approval / consent* prior to works commencement. The said plans / calculations / certificate* have been prepared by

_____ _____ (RSE / RGE / QE / CE / DCC / ICE / ICC*)

(name in full) (Chinese)

the appointment of whom has been notified to you in the Form EPS-F1 submitted on _____

Date: _____

_____

Signature of Project Manager

_____

Name in full

_____

Name of Contractor

* Delete whichever is inapplicable

FORM EPS-F2 (SHEET 2 OF 2)

Certificate of **Preparation of Plans***
Temporary Works Design* / Method Statement* /
Completion *
Foundation Design*

In accordance with the provisions of the Contract, I hereby certify that:

a. the plans / geotechnical report / supporting documentation / structural details / calculations / method statement / Temporary Works design / completion of Temporary Works inspected by me on Site as shown on the plans and record photos* attached relating to the above demolition/ foundation / building works* and which have been signed by me, have been prepared / checked* and found satisfactory as being properly and safely designed / constructed* for the intended purpose by me or under my supervision or direction and that

b. the attached plans / geotechnical report / supporting documentation / structural details / calculations / method statement / Temporary Works design / completion certificate of Temporary Works* comply in all respects with the provisions of the Contract.

Date: _____

_____
Signature of RSE / RGE / QE / CE / ICE / Authorized Representative of DCC[1] / Authorized Representative of ICC[1]*

_____
Name in full

Certificate of Registration No. of RSE / RGE * : _____

Date of Expiry of Registration *[2] : _____

Company Name[#] of RSE / RGE / QE / CE / ICE / DCC / ICC* :

Business Registration Certificate No.[#] :

* Delete whichever is inapplicable

"NA" should be given if the RSE / RGE / QE / CE is directly employed by the Contractor.

Notes :-

1. The Authorized Representative should sign with the company chop.
2. Date of Expiry of Registration are applicable to RSE / RGE's submission only.

FORM EPS-F3 (SHEET 1 OF 2)

Certificate of Compliance and Confirmation of Appointment of RSE for Temporary Works Providing Support to a Tower Crane

Project Name : _____

ICU reference no. : _____

Address of site : _____

Tower crane no. : _____ (with layout plan)

Stage of works [1] (if any) : _____

Part 1: Certificate of Compliance *(to be completed by RSE and his employing company)*

I, (name in full)_____ (Chinese) _____ (I.D. No.^/Passport No. ^ *) _____ (Telephone No.) _____, and my employing company (employing company name) _____ confirm that I have been appointed by the Contractor (Name) _____ as the RSE in respect of the temporary works providing support to a tower crane at the subject site, and I hereby certify that :

(a) I have prepared and duly signed all the plans and construction drawings[2] (drawing number _____) for the temporary works providing support to the tower crane at the subject site, and the associated design justifications[3] (report reference number _____);

(b) the temporary works including the connections between the tower crane, the temporary works and the permanent structures (if applicable) are designed in compliance with the Buildings Ordinance, the regulations made thereunder and the relevant codes of practice and are structurally safe;

(c) (i)* the temporary works are under Case 2 Temporary Works that have no effect on the permanent structures, adjoining buildings and lands by way of overstressing or overloading.

or

(ii)* the temporary works are under Case 3 Temporary Works that may have effect on the permanent structures, adjoining buildings or lands by way of overstressing or overloading and submission to ICC is required for their review on the effect to the permanent structures, adjoining building and lands by way of overstressing or overloading. *

1 Stage of temporary works providing support to tower crane (e.g. free-standing stage, climbing stage or extension of height of the tower cranes etc.)

2 Plan and construction drawings include all necessary construction details and specification of the temporary works, sequence of construction, method statements, details of precautionary and protective measures.

[3] Design justifications include design calculations of temporary works and the assessment on the effects on the permanent structures, the adjoining buildings and lands.

FORM EPS-F3 (SHEET 2 OF 2)

Certificate of Compliance and Confirmation of Appointment of RSE for Temporary Works Providing Support to a Tower Crane

2. I declare that I am a registered structural engineer (RSE) responsible for the temporary works design providing support to a tower crane.

Name of RSE	:	_____	Name of RSE's employing company[#]	:	_____
RSE Registration No.	:	_____	Business Registration Certificate No.[#]	:	_____
Date	:	_____	Signature of Authorized Representative of RSE's employing company[#]	:	_____
Signature of RSE	:	_____	RSE's employing Company Chop[#]	:	_____

Any false certification or declaration may be subject to legal action

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Part 2: Confirmation of Appointment *(to be completed by the Contactor's Project Manager)*

I (name in full)_____ (Chinese) _____, the person appointed to act for the Contractor in the subject project, hereby confirm that the above RSE has been appointed in respect of the temporary works providing support to the tower crane for the subject site and undertake that the temporary works will be carried out in accordance with the certified plans and construction drawings designed by the RSE and will be properly maintained to ensure that they are structurally safe and intact.

		Name of the Contractor	:	
		Certificate of Registration No. of the Contractor	:	

Date of expiry of registration : _____

Date : _____

Signature : _____

Any false certification or declaration may be subject to legal action

^ In accordance with the Hong Kong Identity Card / Passport record

* Delete where appropriate

“NA” should be given if the RSE is directly employed by the Contractor.

FORM EPS-F4 (SHEET 1 OF 2)

Certificate of Compliance and Confirmation of Appointment of Independent Checking Consultant (ICC) for Temporary Works Providing Support to a Tower Crane

Project Name : _____

ICU reference no. : _____

Address of site : _____

Tower crane no. : _____ (with layout plan)

Stage of works [1] (if any) : _____

Part 1: Certificate of Compliance *(to be completed by ICC)*

We (Company name of ICC) _____ (Business Registration Certificate No.) _____ (Telephone No.) _____, confirm that we have been appointed by the Contractor (Name) _____ as the ICC in respect of the temporary works providing support to a tower crane at the subject site, and we hereby confirm that we take up the role of the ICC in respect of the above temporary work, we certify that :

(a) We have checked and duly signed all the plans and construction drawings[2] (drawing number _____) for the temporary works providing support to the tower crane at the subject site, and the associated design justifications[3] (report reference number _____), prepared by the RSE (name in full) _____ ;

(b) the temporary works including the connections between the tower crane, the temporary works and the permanent structures (if applicable) are designed in compliance with the Buildings Ordinance, the regulations made thereunder and the relevant codes of practice and are structurally safe;

(c) (i)* the temporary works are under Case 2 Temporary Works that have no effect on the permanent structures, adjoining buildings and lands by way of overstressing or overloading.

or

(ii)* the temporary works are under Case 3 Temporary Works that may have effect on the permanent structures, adjoining buildings or lands by way of overstressing or overloading and submission to ICC is required for our review on the effect to the permanent structures, adjoining building and lands by way of overstressing or overloading. *

1 Stage of temporary works providing support to tower crane (e.g. free-standing stage, climbing stage or extension of height of the tower cranes etc.)

2 Plan and construction drawings include all necessary construction details and specification of the temporary works, sequence of construction, method statements, details of precautionary and protective measures.

3 Design justifications include design calculations of temporary works and the assessment on the effects on the permanent structures, the adjoining buildings and lands.

FORM EPS-F4 (SHEET 2 OF 2)

Certificate of Compliance and Confirmation of Appointment of Independent Checking Consultant (ICC) for Temporary Works Providing Support to a Tower Crane

2. We declare that we have the qualification and experience for checking the temporary works providing support to a tower crane at the subject site.

3. We confirm that the RSE and us are independent from each other and have no holding, subsidiary, employer / employee or any other relationship

Name of Director of ICC :		Company name of ICC :	
RSE Registration No. of Director of ICC :		Business Registration Certificate No. :	
Date :		Signature of Authorized Representative of ICC :	
Signature of Director of ICC :		Company Chop of ICC :	

Any false certification or declaration may be subject to legal action

Part 2: Confirmation of Appointment *(to be completed by the Contractor's Project Manager)*

I (name in full)_____ (Chinese) _____, the person appointed to act for the Contractor in the subject project, hereby confirm that the above ICC has been appointed in respect of the temporary works providing support to the tower crane for the subject site.

		Name of the Contractor	:	
		Certificate of Registration No. of the Contractor	:	
		Date of expiry registration	:	
		Date	:	
		Signature	:	

Any false certification or declaration may be subject to legal action

^ In accordance with the Hong Kong Identity Card / Passport record/TCP No.

* Delete where appropriate

FORM EPS-F5 (SHEET 1 OF 2)

Certificate of Completion for Temporary Works Providing Support to a Tower Crane by the Contractor

Project Name : _____

ICU reference no. : _____

Address of site : _____

Tower crane no. : _____ (with layout plan)

Stage of works [1] (if any) : _____

Part 1: Certificate of Completion *(to be completed by technically competent person (TCP) T4 in registered contractor (RC)'s stream)*

I, (name in full)_____ (Chinese) _____ (I.D. No.^/Passport No. ^/TCP No.^*) _____ (Telephone No.) _____, the person appointed as TCP-T4 in RC's stream in the supervision plan submitted to the Independent Checking Unit on (date) _____ (Submission ref. no._____), hereby certify that:

(a) the temporary works providing support to the tower crane have been completed and I confirm that I have personally inspected the temporary works on (date) _____ and found satisfactory that the works have been completed in accordance with the certified plans and construction drawings (drawing number _____);

(b) the results of the associated testing of materials and workmanship (including on-site and off-site welds) have been reviewed by me and found technically acceptable;

(c) the temporary works including the connections between the tower crane, the temporary works and permanent structures are structurally safe.

Name of TCP : _____

Date : _____

Signature of TCP : _____

Any false certification or declaration may be subject to legal action

[1] Stage of temporary works providing support to tower crane (e.g. free-standing stage, climbing stage or extension of height of the tower crane etc.)

FORM EPS-F5 (SHEET 2 OF 2)

Certificate of Completion for Temporary Works Providing Support to a Tower Crane by the Contractor

Part 2: Certificate of Completion

(to be completed by appointed RSE / director of the Independent Checking Consultant (ICC))*

I/We*, (name of RSE / director of the ICC*)_____ (Chinese if any) _____ is appointed by the Contractor as the RSE / ICC* for temporary works providing support to a tower crane in the subject project, hereby certify that:

(a) the temporary works providing support to the tower crane have been completed and I/we* confirm that I/we* have inspected the temporary works on (date) _____ and found satisfactory that the works have been completed in accordance with the certified plans and construction drawings (drawing number _____);

(b) the results of the associated testing of materials and workmanship (including on-site and off-site welds) have been reviewed by me and found technically acceptable;

(c) the temporary works including the connections between the tower crane, the temporary works and permanent structures are structurally safe.

Name of RSE/ Director of ICC*	: _____	Company name of RSE/ICC*	: _____
RSE Registration No.	: _____	Business Registration Certificate No.	: _____
Date	: _____	Signature of Authorized Representative of RSE's employing company / ICC	: _____
Signature of RSE/ Director of ICC*	: _____	Company Chop of RSE's employment company / ICC	: _____

Any false certification or declaration may be subject to legal action

^ In accordance with the Hong Kong Identity Card/Passport record / TCP No.

* Delete where appropriate

FORM EPS-F6 (SHEET 1 OF 1)

Confirmation of Completeness of Document and Temporary Works Providing Support to the Free-standing Tower Crane

Project Name : _____

ICU reference no. : _____

Address of site : _____

Tower crane no. : _____ (with layout plan)

Confirmation of Completeness of Document and Temporary Works Providing Support to the Free-standing Tower Crane have no Adverse Effect to Permanent Structures

(to be completed by Independent Checking Consultant (ICC))*

To: ICU

We, (name of director of the ICC)_____ (Chinese if any) _____ is appointed by the Contractor as the ICC in the subject project, hereby confirm that:

(a) the completeness of submitted documents including the plans, construction drawings, design justifications, duly signed form EPS-F03, EPS-F04 and EPS-F05 for the temporary works providing support to the free-standing tower crane are satisfactory;

(b) the temporary works, sequence of construction or method statement of the free-standing tower crane have no adverse effect on the permanent structures, adjoining buildings and lands, by way of overstressing or overloading.

Name of Director of ICC :		Company name of ICC :	
RSE Registration No. :		Business Registration Certificate No. :	
Date :		Signature of Authorized Representative :	
Signature of Director of ICC :		Company Chop :	

Any false certification or declaration may be subject to legal action

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* Delete where appropriate

APPENDIX PRE.B6/II

SPECIAL CONDITIONS OF CONTRACT

PRE.B6.APPEND2.D GUIDELINES ON SCOPE AND CONTENTS OF SUB- CONTRACTORS MANAGEMENT PLAN

The Sub-contractors Management Plan shall include (but not limited to) the following:

1. Scope of works to be sub-contracted including the form and extent of sub-contracting arrangement such as labour only, labour and plant, labour and material, plant only, lump sum or any other combination of types. Proof of ownership of construction plant and material shall be addressed. The scope of works to be sub-contracted shall comply with the relevant contractual provisions for limiting the tiers of sub-contracting;
2. Particulars of sub-contracts (irrespective of tiers) as required under the template in Table 1 below;
3. The Contractor's approach to demand / ensure his sub-contractors to:
   a. Abstain from sub-contracting the whole of the works sub-contracted to them;
   b. Report upwards their sub-contracting arrangement and any subsequent changes with written declarations of no "hidden" sub-contracts for any part of the Works sub-contracted to him.
4. The Contractor's proposed measures for supervision of the works and monitoring of the performance of sub-contractors, particularly the aspects of the works programming, quality and safety of the works, material compliance and environmental protection;
5. The Contractor's proposed measures for monitoring the performance of the sub-contractors in complying with the requirements in the Contract in reporting site accidents;
6. Criteria for selection of sub-contractors involving trades not available in the Registered Specialist Trade Contractors Scheme (RSTCS);
7. The Contractor's approach to ensure all his sub-contractors (irrespective of tiers) to adopt written contracts in their sub-contracting and that all the sub-contractors comply with the requirements as stipulated in Clause SCC3.2 of the Special Conditions of Contract "Sub-contract conditions". In respect of the Construction Industry Security of Payment Ordinance (Cap. 652), the Contractor shall also cause all his sub-contractors to acknowledge the communication channels for notifying imminent delay in work or supply and the obligation to notify the Contractor about the latest status of any adjudication proceedings for their sub-contracts stipulated under PRE.B6.730 sub-clause 4;
8. Details of the Contractor's superintendence and management team as required in Clause 5.8 of the General Conditions of Contract "Contractor's superintendence", employed on direct supervision and management of sub-contractors. An organization chart showing the responsibilities of the Contractor's direct staff in supervision and management of his sub-contractors should be submitted;
9. The Contractor's proposed control measures and checking mechanism for material compliance in accordance with the Guidelines on Scope and Contents of Quality Control System in APPENDIX PRE.B8/XII formulated in coordination with the sub-contractors (irrespective of tiers), which shall cover but not limited to the following:
   a. The risk levels of the architectural / building / structural / building services materials in case of non-compliance with specifications or failure in function. The risk levels shall be identified and reviewed with the sub-contractors;

b. The system of checking for material non-compliance. The system shall be conveyed to and reviewed with the sub-contractors to ensure effective implementation;

c. The risk control measures which shall be incorporated into the sub-contract agreements;

d. Summary of materials purchasing records to be submitted on a need basis as required by the CM;

e. Summary of delivery note / approval records of material supplied by sub-contractors to be submitted to the CM on regular basis and as required by the CM.

10. Declaration through the standard declaration form in Annex 1 to this APPENDIX PRE.B6/II that members of staff on the Contractor's management team are prohibited to be given a sub-contract to any part of the Works or to have a vested interest in any of the sub-contractors irrespective of tiers;

11. The Contractor's proposed measures to ensure the compliance with the implementation of the system of payment of wages to the Site Personnel as stipulated in Clause SCC6.1 of the Special Conditions of Contract "Payment of wages of Site Personnel". The Contractor's proposed measures for ensuring timely payments to sub-contractors and payments by sub-contractors to sub-contractors of lower tiers;

12. The Contractor's proposed measures for supervision of plumbing works and monitoring of the performance of the Plumbing Sub-contractor and Licensed Plumber, particularly including but not limited to the following:

    a. In addition to compliance with the Waterworks Regulations and associated requirements, measures for the following material control aspects:

        i. Central procurement of soldering and brazing joint materials by the Contractor or the domestic Plumbing Sub-contractor;

        ii. Verification check of document upon delivery of materials for plumbing installation including soldering and brazing joint materials to Site;

        iii. Quarantine test for joint materials by non-destructive method to ensure that soldering alloys with lead and brazing alloys with cadmium are not used for jointing copper pipes;

        iv. Inventory record of materials for plumbing installation delivered to Site, including soldering and brazing materials;

        v. Storing the verified / quarantined soldering and brazing materials in lockable storeroom. Maintain a daily consumption ledger for soldering and brazing materials;

        vi. Measures to ensure that all workers shall not use soldering alloys with lead and brazing alloys with cadmium for jointing of copper pipes. Measures should include, but not limited to, construction mock-up for internal and external brazing and soldering joint at sample wing, sample flats and fabrication workshop, affixing display panels indicating the proper work procedures for workers' reference, and daily briefing to workers about quality of work etc.;

        vii. Verification test for jointing material of copper pipe during construction stage to ensure that soldering alloys with lead and brazing alloys with cadmium are not used.

    b. Defining the roles of Licensed Plumber;

    c. Procedures for on-site supervision and monitoring of plumbing Sub-contractor and Licensed Plumber;

d. If the use of XRF analyser is proposed for on-site metallic composition test for plumbing materials, the following information shall be submitted prior to carrying out the test including but not limited to:

i. Detailed schedule of date, time and locations of testing works using XRF analyser;

ii. Copy of the licence(s) of the XRF analyser(s) to be used;

iii. Copy of the licence(s) of the operator to use the XRF analyser;

iv. Copy of the notification(s) and supporting documents submitted to the Radiation Board for the use of non-medical irradiating apparatus at ad hoc work sites;

v. The Contractor's written confirmation that no objection is received from the Radiation Board for the use of non-medical irradiating apparatus at ad hoc work sites;

vi. Safety plan to illustrate the precautionary measures to be taken and the operating procedures of XRF analyser. The safety plan shall be prepared and endorsed by the licenced operator(s) of the XRF analyser and the Safety Officer.

13. The scope and contents of Sub-contractors Management Plan in this clause are not exhaustive. The Contractor may add any other items which he considers pertinent to the proper management of his sub-contractors.

Table 1 - Particulars of Sub-contracts(1)

No.	Contract No	Contract Title	Contract Sum ($)	Contact Point	Company Name of Sub-contractor	Commencement Date	Program	No. of Tier	Form of Sub-contractor	Type (2) (RSTC or RS)	Trade (3)	Specialty (3) (NA for RSTC)	Registration No.	Expiry Date	Value (4)	Grouping (5) (1, 1 (Advanced), 2 or NA)
e.g.	CV/XXXX/XX	Construction of XXX	100,000,000	Mr. XXX, E/XX	ABC Company Ltd.	1-10-2020	9 months	1	labour, plant & material	RSTC	Concreting Formwork	NA	XXXXXX	31-3-2022	E	1
	CV/XXXX/XX	Construction of XXX	100,000,000	Mr. XXX, E/XX	123 Company Ltd.	1-10-2020	12 months	2	labour & plant	RS	Fire Services Installation	Fire services pipe work	XXXXXX	31-3-2022	D	NA
1																
2																

Notes:

1. Apart from the above information, the Contractor shall provide additional information and supporting document upon requested.
2. RSTC refers to the Registered Specialist Trade Contractors under the Registered Specialist Trade Contractors Scheme (RSTCS) of the Construction Industry Council (CIC).
   RS refers to the Registered Subcontractors under the RSTCS.
3. One row for one particular trade or specialty. Sub-contract with multiple trades or specialties shall be reported individually in several rows. For details of the classification of trade and specialty, please refer to the website of the RSTCS at www.rstc.cic.hk managed by the CIC. RSTCS covers 22 designated trade groups, viz. (1) Concreting, (2) Concreting Formwork, (3) Curtain Wall, (4) Demolition, (5) Erection of Concrete Precast Component, (6) Reinforcement Bar Fixing, (7) Scaffolding, (8) Plastering, (9) Suspended Ceiling, (10) Tower Crane (Erecting, Dismantling, Altering Height), (11) Building Drainage Installation, (12) Levelling and Setting Out, (13) Building Maintenance, (14) Interior Fitting-out, (15) Painting, (16) Metal Work, (17) Structural Steelwork, (18) Horticultural Works, (19) Arboriculture Works, (20) Skyrise Greenery Works, (21) Truss-out Scaffolding and (22) Site Lifting Operations.
4. One value for one particular trade group and specialty. The ranges of Value A to G are shown below:
   A: Value < $1M
   B: $1M ≤ Value < $3M
   C: $3M ≤ Value < $6M
   D: $6M ≤ Value < $15M
   E: $15M ≤ Value < $30M
   F: $30M ≤ Value < $50M
   G: Value ≥ $50M
5. Group 1, Group 1 (Advanced) and Group 2 refer to the tender limits set by CIC for the 22 designated trades mentioned in (3) above, which are only applicable to RSTC. For details of the tender limits, please refer to the website of the RSTCS at www.rstc.cic.hk managed by the CIC.

Annex 1 to APPENDIX PRE.B6/II

Standard Declaration Form by the Contractor on Compliance with Provisions in Sub-contractors Management Plan

To : Contract Manager

Contract No. : _____

Contract Title : _____

In accordance with the Guidelines on Scope and Contents of Sub-contractors Management Plan referred to in Clause PRE.B6.035 of the Specification, I / we declare and confirm that we have complied with and undertake to continue to comply with the following provisions, and declare and confirm that I / we have ensured and undertake to continue to ensure that our members of staff on the Contractor's management team as referred to in item (10) of APPENDIX PRE.B6/II to the Specification are aware of the following provisions:

(a) Members of staff on the Contractor's management team are prohibited from being given a sub-contract to any part of the Works or having a vested interest in any of the sub-contractors irrespective of tiers;

(b) Members of staff on the Contractor's management team are required to submit written declarations to the Contract Manager upon his written request from time to time or at any time that they do not have a sub-contract to any part of the Works or any vested interest in any of the sub-contractors irrespective of tiers.

(Name of the Contractor): _____

(Name of the Signatory): _____

(Position of the Signatory): _____

(Date): _____

Annex 2 to APPENDIX PRE.B6/II

Guidelines on Documentary Proof to Demonstrate the Compliance of the Provisions in the Sub-contractors Management Plan

1. The CM should base on his professional judgement in selecting samples of sub-contract document / report for documentary proof.
2. Documentary proof should be limited to relevant information for the demonstration of the compliance of the provisions in the submitted Sub-contractors Management Plan i.e. information as stipulated in the Guidelines on Scope and Contents of Sub-contractors Management Plan at APPENDIX PRE.B6/II to the Specification.
3. Documentary proof should exclude sensitive commercial information such as price, payment conditions (except for purpose of proving compliance with the requirements as stipulated in the Contract (i.e. Clause SCC3.2 of the Special Conditions of Contract "Sub-contract conditions" and those under PRE.B6.730 if the Construction Industry Security of Payment Ordinance applies to the Contract)), bills of quantity, etc.

APPENDIX PRE.B6/III

PRE.B6.APPEND3.B HOMES FUNCTIONS AND DETAILS OF IMPLEMENTATION ARRANGEMENT

		HOMES Function	Hard-copy	e-copy to HOMES	Remark
(i)	Letters (excluding those concerning such functions as described in Clause SCC22.4(6) and PRE.B6.820(9))	x			*
(ii)	Site Instructions				*
(iii)	Contractor's Organization Chart				*
(iv)	Contract Programme *a. - Master Programme & Milestone;* *- Site Progress; and* *- Site Checkpoint Programme*				*
	b. - Weekly site progress photo				*
(v)	Drawings				**
(vi)	Documents for material management				***
(vii)	Site Diary	x		x	-
(viii)	Contractor's Daily Report	x		x	-
(ix)	Monthly Labour Return	x		x	-
(x)	Request for Inspection *[for building contract]*	x			-
(xi)	Request for Inspection *a. [for foundation contract (Large Diameter Bored Pile, Socketed Steel H-Pile, Minipile and Footing]*	x		x	-
	b. [for foundation contract (Other foundation types)]				-

(xii)	Site Direction / Memo	x		x	-
(xiii)	Site Inspection Form (inspection summary for piling) *a. [for foundation contract (Large Diameter Bored Pile, Socketed Steel H-Pile, Minipile and Footing)]*	x		x	-
	b. [for foundation contract (Other foundation types)]				*
(xiv)	Site Inspection Form (for Building Works Inspection and Structural Works Inspection) *a. [for building contract only]*	x		x	-
(xv)	Site Inspection Form (for Building Services Works Inspection) *a. [for building contract only]*	x		x	****
(xvi)	Final Flats Inspection Form *[for building contract only]*	x		x	-
(xvii)	Safety Alert	x		x	-
(xviii)	Site Alert	x	x	x	-
		Legend : "√" = Function/Requirement applicable; "x" = Function/Requirement not applicable "*" = Hard copy / photos to be uploaded to HOMES "**" = Only drawing list to be uploaded to HOMES "***" = Details refer to Introduction of Material Management under Contract module of HOMES. "****" = From Start Date to End Date for Nominated Sub-contract works; but not for Main Contract works.			

APPENDIX PRE.B6/IV

PRE.B6.APPEND4.9 STANDARD FORM FOR RECORD OF THE 15-MINUTE FLUSHING FOR THE SINK MIXER INSTALLED AT KITCHEN

FORM PRE.B6.APPEND4.9

STANDARD FORM FOR RECORD OF THE 15-MINUTE FLUSHING FOR THE SINK MIXER INSTALLED AT KITCHEN

<Standard record form for 15-minute flushing under PRE.B6.650>

Contract Title :

Contract No. :

To: Hong Kong Housing Authority

Attention: Contract Manager

Date of Flushing:_____ Scheduled Intake Date: _____

Location of 15 minute Flushing				Water Meter Reading			Witnessed by Site Staff	
Block	Floor	Flat	*Water Meter No.	Before Flushing (a)	After Flushing (b)	Reading Range (c) = (b) - (a)	Name & Post	Signature

*All digits shown on the Water Meter to be recorded.

Checked by Contractor's Representative

Authorized Signature of the Contractor

Name in full

Post

Date

Endorsed By PCOW

Authorized Signature of HD

Name in full

Post

Date

APPENDIX PRE.B6/V

PRE.B6.APPEND5.9 LIST OF DRAWINGS SHOWING THE DESIGN INTENT AND/OR THE EMPLOYER'S REQUIREMENTS FOR WORKS ITEMS TO BE DESIGNED BY THE CONTRACTOR UNDER PRE.B6.085(1)(D) AND PRE.B6.085(1)(E)

No.	Item	Location	Drawing No.

APPENDIX PRE.B6/VI

PRE.B6.APPEND6.N AUTHORITY FOR PAYMENT TO THE BANK (SAMPLE ONLY)

PRE.B7 DOCUMENTATION AND RECORDS

DEFINITIONS AND ABBREVIATIONS

PRE.B7.010.9 APPROVAL

"Approval" or "Approved" means the approval in writing by the CM as required under the Contract. "Approval" or "Approved" shall not relieve the Contractor from any responsibility imposed by the Contract and shall not be relied upon by the Contractor to alter, transfer or otherwise change, diminish or void any liability or obligation imposed on him by the Contract.

PRE.B7.020.9 INSTRUCTED

"Instructed" means an instruction in writing by the CM, but shall not relieve the Contractor from his responsibilities imposed by the Contract.

PRE.B7.030.9 PROPRIETARY NAMES

1. The phrase "or products having equivalent functions or performance" is deemed to be included whenever materials are specified by using
   a. Proprietary names;
   b. Proprietary names in conjunction with the phrases "or Approved equivalent", "or equivalent", "equivalent and approved", "equal or equivalent", "equal or approved", "equal and approved" and other similar phrases.
2. When the phrase "or products having equivalent functions or performance" is deemed to be included or is used in conjunction with the name of a proprietary material, materials of different manufacture but having equivalent functions or performance may be substituted if prior Approval has been obtained, provided that:
   a. Proof of equivalent functions or performance including details of functions or performance standards of the specified product and the proposed alternative is provided to CM for comparison;
   b. Rates and prices will not be changed from those for the proprietary materials specified.
3. If the Contractor intends to use the intellectual property rights of another party in performing his obligations under the Contract, appropriate licences should be obtained from relevant owners.

PRE.B7.040.9 SPECIFIED

"When specified" or "as specified" means the incorporation of a particular clause or alternative by specific reference in the Drawings or Specifications. When alternatives are given in this Specification the Contractor is at liberty to make his own choice from the alternatives listed.

PRE.B7.050.A MANUFACTURER'S RECOMMENDATIONS

"Manufacturer's recommendations" means those recommendations or instructions, printed or in writing and produced by the manufacturer of any specified product, current at 42 days prior to the date for the return of tenders.

PRE.B7.060.9 REGULATIONS

"Regulations" means any Ordinance or Regulation published by Government, bylaws of any local or duly constituted authority and rules or regulation of public bodies and companies which may be applicable to the Works.

PRE.B7.062.9 HOUSING DEPARTMENT

"Housing Department" means "The Housing Department of the Government of the Hong Kong Special Administrative Region".

PRE.B7.070.C ABBREVIATIONS

Abbreviations used have the following meanings:

AFCD	-	Agriculture, Fisheries and Conservation Department of the Government of the Hong Kong Special Administrative Region.
AP	-	Authorized Person.
BD	-	Buildings Department of the Government of the Hong Kong Special Administrative Region.
BEAM Plus	-	Hong Kong Building Environmental Assessment Method for New Buildings.
BQ	-	Bills of Quantities.
BS	-	British Standards.
BS EN	-	European Standard adopted as British Standard.
BS EN ISO	-	European Standard and International Organization for Standardization Standard adopted as British Standard.
CABD	-	Communal Aerial Broadcast Distribution.
CCTV	-	Closed-circuit Television.
CEDD	-	Civil Engineering and Development Department of the Government of the Hong Kong Special Administrative Region.
CIC	-	Construction Industry Council.
CLP	-	CLP Power Hong Kong Limited.
CM	-	Contract Manager.
CoPSS	-	Code of Practice for Site Supervision 2009 (2021 Edition).
CP	-	Codes of Practice.
CS	-	Hong Kong Construction Standard.
DEVB	-	Development Bureau of the Government of the Hong Kong Special Administrative Region.
DIN	-	German Industrial Standard.
DSD	-	Drainage Services Department of the Government of the Hong Kong Special Administrative Region.
ELSP	-	Excavation and Lateral Support Plan.
ELSW	-	Excavation and Lateral Support Works.
EMSD	-	Electrical and Mechanical Services Department of the Government of the Hong Kong Special Administrative Region.
EPD	-	Environmental Protection Department of the Government of the Hong Kong Special Administrative Region.
EP	-	Establishment Period.
EW	-	Establishment Works.
ETWB	-	Former Environment, Transport and Works Bureau of the Government of the Hong Kong Special Administrative Region.

FSD	-	Fire Services Department of the Government of the Hong Kong Special Administrative Region.
GCC	-	General Conditions of Contract.
GEO	-	Geotechnical Engineering Office.
HA	-	The Hong Kong Housing Authority.
HD	-	The Housing Department of the Government of the Hong Kong Special Administrative Region.
HKAS	-	Hong Kong Accreditation Service.
HKCA	-	Hong Kong Construction Association Limited.
HKE	-	Hong Kong Electric Company Limited.
HOKLAS	-	Hong Kong Laboratory Accreditation Scheme.
HyD	-	Highways Department of the Government of the Hong Kong Special Administrative Region.
ICU	-	Independent Checking Unit under the Office of the Permanent Secretary for Housing of the Government of the Hong Kong Special Administrative Region.
ITS	-	Independent Tree Specialist.
JIS	-	Japanese Industrial Standard.
LANP	-	Development Bureau's List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Landslip Preventive / Remedial Works to Slopes / Retaining Walls.
LD	-	Labour Department of the Government of the Hong Kong Special Administrative Region.
MVAC	-	Mechanical Ventilation and Air Conditioning.
MTRCL	-	MTR Corporation Limited.
NSC	-	Nominated Sub-contractor.
OSHC	-	Occupational Safety and Health Council.
OVT	-	Old and Valuable Tree.
PASS	-	Performance Assessment Scoring System.
PNAP	-	Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (issued by Buildings Department).
PNRC	-	Practice Note for Registered Contractors (issued by Buildings Department).
RGE	-	Registered Geotechnical Engineer.
RSC	-	Registered Specialist Contractor.
RSC(GIFW)	-	Registered Specialist Contractor in the Ground Investigation Field Works Category.
RSC(SF)	-	Registered Specialist Contractor in the Site Formation Works Category.
RSE	-	Registered Structural Engineer.
SCC	-	Special Conditions of Contract.
SSF	-	Subsidised Sale Flats.
SP	-	Supervision Plan.
TCP	-	Technically Competent Person (defined in TMSP).

TMSP	-	Technical Memorandum for Supervision Plans 2009 (issued by Buildings Department).
WSD	-	Water Supplies Department of the Government of the Hong Kong Special Administrative Region.

PRE.B7.080.9 SPECIFICATION

1. This Specification is applicable to the whole of the Works in so far as it is not overridden by the General Conditions of Contract, Special Conditions of Contract, Drawings or the instructions of the Contract Manager;
2. Materials and Workmanship specified in one Worksection of the Specification will apply to the same items in other Worksections unless particularly stated otherwise.

PRE.B7.090.A GS CEW

1. Reference to "Hong Kong Government General Specification for Civil Engineering Works, 2020 Edition", abbreviated in this Specification as "GS CEW", will be deemed to include amendments and revisions, etc, published 42 days prior to the date for the return of tenders;
2. Whenever a clause in the "GS CEW" is referred to, the provisions of the clause will be applicable to this Contract except where specifically modified by this Specification. The word 'Engineer' in the relevant clauses will be substituted by the abbreviation "CM".

PRE.B7.100.9 SITE STAFF

The words "Site Staff" mean the Clerk of Works or Inspector of Works or the Building Services Inspector or Amenities Officers or their assistants appointed by the CM to assist him and/or his representatives to watch and inspect the Works, to test and examine any materials to be used and workmanship employed in connection with the Works, and to carry out such other duties as may be required by the CM and/or his representatives.

PRE.B7.110.9 THE EMPLOYER'S DIRECT CONTRACTOR

The words "The Employer's Direct Contractor" mean the contractor appointed to undertake works in accordance with the Employer's "Annual Contract for Minor New Soft Landscape Works".

PRE.B7.120.A INDEPENDENT CHECKING UNIT

"Independent Checking Unit" means the Independent Checking Unit under the Office of the Permanent Secretary for Housing of the Government of the Hong Kong Special Administrative Region.

PRE.B7.130.9 BUILDING WORKS

The words "Building Works" means "building works" referred under "Interpretation", Section 2 of Buildings Ordinance, Chapter 123.

PRE.B7.132.9 NEW BUILDING

The words "New Building" means "new building" referred under "Interpretation", Section 2 of Buildings Ordinance, Chapter 123.

PRE.B7.135.9 SITE FORMATION WORKS

The words 'Site Formation Works' means 'site formation works' referred to under 'Interpretation', Section 2 of Buildings Ordinance, Chapter 123.

PRE.B7.140.9 DIRECTOR

"The Director" referred to in this Specification is the Director of Housing.

PRE.B7.145.9 TENANT OR OCCUPANT

Any reference to "tenant" or "occupant" shall mean "resident".

PRE.B8 CONTRACTOR'S OBLIGATIONS

AUTHENTICITY OF INFORMATION

PRE.B8.005.N CONSENT TO THE EMPLOYER FOR VERIFICATION OF DOCUMENTS SUBMITTED BY THE CONTRACTOR

1. The Contractor shall give consent to the Employer to obtain from:
   a. any party who has been named in the Tender and/or documents submitted by the Contractor in the course of performance of the Contract;
   b. any issuing body of any test reports, certificates or documentary evidence mentioned or referred to in the Tender and/or documents submitted by the Contractor in the course of performance of the Contract; and
   c. any other parties such as banks, insurers, employers/clients/project managers/professionals of the projects/contracts listed in the submitted information and/or documents, professional bodies/institutions, universities or the like that have been referred to in the Tender and/or documents submitted by the Contractor in the course of performance of the Contract,

   all information which the Employer considers relevant for the enforcement and administration of the Contract, including but not limited to information to verify the legitimacy, completeness, authenticity and accuracy of any information included in the Tender and/or documents submitted by the Contractor in the course of performance of the Contract.
2. The consent specified in sub-clause (1) above shall be valid throughout the course of performance of the Contract. If any consent from any other person is required for the Employer to obtain any of the aforesaid information or document, the Contractor shall undertake to obtain such consent when required by the Employer. Further, upon request by the Employer or the CM, the Contractor shall provide a written authorization to the Employer if such written authorization is needed for the Employer to obtain information and/or document(s) from the person or issuing body referred to in sub-clauses (1)(a) to (1)(c) above.
3. The Contractor shall submit the names, qualifications, experience, documentary proof of the employment status and other required information of any members of his management team for approval of the CM in accordance with the Contract. The Contractor shall also submit to the Employer through the CM a signed declaration and consent by each member of his management team in the form set out in APPENDIX PRE.B8/XXIII to declare that the submitted information as to the qualifications, experience, employment status and other required information is true, accurate and complete, and to give consent to the Employer to obtain from and verify the authenticity of the submitted information with the relevant parties and to collect, use and input such information into the database of the Employer (if any) for the purposes of contract procurement and management of the Contract and any other contracts of the Employer. Should there be a replacement of any member of his management team, the Contractor shall propose a competent substitute with the qualifications and experience as specified in the Contract. The Contractor shall submit the name, qualifications, experience, documentary proof of the employment status and other required information of such substitute for approval of the CM and a signed declaration and consent by such substitute to the Employer through the CM in the same form set out in APPENDIX PRE.B8/XXIII.

4. Should there be a replacement of any person of the PSP or the IDC named in the Accepted Contractor's Proposals, the Contractor shall propose a substitute for such person having no less experience and qualification than the person whom he is substituting. The Contractor shall submit the name, qualifications, experience, documentary proof of the employment status and other required information of such substitute for approval of the CM and a signed declaration and consent by such substitute to the Employer through the CM in the form set out in APPENDIX PRE.B8/XXIII.
5. Notwithstanding sub-clauses (3) and (4) above, when required by the CM, the Contractor shall submit the name, qualifications, experience, documentary proof of the employment status and other required information of any person proposed in accordance with the Contract and a signed declaration and consent by such person to the Employer through the CM in the form set out in APPENDIX PRE.B8/XXIII.

USE OF SITE

PRE.B8.010.9 PURPOSE

Do not use the Site, or permit the Site to be used by others for any purpose other than carrying out the Works or work ancillary thereto carried out by any Direct Contractor.

PRE.B8.020.9 ADVERTISING

Do not display, or permit advertisements to be displayed on the Site.

PRE.B8.030.9 WORKERS

Do not permit workers to live on Site. Exception is made for guards and watchmen.

PRE.B8.040.9 OCCUPANCY AND RENTAL OF PRIVATE LAND OF ECOLOGICAL VALUES

The Contractor shall not rent or occupy any private land falling within the designated areas listed below for any purposes arising out of or in connection with the Contract unless prior approval is obtained from the CM:

1. Existing country parks designated under the Country Parks Ordinance (Cap. 208);
2. Areas designated as Coastal Protection Area, Site of Special Scientific Interest, Green Belt, Conservation Area and Other Specified Uses (River Park) on statutory plans (i.e. Outline Zoning Plans and Development Permission Area Plans) under the Town Planning Ordinance (Cap. 131);
3. Restricted areas under the Wild Animals Protection Ordinance (Cap. 170);
4. Areas designated under the Marine Parks Ordinance (Cap. 476).

SECURITY

PRE.B8.110.9 SECURITY MEASURES

1. In addition to the security measures described in GCC Clause 5.11 and elsewhere in this Specification, provide all necessary security measures and accept full responsibility for the adequacy of precautions taken;
2. Seek the advice of the Crime Prevention Bureau of the Hong Kong Police Force on security matters;
3. Re-appraise on a regular basis and implement security measures to coincide where necessary with changes on Site;
4. Display notices giving warning of prosecution of trespassers.

PRE.B8.120.A SECURITY GUARDS

Option 1

1. Keep capable security guards about the Site and on the Works, day and night;
2. At commencement of the Works, provide a minimum of ..... security guards at all times;
3. Once the construction of the structural frame and ceiling slab of 6/F of a domestic block is completed, provide a minimum of ..... security guards for the Contract at all times, such that at least one security guard is allocated to individual blocks;
4. The CM may approve a lesser number of security guards when any Section of the Works has been completed, or increase the number as is considered necessary for the Works;
5. As soon as the security gate and fence are installed at the staircase of each domestic block, as required by PRE.B8.160, station the security guard at all times at G/F of the block to control access to the upper floors of the block;
6. Provide securely built hut(s) or room(s) to accommodate all the security guards, and fit each with a direct telephone line or equivalent and a lock operated internally. Fix the huts securely to the ground and fit windows with burglar grilles;
7. Provide each security guard with a walkie-talkie and make suitable arrangements for regular patrolling and reporting by security guards and for a key system check on each store.

Option 2

1. Keep capable security guards about the Site and on the Works, day and night;
2. At commencement of the Works, provide a minimum of ..... security guards at all times;
3. The CM may approve a lesser number of security guards when any Section of the Works has been completed, or increase the number as is considered necessary for the Works;
4. Provide securely built hut(s) or room(s) to accommodate all the security guards, and fit each with a direct telephone line or equivalent and a lock operated internally. Fix the huts securely to the ground and fit windows with burglar grilles;
5. Provide each security guard with a walkie-talkie and make suitable arrangements for regular patrolling and reporting by security guards and for a key system check on each store.

PRE.B8.140.9 PERSONNEL CONTROL

1. Provide smart cards, as specified in PRE.B8.2610, to all workers for wearing conspicuously at all times on Site;
2. Keep daily records of all vehicles and people with no smart cards.

PRE.B8.150.9 ENTRANCE WARNING NOTICES

Post and maintain permanent warning notices at each site entrance, in both Chinese and English characters, indicating the following:

1. Vehicular entry/exit, (at vehicular accesses only);
2. That all workers must show their identity passes, and all vehicles and personnel without identity passes must report to security control at site entrance;
3. The prosecution of trespassers.

PRE.B8.160.9 PARTICULAR REQUIREMENTS FOR EVERY STAIRCASE OF DOMESTIC BLOCKS

Provide at the space above parapet wall at the G/F or at first landing of every staircase of the domestic block:

1. Local audio alarm system;
2. Temporary security metal gate and security fence to space above parapet wall:
   a. Construct the gate and fence to prevent access to the upper floors when locked;
   b. Fit the gate with a rim lock to be operated by key from both sides;
   c. Install at least 12 months before the original contract completion date of each domestic block;
   d. Maintain the gate in good condition until it is removed at such time, either when the installation of the permanent security gate is complete or as agreed with the CM;
   e. Make good the affected area after the gate is removed;
   f. Submit detailed design and location of the metal gate and security fence to the CM for comment before commencing installation of the same.

PRE.B8.162.A SITE SECURITY PLAN

1. Submit a Site Security Plan to the CM for information and comment on the following occasions:
   a. Within 14 days of the date of the Letter of Acceptance;
   b. Necessitated by revisions of programme in accordance with GCC Clauses 8.4 or 8.5;
   c. When the Site Security Plan is revised by the Contractor.
2. The Site Security Plan comprises but is not restricted to the following:
   a. Policy Statement for security on the Site;
   b. Security staff organisational structure which shows:
      i. Duty list of the responsible officers;
      ii. Chain of responsibility;
      iii. Details of the resources allocated on the Site;
      iv. Emergency contact telephone number for security aspects of the Works.
   c. Means of compliance on the following aspects of works at various stages of construction which are to be programmed into the programme or revised programme furnished pursuant to GCC Clauses 5.7, 8.4 and 8.5:
      i. Proposed number, qualification and surveillance check on the performance of security guards;
      ii. Control for the care of personal security and safety of all people on site;
      iii. Control for the care and storage of any Constructional Plant, temporary buildings and materials and anything whatsoever on the Site or delivered to or placed on the Site in connection with or for the purpose of the Works or any Specialist Works;
      iv. Control over hoardings, gantries, fencings, etc.;
      v. Control of accessibility at Site entrance(s) and individual building blocks;
      vi. Control of entry and exit of visitors and vehicles to and from the Site with records;
      vii. Control over delivery and removal of materials, goods, equipment and plant with records;
      viii. Control over unused materials, goods, plant and equipment;
      ix. Control over storage of concrete cubes;
      x. Adequacy of temporary lighting inside the buildings, within the Site and around the Site boundary especially during night time.

d. Procedures and records for security control and patrolling services on building blocks, storage areas for materials, goods, equipment and plant and the Site for the times / periods as follows:
   i. At day and night time;
   ii. At and within 6 months of the date for completion of each Section and the Works;
   iii. For the period 45 days after the CM has certified completion of each Section and the Works pursuant to GCC Clause 5.12.
e. Emergency procedures in case of crime e.g. theft, burglary etc. or fire, including systems of reporting, recording and remedial measures;
f. Site security reports submitted at monthly site meetings to include, but not restricted to, the following information:
   i. Site security measures implemented on the Site;
   ii. Designated site security personnel for implementing and monitoring the plan;
   iii. Cases of failure;
   iv. Feedback from Nominated Sub-contractors, Suppliers or others.
g. Proposal for security training to the concerned personnel including Site Agent, General Foremen, Block Foremen and other concerned Site Staff;
h. Programme for reference to the local regional Crime Prevention Unit of the Hong Kong Police Force.

3. Accept full responsibility under the Contract. The obligation for site security is not relieved by:
   a. The CM's consent to the Site Security Plan and any proposed revision or update;
   b. The CM's rejection of the Site Security Plan and any proposed revision or update;
   c. Implementation of the Site Security Plan.
4. Do not impose any obligation or responsibility on the Employer or the CM with regard to site security.

PRE.B8.170.9 SECURITY ON COMPLETION

Option 1

1. Leave the Works secure, with all accesses locked;
2. Tag and label all other keys where applicable;
3. Account for all keys and hand to the CM.

Option 2

Unless otherwise Instructed, leave the Works secure and all accesses locked. If the CM orders Site Security Services as a requirement to fulfil the obligations imposed by the Special Conditions of Contract,

1. Supply, on Site at all times, at least one security guard;
2. Operate (including provision of electricity supply), at any time whenever it is dark, lighting associated with walkways, hoardings, and accesses;
3. Keep the Site closed with all accesses locked;
4. Do not permit visitors to enter the Site unless Approved.

Option 3

1. Leave the Works secure, with all accesses locked;
2. Account for all keys and hand back to the Housing Manager.

SAFETY

PRE.B8.210.E COMPLIANCE WITH SAFETY REGULATIONS AND CONTRACT REQUIREMENTS

Option 1

In relation to the requirements of GCC Clause 5.11 and PRE.B6.070, comply with all current Regulations concerning safety on the Site in particular the Factories and Industrial Undertakings Regulations and the requirements specified in the Contract as follows:

1. Safety Officers:
   a. Employ Safety Officer(s) and Safety Supervisor(s) in accordance with the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations with specific detailed requirements as follows, and employ any other safety personnel in excess of the following as may be required by any enactments, regulations, by-laws or rules that may be in force at any time during the progress of the Works:
      i. The number of Safety Officer(s) to be employed shall depend on the total number of persons employed on Site as indicated below:

Total no. of persons employed on Site	No. of Safety Officer(s) required
Not more than 200	1
201 to 700	2
701 to 1200	3
1201 and above	4

      ii. The number of Safety Supervisor(s) to be employed shall depend on the total number of persons employed on Site and in compliance with the above said regulations;
      iii. The total number of persons employed on Site as per sub-clauses (a)(i) and (a)(ii) shall include the workforce of the Contractor, the Contractor's sub-contractors and Nominated Sub-contractors but shall exclude the workforce of those separate contractors employed directly by the Employer;
      iv. The Safety Officer(s) and Safety Supervisor(s) must be employed full time solely and designated for the Contract. The Safety Officer(s) shall be registered by the Commissioner for Labour under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations. The Safety Supervisor(s) shall be accredited under the Hong Kong Safety and Health Certification Scheme managed by the OSHC. Enhancement courses for Safety Supervisor(s) are conducted by the OSHC and CIC.
   b. Do not commence any construction work on the Site without the appointment of the required number of Safety Officer(s) and Safety Supervisor(s) unless expressly permitted by the CM in writing;
   c. Before commencement of the Works, and whenever there is a change in the appointment of Safety Officer(s) and/or Safety Supervisor(s), report to the CM a written confirmation that Safety Officer(s) and Safety Supervisor(s) are employed in accordance with the Contract. Such written confirmation shall append with the following documents:
      i. The name and a copy of the written notification of registration from the Commissioner for Labour for each Safety Officer;

ii. A signed statement by each Safety Officer declaring that he is registered as a Safety Officer and he will advise the CM in writing immediately if he is no longer so registered;

iii. Subject to sub-clause (1)(a)(iv) above, the name and a copy of the written certification of accreditation under the Hong Kong Safety and Health Certification Scheme for each Safety Supervisor;

iv. Subject to sub-clause (1)(a)(iv) above, a signed statement by each Safety Supervisor declaring that he is accredited as a Safety Supervisor under the Hong Kong Safety and Health Certification Scheme and he will advise the CM in writing immediately if he is no longer so accredited.

d. The duties of Safety Supervisor shall be as stipulated in the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations;

e. The duties of the Safety Officer shall be solely directed towards safety and health matters. In addition to the duties stipulated in the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, the Safety Officer's duties include:

i. Site inspection:

- Carry out comprehensive safety inspections on all activities on the Site including temporary works and scaffolding at weekly intervals. The safety inspection shall identify any unsafe operation or potential hazards;
- The Safety Officer shall be clearly identified on the Site by wearing an armband or a safety helmet appropriately marked in Chinese and English;
- The Contractor shall empower the Safety Officer to order any person working on the Site to suspend any unsafe operation or to take urgent action to make safe the Site or the Works or to disallow any practice which may infringe the Safety Plan or any statutory safety requirement;
- Give prior notice to the CM of the date and time of the weekly inspection and allow the CM or his representatives to attend the inspection;
- Liaise with the Nominated Sub-contractors' Safety Supervisors;
- Prepare safety inspection reports.

ii. Safety Plan:

- Supervise and monitor implementation of the Safety Plan;
- Ensure that sub-contractors and all persons working on the Site are made aware of and comply with the Safety Plan.

iii. Accident / Incident report, investigation and follow up actions:

Carry out the duties relating to accident / incident report, investigation and follow up actions as specified in the Safety Plan;

iv. Training:

- Include in the Safety Plan or its monthly update the programme and the number of workers to receive training including site specific induction training, tool box talks and Silver Card training for the coming month;
- Conduct general induction training, site specific induction training as specified. Supervise the conduction of tool box talks specified;
- Identify those workers in the specified trades without valid Silver Card and coordinate their enrolment in requisite Silver Card training provided by CIC;
- At the end of each period of interim certificates report, report to the CM the actual number of workers trained as specified.

v. Site Safety Committee:
   - Arrange and coordinate Site Safety Committee;
   - Invite Nominated Sub-contractors' Safety Supervisors to attend Site Safety Committee meeting and other safety-related meetings.

vi. Risk Assessment Report:
   - Prepare risk assessment reports for the following month and recommend measures to remove or minimize hazards;
   - Adopt the methodology given at the leaflet Five Steps to Risk Assessment, the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work and the Guidance Notes on Prevention of Heat Stroke at Work issued by LD.

vii. Action on LD's contravention notices:
   - Attend to the notices issued by LD to the Contractor advising that safety related regulations are contravened, in particular:
     - Construction Site (Safety) Regulations;
     - Subsidiary regulations of the Factories and Industrial Undertakings Ordinance.
   - Take all necessary actions to ensure full compliance with all statutory requirements;
   - Report monthly to the CM the following LD's notices received:
     - Construction Site Inspection Report with category Part I or Part II contravention;
     - Improvement Notice;
     - Suspension Notice.
   - Inform the Nominated Sub-contractor's Safety Supervisor(s) in writing and make a copy to the CM, if any of the above notices received are associated with contravention made by the Nominated Sub-contractor(s).

viii. Safety audit:

   Implement the recommendations of the external Safety Audit Report;

ix. Safety Officer's report:

   Compile and report the above duties to the CM at the monthly site meetings;

x. Safety diary:
   - Maintain a safety diary which shall record all matters related to safety and health, including Safety Supervisors' reports, details of safety inspections and audits, accidents, dangerous occurrences, safety related incidents, etc.;
   - Check to ensure that all unsafe situations are promptly rectified and the dates of their completion duly recorded in the safety diary;
   - The safety diary shall be made available for inspection by the CM upon request and copy thereof shall be submitted to the CM upon request.

xi. Keep a register of the names, telephone numbers, addresses and qualifications of any competent persons and competent examiner as defined in the Construction Sites (Safety) Regulations, who has carried out duties on this Contract. Keep a register of the names of Safety Supervisors and their duties discharged as required under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations. Keep examination reports and certificates required by legislations or Contract;

2. Safety Plan:
   a. Prepare and submit to the CM 3 copies of a draft Safety Plan within 14 days of the date of the Letter of Acceptance. Arrange and hold an ad hoc meeting (or meetings if necessary) with the CM or his representatives to discuss the draft Safety Plan within 7 days from the submission of such plan. If the CM is of the opinion that the draft Safety Plan does not meet the requirements of the Contract, he can request for remedy of the deficiency. Comply with any such the CM's request prior to submitting 6 copies of the Safety Plan to the CM for endorsement within 35 days of the date of the Letter of Acceptance;
   b. Update the Safety Plan at monthly intervals or when required by the CM so that the Safety Plan is at all times a comprehensive and contemporary statement of the Contractor's safety and health policies, procedures and requirements to achieve the safety and health obligations and responsibilities under the Contract. In the circumstance that there is no amendment of the Safety Plan in the monthly updating, submit explanation in writing with detail elaborations on why no amendment is required;
   c. The CM may by notice in writing require the Contractor to supplement, revise or update the Safety Plan if he is of the opinion that the Safety Plan is insufficient or requires revision or modification in the interest of the safety, whether for the Works and / or the safety and health of persons on or adjacent to the Site or protection of any property on or adjacent to the Site or otherwise. Comply with the CM's requirements within 7 days of such notice;
   d. Ensure the Safety Plan has incorporated the Nominated Sub-contractor's safety plan in respect of the Nominated Sub-contract Works. Request the Nominated Sub-contractor to prepare and submit a safety plan in respect of the Nominated Sub-contract Works within 14 days of the Letter of Acceptance of the Nominated Sub-contractor's tender for agreement and incorporation into the Safety Plan. Ensure consistency between the Safety Plan and the safety plan in respect of the Nominated Sub-contract Works. Submit the agreed safety plan in respect of the Nominated Sub-contract Works to the CM for endorsement. Revise and update the Safety Plan to incorporate the safety plan in respect of the Nominated Sub-contract Works endorsed by the CM when the Safety Plan is due to be revised or updated;
   e. Request the Nominated Sub-contractor to revise or update the safety plan in respect of the Nominated Sub-contract Works by virtue of a revision or update of the Safety Plan pursuant to sub-clauses (2)(b) and 2(c) above. Ensure the revised or updated safety plan in respect of the Nominated Sub-contract Works is consistent with the Safety Plan and submit the revised or updated safety plan in respect of the Nominated Sub-contract Works to the CM for endorsement;
   f. The CM's endorsement, comment or rejection of the Safety Plan, the safety plan in respect of the Nominated Sub-contract Works, and of any proposed revision or update, and the implementation of the Safety Plan by the Contractor including the safety plan in respect of the Nominated Sub-contract Works shall not relieve the Contractor from any obligations or responsibilities under the Contract or any statutory regulations;
   g. The Safety Plan and subsequent monthly updated Safety Plan, if any, shall contain, without limitation, details of the following:
      i. Company safety and health policy:

         A safety and health policy is a written statement produced by the Contractor, signed by a senior member of the management board, in which it sets out its aims and objectives for securing safety and health and the means whereby the objectives can be met. It is the Contractor's statement of intent on matters of safety and health;

ii. Safety organisation:

The safety staff organisational structure including an organisation chart which shows the chain of responsibility and accountability from managing director, project manager, safety manager, Site Agent, Safety Officer(s) and Safety Supervisors. Responsibilities and duties of these safety personnel shall be defined;

iii. Safety and health training:

- Provide all employees and others with adequate information, instruction and training on safety and health. Adopt the methodology given at the guide Five Steps to Information, Instruction and Training issued by LD. State in the safety and health policy the detail arrangements for providing safety and health training;
- The safety and health training shall include but not limited to the following:
  - General induction training;
  - Site specific induction training;
  - Tool box talks;
  - Trade specific safety and health training to be arranged and conducted by the respective Nominated Sub-contractors;
  - Silver Card training;
  - Lunchtime's safety talks.

iv. In-house safety rules and regulations:

- Activities which are complex or inherently hazardous must be accompanied by:
  - Detailed working procedures to clearly identify the hazards and / or potential risks;
  - Clear steps to be taken to manage and to minimise the risks;
  - Operation procedures to ensure safety at work;
  - Provisions to ensure everyone involved is aware of the hazards and the safety precautionary measures to take.
- Strictly control access to particularly hazardous areas or operations. List the activities identified as demanding permits to work. The person identified by job title shall be responsible for the design / preparation of permits;
- A lock-off involves the physical isolation or locking-off to danger zones. The danger zones or operations shall be fenced off by barriers provided with warning notices to prevent unauthorized workers from entering the danger zones. Post a site layout plan indicating danger zones at conspicuous locations of the Site. The permit-to-work system shall cover the following high risk activities -
  - Work in confined spaces (Implement the permit-to-work system given at Appendix 1 of the CoP for Safety and Health at Work in Confined Spaces issued by LD. Follow the safety requirements for works in confined space related to underground drainage work as specified in PRE.B8.215);
  - Work in lift shaft;

- Mobile crane, heavy machinery, piling rig and mobile elevating work platform operating or moving on the Site;
- Hot work;
- Lifting operation by tower cranes and mobile cranes, crawler cranes, or cranes alike or lifting operation by mechanical means (excluding lifting operation with load not exceeding 2.5 tonne within a distance of 2.5 metres from the edge of such crane);
- Work with electrical hazard under Electricity (Wiring) Regulations;
- Use of ladder for work above ground for work purpose.

v. Safety Committee as specified;

vi. Programme for inspection, thorough examination and testing of hazardous conditions:

- Provide a complaint management system which may include a hotline phone number, complaint management software, or both, to facilitate reporting, tracking and resolution of unsafe conditions or complaints by workers to a Contractor's superintendent. Post notices at conspicuous locations on the Site. Take follow-up action to deal with the reports received.
- Closely monitor the implementation of the safety and health legal requirements, policies and procedures by effective arrangements including formal inspection, thorough examination and testing. This function must be allocated to suitably trained and experienced competent individuals. Reports (in the format prescribed by legislations if required) highlighting actions to be taken following an inspection shall be speedily prepared and issued to the appropriate superintendent and the CM;
- Inspections should include, but not limited to all:
  - Excavation, shafts, earthworks and tunnels;
  - Cofferdams and caissons, and suspected dangerous atmospheres;
  - Scaffolding;
  - False work;
  - Working platforms;
  - Safety belts and anchorage systems (refer to the Guidance Notes on Classification and Use of Safety Belts and their Anchorage System issued by LD with respect to the information on some anchorage systems, the types, uses and specifications of safety belts under several national safety standards);
  - Coverings for openings;
  - Gangways and runs;
  - Guard rails, barriers, toe boards and fences;
  - Local exhaust;
  - Pressure system and gas containers;
  - Breathing apparatus, revival and other safety and rescue equipment;
  - Electrical equipment and appliances;
  - Fire fighting equipment;
  - First-aid box provisions.
- Inspections, thorough examination and testing shall include, but not limited to:

- Suspended working platforms;
- Lifting appliances and lifting gear;

  (Refer to the Construction Sites (Safety) Regulations and the Guidance Notes on the Inspection, Thorough Examination and Testing of Suspended Working Platforms and the Guidance Notes on the Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by LD);
- Tower cranes (including its anti-collision system), static and mobile cranes;
- Material hoists and passenger lifts.

vii. Job hazard analysis:

- Carry out risk assessment to identify hazards in the workplace and assess the risk to employees and others who may be affected. Assessments shall be carried out by competent persons. When a risk assessment has indicated that a task poses a significant risk to safety and health, a written safe system of work shall be produced;
- A safe system of work must include not only procedures, equipment, materials and environment that are safe, but also safe workforce i.e. adequately trained, informed and supervised. Where appropriate, the safety system should also specify any checks to be made before the task is carried out;
- Refer to Form DCMP-F788 Generic (non-exhaustive) Checklist for High Risk Activities which gives examples of construction operations / activities requiring job hazard analysis. Contractor shall build up the list as appropriate and establish appropriate control measures / safe operation procedures. The DCMP-F788 is retrievable from the Question no. 5 of the Frequently Asked Questions (FAQ) of the Housing Authority Site Safety Website;
- Develop safe systems of work in a systematic manner, following the guidebook Safe Systems of Work issued by LD.

viii. Personal protection programme:

The type of personal protective equipment (PPE) to be worn in particular situations and any specific requirement related thereto shall be established as a result of a risk assessment which will be the first step towards ensuring compatibility between the risk and correct personal protective equipment. Develop procedures for PPE issue, maintenance and reporting defects;

ix. Accident / Incident report, investigation and follow up actions:

- Report accidents / incidents and dangerous occurrence as defined in the Factories and Industrial Undertakings Regulations to LD in the prescribed Form 2 with Supplementary Information on Accidents on Construction Sites & Dangerous Occurrence Report Form;
- Copy the Supplementary Information Sheet, Dangerous Occurrence Report Form, Suspension Notice and Improvement Notice issued by the LD to the CM according to GCC Clause 5.21;

- Notify the CM immediately of all 'reportable accidents' as defined under the Factories and Industrial Undertakings Regulations and of the accidents / incidents to be reported in prescribed forms using smartphone or the web through the Housing Authority Safety Alert Module and followed by submission of the completed documents to the CM under the accident / incident reporting procedures of the HD set out at the Housing Authority Site Safety Website (http://www.housingauthority.gov.hk/sitesafety) and comply with the procedures;
- Notify the Site Staff immediately (i.e. within the day of the accident / incident) of accidents / incidents on Site, including:
  - Serious accidents / incidents;
  - Reportable accidents, dangerous occurrence and near miss / incidents (if the accidents / incidents, though not serious by immediate effect, may have potentially serious consequence, such as those involving but not limited to falling from height, falling object, being struck by moving object, injury to head, profuse bleeding, injured person becoming unconscious, body of injured person pierced by foreign object, public safety etc.) on Site;
  - Death of person;
  - Tree failure incidents resulting in any of the following:
    - Loss of human life;
    - Major injury where the injured is admitted or to be admitted to hospital;
    - Substantial damage to properties;
    - Serious / complete blockage to main pedestrian / vehicular access.
  - Any emergency situations as referred to in sub-clause (2)(g)(x).
- Inform the CM immediately whether the progress of construction works or the office operation of the Contractor and / or his sub-contractors are being affected or likely to be affected by the emergency situations as referred to in sub-clause (2)(g)(x);
- Provide statistics and analysis of accidents / incidents, investigate and ascertain the contributory factors and root causes, identify the trends and recommend means of prevention and improvement;
- The accident / incident investigation shall include, but not limited to, the following major items:
  - Causes of the sub-standard safety performance;
  - Potential deficiencies of the safety control system;
  - Areas of review and lessons learnt;
  - Recommendations to prevent recurrences;
  - Improvements to the safety control system to meet the Legislations and recommendations of the investigation report.
- Provide statistics and trends of late report of accidents / incidents, later than the time prescribed under the relevant legislations and Contract clauses; identify the causes and recommend means of improvement;
- Provide necessary information to the Nominated Sub-contractors' Safety Supervisors for preparing Nominated Sub-contractors' accident / incident report and investigation;

- Provide means to communicate accident / incident statistics information, recommendation to prevent recurrences and lessons learnt from previous accidents / incidents to all persons working on the Site.

x. Emergency preparedness:

- An emergency situation means a situation requiring emergency assistance of fire services / police / ambulance etc.. It includes:
  - An accident which results in death or serious injury;
  - A fire breaking out which requires rescue crews from Fire Services Department to effect control;
  - A flood that causes or threatens life on Site;
  - A leakage of dangerous goods or chemicals;
  - An accident of geotechnical concern such as landslip, rockfall, retaining wall failure, ground subsidence or land instability;
  - An outbreak of epidemic / infectious disease on Site;
  - Any superintendent or worker of the Contractor or his sub-contractors on Site who has been confirmed or suspected of contracting epidemic / infectious disease;
  - Any other accident / incident which creates a dangerous situation.
- Evacuation plans to be drawn for all areas. Call the hotline 999 and notify Site Staff immediately in case of emergency. Calling the local police station, fire services station and ambulance depot for police, fire services and ambulance can be accepted as an alternative to calling the hotline 999. The procedures are to be reviewed and revised periodically, especially when the work-site configuration is altered or changed in some way;
- Prepare emergency procedures for responding, monitoring and reporting on the following potential emergency situations:
  - Fire;
  - Accidents / Incidents;
  - Typhoons;
  - Heavy rainstorms, black rainstorms, floods;
  - Tree failures;
  - Working in confined space;
  - Leakage of chemicals or dangerous goods;
  - Damage of existing utilities;
  - Underground contamination;
  - Traffic incidents;
  - Announcement by the Government of any response level under the three-tier response levels, i.e. “Alert”, “Serious” and “Emergency” in the context of preparing for and responding to infectious disease of public health significance;
  - Outbreak of epidemic / infectious disease on Site;
  - Any superintendent or worker of the Contractor or his sub-contractors on Site confirmed or suspected of contracting epidemic / infectious disease;

- Any superintendent of the Contractor put under quarantine or medical surveillance for having close contact with infected personnel of epidemic / infectious disease and such superintendent has contacted with HA / HD officer or visited any HA / HD premises or sites;
- Geotechnical concerns such as flood, landslip / rockfall, retaining wall failure, ground subsidence, or any land instability.

- Prepare contingency plans with detailed arrangements to be adopted to mitigate the effects of the above potential emergency situations on the Contractor's organization and disruption to the progress of the Works. The contingency plans should aim at maintaining or resuming the progress of the Works as soon as possible whilst ensuring the safety and health of all personnel on the Site.

xi. Safety promotion:

- The effort made by different sub-contractors or individuals to reduce accidents at work by the application of soundly based policies, procedures and disciplines to be recognised by the presentation of safety and health award. Adopt proactive attitude towards improving safety and health performance and / or the best related achievement in reducing number of accidents. The Site as a whole is encouraged to participate in the following designated safety and health campaigns:
  - "Construction Safety Promotional Campaign", "Occupational Health Award" or "Hong Kong Occupational Safety and Health Award" led by OSHC;
  - "Construction Industry Safety Award Scheme" led by LD;
  - "Considerate Contractors Site Award Scheme" led by DEVB and CIC.
- The Contractor is also encouraged to organize site-based safety and health awards and competitions to promote participation of his workers and teams in safety and health theme competitions during the contract period. The adjudicating team shall comprise the site management team, safety personnel and workers' representatives, and shall act openly and fairly in such events.

xii. Health assurance programme:

- The health of employees and others affected by the Contractor's activities must form an important part of the Contractor's safety and health policy. Work related health aspects, such as pre-employment and routine medical examination of employees engaged in specific jobs, shall be considered (refer to the Guidance Notes on Medical Examinations for Workers engaged in Hazardous Occupations in Industrial Undertakings issued by LD). Similarly, health related matters which may affect the workplace such as fumes or vapours from hazardous or toxic substances, pollution, noise, radiation etc., are to be reviewed;
- Health surveillance is to be used to detect adverse health effects at an early stage. Appropriate risk assessment to identify the circumstances in which health surveillance becomes necessary.

xiii. Health care plan:

Implement a health care plan for workers on Site as specified under PRE.B8.300;

xiv. Evaluation, selection and control of sub-contractors:

The means by which to ensure sub-contractors of all levels including Nominated Sub-contractors and Specialist Sub-contractors comply with the Safety Plan and statutory requirements on safety and health;

xv. Process control programme:

Safety rules, regulations and working procedures covering all safety and health aspects, and in particular method statements and permit-to-work systems for identified high risk operations are to be addressed. Prepare pictorial or graphical presentation of safe working procedures and method statements of identified high risk operations for understanding by frontline personnel;

xvi. Safety plans in respect of Nominated Sub-contract Works:

Incorporate safety plans in respect of Nominated Sub-contract Works in the Safety Plan when submitted by the Nominated Sub-contractors;

xvii. Non-smoking policy:

Mandate a non-smoking policy including the rules adopted by the Contractor with respect to prohibition of smoking on Site. In the event that the Contractor does not fully prohibit smoking on Site, include a site plan showing the number and sizes of the designated smoking areas and describe the associated requirements of provisions of fire fighting appliances and cleaning services in the policy as per PRE.B8.360;

h. Comply with the Safety Plan and ensure all Safety Officers, Safety Supervisors and all personnel who are in a position of authority among sub-contractors including Nominated Sub-contractors have access to the Safety Plan and made aware of their obligation to comply with the Safety Plan. Any Specialist Contractor and other entities (e.g. Utility Undertakings) working on the Site shall be provided with a copy of the Safety Plan and be required to comply with it, and report to the CM for any non-compliance on their part;

i. Provide all facilities, access and assistance to the CM to periodically check that the Safety Plan is being implemented properly and fully. If the CM is of the opinion that the Contractor fails to implement the Safety Plan properly and fully and the failure does or may adversely affect the safety, whether for the Works and / or the safety and health of persons on or adjacent to the Site, or protection of any property on or adjacent to the Site or otherwise, the CM shall notify the Contractor in writing of the failure. The Contractor shall take action to remedy the failure immediately. The CM may suspend the Works, or any part of it, until such time the failure has been rectified.

3. Housing Authority Safety Auditing System (HASAS):

a. Safety Auditor:

To be nominated centrally by the Safety and Health Unit of Housing Department using a random selection computing programme based on the list provided by OSHC after checking and confirmation of the following requirements by OSHC:

i. Must be from the OSHC's list of Accredited Safety Auditors after the date of the Letter of Acceptance;

ii. Must have no current commercial dealings with the Contractor and the Nominated Sub-contractors;

iii. Clear of any conflict of interest in exercising his role as safety auditor.

b. The Contractor may agree or reject such nomination with valid reason. If the nominee is rejected, re-nominate by the Safety and Health Unit of Housing Department using a random selection computing programme to repeat the selection process as in sub-clause (3)(a) above until an Accredited Safety Auditor is selected and appointed;

c. Once nomination is agreed:

i. The Accredited Safety Auditor shall conduct safety audit with the Contractor's and the Nominated Sub-contractors' representatives under the management of the OSHC once every 3 months;

ii. The CM may instruct the Accredited Safety Auditor to commence the Safety Audit at any time, but not later than the end of the 3rd month from the notified date for commencement of the Works;

iii. Provide attendance of most senior site representative at each safety audit;

iv. Provide all necessary attendance for the safety audit including fully facilitating the inspection of the Site and the Works and all certificates, records and reports relating to safety and health matters, and fully cooperate with the Accredited Safety Auditor in the carrying out of the safety audit;

v. Report to the Accredited Safety Auditor innovative and functional safety installation or safety measures, applications of Building Information Modelling for safety and applications of Radio Frequency Identification for safety implemented for this Contract for onward payment assessment.

d. The Project Director / Heads of Projects of the Contractor shall sign an acknowledgement of receipt of the Safety Audit Report prepared by the Accredited Safety Auditor and submit to OSHC for record;

e. Implement the recommendations of the Accredited Safety Auditor within the time frame specified in the Safety Audit Report;

f. The Safety Officer shall report on the implementation of Accredited Safety Auditor's recommendations in the monthly site meeting;

g. Allow for all work undertaken in preparation for the safety audit or in the implementation of the Accredited Safety Auditor's recommendations. Neither shall entitle the Contractor to any extension of time for completion of the Works.

4. Green Card and Silver Card:

a. The Contractor, and any of his sub-contractors including Nominated Sub-contractors, shall provide and employ for the purposes of the Works such technical personnel and such skilled, semi-skilled and unskilled labourers who, upon their first appearance in the Site and throughout their working in the Site, are a holder of either a valid Green Card issued by an organisation or institution recognized by LD or a valid Construction Workers Registration Card issued under the Construction Workers Registration Ordinance. The Green Card referred to in this sub-clause is a statutory identification document issued to a person by an organization or institution recognized by LD upon completion of the training on Green Card;

b. The following trades shall be carried out by workers holding Silver Cards issued by CIC upon their first appearance in the Site and throughout their working in the Site:

i. Painter and Decorator;

ii. Carpenter;

iii. Demolition Worker (Building);

iv. Plumber;

v. Bar Bender and Fixer;

vi. Plasterer and Tiler;

vii. Bamboo Scaffolder and Metal Scaffolder;

viii. Construction Materials Rigger;

ix. Rigger and Signaller;

x. Curtain Wall Installer;

xi. Tower Crane Worker (Erecting, Dismantling, Telescoping & Climbing);

xii. Concretor;

xiii. Tunnel Worker;

xiv. Lift Mechanic.

c. Arrange and release workers of the trades listed in sub-clauses (4)(b)(i) to (4)(b)(xiii) to attend Silver Card training or revalidation training. Bear the fees for the training courses and pay workers the wages which they would otherwise earn during that period of attending the training courses had the Contractor not released them to attend the training courses;

d. The Nominated Sub-contractor for lift installation shall arrange and release workers of the trade listed in sub-clause (4)(b)(xiv) to attend Silver Card training or revalidation training. The Nominated Sub-contractor for lift installation shall bear the fees for the training courses and pay workers the wages which they would otherwise earn during that period of attending the training courses had the Nominated Sub-contractor for lift installation not released the workers to attend the training courses;

e. Keep record of payment for the fees of the training courses and, if applicable, payment of wages to workers who have attended Silver Card training, with workers' signed acknowledgement of receipt;

f. Keep record of card numbers, card holders' names and expiry dates of the cards, for the inspection by the CM. Ensure that the Green Cards or Silver Cards held by all workers are valid;

g. Submit to the CM a duly completed prescribed form (DASM-F6211) for the record of Silver Card holders for all workers engaged in the specified trades as listed in sub-clause(4)(b);

h. The Contractor shall ensure that all such personnel and workers shall at all times put on the appropriate Silver Card or Green Card or a valid Construction Workers Registration Card with a printed statement indicating that the holder has a valid Green Card and that such Green Card has not yet expired while they are within the Site. The CM shall, pursuant to GCC Clause 5.9(2), have the power to require the Contractor to remove forthwith any person employed by the Contractor, or by any of his sub-contractors including Nominated Sub-contractors, from the Works who has not complied with the requirements prescribed by sub-clauses (4)(a) and (4)(b) above.

5. Induction training, tool box talks, lunchtime’s safety talks and other training:

The training material shall cover critical items, namely working at height, housekeeping, materials handling, stacking and storing, prevention against falling objects, lifting operations, tower crane and mobile crane among other site activities in the form of audio-visual medium. The training will be subject to verification by safety auditor managed by OSHC;

a. Site specific induction training:

All persons employed on the Works or in connection with the Contract whether in the employment of the Contractor or his sub-contractor shall receive site specific induction training. The induction training shall cover contents to alert persons new to the Site to know specific hazards related to the Site or works nature and activities in operation, and necessary precautionary measures. This training should be carried out on the first working day of any such employee commencing work on the Site. Thereafter, he / she shall be given refresher training at intervals of about 6 months depending on the amount of changes to the site condition. The course shall be conducted by Safety Officers;

b. Tool box talks:
   i. Provide tool box talks to workers once per week. The talks shall be attended by workers who are working on the Site and engaged in activities relevant to the topic of that training. The topics and contents of tool box talks shall be proposed by the Safety Officer having regard to the activities of the Site and the prevailing safety concern at that time;
   ii. Tool box talks shall be conducted based on training kits published by HKCA. If the proposed topic is not amongst one of those published by HKCA kits, the Contractor shall then develop training kits of comparable standard for approval by the CM;
   iii. The Contractor's Safety Officer shall ensure that tool box talks are carried out by Safety Supervisors, foremen or gangers who have received training organised by HKCA or other approved training organisations.
c. Lunchtime's safety talks:
   i. Provide lunchtime's safety talks monthly to workers of at least 10% of daily average worker number of the corresponding month. The topics and contents of lunchtime's safety talks shall be proposed by the Safety Officer and contain but not limited to accident/incident review, findings of Safety PASS, findings of safety audit and surprise inspection by OSHC and findings of inspection by LD;
   ii. The Contractor's Safety Officer shall ensure that lunchtime's safety talks are conducted by Safety Supervisors, foremen or gangers who have received training organised by HKCA or other approved training organisations, or by the training officers of trade associations or workers' unions which are member organisations of Housing Department Site Safety Subcommittee.
d. Arrange safety training of workers involved in unsafe act to let the workers concerned to review their unsafe act and learn the correct practice under the guidance of a safety representative (the ganger of the respective trade) within 7 working days of identification of unsafe act. The unsafe act may be identified by but not limited to the inspectors of Labour Department, surprise safety inspectors of OSHC, the accredited safety auditors during the safety audit, site inspecting officers of HD, the CM or his representatives and the site supervisory personnel of the Contractor.
e. Allow the CM or his representatives to attend any of the training courses viz. general induction training, site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act to verify that they are conducted according to specification;
f. Maintain attendance records on site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act the names of the trainers, names and trades of the persons receiving the training and their signatures; maintain electronic photo records taken during the training and talks that show the attendants attending such training and talks. These records shall be made available for the CM's inspection upon request by the CM;

g. The Contractor's Site Agent or Safety Officer shall certify the accuracy of attendance records on site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act before they are submitted monthly to the CM;

h. Management and other staff, other than workers, employed on the Works or in connection with the Contract whether in the employment of the Contractor or his sub-contractors shall have received appropriate training on safety and health commensurate with their duties;

i. Maintain attendance records on Site for all safety training conducted or arranged. These records shall include the topics and dates of the events, the names of trainers, names and trades of the persons receiving the training and their signature. Electronic means of keeping these records with print outs for submission will be acceptable subject to the approval of the CM. These records shall be made available for the CM's inspection upon request by the CM;

j. Submit the Nominated Sub-contractors' trade specific safety training proposal to the CM for approval;

k. Unskilled labourers who are employed by the Contractor, or any of his sub-contractors including Nominated Sub-contractors, shall upon their first appearance on the Site have satisfactorily completed the training course "Basic Safety for Construction General Workers" organised by OSHC, otherwise arrange those unskilled labourers without having completed the above training to enrol in the above training course upon their first appearance on the Site. Acceptance of alternative training provided by other organisations is subject to verification by the CM that the alternative training is based on course contents of equivalent or higher standards than the aforesaid course of OSHC. Keep a record of the certificates, including the names of the certificate holders, the issue dates of the certificates and the relevant trade category for inspection by the CM, and report the status at the site meeting. Notwithstanding the above requirement, there is a grace period for arranging unskilled labourers to enrol in the above training course up to 31 December 2026 after which any unskilled labourer who has not yet satisfactorily completed the above training shall be arranged to enrol in the above training course upon their first appearance on the Site.

6. Site Safety Committee:

a. Establish a Site Safety Committee which shall be responsible for ensuring the implementation of the Safety Plan, reviewing and monitoring the effectiveness of the safety and health measures taken and seeking the cooperation and commitment of staff at all levels;

b. The Site Safety Committee shall be chaired by the Site Agent with members comprising the Contractor's project manager, Safety Officers, all Nominated Sub-contractors' Safety Supervisors, selected Safety Representatives and other staff of the Contractor or sub-contractors as may be considered necessary. It shall meet at least monthly discussing all matters relating to the implementation of the Safety Plan. The first meeting shall be held no later than 28 days from and including the date for commencement of the Works notified by the CM in accordance with GCC Clause 8.1. The Contractor may invite any other party such as the LD, Police or representatives of Utility Undertakings to attend the meeting to provide advice as necessary;

c. Give advance notice of every Site Safety Committee meeting to the CM who will attend the meeting in person or nominate a representative to attend the meeting as an observer;

d. The following items shall, amongst others, be reported and discussed at the Site Safety Committee meeting:

i. Review of the Safety Plan, update risk assessment for the work scheduled at least for the next 2 months, review and establish safety and health provisions, safe working procedures and method statements, update the emergency and rescue procedure;

ii. Update of the safety organisation chart and review of the adequacy of safety personnel;

iii. Review of the safety performance of sub-contractors;

iv. Any unsafe practices and conditions identified during safety inspections / audits and any follow up action;

v. Advisory / warning or contravention notices and any Improvement / Suspension Notices received from LD;

vi. Review of accident frequency rates and statistics of the Contractor and sub-contractors and identification of trends;

vii. Details of the Contractor's accident and dangerous occurrence experience;

viii. Safety and health training undertaken in the previous month and the proposed training programme for the following month;

ix. Details of safety promotional activities;

x. Safety coordination among various sub-contractors working in close proximity to each other;

xi. Submission of forms GF527 and GF527A or other pertinent forms on the employment statistics of the Contract on a monthly basis as detailed in PRE.B8.1455;

xii. Compilation and submission to the Commissioner for Labour the Supplementary Information on Accidents on Construction Sites for the purpose of analysis in addition to the statutory forms and the requirements of GCC Clause 5.21;

xiii. Updated Safety Plan.

e. Prepare minutes of the Site Safety Committee meeting and copy it to the CM within 5 working days of the meeting.

7. Safe Working Cycle:

a. Practise Safe Working Cycle to improve and promote the safety and health of the Site. Safe Working Cycle should begin when there are workers working on the Site, and shall cease by the certified date of completion of the Works. The activities of Safe Working Cycle are classified into 3 categories. They are Daily Cycle, Weekly Cycle and Monthly Cycle. Details of each category of Safe Working Cycle are given below:

i. Daily Cycle:

- Pre-work Exercise and Safety (PES) meeting;
- Hazard Identification Activity (HIA) meeting;
- Pre-work Safety Checks;
- Safety inspection by Site Agent or his representatives;
- Guidance and supervision during work;
- Safety coordination meeting;
- Daily cleaning and tidying up of the Site;
- Checking of the Site after each day's work.

ii. Weekly Cycle:

- Weekly safety inspection by Site Agent and Safety Officer and the CM or his representatives;
- Weekly safety coordination meeting;
- Weekly overall cleaning and tidying up of the Site;
- Advance planning of the cleaning and tidying up, safety checks of the workplace, machineries and plant, before and after public holidays in the coming week(s). Site Agent and Safety Officer shall prepare a checklist of work making reference to the Handbook on Work Safety Immediately Before and After Public Holidays issued by OSHC and assign competent personnel for implementation and monitoring.

iii. Monthly Cycle:

- Site Safety Committee meeting and pre-meeting inspection.

b. The first 3 items under Daily Cycle described in sub-clause (7)(a)(i), namely, Pre-work Exercise and Safety (PES) meeting, Hazard Identification Activity (HIA) meeting and Pre-work Safety Checks, are collectively referred to as the "Pre-work Activities". Pre-work Activities are to be held for attendance by persons employed on the Works (excluding clerical and administrative staff in site office), irrespective of whether they are in the employment of the Contractor or sub-contractors. Detail requirements for the Pre-work Activities are:

i. Arrange and hold Pre-work Exercise & Safety (PES) meeting of about 10 to 15 minutes for all persons employed on the Works. The PES meeting shall be led by the Site Agent or senior staff of site management of the Contractor, who has attended the training course on Safe Working Cycle of OSHC or CIC. The PES meeting shall start with physical exercise, followed by a briefing to workers on the prevailing safety and health matters related to the Site, such as common hazards and control measures, safety precautions, specific safety concerns etc.;

ii. Arrange and hold Hazard Identification Activity (HIA) meeting of about 10 minutes for the attendees immediately after the PES meeting. Alternatively, the HIA meetings can be held in small groups according to the trades, work teams or works areas set out by the Contractor for the Site. If so, the Contractor shall ensure that the assigned persons are competent to lead the HIA meetings. Persons who have attended one-day training course on HIA leadership provided by OSHC are considered competent to lead the HIA meetings. The issues discussed at the HIA meetings shall cover, but not limited to:

- Implementation of the already devised safe systems of work for hazardous works to be carried out in accordance with the Safety Plan;
- Hazards and control measures specific to the works or trades;
- Special safety concerns;
- Assurance of safety requirements and measures;
- Reprimand of repeated irregularities and malpractice etc..

iii. Arrange and hold Pre-work Safety Checks for the attendee immediately after the HIA meeting. The Pre-work Safety Checks shall be carried out by foremen, gangers, Safety Supervisors or Safety Representatives of the attendees according to the trades, work teams or works areas. The Pre-work Safety Checks shall include the checking of personal protective equipment worn by attendees before they start working on that day such as safety helmet, reflective vest, ear protectors, eye protectors, safety harness, safety footwear etc..

c. Pre-Work Activities are to be held daily, but in any case the frequency of Pre-work Activities for attendance by each person employed on the Works shall not be less than once a week. The Pre-work Activities shall be carried out prior to any work carried out by the persons attending the Pre-work Activities on that day;

d. Maintain attendance records of the workers participating in the Pre-Work Activities including their names and trades. Such attendance records are to be certified by Site Agent. Maintain electronic photo record showing the attendants during such activities. These records shall be made available for the CM's inspection upon request by the CM;

e. Trade Specific Pre-Work Activities (Hazard Identification Activity meetings and Pre-work Safety Checks) are to be conducted by the respective Nominated Sub-contractors prior to the commencement of particular type of the nominated sub-contract works.

8. Safety Representatives:

a. Appoint the ganger of each labour group or team working on Site to act as Safety Representative. The ganger of the bar benders and fixers responsible for supervision and fabrication of reinforcement cages for barrettes and large diameter bored piles must be appointed as Safety Representative. The Safety Representatives shall be clearly identified on Site by wearing an armband or a safety helmet appropriately marked in Chinese and English;

b. The Safety Representatives shall attend Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by OSHC or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by CIC. Acceptance of training provided by other organizations is subject to verification that the training is based on course contents of equivalent or above standards and the appointed superintendent has attained the associated qualification;

c. In respect of underpinning safety management, the Safety Representatives shall be responsible for ensuring that:

i. The directives on safety and health matters from the Contractor, the Safety Officer, Safety Supervisors, Site Agent and Foremen are duly carried out;

ii. Safety practices are adopted by the workers;

iii. Protective clothing and equipment are used by the workers at all times on the Site.

d. Ensure that the Safety Representatives and the workers on the Site under supervision of the Safety Representatives are aware of the roles and responsibilities of the Safety Representatives on safety and health matters.

9. Lift Well Works:

In addition to any obligation under GCC clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of lift well works as recommended in the latest edition of the Guidelines on Safety of Lift Shaft Works issued by CIC and as stated in this sub-clause (9). All references to "lift shaft" in the said Guidelines shall mean "lift well" for the purpose of this sub-clause (9). Examine critically the practices and / or measures as recommended in the said Guidelines, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guidelines may be proposed for the CM's approval before implementation. In addition, carry out the site safety practices and measures including but not limited to the following which are highlights of the said Guidelines with more specific or stringent requirements:

a. The Site Safety Committee shall finalise and endorse the lift installation safety plan submitted by the Nominated Sub-contractor for lift installation, and shall incorporate such plan into the Safety Plan for submission to the CM for his approval;

b. Provide sufficient protection to lift wells before commencement of any lift well works thereto;

c. Provide and maintain temporary work, services and protective measures:

   i. Be responsible for keeping proper records of all inspection records for safety provisions;

   ii. Appoint suitable competent persons to conduct bi-weekly inspections and maintain lift well platforms, scaffolding, wall anchors, independent lifelines and gangways connecting floor edges of lift well and the scaffolding;

   iii. If a scaffolding section is required to be altered to facilitate lift car assembly, conveying of components or other lift installation work, the altered scaffolding shall be supported and reinforced by designated anchors on the wall of lift well in accordance with the designed requirements stipulated in the Safety Plan;

   iv. Be responsible for keeping all keys and locks of lift well protection cages in a neatly and orderly manner. The keys shall only be released to other sub-contractors under the conditions of a permit-to-work system. A log shall be kept to register the locations of the door keys or the person-in-charge for holding such keys;

   v. Provide temporary electricity at voltage 110V with circuits equipped with waterproof sockets for use by the Nominated Sub-contractor for lift installation;

   vi. Obtain from the Nominated Sub-contractor for lift installation the necessary information on the required position of independent lifelines inside lift well. Install at least 3 sets of independent lifelines anchored to eyebolts inside a lift well before handing over to the Nominated Sub-contractor for lift installation. At least one independent lifeline shall be located near the door openings of a lift well;

   vii. Allow no lift worker and other trade worker to work simultaneously inside a lift well;

   viii. Keep to a minimum the number of workers working within a lift well at the same time to the extent that simultaneous working at different levels is strongly not advisable. If simultaneous working at different levels is practically unavoidable, it shall only be limited to one work activity and prior approval from the CM shall be obtained;

ix. Provide anchorage near the lift well openings at the lowest landing floor for use by worker to lock fall arrestor and safety harness when required to access lift pit. Provide anchorage near the lift well openings at other landing floors if necessary for use by worker to lock fall arrestor and safety harness when working near or in the lift well;

x. For anchorages which are installed by the Contractor for any use, appoint QE or a registered professional engineer to check the design and method statement for the construction and to certify the load bearing capacity and the fixing details of the anchorages;

xi. If any particular anchorage plus the corresponding applied load may have effect on the permanent structure by way of overstressing or overloading, appoint QE or a person whose qualification and experience are not inferior to a TCP T5 to certify the plans, design information / justification, load bearing capacity, fixing details and method statement of the anchorages for submission to the CM for approval. The person so appointed should also certify the completion of such works.

d. Conduct risk assessment and prepare the method statements that are not provided by the Nominated Sub-contractor for lift installation:

i. The risk assessment report shall be signed by the Safety Officer and endorsed by the Site Agent and made available on Site for inspection by the CM and LD;

ii Make reference to the sample of risk assessment report at Annex C of Volume 2 of CIC Guidelines on Safety of Lift Shaft Works.

e. Design, construct, use and maintain every lift well platform;

f. Develop and implement a permit-to-work system for lift well works:

i. Enforce and implement permit-to-work system and endorse permits of the permit-to-work system for all hazardous trade processes;

ii. Each permit of the permit-to-work system shall specify details of its length of validity in terms of shift and the type of trade workers who are required to work inside the lift well;

iii. Make reference to the sample form for Permit-to-Work (Work inside lift shaft) at Annex C of Volume 1 of CIC Guidelines on Safety of Lift Shaft Works.

g. Provide fall arrest system and associated safety training that are not provided by the Nominated Sub-contractor for lift installation;

h. Refer to PRE.B10.010 sub-clauses (7) and (8) for the certification requirement of QE and RSE;

i. Provide sufficient safety precautionary measures for buildings with "temporary occupation permit" arrangement, etc..

10. Surprise Safety Inspection Programme (SSIP):

a. Professional Safety Inspectors appointed by OSHC shall conduct surprise safety inspection;

b. The surprise safety inspection may be conducted at any time after the date for commencement of the Works till the certified date of completion of the Works;

c. Surprise safety inspection shall be conducted to every discrete site in bundled contracts. Site visit to every discrete site is required unless there is no significant active site works being carried out on a particular site or all the site works of a particular site have been certified complete;

d. Provide all necessary attendance for the surprise safety inspection including fully facilitating the inspection of the Site, the Works and all necessary supporting documents such as certificates, records and reports relating to safety and health matters, and fully cooperate with the Safety Inspector in the carrying out of the surprise safety inspection;

e. A Contractor's representative must accompany the Safety Inspector throughout the inspection;

f. The Contractor's representative shall fill in the forms of the Record of Caring Opportunities (Form DCMP-F7135 and DCMP-F7136) and hand in the Form DCMP-F7135 to the CM or his representatives and submit the Form DCMP-F7136 to the Safety and Health Unit;

g. The Contractor's representative shall acknowledge the result of the inspection by signing in the presence of Site Staff and submit a copy of signed report to the CM and another copy to OSHC for record;

h. Rectify the non-conformance items recorded by the Safety Inspector; and

i. The Site Agent shall report the results of surprise safety inspection, implementation of the Safety Inspector's recommendations, caring actions taken for the involved employees/workers and supervisors, and the respective follow up rectification actions for non-conformance items in the monthly site meeting.

11. Comply with the requirements of the Construction Sites (Safety) Regulations, and adopt the practices and / or measures in respect of first aid facilities and first aiders recommended in the latest edition of the Reference Materials on Construction Site Welfare, Health and Safety Measures issued by CIC. First aid room shall be provided on Site and fitted with:

    a. sufficient first aid supplies and equipment for transporting the injured persons, including but not limited to stretchers;

    b. First aid kits, up to the standard required by the Occupational Safety and Health Ordinance (Cap. 509) and the Factories and Industrial Undertakings Ordinance (Cap. 59).

12. Safety Climate Index Survey (SCI):

    a. Conduct a safety climate index survey for at least 30% of employees (the minimum sample size shall be 30 people) every six months with reference to the guidebook "Construction Industry Safety Climate Index Software" issued by the OSHC;

    b. Analyse the safety climate index result and prepare the SCI report;

    c. Develop and implement an action plan according to the analysed result;

    d. Submit the safety climate index survey report, action plan and the excel file of raw data base to the Safety and Health Unit of Housing Department for record within 6 months after the certified date of completion of the Works.

13. Work Safe Behaviour Programme:

    a. Use a work safe behaviour programme with reference to the guidebook "Implementing The Work Safe Behaviour (WSB) Programme" issued by the OSHC. Persons who have completed 12-hour train-the-trainer course for work safe behaviour and safety climate index survey offered by OSHC are considered competent to deliver internal training of WSB observers. The course duration of the internal training of WSB observers should be at least 3 hours;

    b. Identify the major high risk activities to the Site Staff for comment according to the construction cycle and review on a half-yearly basis;

c. Based on the major high risk site activities identified, create and develop relevant work safe behaviour checklists and conduct observations with observed data analysed for behaviour interventions. Templates of the work safe behaviour checklists can be downloaded from the Housing Authority Site Safety Website for reference [Home > Tools > Work Safe Behaviour Programme];

d. Analyse the work safe behaviour result and prepare the WSB report;

e. Develop and implement an action plan according to the analysed result;

f. Submit the work safe behaviour report, action plan and the excel file of raw data base to the Safety and Health Unit of Housing Department for record within 6 months after the certified date of completion of the Works.

Option 2

In relation to the requirements of GCC Clause 5.11 and PRE.B6.070, comply with all current Regulations concerning safety on the Site in particular the Factories and Industrial Undertakings Regulations and the requirements specified in the Contract as follows:

1. Safety Officers:

a. Employ Safety Officer(s) and Safety Supervisor(s) in accordance with the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations with specific detailed requirements as follows, and employ any other safety personnel in excess of the following as may be required by any enactments, regulations, by-laws or rules that may be in force at any time during the progress of the Works:

i. The number of Safety Officer(s) to be employed shall depend on the total number of persons employed on Site as indicated below:

Total no. of persons employed on Site	No. of Safety Officer(s) required
Not more than 200	1
201 to 700	2
701 to 1200	3
1201 and above	4

ii. The number of Safety Supervisor(s) to be employed shall depend on the total number of persons employed on Site and in compliance with the above said regulations;

iii. The total number of persons employed on Site as per sub-clauses (a)(i) and (a)(ii) shall include the workforce of the Contractor, the Contractor's sub-contractors but shall exclude the workforce of those separate contractors employed directly by the Employer;

iv. The Safety Officer(s) and Safety Supervisor(s) must be employed full time solely and designated for the Contract. The Safety Officer(s) shall be registered by the Commissioner for Labour under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations. The Safety Supervisor(s) shall be accredited under the Hong Kong Safety and Health Certification Scheme managed by the OSHC. Enhancement courses for Safety Supervisor(s) are conducted by the OSHC and CIC.

b. Do not commence any construction work on the Site without the appointment of the required number of Safety Officer(s) and Safety Supervisor(s) unless expressly permitted by the CM in writing;

c. Before commencement of the Works and whenever there is a change in the appointment of Safety Officer(s) and/or Safety Supervisor(s), report to the CM a written confirmation that Safety Officer(s) and Safety Supervisor(s) are employed in accordance with the Contract. Such written confirmation shall append with the following documents:

   i. The name and a copy of the written notification of registration from the Commissioner for Labour for each Safety Officer;

   ii. A signed statement by each Safety Officer declaring that he is registered as a Safety Officer and he will advise the CM in writing immediately if he is no longer so registered;

   iii. Subject to sub-clause (1)(a)(iv) above, the name and a copy of the written certification of accreditation under the Hong Kong Safety and Health Certification Scheme for each Safety Supervisor;

   iv. Subject to sub-clause (1)(a)(iv) above, a signed statement by each Safety Supervisor declaring that he is accredited as a Safety Supervisor under the Hong Kong Safety and Health Certification Scheme and he will advise the CM in writing immediately if he is no longer so accredited.

d. The duties of Safety Supervisor shall be as stipulated in the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations;

e. The duties of the Safety Officer shall be solely directed towards safety and health matters. In addition to the duties stipulated in the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, the Safety Officer's duties include:

   i. Site inspection:

      - Carry out comprehensive safety inspections on all activities on the Site including temporary works and scaffolding at weekly intervals. The safety inspection shall identify any unsafe operation or potential hazards;
      - The Safety Officer shall be clearly identified on the Site by wearing an armband or a safety helmet appropriately marked in Chinese and English;
      - The Contractor shall empower the Safety Officer to order any person working on the Site to suspend any unsafe operation or to take urgent action to make safe the Site or the Works or to disallow any practice which may infringe the Safety Plan or any statutory safety requirement;
      - Give prior notice to the CM of the date and time of the weekly inspection and allow the CM or his representatives to attend the inspection;
      - Prepare safety inspection reports.

   ii. Safety Plan:

      - Supervise and monitor implementation of the Safety Plan;
      - Ensure that sub-contractors and all persons working on the Site are made aware of and comply with the Safety Plan.

   iii. Accident / Incident report, investigation and follow up actions:

      Carry out the duties relating to accident / incident report, investigation and follow up actions as specified in the Safety Plan;

   iv. Training:

      - Include in the Safety Plan or its monthly update the programme and the number of workers to receive training including site specific induction training, tool box talks and Silver Card training for the coming month;

- Conduct general induction training, site specific induction training as specified. Supervise the conduction of tool box talks specified;
- Identify those workers in the specified trades without valid Silver Card and coordinate their enrolment in requisite Silver Card training provided by CIC;
- At the end of each period of interim certificates report, report to the CM the actual number of workers trained as specified.

v. Site Safety Committee:

Arrange and coordinate Site Safety Committee;

vi. Risk Assessment Report:

- Prepare risk assessment reports for the following month and recommend measures to remove or minimize hazards;
- Adopt the methodology given at the leaflet Five Steps to Risk Assessment, the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work and the Guidance Notes on Prevention of Heat Stroke at Work issued by LD.

vii. Action on LD's contravention notices:

- Attend to the notices issued by LD to the Contractor advising that safety related regulations are contravened, in particular:
  - Construction Site (Safety) Regulations;
  - Subsidiary regulations of the Factories and Industrial Undertakings Ordinance.
- Take all necessary actions to ensure full compliance with all statutory requirements;
- Report monthly to the CM the following LD's notices received:
  - Construction Site Inspection Report with category Part I or Part II contravention;
  - Improvement Notice;
  - Suspension Notice.

viii. Safety audit:

Implement the recommendations of the external Safety Audit Report;

ix. Safety Officer's report:

Compile and report the above duties to the CM at the monthly site meetings;

x. Safety diary:

- Maintain a safety diary which shall record all matters related to safety and health, including Safety Supervisors' reports, details of safety inspections and audits, accidents, dangerous occurrences, safety related incidents, etc.;
- Check to ensure that all unsafe situations are promptly rectified and the dates of their completion duly recorded in the safety diary;
- The safety diary shall be made available for inspection by the CM upon request and copy thereof shall be submitted to the CM upon request.

xi. Keep a register of the names, telephone numbers, addresses and qualifications of any competent persons and competent examiner as defined in the Construction Sites (Safety) Regulations, who has carried out duties on this Contract. Keep a register of the names of Safety Supervisors and their duties discharged as required under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations. Keep examination reports and certificates required by legislations or Contract.

2. Safety Plan:

a. Prepare and submit to the CM 3 copies of a draft Safety Plan within 14 days of the date of the Letter of Acceptance. Arrange and hold an ad hoc meeting (or meetings if necessary) with the CM or his representatives to discuss the draft Safety Plan within 7 days from the submission of such plan. If the CM is of the opinion that the draft Safety Plan does not meet the requirements of the Contract, he can request for remedy of the deficiency. Comply with any such the CM's request prior to submitting 6 copies of the Safety Plan to the CM for endorsement within 35 days of the date of the Letter of Acceptance;

b. Update the Safety Plan at monthly intervals or when required by the CM so that the Safety Plan is at all times a comprehensive and contemporary statement of the Contractor's safety and health policies, procedures and requirements to achieve the safety and health obligations and responsibilities under the Contract. In the circumstance that there is no amendment of the Safety Plan in the monthly updating, submit explanation in writing with detail elaborations on why no amendment is required;

c. The CM may by notice in writing require the Contractor to supplement, revise or update the Safety Plan if he is of the opinion that the Safety Plan is insufficient or requires revision or modification in the interest of the safety, whether for the Works and / or the safety and health of persons on or adjacent to the Site or protection of any property on or adjacent to the Site or otherwise. Comply with the CM's requirements within 7 days of such notice;

d. The CM's endorsement, comment or rejection of the Safety Plan, and of any proposed revision or update, and the implementation of the Safety Plan by the Contractor shall not relieve the Contractor from any obligations or responsibilities under the Contract or any statutory regulations;

e. The Safety Plan and subsequent monthly updated Safety Plan, if any, shall contain, without limitation, details of the following:

i. Company safety and health policy:

A safety and health policy is a written statement produced by the Contractor, signed by a senior member of the management board, in which it sets out its aims and objectives for securing safety and health and the means whereby the objectives can be met. It is the Contractor's statement of intent on matters of safety and health;

ii. Safety organisation:

The safety staff organisational structure including an organisation chart which shows the chain of responsibility and accountability from managing director, project manager, safety manager, Site Agent, Safety Officer(s) and Safety Supervisors. Responsibilities and duties of these safety personnel shall be defined;

iii. Safety and health training:

- Provide all employees and others with adequate information, instruction and training on safety and health. Adopt the methodology given at the guide Five Steps to Information, Instruction and Training issued by LD. State in the safety and health policy the detail arrangements for providing safety and health training;
- The safety and health training shall include but not limited to the following:
  - General induction training;
  - Site specific induction training;
  - Tool box talks;
  - Trade specific safety and health training;
  - Silver Card training;
  - Lunchtime's safety talks.

iv. In-house safety rules and regulations:

- Activities which are complex or inherently hazardous must be accompanied by:
  - Detailed working procedures to clearly identify the hazards and / or potential risks;
  - Clear steps to be taken to manage and to minimise the risks;
  - Operation procedures to ensure safety at work;
  - Provisions to ensure everyone involved is aware of the hazards and the safety precautionary measures to take.
- Strictly control access to particularly hazardous areas or operations. List the activities identified as demanding permits to work. The person identified by job title shall be responsible for the design / preparation of permits;
- A lock-off involves the physical isolation or locking-off to danger zones. The danger zones or operations shall be fenced off by barriers provided with warning notices to prevent unauthorized workers from entering the danger zones. Post a site layout plan indicating danger zones at conspicuous locations of the Site. The permit-to-work system shall cover the following high risk activities -
  - Work in confined spaces (Implement the permit-to-work system given at Appendix 1 of the CoP for Safety and Health at Work in Confined Spaces issued by LD. Follow the safety requirements for works in confined space related to underground drainage work as specified in PRE.B8.215;
  - Work in lift shaft;
  - Mobile crane, heavy machinery, piling rig and mobile elevating work platform operating or moving on the Site;
  - Hot work;
  - Lifting operation by tower cranes and mobile cranes, crawler cranes, or cranes alike or lifting operation by mechanical means (excluding lifting operation with load not exceeding 2.5 tonne within a distance of 2.5 metres from the edge of such crane);
  - Work with electrical hazard under Electricity (Wiring) Regulations;
  - Use of ladder for work above ground for work purpose.

v. Safety Committee as specified;

vi. Programme for inspection, thorough examination and testing of hazardous conditions:

- Provide a complaint management system, which may include a hotline phone number, a complaint management software, or both, to facilitate reporting, tracking and resolution of unsafe conditions and complaints by workers to a Contractor's superintendent. Post notices of the complaint management system at conspicuous locations on the Site. Take follow-up action to deal with the reports received;
- Closely monitor the implementation of the safety and health legal requirements, policies and procedures by effective arrangements including formal inspection, thorough examination and testing. This function must be allocated to suitably trained and experienced competent individuals. Reports (in the format prescribed by legislations if required) highlighting actions to be taken following an inspection shall be speedily prepared and issued to the appropriate superintendent and the CM;
- Inspections should include, but not limited to all:
  - Excavation, shafts, earthworks and tunnels;
  - Cofferdams and caissons, and suspected dangerous atmospheres;
  - Scaffolding;
  - Falsework;
  - Working platforms;
  - Safety belts and anchorage systems (refer to the Guidance Notes on Classification and Use of Safety Belts and their Anchorage System issued by LD with respect to the information on some anchorage systems, the types, uses and specifications of safety belts under several national safety standards);
  - Coverings for openings;
  - Gangways and runs;
  - Passageway for workers to be clear and tidy;
  - Heavy machinery in use has been fenced off;
  - Guard rails, barriers, toeboards and fences;
  - Local exhaust;
  - Pressure system and gas containers;
  - Breathing apparatus, revival and other safety and rescue equipment;
  - Electrical equipment and appliances;
  - Fire fighting equipment;
  - First-aid box provisions.
- Inspections, thorough examination and testing shall include, but not limited to:
  - Suspended working platforms;
  - Lifting appliances and lifting gear;

    (Refer to the Construction Sites (Safety) Regulations and the Guidance Notes on the Inspection, Thorough Examination and Testing of Suspended Working Platforms and the Guidance Notes on the Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by LD)

- Tower cranes (including its anti-collision system), static and mobile cranes.

vii. Job hazard analysis:

- Carry out risk assessment to identify hazards in the workplace and assess the risk to employees and others who may be affected. Assessments shall be carried out by competent persons. When a risk assessment has indicated that a task poses a significant risk to safety and health, a written safe system of work shall be produced;
- A safe system of work must include not only procedures, equipment, materials and environment that are safe, but also safe workforce i.e. adequately trained, informed and supervised. Where appropriate, the safety system should also specify any checks to be made before the task is carried out;
- Refer to Form DCMP-F788 Generic (non-exhaustive) Checklist for High Risk Activities which gives examples of construction operations / activities requiring job hazard analysis. Contractor shall build up the list as appropriate and establish appropriate control measures / safe operation procedures. The DCMP-F788 is retrievable from the Question no. 5 of the Frequently Asked Questions (FAQ) of the Housing Authority Site Safety Website;
- Develop safe systems of work in a systematic manner following the guidebook Safe Systems of Work issued by LD.

viii. Personal protection programme:

The type of personal protective equipment (PPE) to be worn in particular situations and any specific requirement related thereto shall be established as a result of a risk assessment which will be the first step towards ensuring compatibility between the risk and correct personal protective equipment. Develop procedures for PPE issue, maintenance and reporting defects;

ix. Accident / Incident report, investigation and follow up actions:

- Report accidents and dangerous occurrence as defined in the Factories and Industrial Undertakings Regulations to LD in the prescribed Form 2 with Supplementary Information on Accidents on Construction Sites & Dangerous Occurrence Report Form;
- Copy the Supplementary Information Sheet, Dangerous Occurrence Report Form, Suspension Notice and Improvement Notice issued by the LD to the CM according to GCC Clause 5.21;
- Notify the CM immediately of all 'reportable accidents' as defined under the Factories and Industrial Undertakings Regulations and of the accidents / incidents to be reported in prescribed forms using web through the Housing Authority Safety Alert Module and followed by submission of the completed documents to the CM under the accident / incident reporting procedures of the HD set out at the Housing Authority Site Safety Website (http://www.housingauthority.gov.hk/sitesafety) and comply with the procedures;
- Notify the Site Staff immediately (i.e. within the day of the accident / incident) of accidents / incidents on Site, including:
  - Serious accidents / incidents;

- Reportable accidents, dangerous occurrence and near miss / incidents (if the accidents / incidents, though not serious by immediate effect, may have potentially serious consequence, such as those involving but not limited to falling from height, falling object, being struck by moving object, injury to head, profuse bleeding, injured person becoming unconscious, body of injured person pierced by foreign object, public safety etc.) on Site;
- Death of person;
- Tree failure incidents resulting in any of the following:
  - Loss of human life;
  - Major injury where the injured is admitted or to be admitted to hospital;
  - Substantial damage to properties;
  - Serious / complete blockage to main pedestrian / vehicular access.
- Any emergency situations as referred to in sub-clause (2)(e)(x).

- Inform the CM immediately whether the progress of construction works or the office operation of the Contractor and / or his sub-contractors are being affected or likely to be affected by the emergency situations as referred to in sub-clause (2)(e)(x);
- Provide statistics and analysis of accidents / incidents, investigate and ascertain the contributory factors and root causes, identify the trends and recommend means of prevention and improvement;
- The accident / incident investigation shall include, but not limited to, the following major items:
  - Causes of sub-standard safety performance;
  - Potential deficiencies of the safety control system;
  - Areas of review and lessons learnt;
  - Recommendations to prevent recurrences;
  - Improvements to the safety control system to meet the Legislations and recommendations of the investigation report.
- Provide statistics and trends of late report of accidents / incidents, later than the time prescribed under the relevant legislations and Contract clauses; identify the causes and recommend means of improvement;
- Provide means to communicate accident / incident statistics information, recommendation to prevent recurrences and lessons learnt from previous accidents / incidents to all persons working on the Site.

x. Emergency preparedness:

- An emergency situation means a situation requiring emergency assistance of fire services / police / ambulance etc. It includes:
  - An accident which results in death or serious injury;
  - A fire breaking out which requires rescue crews from Fire Services Department to effect control;
  - A flood that causes or threatens life on Site;
  - A leakage of dangerous goods or chemicals;
  - An accident of geotechnical concern such as landslip, rockfall, retaining wall failure, ground subsidence or land instability;
  - An outbreak of epidemic / infectious disease on Site;

- Any superintendent or worker of the Contractor or his sub-contractors on Site who has been confirmed or suspected of contracting epidemic / infectious disease;
- Any other accident / incident which creates a dangerous situation.

- Evacuation plans to be drawn for all areas. Call the hotline 999 and notify Site Staff immediately in case of emergency. Calling the local police station, fire services station and ambulance depot for police, fire services and ambulance can be accepted as an alternative to calling the hotline 999. The procedures are to be reviewed and revised periodically, especially when the work-site configuration is altered or changed in some way;
- Prepare emergency procedures for responding, monitoring and reporting on the following potential emergency situations:
  - Fire;
  - Accidents / Incidents;
  - Typhoons;
  - Heavy rainstorms, black rainstorms, floods;
  - Tree failures;
  - Working in confined space;
  - Leakage of chemicals or dangerous goods;
  - Damage of existing utilities;
  - Underground contamination;
  - Traffic incidents;
  - Announcement by the Government of any response level under the three-tier response levels, i.e. “Alert”, “Serious” and “Emergency” in the context of preparing for and responding to infectious disease of public health significance;
  - Outbreak of epidemic / infectious disease on Site;
  - Any superintendent or worker of the Contractor or his sub-contractors on Site confirmed or suspected of contracting epidemic / infectious disease;
  - Any superintendent of the Contractor put under quarantine or medical surveillance for having close contact with infected personnel of epidemic / infectious disease and such superintendent has contacted with HA / HD officer or visited any HA / HD premises or sites;
  - Geotechnical concerns such as flood, landslip / rockfall, retaining wall failure, ground subsidence, or any land instability.
- Prepare contingency plans with detailed arrangements to be adopted to mitigate the effects of the above potential emergency situations on the Contractor’s organization and disruption to the progress of the Works. The contingency plans should aim at maintaining or resuming the progress of the Works as soon as possible whilst ensuring the safety and health of all personnel on the Site.

xi. Safety promotion:

- The effort made by different sub-contractors or individuals to reduce accidents at work by the application of soundly based policies, procedures and disciplines to be recognised by the presentation of safety and health award. Adopt proactive attitude towards improving safety and health performance and / or the best related achievement in reducing number of accidents. The Site as a whole is encouraged to participate in the following designated safety and health campaigns:
  - "Construction Safety Promotional Campaign", "Occupational Health Award" or "Hong Kong Occupational Safety and Health Award" led by OSHC;
  - "Construction Industry Safety Award Scheme" led by LD;
  - "Considerate Contractors Site Award Scheme" led by DEVB and CIC.
- The Contractor is also encouraged to organize site-based safety and health awards and competitions to promote participation of his workers and teams in safety and health theme competitions during the contract period. The adjudicating team shall comprise the site management team, safety personnel and workers' representatives, and shall act openly and fairly in such events.

xii. Health assurance programme:

- The health of employees and others affected by the Contractor's activities must form an important part of the Contractor's safety and health policy. Work related health aspects, such as pre-employment and routine medical examination of employees engaged in specific jobs, shall be considered (refer to the Guidance Notes on Medical Examinations for Workers engaged in Hazardous Occupations in Industrial Undertakings issued by LD). Similarly, health related matters which may affect the workplace such as fumes or vapours from hazardous or toxic substances, pollution, noise, radiation etc., are to be reviewed;
- Health surveillance is to be used to detect adverse health effects at an early stage. Appropriate risk assessment to identify the circumstances in which health surveillance becomes necessary.

xiii. Health care plan:

Implement a health care plan for workers on Site as specified under PRE.B8.300;

xiv. Evaluation, selection and control of sub-contractors:

The means by which to ensure sub-contractors of all levels comply with the Safety Plan and statutory requirements on safety and health;

xv. Process control programme:

Safety rules, regulations and working procedures covering all safety and health aspects, and in particular method statements and permit-to-work systems for identified high risk operations are to be addressed. Prepare pictorial or graphical presentation of safe working procedures and method statements of identified high risk operations for understanding by frontline personnel;

xvi. Non-smoking policy:

Mandate a non-smoking policy including the rules adopted by the Contractor with respect to prohibition of smoking on Site. In the event that the Contractor does not fully prohibit smoking on Site, include a site plan showing the number and sizes of the designated smoking areas and describe the associated requirements of provisions of fire fighting appliances and cleaning services in the policy as per PRE.B8.360.

f. Comply with the Safety Plan and ensure all Safety Officers, Safety Supervisors and all personnel who are in a position of authority among sub-contractors have access to the Safety Plan and made aware of their obligation to comply with the Safety Plan. Any Specialist Contractor and other entities (e.g. Utility Undertakings) working on the Site shall be provided with a copy of the Safety Plan and be required to comply with it, and report to the CM for any non-compliance on their part;

g. Provide all facilities, access and assistance to the CM to periodically check that the Safety Plan is being implemented properly and fully. If the CM is of the opinion that the Contactor fails to implement the Safety Plan properly and fully and the failure does or may adversely affect the safety, whether for the Works and / or the safety and health of persons on or adjacent to the Site, or protection of any property on or adjacent to the Site or otherwise, the CM shall notify the Contractor in writing of the failure. The Contractor shall take action to remedy the failure immediately. The CM may suspend the Works, or any part of it, until such time the failure has been rectified.

3. Housing Authority Safety Auditing System (HASAS):

a. Safety Auditor:

To be nominated centrally by the Safety and Health Unit of Housing Department using a random selection computing programme based on the list provided by OSHC after checking and confirmation of the following requirements by OSHC:

i. Must be from the OSHC's list of Accredited Safety Auditors after the date of the Letter of Acceptance;

ii. Must have no current commercial dealings with the Contractor;

iii. Clear of any conflict of interest in exercising his role as safety auditor.

b. The Contractor may agree or reject such nomination with valid reason. If the nominee is rejected, re-nominate by the Safety and Health Unit of Housing Department using a random selection computing programme to repeat the selection process as in sub-clause (3)(a) above until an Accredited Safety Auditor is selected and appointed;

c. Once nomination is agreed:

i. The Accredited Safety Auditor shall conduct safety audit with the Contractor's representatives under the management of the OSHC once every 3 months;

ii. The CM may instruct the Accredited Safety Auditor to commence the Safety Audit at any time, but not later than the end of the 3rd month from the notified date for commencement of the Works;

iii. Provide attendance of most senior site representative at each safety audit;

iv. Provide all necessary attendance for the safety audit including fully facilitating the inspection of the Site and the Works and all certificates, records and reports relating to safety and health matters, and fully cooperate with the Accredited Safety Auditor in the carrying out of the safety audit;

v. Report to the Accredited Safety Auditor innovative and functional safety installation or safety measures, applications of Building Information Modelling for safety and applications of Radio Frequency Identification for safety implemented for this Contract for onward payment assessment.

d. The Project Director / Heads of Projects of the Contractor shall sign an acknowledgement of receipt of the Safety Audit Report prepared by the Accredited Safety Auditor and submit to OSHC for record;

e. Implement the recommendations of the Accredited Safety Auditor within the time frame specified in the Safety Audit Report;

f. The Safety Officer shall report on the implementation of Accredited Safety Auditor's recommendations in the monthly site meeting;

g. Allow for all work undertaken in preparation for the safety audit or in the implementation of the Accredited Safety Auditor's recommendations. Neither shall entitle the Contractor to any extension of time for completion of the Works.

4. Green Card and Silver Card:

a. The Contractor, and any of his sub-contractors, shall provide and employ for the purposes of the Works such technical personnel and such skilled, semi-skilled and unskilled labourers who, upon their first appearance in the Site and throughout their working in the Site, are a holder of either a valid Green Card issued by an organisation or institution recognized by LD or a valid Construction Workers Registration Card issued under the Construction Workers Registration Ordinance. The Green Card referred to in this sub-clause is a statutory identification document issued to a person by an organization or institution recognized by LD upon completion of the training on Green Card;

b. The following trades shall be carried out by workers holding Silver Cards issued by CIC upon their first appearance in the Site and throughout their working in the Site:

i. Painter and Decorator;

ii. Carpenter;

iii. Demolition Worker (Building);

iv. Plumber;

v. Bar Bender and Fixer;

vi. Plasterer and Tiler;

vii. Bamboo Scaffolder and Metal Scaffolder;

viii. Construction Materials Rigger;

ix. Rigger and Signaller;

x. Curtain Wall Installer;

xi. Tower Crane Worker (Erecting, Dismantling, Telescoping & Climbing);

xii. Concretor;

xiii. Tunnel Worker;

xiv. Lift Mechanic.

c. Arrange and release workers of the trades listed in sub-clauses (4)(b)(i) to (4)(b)(xiii) to attend Silver Card training or revalidation training. Bear the fees for the training courses and pay workers the wages which they would otherwise earn during that period of attending the training courses had the Contractor not released them to attend the training courses;

d. Keep record of payment for the fees of the training courses and, if applicable, payment of wages to workers who have attended Silver Card training, with workers' signed acknowledgement of receipt;

e. Keep record of card numbers, card holders' names and expiry dates of the cards, for the inspection by the CM. Ensure that the Green Cards or Silver Cards held by all workers are valid;

f. Submit to the CM a duly completed prescribed form (DASM-F6211) for the record of Silver Card holders for all workers engaged in the specified trades as listed in sub-clause(4)(b);

g. The Contractor shall ensure that all such personnel and workers shall at all times put on the appropriate Silver Card or Green Card or a valid Construction Workers Registration Card with a printed statement indicating that the holder has a valid Green Card and that such Green Card has not yet expired while they are within the Site. The CM shall, pursuant to GCC Clause 5.9(2), have the power to require the Contractor to remove forthwith any person employed by the Contractor, or by any of his sub-contractors, from the Works who has not complied with the requirements prescribed by sub-clauses (4)(a) and (4)(b) above.

5. Induction training, tool box talks, lunchtime's safety talks and other training:

The training material shall cover critical items, namely working at height, housekeeping, materials handling, stacking and storing, prevention against falling objects, lifting operations, tower crane, and mobile crane among other site activities in the form of audio-visual medium. The training will be subject to verification by safety auditor managed by OSHC;

a. Site specific induction training:

All persons employed on the Works or in connection with the Contract whether in the employment of the Contractor or his sub-contractor shall receive site specific induction training. The induction training shall cover contents to alert persons new to the Site to know specific hazards related to the Site or works nature and activities in operation, and necessary precautionary measures. This training should be carried out on the first working day of any such employee commencing work on the Site. Thereafter, he / she shall be given refresher training at intervals of about 6 months depending on the amount of changes to the site condition. The course shall be conducted by Safety Officers;

b. Tool box talks:

i. Provide tool box talks to workers once per week. The talks shall be attended by workers who are working on the Site and engaged in activities relevant to the topic of that training. The topics and contents of tool box talks shall be proposed by the Safety Officer having regard to the activities of the Site and the prevailing safety concern at that time;

ii. Tool box talks shall be conducted based on training kits published by HKCA. If the proposed topic is not amongst one of those published by HKCA kits, the Contractor shall then develop training kits of comparable standard for approval by the CM;

iii. The Contractor's Safety Officer shall ensure that tool box talks are carried out by Safety Supervisors, foremen or gangers who have received training organised by HKCA or other approved training organisations.

c. Lunchtime's safety talks:

i. Provide lunchtime's safety talks monthly to workers of at least 10% of daily average worker number of the corresponding month. The topics and contents of lunchtime's safety talks shall be proposed by the Safety Officer and contain but not limited to accident / incident review, findings of Safety PASS, findings of safety audit and surprise inspection by OSHC and findings of inspection by LD;

ii. The Contractor's Safety Officer shall ensure that lunchtime's safety talks are conducted by Safety Supervisors, foremen or gangers who have received training organised by HKCA or other approved training organisations, or by the training officers of trade associations or workers' unions which are member organisations of Housing Department Site Safety Subcommittee.

d. Arrange safety training of workers involved in unsafe act to let the workers concerned to review their unsafe act and learn the correct practice under the guidance of a safety representative (the ganger of the respective trade) within 7 working days of identification of unsafe act. The unsafe act may be identified by but not limited to the inspectors of Labour Department, surprise safety inspectors of OSHC, the accredited safety auditors during the safety audit, site inspecting officers of HD, the CM or his representatives and the site supervisory personnel of the Contractor.

e. Allow the CM or his representatives to attend any of the training courses viz. general induction training, site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act to verify that they are conducted according to specification;

f. Maintain attendance records on site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act the names of the trainers, names and trades of the persons receiving the training and their signatures; maintain electronic photo records taken during the training and talks that show the attendants attending such training and talks. These records shall be made available for the CM's inspection upon request by the CM;

g. The Contractor's Site Agent or Safety Officer shall certify the accuracy of attendance records on site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act before they are submitted monthly to the CM;

h. Management and other staff, other than workers, employed on the Works or in connection with the Contract whether in the employment of the Contractor or his sub-contractors shall have received appropriate training on safety and health commensurate with their duties;

i. Maintain attendance records on Site for all safety training conducted or arranged. These records shall include the topics and dates of the events, the names of trainers, names and trades of the persons receiving the training and their signature. Electronic means of keeping these records with print outs for submission will be acceptable subject to the approval of the CM. These records shall be made available for the CM's inspection upon request by the CM;

j. Unskilled labourers who are employed by the Contractor, or any of his sub-contractors, shall upon their first appearance on the Site have satisfactorily completed the training course "Basic Safety for Construction General Workers" organised by OSHC, otherwise arrange those unskilled labourers without having completed the above training to enrol in the above training course upon their first appearance on the Site. Acceptance of alternative training provided by other organisations is subject to verification by the CM that the alternative training is based on course contents of equivalent or higher standards than the aforesaid course of OSHC. Keep a record of the certificates, including the names of the certificate holders, the issue dates of the certificates and the relevant trade category for inspection by the CM, and report the status at the site meeting. Notwithstanding the above requirement, there is a grace period for arranging unskilled labourers to enrol in the above training course up to 31 December 2026 after which any unskilled labourer who has not yet satisfactorily completed the above training shall be arranged to enrol in the above training course upon their first appearance on the Site.

6. Site Safety Committee:

a. Establish a Site Safety Committee which shall be responsible for ensuring the implementation of the Safety Plan, reviewing and monitoring the effectiveness of the safety and health measures taken and seeking the cooperation and commitment of staff at all levels;

b. The Site Safety Committee shall be chaired by the Site Agent with members comprising the Contractor's project manager, Safety Officers, selected Safety Representatives and other staff of the Contractor or sub-contractors as may be considered necessary. It shall meet at least monthly discussing all matters relating to the implementation of the Safety Plan. The first meeting shall be held no later than 28 days from and including the date for commencement of the Works notified by the CM in accordance with GCC Clause 8.1. The Contractor may invite any other party such as the LD, Police or representatives of Utility Undertakings to attend the meeting to provide advice as necessary;

c. Give advance notice of every Site Safety Committee meeting to the CM who will attend the meeting in person or nominate a representative to attend the meeting as an observer;

d. The following items shall, amongst others, be reported and discussed at the Site Safety Committee meeting:

i. Review of the Safety Plan, update risk assessment for the work scheduled at least for the next 2 months, review and establish safety and health provisions, safe working procedures and method statements, update the emergency and rescue procedure;

ii. Update of the safety organisation chart and review of the adequacy of safety personnel;

iii. Review of the safety performance of sub-contractors;

iv. Any unsafe practices and conditions identified during safety inspections / audits and any follow up action;

v. Advisory / warning or contravention notices and any Improvement / Suspension Notices received from LD;

vi. Review of accident frequency rates and statistics of the Contractor and sub-contractors and identification of trends;

vii. Details of the Contractor's accident and dangerous occurrence experience;

viii. Safety and health training undertaken in the previous month and the proposed training programme for the following month;

ix. Details of safety promotional activities;

x. Safety coordination among various sub-contractors working in close proximity to each other;

xi. Submission of forms GF527 and GF527A or other pertinent forms on the employment statistics of the Contract on a monthly basis as detailed in PRE.B8.1455;

xii. Compilation and submission to the Commissioner for Labour the Supplementary Information on Accidents on Construction Sites for the purpose of analysis in addition to the statutory forms and the requirements of GCC Clause 5.21;

xiii. Updated Safety Plan.

e. Prepare minutes of the Site Safety Committee meeting and copy it to the CM within 5 working days of the meeting.

7. Safe Working Cycle:

a. Practise Safe Working Cycle to improve and promote the safety and health of the Site. Safe Working Cycle should begin when there are workers working on the Site, and shall cease by the certified date of completion of the Works. The activities of Safe Working Cycle are classified into 3 categories. They are Daily Cycle, Weekly Cycle and Monthly Cycle. Details of each category of Safe Working Cycle are given below:

   i. Daily Cycle:

      - Pre-work Exercise and Safety (PES) meeting;
      - Hazard Identification Activity (HIA) meeting;
      - Pre-work Safety Checks;
      - Safety inspection by Site Agent or his representatives;
      - Guidance and supervision during work;
      - Safety coordination meeting;
      - Daily cleaning and tidying up of the Site;
      - Checking of the Site after each day's works.

   ii. Weekly Cycle:

      - Weekly safety inspection by Site Agent and Safety Officer and the CM or his representatives;
      - Weekly safety coordination meeting;
      - Weekly overall cleaning and tidying up of the Site;
      - Advance planning of the cleaning and tidying up, safety checks of the workplace, machineries and plant, before and after public holidays in the coming week(s). Site Agent and Safety Officer shall prepare a checklist of work making reference to the Handbook on Work Safety Immediately Before and After Public Holidays issued by OSHC and assign competent personnel for implementation and monitoring.

   iii. Monthly Cycle:

      - Site Safety Committee meeting and pre-meeting inspection.

b. The first 3 items under Daily Cycle described in sub-clause (7)(a)(i), namely, Pre-work Exercise and Safety (PES) meeting, Hazard Identification Activity (HIA) meeting and Pre-work Safety Checks, are collectively referred to as the "Pre-work Activities". Pre-work Activities are to be held for attendance by persons employed on the Works (excluding clerical and administrative staff in site office), irrespective of whether they are in the employment of the Contractor or sub-contractors. Detail requirements for the Pre-work Activities are:

   i. Arrange and hold Pre-work Exercise & Safety (PES) meeting of about 10 to 15 minutes for all persons employed on the Works. The PES meeting shall be led by the Site Agent or senior staff of site management of the Contractor, who has attended the training course on Safe Working Cycle of OSHC or CIC. The PES meeting shall start with physical exercise, followed by a briefing to workers on the prevailing safety and health matters related to the Site, such as common hazards and control measures, safety precautions, specific safety concerns etc.;

ii. Arrange and hold Hazard Identification Activity (HIA) meeting of about 10 minutes for the attendees immediately after the PES meeting. Alternatively, the HIA meetings can be held in small groups according to the trades, work teams or works areas set out by the Contractor for the Site. If so, the Contractor shall ensure that the assigned persons are competent to lead the HIA meetings. Persons who have attended one-day training course on HIA leadership provided by OSHC are considered competent to lead the HIA meetings. The issues discussed at the HIA meetings shall cover, but not limited to:

- Implementation of the already devised safe systems of work for hazardous works to be carried out in accordance with the Safety Plan;
- Hazards and control measures specific to the works or trades;
- Special safety concerns;
- Assurance of safety requirements and measures;
- Reprimand of repeated irregularities and malpractice etc..

iii. Arrange and hold Pre-work Safety Checks for the attendee immediately after the HIA meeting. The Pre-work Safety Checks shall be carried out by foremen, gangers, Safety Supervisors or Safety Representatives of the attendees according to the trades, work teams or works areas. The Pre-work Safety Checks shall include the checking of personal protective equipment worn by attendees before they start working on that day such as safety helmet, reflective vest, ear protectors, eye protectors, safety harness, safety footwear etc..

c. Pre-Work Activities are to be held daily, but in any case the frequency of Pre-work Activities for attendance by each person employed on the Works shall not be less than once a week. The Pre-work Activities shall be carried out prior to any work carried out by the persons attending the Pre-work Activities on that day;

d. Maintain attendance records of the workers participating in the Pre-Work Activities including their names and trades. Such attendance records are to be certified by Site Agent. Maintain electronic photo record showing the attendants during such activities. These records shall be made available for the CM's inspection upon request by the CM.

8. Safety Representatives:

a. Appoint the ganger of each labour group or team working on Site to act as Safety Representative. The ganger of the bar benders and fixers responsible for supervision and fabrication of reinforcement cages for barrettes and large diameter bored piles must be appointed as Safety Representative. The Safety Representatives shall be clearly identified on Site by wearing an armband or a safety helmet appropriately marked in Chinese and English;

b. The Safety Representatives shall attend Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by OSHC or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by the CIC. Acceptance of training provided by other organizations is subject to verification that the training is based on course contents of equivalent or above standards and the appointed superintendent has attained the associated qualification;

c. In respect of underpinning safety management, the Safety Representatives shall be responsible for ensuring that:

i. The directives on safety and health matters from the Contractor, the Safety Officer, Safety Supervisors, Site Agent and Foremen are duly carried out;

ii. Safety practices are adopted by the workers;

iii. Protective clothing and equipment are used by the workers at all times on the Site.

d. Ensure that the Safety Representatives and the workers on the Site under supervision of the Safety Representatives are aware of the roles and responsibilities of the Safety Representatives on safety and health matters.

9. Surprise Safety Inspection Programme (SSIP):
   a. Professional Safety Inspectors (SI) appointed by OSHC shall conduct surprise safety inspection;
   b. The surprise safety inspection may be conducted at any time after the date for commencement of the Works till the certified date of completion of the Works;
   c. Surprise safety inspection shall be conducted to every discrete site in bundled contracts. Site visit to every discrete site is required unless there is no significant active site works being carried out on a particular site or all the site works of a particular site have been certified complete;
   d. Provide all necessary attendance for the surprise safety inspection including fully facilitating the inspection of the Site, the Works and all necessary supporting documents such as certificates, records and reports relating to safety and health matters, and fully cooperate with the Safety Inspector in the carrying out of the surprise safety inspection;
   e. A Contractor's representative must accompany the Safety Inspector throughout the inspection;
   f. The Contractor's representatives shall fill in the forms of the Record of Caring Opportunities (Form DCMP-F7135 and DCMP-F7136) and hand in the Form DCMP-F7135 to the CM or his representatives and submit the Form DCMP-F7136 to the Safety and Health Unit;
   g. The Contractor's representative shall acknowledge the result of the inspection by signing in the presence of Site Staff and submit a copy of signed report to the CM and another copy to OSHC for record;
   h. Rectify the non-conformance items recorded by the Safety Inspector; and
   i. The Site Agent shall report the results of surprise safety inspection, implementation of the Safety Inspector's recommendations, caring actions taken for the involved employees/workers and supervisors, and the respective follow-up rectification actions for non-conformance items in the monthly site meeting.
10. Comply with the requirements of the Construction Sites (Safety) Regulations, adopt the practices and / or measures in respect of first aid facilities and first aiders recommended in the latest edition of the Reference Materials on Construction Site Welfare Health and Safety Measures issued by CIC. First aid room shall be provided on Site and fitted with:
    a. Sufficient first aid supplies and equipment for transporting the injured persons, including but not limited to stretchers;
    b. First aid kits, up to the standard required by the Occupational Safety and Health Ordinance (Cap. 509) and the Factories and Industrial Undertakings Ordinance (Cap. 59).
11. Safety Climate Index Survey (SCI):
    a. Conduct a safety climate index survey for at least 30% of employees (the minimum sample size shall be 30 people) every six months with reference to the guidebook "Construction Industry Safety Climate Index Software" issued by OSHC;
    b. Analyse the safety climate index result and prepare the SCI report;
    c. Develop and implement an action plan according to the analysed result;

d. Submit the safety climate index survey report, action plan and the excel file of raw data base to the Safety and Health Unit of Housing Department for record within 6 months after the certified date of completion of the Works.

12. Work Safe Behaviour Programme:
    a. Use a work safe behaviour programme with reference to the guidebook "Implementing The Work Safe Behaviour (WSB) Programme" issued by the OSHC. Persons who have completed 12-hour train-the-trainer course for work safe behaviour and safety climate index survey offered by OSHC are considered competent to deliver internal training of WSB observers. The course duration of the internal training of WSB observers should be at least 3 hours;
    b. Identify the major high risk activities to the Site Staff for comment according to the working cycle;
    c. Based on the major high risk activities identified, create and develop relevant work safe behaviour checklists and conduct observations with observed data analysed for behaviour interventions. Templates of the work safe behaviour checklists can be downloaded from the Housing Authority Site Safety Website for reference;
    d. Analyse the work safe behaviour result and prepare the WSB report;
    e. Develop and implement an action plan according to the analysed result;
    f. Submit the work safe behaviour report, action plan and the excel file of raw data base to the Safety and Health Unit of Housing Department for record within 6 months after the certified date of completion of the Works.

Option 3

In relation to the requirements of GCC Clause 5.11 and PRE.B6.070, comply with all current Regulations concerning safety on the Site in particular the Factories and Industrial Undertakings Regulations and the requirements specified in the Contract as follows:

1. Safety Plan:
    a. Prepare and submit to the CM a detailed and comprehensive draft Safety Plan within 28 days of the notified date for commencement of the Works and shall implement the same throughout the progress of the Works;
    b. Update the Safety Plan from time to time and as necessary, or when required by the CM, revise and update the Safety Plan so that it is at all times a comprehensive and contemporary statement of the Contractor's safety and health policies, procedures and requirements to achieve the safety and health obligations and responsibilities under the Contract. The submission to the CM of a revision and / or update of the Safety Plan shall be made in accordance with GCC Clause 4.3;
    c. The CM may by notice in writing require the Contractor to supplement, revise or update the Safety Plan if he is of the opinion that the Safety Plan is insufficient or requires revision or modification in the interest of the safety, whether for the Works and / or the safety and health of persons on or adjacent to the Site or protection of any property on or adjacent to the Site or otherwise. Comply with the CM's requirements within a reasonable time;
    d. The CM's endorsement, comment or rejection of the Safety Plan and of any proposed revision or update, and the implementation of the Safety Plan by the Contractor shall not relieve the Contractor from any obligations or responsibilities under the Contract or any statutory regulations;

e. Comply with the Safety Plan and ensure that all Safety Officers, Safety Supervisors and all personnel who are in a position of authority among sub-contractors have access to a copy of the Safety Plan and made aware of their obligation to comply with the Safety Plan. Any Specialist Contractor and other entities (e.g. Utility Undertakings) working on the Site shall be provided with a copy of the Safety Plan and be required to comply with it, and report to the CM for any non-compliance on their part. The Safety Supervisor(s) shall be accredited under the Hong Kong Safety and Health Certification Scheme managed by the OSHC. Enhancement courses for Safety Supervisor(s) are conducted by the OSHC and CIC;

f. Provide all facilities, access and assistance to the CM to periodically check that the Safety Plan is being implemented properly and fully. If the CM is of the opinion that the Contactor fails to implement the Safety Plan properly and fully and the failure does or may adversely affect the safety, whether for the Works and / or the safety and health of persons on or adjacent to the Site, or protection of any property on or adjacent to the Site or otherwise, the CM shall notify the Contractor in writing of the failure. The Contractor shall take action to remedy the failure immediately. The CM may suspend the Works, or any part of it, until such time the failure has been rectified;

g. The Safety Plan and any subsequent updated Safety Plan, if any, shall contain, without limitation, details of the following:

   i. A policy statement for safety and health signed by the managing director of the Contractor and his most senior representative on the Site;

   ii. Statutory and contractual obligations regarding safety and health imposed on the Contractor and the means by which the Contractor will achieve due compliance;

   iii. The safety staff organisational structure including an organisation chart which shows the chain of responsibility and accountability from managing director, project manager, safety manager, and site agent. Define responsibilities and duties of these safety personnel;

   iv. The means by which to ensure sub-contractors of all levels shall comply with the Safety Plan and statutory requirements on safety and health;

   v. Assessment of the risks to safety and health associated with the Works, where appropriate, and proposals for necessary precautions including safe working procedures and methods for the following:

      - Work at height and the associated risks of fall of persons and objects;
      - Use of lifting appliances and lifting gear;
      - Excavation;
      - Use of electricity;
      - Use of machinery, construction plant and equipment;
      - Temporary works;
      - Use of dangerous substances including insecticides and pesticides;
      - Use of hand tools;
      - Working in hot, cold and inclement weather;
      - Working on slopes;
      - Working in roads and footways;
      - Natural hazards from contact with soil, plants, noxious animals and insects.

   vi. Emergency procedures:

- Prepare emergency procedures for responding, monitoring and reporting on the following potential emergency situations:
  - Fire;
  - Accidents;
  - Typhoons;
  - Heavy rainstorms, black rainstorms, floods;
  - Tree failures
  - Leakage of chemicals or dangerous goods;
  - Damage of existing utilities;
  - Traffic incidents;
  - Announcement by the Government of any response level under the three-tier response levels, i.e. “Alert”, “Serious” and “Emergency” in the context of preparing for and responding to infectious disease of public health significance;
  - Outbreak of epidemic / infectious disease on Site;
  - Any superintendent or worker of the Contractor or his sub-contractors on Site confirmed or suspected of contracting epidemic / infectious disease;
  - Any superintendent of the Contractor put under quarantine or medical surveillance for having close contact with infected personnel of epidemic / infectious disease and such superintendent has contacted with HA / HD officer or visited any HA / HD premises or sites.
- Prepare contingency plans with detailed arrangements to be adopted to mitigate the effects of the above potential emergency situations on the Contractor’s organization and disruption to the progress of the Works. The contingency plans should aim at maintaining or resuming the progress of the Works as soon as possible whilst ensuring the safety and health of all personnel on the Site.
- Call the hotline 999 and notify Site Staff immediately in case of emergency. Calling the local police station, fire services station and ambulance depot for police, fire services and ambulance can be accepted as an alternative to calling the hotline 999.

vii. Procedures for reporting and recording accidents and dangerous occurrences. Include, but do not limit to the following:

- Report accidents / incidents and dangerous occurrence as defined in the Factories and Industrial Undertakings Regulations to LD in the prescribed Form 2 with Supplementary Information on Accidents on Construction Sites & Dangerous Occurrence Report Form;
- Copy the Supplementary Information Sheet, Dangerous Occurrence Report Form, Suspension Notice and Improvement Notice issued by the LD to the CM according to GCC Clause 5.21;

- Notify the CM immediately of all 'reportable accidents' as defined under the Factories and Industrial Undertakings Regulations and of the accidents / incidents to be reported in prescribed forms using the web through the Housing Authority Safety Alert Module and followed by submission of the completed documents to the CM under the accident / incident reporting procedures of the HD set out at the Housing Authority Site Safety Website (http://www.housingauthority.gov.hk/sitesafety) and comply with the procedures;
- Notify the Site Staff immediately (i.e. within the day of the accident / incident) of accidents / incidents on Site, including:
  - Serious accidents / incidents;
  - Reportable accidents, dangerous occurrence and near miss / incidents (if the accidents / incidents, though not serious by immediate effect, may have potentially serious consequence, such as those involving but not limited to falling from height, falling object, being struck by moving object, injury to head, profuse bleeding, injured person becoming unconscious, body of injured person pierced by foreign object, public safety etc.) on Site;
  - Death of person;
  - Tree failure incidents resulting in any of the following:
    - Loss of human life;
    - Major injury where the injured is admitted or to be admitted to hospital;
    - Substantial damage to properties;
    - Serious / complete blockage to main pedestrian / vehicular access.
  - Any emergency situations requiring emergency assistance for fire services / police / ambulance etc., including:
    - An accident which results in death or serious injury;
    - A fire breaking out which requires rescue crews from Fire Services Department to effect control;
    - A flood that causes or threatens life on Site;
    - A leakage of dangerous goods or chemicals;
    - An outbreak of epidemic / infectious disease on Site;
    - Any superintendent or worker of the Contractor or his sub-contractors on Site who has been confirmed or suspected of contracting epidemic / infectious disease;
    - Any other accident / incident which creates a dangerous situation.
- Inform the CM immediately whether the progress of construction works or the office operation of the Contractor and / or his sub-contractors are being affected or likely to be affected by the above emergency situations.
- Provide statistics and analysis of accidents / incidents, investigate and ascertain the contributory factors and root causes, identify the trends and recommend means of prevention and improvement;
- The accident / incident investigation shall include, but not limited to, the following major items:
  - Causes of the sub-standard safety performance;
  - Potential deficiencies of the safety control system;
  - Areas of review and lessons learnt;

- Recommendations to prevent recurrences;
- Improvements to the safety control system to meet the Legislations and recommendations of the investigation report.

- Provide statistics and trends of late report of accidents / incidents, later than the time prescribed under the relevant legislations and Contract clauses; identify the causes and recommend means of improvement;
- Provide means to communicate accident / incident statistics information, recommendation to prevent recurrences and lessons learnt from previous accidents / incidents to all persons working on the Site.

viii. Proposed items in the Safety Supervisor's report presented at the monthly site meeting. Include, but do not limit to the following:

- Implementation and updating of the Safety Plan and all relevant aspects of safety and health to be addressed;
- Safety inspections and monthly self-audit against the Safety Plan;
- Risk assessment of the construction activities to be carried out in the following month;
- Report on accidents / incidents and dangerous occurrences during the month;
- Implementation of the recommendations in the monthly self-audit;
- Examination reports and test certificates required by legislations or the Contract.

ix. The personal protective equipment which will be required for the Works and the means for ensuring proper and where appropriate, mandatory use by the persons on the Site;

x. The means and frequency by which safety equipment, scaffold, working platform, lifting appliance, machinery, electrical equipment and installation, lighting, warning signs and guarding equipment will be inspected, tested and maintained and records kept and made available for inspection;

xi. Proposal for safety training for workers engaged in hazardous trades including attendance at relevant courses run by OSHC.

2. Green Card:
   a. The Contractor, and any of his sub-contractors, shall provide and employ for the purposes of the Works such technical personnel and such skilled, semi-skilled and unskilled labourers who, upon their first appearance in the Site and throughout their working in the Site, are a holder of a valid Green Card issued by an organisation or institution recognized by LD or a valid Construction Workers Registration Card issued under the Construction Workers Registration Ordinance. The Green Card referred to in this sub-clause is a statutory identification document issued to a person by an organization or institution recognized by LD upon completion of the training on Green Card;
   b. Keep record of card numbers, card holders' names and expiry dates of the cards, for the inspection by the CM. Ensure that the Green Cards held by all workers are valid;

c. The Contractor shall ensure that all such personnel and workers shall at all times put on the appropriate Green Card or a valid Construction Workers Registration Card with a printed statement indicating that the holder has a valid Green Card and that such Green Card has not yet expired while they are within the Site. The CM shall, pursuant to GCC Clause 5.9(2), have the power to require the Contractor to remove forthwith any person employed by the Contractor, or by any of his sub-contractors, from the Works who has not complied with the requirements prescribed by sub-clause (2)(a) above.

d. Unskilled labourers who are employed by the Contractor, or any of his sub-contractors, shall upon their first appearance on the Site have satisfactorily completed the training course "Basic Safety for Construction General Workers" organised by OSHC, otherwise arrange those unskilled labourers without having completed the above training to enrol in the above training course upon their first appearance on the Site. Acceptance of alternative training provided by other organisations is subject to verification by the CM that the alternative training is based on course contents of equivalent or higher standards than the aforesaid course of OSHC. Keep a record of the certificates, including the names of the certificate holders, the issue dates of the certificates and the relevant trade category for inspection by the CM, and report the status at the site meeting. Notwithstanding the above requirement, there is a grace period for arranging unskilled labourers to enrol in the above training course up to 31 December 2026 after which any unskilled labourer who has not yet satisfactorily completed the above training shall be arranged to enrol in the above training course upon their first appearance on the Site.

PRE.B8.211.N PROHIBITION OF IMPOSING ADMINISTRATIVE CHARGES FOR REPORTING OF SITE ACCIDENTS AND ELIMINATION OF UNDER-REPORTING OF SITE ACCIDENTS

1. The Contractor shall not impose charges of any form on any sub-contractor, or deduct any amount from the payment to which any sub-contractor is entitled, for reporting accidents and processing any claims for compensation under the Employees' Compensation Ordinance (Cap. 282) on behalf of the sub-contractor. For the avoidance of doubt, sub-contractor in this clause means all types of sub-contractors, irrespective of tiers.

2. The Contractor shall ensure that the following sub-contract provisions in sub-clauses (2)(a) to (2)(e) ("Mandatory Sub-contract Provisions for Prohibition of Imposing Administrative Charges for Reporting of Site Accidents and Elimination of Under-reporting of Site Accidents") are included *mutatis mutandis* in all sub-contracts entered into with his sub-contractors. The Contractor shall, if necessary, within a reasonable time enter into a supplemental agreement with his sub-contractors to comply with the requirements in this sub-clause. The following sub-contract provisions in sub-clauses (2)(a) to (2)(e) shall also be incorporated *mutatis mutandis* into sub-contracts at any tiers under the Contract:

   a. In these Mandatory Sub-contract Provisions for Prohibition of Imposing Administrative Charges for Reporting of Site Accidents and Elimination of Under-reporting of Site Accidents, the following words and expressions shall have the meanings hereby assigned to them except when the context otherwise requires:"Employer" means the Hong Kong Housing Authority;

   "Contract Manager" means the Contract Manager for the Contract;

   "Contract" means the main contract (Contract No. _____) made between the Employer and the Contractor;

"Contractor" means the contractor who has entered into the Contract with the Employer and entered into the Sub-contract with the Sub-contractor; *[Note: Replace the words "the Sub-contract with the Sub-contractor" with "a sub-contract with a sub-contractor at the first tier of the same chain of sub-contracting in connection with this Sub-contract" for the second or lower tiers sub-contracts]*

"Sub-contract" means this agreement;

"Sub-contractor" means the party who entered into this Sub-contract with the Contractor; *[Note: Replace the words "the Contractor" with "the Higher-tier-sub-contractor" for the second or lower tiers sub-contracts]*

"sub-contractors" means all types of sub-contractors of the Sub-contractor, irrespective of tiers;

"Higher-tier-sub-contractor" means the party who entered into a sub-contract at higher tier than this Sub-contract with another party and entered into this Sub-contract with the Sub-contractor; *[Note: Adopt this definition for the second or lower tiers sub-contracts only]*

b. The Sub-contractor shall not impose charges in any form on any sub-contractor, or deduct any amount from the payment to which any sub-contractor is entitled, for reporting any accidents and processing any claims for compensation under the Employees' Compensation Ordinance (Cap. 282) on behalf of the sub-contractor;

c. Where injury by accident arising out of and in the course of the employment is caused to any person employed by the Sub-contractor or sub-contractors on the Works or in connection with the Contract, the Sub-contractor shall, without delay, report the matter to the Contractor *[Note: Add "via the Higher-tier-sub-contractor" for the second or lower tiers sub-contracts]* for notifying the Commissioner for Labour in such form and manner as required by the law and for reporting to the Contract Manager. This provision shall apply irrespective of whether the person claims for compensation;

d. Upon request by the Contractor *[Note: Add "or the Higher-tier-sub-contractor" for the second or lower tiers sub-contracts]*, the Sub-contractor shall provide the original documents of the sub-contracts to the Contractor *[Note: Replace "the Contractor" with "the Higher-tier-sub-contractor" for the second or lower tiers sub-contracts]* who is authorized to provide the same to the Contract Manager *[Note: Add "and the Contractor" for the second or lower tiers sub-contracts]* for inspection;

e. The compliance of these Mandatory Sub-contract Provisions for Prohibition of Imposing Administrative Charges for Reporting of Site Accidents and Elimination of Under-reporting of Site Accidents by the Sub-contractor is entirely without prejudice to and does not relieve the Sub-contractor from any of his obligations or responsibilities under this Sub-contract, the Factories and Industrial Undertakings Ordinance (Cap. 59), the Occupational Safety and Health Ordinance (Cap. 509) and the Employees' Compensation Ordinance (Cap. 282), and all their subsidiary legislation.

3. For sub-contracts at any lower tiers of sub-contracting, the Contractor shall take all reasonable steps to ensure that the provisions at sub-clause (2) above are included mutatis mutandis in all such sub-contracts. The Contractor shall take all reasonable steps to ensure that sub-contractors at any lower tiers of sub-contracting shall, if necessary, within a reasonable time enter into a supplemental agreement to include the provisions at sub-clause (2) above mutatis mutandis in all such sub-contracts.

4. Upon request by the CM, the Contractor shall provide the original documents of the sub-contracts to the CM, for inspection.

5. The Contractor shall make necessary arrangements to ensure that all sub-contractors report all accidents on the Site involving their employees via their upper tier sub-contractors (if applicable) to the Contractor without delay. Such arrangement shall be incorporated in the Safety Plan and Sub-contractors Management Plan required under the Contract.
6. The compliance of this clause by the Contractor is entirely without prejudice to and does not relieve the Contractor from any of his obligations or responsibilities under the Contract, the Factories and Industrial Undertakings Ordinance (Cap. 59), the Occupational Safety and Health Ordinance (Cap. 509) and the Employees' Compensation Ordinance (Cap. 282), and all their subsidiary legislation.

PRE.B8.213.A SITE SAFETY FOR BUILDING SERVICES WORKS

The Contractor shall ensure that the Specialist Sub-contractors for *electrical works, fire services works, fire services and water pump works, air-conditioning and mechanical ventilation works, lift works and lift and escalator works comply with the followings:

1. Safety Supervisor:
   a. Each BS Specialist Sub-contractor shall provide a Safety Supervisor for the respective Specialist Sub-contract. The person designated as Safety Supervisor shall be competent, technically qualified, English and Cantonese speaking and approved by the CM, with power to receive, via the Contractor, the instructions of the CM. This Safety Supervisor and the Building Services Site Supervisor referred to in PRE.B6.060 may be the same person;
   b. The designated Safety Supervisor shall have attended the Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by the OSHC or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by the CIC. Acceptance of training provided by other organizations is subject to verification that the training is based on course contents of equivalent or above standards and the appointed superintendent has attained the associated qualification. The Safety Supervisor(s) shall be accredited under the Hong Kong Safety and Health Certification Scheme managed by the OSHC. Enhancement course for Safety Supervisor(s) are conducted by the OSHC and CIC. Before commencement of construction of the Works and whenever there is a change in the appointment of Safety Supervisor(s), report to the CM a written confirmation that Safety Supervisor(s) are employed in accordance with the respective Specialist Sub-contract, the written confirmation shall be appended with the name and a copy of the written certification of accreditation under the Hong Kong Safety and Health Certification Scheme for each Safety Supervisor, and a signed statement by each Safety Supervisor declaring that he is accredited as a Safety Supervisor under the Hong Kong Safety and Health Certification Scheme and the Safety Supervisor will advise the CM in writing immediately if he is no longer so accredited;
   c. In addition to those duties as imposed by the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, the Safety Supervisor shall from time to time perform the safety functions including:
      i. Site inspection:
         - Carry out safety inspections on the BS Specialist Sub-contractor's activities on Site. The safety inspection shall identify any unsafe operation or potential hazards;
         - Prepare safety inspection reports;
         - Liaise with the Safety Officers and Safety Supervisors of the Contractor.
      ii. Safety Plan:
         - Monitor implementation and updating of the Safety Plan;

- Promote awareness and compliance with the Safety Plan to all Specialist Sub-contractor's workers on Site.

iii. Accident / Incident report and investigation:

Cooperate with the Safety Officers employed by the Contractor in the collection of accident / incident data, investigation, determination of the cause and recommendation on means of prevention and improvement in respect of the building services Specialist Sub-contract works;

iv. Training:

- Coordinate and supervise the conduct of trade specific safety training and pre-work activities;
- Identify those workers in the specified trades as detailed in PRE.B8.210 without valid Silver Card and coordinate their enrolment in requisite Silver Card training provided by CIC;
- At the end of each period of relevant interim certificates report, report to the PSPs and the Contractor the actual number of workers trained in each of the safety courses and pre-work activities.

v. Site Safety Committee:

- Attend site safety committee meetings and other safety-related meetings organized by the Contractor;
- Follow up on necessary actions arising from the Site Safety Committee.

vi. Risk Assessment Report:

- Prepare risk assessment reports before commencement of a new trade and recommend measures to remove or minimize hazards;
- Adopt the methodology given at the leaflet Five Steps to Risk Assessment issued by LD.

vii. Action on LD's contravention notices:

- When called upon by the Safety Officer employed by the Contractor, attend to the notices issued by the LD to the Contractor associated with contravention made by the BS Specialist Sub-contractor;
- Take all necessary actions to ensure full compliance with statutory requirements;
- Liaise with and report to the Contractor on notices received which are associated with contravention made by the BS Specialist Sub-contractor.

viii Safety audit:

Implement the recommendations of the external Safety Audit Report;

ix. Safety Supervisor's report:

Compile and report the above duties to the CM via the Contractor at monthly site meetings.

2. Safety plan in respect of each type of building services Specialist Sub-contract Works:

a. Each BS Specialist Sub-contractor other than Specialist Sub-contractor for *lift works / lift and escalator works shall prepare a safety plan in respect of his Specialist Sub-contract Works. It shall be based on guidelines prescribed by the Occupational Safety and Health Council (OSHC) and shall be submitted to the Contractor for agreement and incorporation into the Safety Plan for the Contract. Then, the Contractor shall submit agreed safety plan in respect of building services Specialist Sub-contract Works to the CM for endorsement. The Contractor shall revise or update the Safety Plan for the Contract to incorporate the safety plan in respect of the building services Specialist Sub-contract Works endorsed by the CM prior to submitting the Safety Plan for the Contract to the CM;

b. The Specialist Sub-contractor's attention is drawn to the provisions of Clause 5.11 of the General Conditions of Contract and without prejudice to the generality of the BS Specialist Sub-contractor's responsibilities under the Specialist Sub-contract for building services works or any statutory regulation with respect to safety and health, the BS Specialist Sub-contractor shall comply with the respective obligations set out in the Safety Plan throughout the whole progress of the building services Specialist Sub-contract Works and shall comply with the provisions of this clause;

c. The BS Specialist Sub-contractor for *lift works / lift and escalator works shall prepare safety plans in respect of his Specialist Sub-contract Works. It shall be based on guidelines prescribed by OSHC and the latest edition of the Guidelines on Safety of Lift Shaft Works issued by CIC (hereinafter referred to as “CIC Guidelines”). All references to “lift shaft” in the CIC Guidelines shall mean “lift well” for the purpose of this sub-clause. The safety plan in respect of the building services Specialist Sub-contract Works shall be submitted to the Site Safety Committee for review and comment, and then the Contractor shall submit the finalised safety plan in respect of the building services Specialist Sub-contract Works endorsed by the Site Safety Committee to the CM for approval;

d. A "safety plan in respect of the building services Specialist Sub-contract Works" means a safety plan including any supplemental or revised or updated version, submitted by the BS Specialist Sub-contractor and agreed by the Contractor, and endorsed by the CM in writing all in accordance with the provisions under this clause;

e. Each BS Specialist Sub-contractor shall compile and submit the necessary subsequent updating of the safety plans in respect of building services Specialist Sub-contract Works to suit the site progress, as determined by the Contractor, or the CM, so that it is at all times a comprehensive and contemporary statement of the BS Specialist Sub-contractor's policies, procedures and requirements to achieve the safety and health requirements of the respective Specialist Sub-contract;

f. If the CM is of the opinion that the safety plan in respect of the building services Specialist Sub-contract Works is insufficient and requires revision or modification in the interest of the safety, whether for the building services Specialist Sub-contract Works and / or the safety and health of persons on or adjacent to the Site or protection of any property on or adjacent to the Site or otherwise, the CM may notify the BS Specialist Sub-contractor in writing and the BS Specialist Sub-contractor shall submit a revised or updated safety plan in respect of building services Specialist Sub-contract Works for the Contractor's agreement and submission of the agreed safety plan in respect of building services Specialist Sub-contract Works to the CM for endorsement within 7 days from the date of the CM's notice;

g. The Contractor's agreement to or the CM's endorsement of the safety plan in respect of building services Specialist Sub-contract Works or any proposed revision or update thereof shall not relieve each BS Specialist Sub-contractor from his obligation or responsibility under the respective Specialist Sub-contract;

h. The safety plan in respect of building services Specialist Sub-contract Works and its subsequent updates shall contain, but not limited to details in the following aspects:

i. Company safety and health policy;

ii. Safety organisation;

iii. Safety and health training;

iv. In-house safety rules and regulations;

v. Site Safety Committee;

vi. Programme for inspection, thorough examination and testing of hazardous conditions;

vii. Job hazard analysis;

viii. Personal protection programme;

ix. Accident / Incident report, investigation and follow up actions;

x. Emergency preparedness;

xi. Safety promotion;

xii. Health assurance programme;

xiii. Evaluation, selection and control of sub-contractor;

xiv. Process control programme;

xv. Non-smoking policy;

xvi. Works plans for lift works including the following:

- Lift provisions agreed by the Contractor such as details of the positions of floor openings in lift machine room, structural links in the ceiling of lift well, independent lifelines, design plan for modification of scaffolding sections to facilitate lift installation work in lift well, etc.;
- Machine-room-less lift provisions agreed by the Contractor such as details of the positions of floor openings in lift well, structural links in the ceiling of lift well, independent lifelines, design plan for modification of scaffolding sections to facilitate lift installation work in lift well, etc.;
- The administration mechanism and details of permit-to-work system on hazardous trade processes;
- Risk assessment report, similar to Annex C of Volume 2 of CIC Guidelines;
- Pre-work check reference table, similar to Annex D of Volume 2 of CIC Guidelines;
- The content, frequency and duration of safety and health training for lift workers;
- Lift well handover checklist, similar to Annex E of Volume 2 of CIC Guidelines. The responsibilities for the subsequent management and maintenance of lift well protection measure until removal shall be clearly defined and properly recorded in the Safety Plan for the Contract;
- Measure / protection to inhibit fire spread between floor compartments through lift well and openings and within lift wells;
- Effective communication system for lift installation work.

3. Housing Authority Safety Auditing System (HASAS):

   Each BS Specialist Sub-contractor shall comply with the following:

   a. Deploy his most senior site representative to attend each safety audit to be conducted by Accredited Safety Auditor nominated by the CM and under the management of the OSHC once every 3 months;

   b. Provide all necessary attendance for the safety audit including fully facilitating the inspection of the works and all certificates, records and reports relating to safety and health matters, and fully cooperate with the Accredited Safety Auditor in the carrying out of the safety audit;

   c. Read the Safety Audit Report prepared by the Accredited Safety Auditor and get his Managing Director / Project Manager to sign the report. Submit a copy of signed report to the PSPs, the CM and another copy to OSHC for record;

   d. Implement the recommendations of the Accredited Safety Auditor within the time frame specified in the Safety Audit Report and report the implementation to the CM and the Contractor;

4. Site Safety Committee:

   a. Each BS Specialist Sub-contractor shall assign his Safety Supervisor(s) or other staff as may be considered necessary to attend the Site Safety Committee meetings and other safety-related meetings organized by the Contractor, at an interval as determined by the Contractor;

   b. BS Specialist Sub-contractors shall cooperate with the Contractor to follow up on remedial action against deficiencies as revealed by the Site Safety Committee;

   c. BS Specialist Sub-contractors shall arrange submission of forms GF527 and GF527A or other pertinent forms on the employment statistics of the Contract to the Contractor for consolidation and submission to the Census and Statistics Department with copy to the PSPs on a monthly basis.

5. Trade Specific Training and Lunchtime's Safety Talk:

   a. Trade Specific Training:

      i. Each BS Specialist Sub-contractor shall provide adequate trade specific safety training to all his site workers in accordance with a training plan provided in the safety plan in respect of his Specialist Sub-contract Works or separately submitted to the CM, via the Contractor, for prior approval if the proposed training has not been included in the safety plan in respect of his Specialist Sub-contract Works. The training duration shall not be less than 1 hour and 45 minutes;

      ii. BS Specialist Sub-contractors shall provide regular safety and health training to his workers and brief them on the risk assessment report, the safety procedural steps of method statements and the implementation of permit-to-work system. The safety and health training shall include drills on steps and procedures to be followed in case of emergency or accident.

   b. Lunchtime's Safety Talk:

      i. BS Specialist Sub-contractors shall provide lunchtime's safety talks to workers monthly. The topics and contents of lunchtime's safety talks shall be proposed by the Safety Supervisor and contain but not limited to accident / incident review, findings of Safety BSPASS, findings of safety audit and surprise inspection by OSHC and findings of inspection by LD;

ii. BS Specialist Sub-contractors shall ensure that lunchtime's safety talks are conducted by Safety Supervisors, foremen or gangers who have received training organised by HKCA, Federation of Electrical and Mechanical Contractors Limited or other approved training organisations, or by the training officers of trade associations or workers' unions which are member organisations of Housing Department Site Safety Subcommittee.

c. BS Specialist Sub-contractors shall perform the following in connection with the trade specific training and lunchtime's safety talk:

i. Allow the PSPs to attend any of the training courses and lunchtime's safety talks to verify that they are conducted according to Specification;

ii. Maintain all safety attendance records on site for all training and lunchtime's safety talks conducted or arranged. These records shall include the topics and dates of the events, the names of the trainers, names and trades of the persons receiving the training and their signatures. Electronic means of keeping these records with print-outs for submission will be acceptable subject to the approval of the CM. These records shall be made available for the PSPs' and the CM's inspection upon request by the PSPs and the CM;

iii. The Safety Supervisor shall certify the accuracy of attendance records of the training before they are submitted monthly to the CM.

d. Unskilled labourers who are employed by the Contractor, or any of his sub-contractors including BS Specialist Sub-contractors, shall upon their first appearance on the Site have satisfactorily completed the training course "Basic Safety for Construction General Workers" organised by OSHC, otherwise arrange those unskilled labourers without having completed the above training to enrol in the above training course upon their first appearance on the Site. Acceptance of alternative training provided by other organisations is subject to verification by the CM that the alternative training is based on course contents of equivalent or higher standards than the aforesaid course of OSHC. Keep a record of the certificates, including the names of the certificate holders, the issue dates of the certificates and the relevant trade category for inspection by the CM, and report the status at the site meeting. Notwithstanding the above requirement, there is a grace period for arranging unskilled labourers to enrol in the above training course up to 31 December 2026 after which any unskilled labourer who has not yet satisfactorily completed the above training shall be arranged to enrol in the above training course upon their first appearance on the Site.

6. Trade Specific Pre-work Activities:

a. Each BS Specialist Sub-contractor shall conduct pre-work activities including Hazard Identification Activity (HIA) meetings and Pre-work Safety Checks for all his workers;

b. HIA meetings can be held in small groups according to the trades, work teams or works areas set out by the BS Specialist Sub-contractor for the Site. If so, the BS Specialist Sub-contractor shall ensure that the assigned persons are competent to lead the HIA meetings. Persons who have attended one-day training course on HIA leadership provided by OSHC are considered competent to lead the HIA meetings. The issues discussed at the HIA meetings shall cover, but not limited to, hazards and control measures specific to the works or trades, special safety concerns, assurance of safety requirements and measures, reprimand of repeated irregularities and malpractices etc.;

c. The Pre-work Safety Checks shall be carried out by foremen, gangers, Safety Supervisors or the Safety Representatives of the attendees according to the trades, work teams or works areas. The Pre-work Safety Checks shall include the checking of personal protective equipment worn by attendees before they start working on that day such as safety helmet, reflective vest, ear protectors, eye protectors, safety harness, safety footwear etc.;

d. HIA meetings are to be held prior to the commencement of a particular type of work, but in any case the frequency shall not be less than once every 2 weeks. HIA meetings shall be attended by the workers prior to their carrying out of the associated particular work on site;

e. Pre-work Safety Checks are to be held prior to the commencement of a particular type of work, but in any case the frequency shall not be less than once a week. For routine work, Pre-work Safety Checks shall be conducted on a half-day basis;

f. Records of HIA meetings and Pre-work Safety Checks, including the names and trades of workers attended / checked, are to be certified by the Safety Supervisor and submitted for inspection by the PSPs.

7. Site Safety Regulations:

   Each BS Specialist Sub-contractor shall, throughout the duration of the Specialist Sub-contract, report monthly to the PSPs and the CM for the following attributable to him from LD:

   a. Warning letters or offences notifications;

   b. Convictions during the period under any site safety regulations or legislation;

   c. Abatement / Improvement / Suspension Notice.

8. Trade Specific Site Safety Item:

   a. For lift works:

      In addition to any obligation under relevant clauses of the Specialist Sub-contract for lift works or similar obligations under any enactment or Regulation, the Specialist Sub-contractor for lift works shall adopt the practices and / or measures in respect of lift well works as recommended in the latest edition of the Guidelines on Safety of Lift Shaft Works issued by the CIC ("Guidelines") and as stated in this sub-clause (8). All references to "lift shaft" in the Guidelines shall mean "lift well" for the purpose of this sub-clause (8). Examine critically the practices and / or measures as recommended in the above-mentioned Guidelines, especially their applicability and suitability to the Specialist Sub-contract for lift works on account of the actual site conditions and the specific safety hazards of the Specialist Sub-contract Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guidelines may be proposed for the CM's approval before implementation. In addition, the Specialist Sub-contractor for lift works shall carry out the trade-specific precautionary site safety measures including but not limited to the following which are highlights of the above mentioned Guidelines with more specific or stringent requirements:

      i. Provision and Maintenance of Temporary Work, Services and Protective Measures:

         - Keep proper inspection records for safety provisions;
         - Properly use and maintain the scaffolding in lift well in good conditions at all times and timely report to the Contractor for any identified damage on scaffolding for immediate repair or replacement. The Specialist Sub-contractor for lift works shall not alter any members of scaffolding;
         - Keep keys and locks of lift well protection cages in a neatly and orderly manner. The locations of the door keys or the person-in-charge for holding such keys shall be registered in a log;

- Be responsible for erection, testing, examination, maintenance and dismantling of winches, chain block systems and other lifting appliances and lifting gears used inside lift well for lift installation work. A competent lift worker or a competent worker who has received training of installation of anchor bolts organised by the anchor bolts provider under the supervision of a competent lift worker shall be employed to install anchor bolts of the lifting appliances;
- For anchorages which are installed by the Specialist Sub-contractor for lift works for any use, appoint a registered professional engineer to check the design and method statement for the construction and to certify the load bearing capacity and the fixing details of the anchorages. Anchorage near the lift well openings at the lowest landing floor will be provided by the Contractor for use by worker to lock fall arrestor and safety harness when required to access lift pit. Anchorage near the lift well openings at other landing floors will be provided by the Contractor if necessary for use by worker to lock fall arrestor and safety harness when working near or in the lift well;
- Provide a switch lock on the inspection / operation switch at the lift car top or similar device for workers working on lift car top of an assembled lift during the lift installation work. Engage a registered lift engineer to examine the assembled lift before it is used to carry lift workers inside its lift car or on its car top for the first time. The examination shall be properly documented in an examination form similar to Annex G of Volume 2 of CIC Guidelines;
- Ensure adequate illumination by 110V temporary lighting connected to an isolated transformer having the centre tap of the secondary winding earthed, ventilation and effective communication systems are provided inside the lift well during the whole lift installation period;
- Effectively earth all electric appliances including portable electric tools, lighting devices and mechanical ventilation equipment used unless it is an approved type that does not require earthing. Lighting devices shall be properly protected against impact damage;
- Install safety nets inside lift well against falling objects. The catching nets shall be made of fire retardant material with net eyes not more than 20 mm x 20 mm. String diameter of the catching net shall be adequately sized or selected for the intended impact load of falling objects as advised by registered safety officer employed by the Specialist Sub-contractor for lift works. The nets shall be installed at not more than 20 m intervals throughout lift well and fixed with adequate fire retardant strings or other means with sufficient strength on the scaffoldings or other fixed secured means / anchorage as advised by registered safety officer employed by the Specialist Sub-contractor for lift works. Gaps between the nets and the lift well walls shall be fully protected against falling objects. The Specialist Sub-contractor for lift works shall inspect the safety nets and the provisions against falling objects on daily basis to ensure safety and proper functioning of the nets, including clearance of debris trapped by the nets and repairing any damaged portion of the nets. When guided-suspended working platform is adopted for lift installation, the Specialist Sub-contractor for lift works shall install a metal cover to protect workers working on the platform against falling objects but the cover and its supports shall not obstruct the operation of the working platform;

- Allow no lift worker and other trade worker to work simultaneously inside a lift well;
- Keep to a minimum the number of workers working within a lift well at the same time to the extent that simultaneous working at different levels is strongly not advisable. If simultaneous working at different levels is practically unavoidable, it shall only be limited to one work activity and prior approval from the PSPs shall be obtained;
- For access to lift pits through cat ladder installed inside the lift well at the wall adjacent to the lift landing, provide a retractable type fall arrestor for use by workers to lock to the anchorage provided by the Contractor near the lift well opening at the lowest landing floor. The retractable type fall arrestor shall comply with EN 360:2002 or equivalent, complete with a retractable lanyard of suitable length according to the depth of the lift pits and manufacturer's recommendation. All manufacturer's instructions regarding usage, inspection, maintenance and storage of the equipment shall be followed. Suitable training shall be provided to the workers before they are allowed to use the system;
- Do not allow hot work and electric arc process inside lift well generally. If it is practically unavoidable, provide adequate measure / protection to inhibit fire spread to or between floor compartments through the lift well and openings and within the lift wells. Fire retarding sheet shall be used to prevent sparks of hot work or electric arc process from falling onto combustible materials or suspension / safety ropes. At the work spot, suitable protective screen of fire retardant nature, such as tarpaulin, shall be used. If tarpaulin is being used as protective screen, its fire retardant characteristics shall meet the requirements of BS 5867-2:2008 (Type B performance requirements) or other equivalent standards;
- Do not allow hot or electric arc cutting of guide rail sections on Site generally. If it is practically unavoidable, obtain the PSPs' prior approval. Provide adequate measure / protection to prevent spread of sparks. At the work spot, suitable protective screen of fire retardant nature, such as tarpaulin, shall be used. If tarpaulin is being used as protective screen, its fire retardant characteristics shall meet the requirements of BS 5867-2:2008 (Type B performance requirements) or other equivalent standards.

ii. Risk Assessment and Method Statement:

- Conduct risk assessment for hazards relevant to lift works such as falling objects, fall-from-height, collapse of platform / supporting structures for lifting appliances, defective lifting appliance and lifting gear, improper rigging, absence of lighting and ventilation, electrocution, fire etc.. With reference to each operation involved in the lift installation process, the assessment shall recommend safety precautions and state the person responsible to execute the safety measures;
- Develop the risk assessment report similar to Annex C of Volume 2 of CIC Guidelines;
- Prepare method statement for each lift installation process, taking into consideration of all safety measures from the risk assessment report.

iii. Implementation of Permit-to-work System:

- Endorse together with the Contractor permits of the permit-to-work system for hazardous trade processes for lift installation work;

- Hazardous trade processes for lift installation work shall include but not limited to the following:
  - Working in a lift pit;
  - Hot work or electric arc process conducted inside or near a lift well;
  - Working on the car top of an assembled lift car;
  - Setting templates and plumb lines;
  - Installing guide rail brackets and guide rails;
  - Electrical equipment, wiring and trunking installation in lift well;
  - Installing architraves, landing sills, landing doors and accessories;
  - Installing lift traction machine and control panel;
  - Installing counterweight assembly;
  - Installing car cage assembly;
  - Adjustment, testing and commissioning at lift well.
- Each permit of the permit-to-work system shall specify details of its length of validity in terms of shift and the type of trade workers who are required to work inside the lift well;
- The permit of permit-to-work system shall be similar to the sample form at Annex C of Volume 1 of CIC Guidelines.

iv. Provision of Effective Communication System and Personal Protective Equipment:

- Provide adequate and effective communication means / equipment, such as walkie-talkie, layout plan showing the designated work area for different work groups, etc., for use by the working personnel during the lift installation work. Key words / signals shall be specified for clarity of use during communication. Mobile phones shall not be considered an effective communication for workers working inside a lift well;
- Do not allow lift workers to work alone inside a lift well generally. If it is practically unavoidable, provide sufficient communication / warning devices such as motion sensor to generate alarm in addition to walkie-talkie for the worker to communicate with a nearby co-worker;
- Inform the Contractor of the required position of independent lifelines inside lift well to be installed and fixed by the Contractor. At least 3 sets of independent lifelines anchored to eyebolts will be installed by the Contractor inside a lift well before handing over to the Specialist Sub-contractor for lift works;
- Provide workers with suitable safety harnesses and fall arrestors when they are required to work inside a lift well.

b. For electrical works:

In addition to any obligation under relevant clauses of the Specialist Sub-contract for electrical works or similar obligations under any enactment or Regulation, the Specialist Sub-contractor for electrical works shall adopt the practices and / or measures in the latest edition of the Code of Practice for the Electricity (Wiring) Regulations in respect of electrical works and as stated in this sub-clause (b).

i. Temporary Provision of Residual Current Operated Circuit Breakers (RCCBs) for Lighting Circuits:

- Provide a temporary RCCB at the main incoming supply of each Miniature Circuit Breaker (MCB) distribution board connected with lighting circuits during construction stage;

- The RCCB shall have a rated residual operating current not exceeding 30mA and comply with requirement as stipulated in ELE3.6;
- The RCCBs shall be properly housed within an enclosure;
- Adequate cable length should be allowed to re-instate to permanent connection to the MCB board after the removal of temporary RCCBs. Trunking and conduit provision should also be installed in such a way to allow easy dismantle and re-instatement after the removal of temporary RCCB enclosures;
- The temporary RCCBs and associated accessories shall be dismantled and removed at a time just prior to the final testing and handover of electrical installation;
- The temporary RCCB can be re-used from previous project subject to the RCCB shall be properly functional and fully comply with the requirement as stated in paragraph (ii) above.

c. For escalator works:

In addition to any obligation under relevant clauses of the Specialist Sub-contract for lift and escalator works or similar obligations under any enactment or Regulation, the Specialist Sub-contractor for lift and escalator works shall adopt the practices and / or measures in respect of escalator works in the latest edition of the Code of Practice for Safety at Work (Lift and Escalator) issued by the Labour Department. In addition, the Specialist Sub-contractor for lift and escalator works shall carry out the trade-specific precautionary site safety measures including but not limited to the following:

i. Provision and Maintenance of Temporary Work, Services and Protective Measures:

- Keep proper inspection records for safety provisions;
- Be responsible for erection, testing, examination, maintenance and dismantling of winches, chain block systems and other lifting appliances and lifting gears used for escalator installation work. A competent escalator worker or a competent worker who has received training of installation of anchor bolts organised by the anchor bolts provider under the supervision of a competent escalator worker shall be employed to install anchor bolts for the lifting appliances;
- For anchorages which are installed by the Specialist Sub-contractor for lift and escalator works for any use, appoint a registered professional engineer to check the design and method statement for the construction and to certify the load bearing capacity and the fixing details of the anchorages;
- Test all emergency stop switches, overspeed and other protection devices before the first run of escalator;
- Provide a lock and a tag on the main switch of the escalator so that the escalator can be turned off, locked and tagged by the person-in-charge to set the escalator into stationary condition for workers to work on the escalator.

9. For *electrical, fire services, fire services and water pump and air-conditioning and mechanical ventilation Specialist Sub-contracts Works in which Integrated Pay for Safety, Environment and Hygiene Scheme is not implemented, and where Safety Supervisors shall have to be designated by the respective Specialist Sub-contractor by reason of the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, the personnel of the respective BS Specialist Sub-contractor so designated shall, in addition to those duties as imposed by the said Regulations, have to perform the additional safety functions of liaising with the Safety Officers and Safety Supervisors of the Contractor and attending the Site Safety Committee Meetings chaired by the Contractor, on all site safety matters;
10. For *electrical, fire services, fire services and water pump and air-conditioning and mechanical ventilation Specialist Sub-contracts Works in which Integrated Pay for Safety, Environment and Hygiene Scheme is not implemented, and where there is no requirement for Safety Supervisors to be designated by the respective Specialist Sub-contractor, the said additional safety functions will have to be performed by the Building Services Site Supervisors as referred to in PRE.B6.060;
11. For *lift / lift and escalator Specialist Sub-contracts Works in which Integrated Pay for Safety, Environment and Hygiene Scheme is not implemented, the respective Specialist Sub-contractor is to designate one of his personnel on Site as the Safety Supervisor within the meaning of the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, notwithstanding that there might not be such a requirement imposed on the respective Specialist Sub-contractor by the said Regulations on the basis of the total number of persons employed by the respective Specialist Sub-contractor on the Site;
12. For *lift / lift and escalator Specialist Sub-contracts Works in which Integrated Pay for Safety, Environment and Hygiene Scheme is not implemented, further to those duties as imposed on a Safety Supervisor by the said Regulations, the Safety Supervisor employed by the Specialist Sub-contractor shall from time to time liaise with the Safety Officers and Safety Supervisors of the Contractor and attend the Site Safety Committee Meetings chaired by the Contractor, on all site safety matters;
13. Safety Awareness

    Subject to the consent of the Contractor as may be required, the Specialist Sub-contractors for *electrical works, fire services works, fire services and water pump works, air-conditioning and mechanical ventilation works, lift works and lift and escalator works are encouraged to participate in the following designated safety campaigns:

    a. Construction Safety Promotional Campaign organised by the OSHC;
    b. Occupational Health Award organised by the OSHC;
    c. Hong Kong Occupational Safety and Health Award organised by OSHC;
    d. Construction Industry Safety Award Scheme organised by the LD;
    e. Considerate Contractors Site Award Scheme organised by the Development Bureau with the CIC.
14. During the construction stage (including testing and commissioning) or Maintenance Period with works to be carried out in the vicinity of work areas where required to ensure safe working condition, BS Specialist Sub-contractors should coordinate with the responsible person of the respective electrical installation for isolation of electrical supply for equipment and / or energised electrical installation. During the construction stage, BS Specialist Sub-contractors shall also strictly follow the same requirements for Maintenance Period as stipulated in PRE.B8.2040.

PRE.B8.215.N SAFETY IN CONFINED SPACE RELATED TO UNDERGROUND DRAINAGE WORK

Further to PRE.B8.210, comply with the particular requirements as follows:

1. For works in confined space in connection with or in the vicinity of underground pipework, drainage / sewage manholes / chambers or structures alike, the following additional requirements shall apply:
    a. Appoint the person-in-charge (e.g. foreman or ganger) of the confined space works and the person-in-charge shall ensure that -
        i. Detailed working procedures and safety precautions are drawn up for the work being carried out;
        ii. All workers are provided with adequate training and information on the personal hygiene and health precautions, the use of personal protective equipment etc;
        iii. Equipment is provided in sufficient quantities and readily available in serviceable condition at the scene for immediate use so that the working procedures and safety precautions can be followed;
        iv. The working procedures and safety precautions are correctly carried out;
        v. A designated competent person is appointed to carry out risk assessment of the working environment and the works to be carried out in the confined space and make recommendations on measures to be taken in relation to safety and health of workers when work is to be undertaken, and he shall not be the certified worker in the same confined space operation;
        vi. No workers enter or work in the confined space other than certified workers;
        vii. He shall not act as the Contractor’s representative on confined space works or designated competent person in the same shift of confined space works concurrently;
        viii. He shall attend the Site at the commencement of the confined space works and shall not leave the Site until all personnel entering the confined space have left that space and return to the open atmosphere;
        ix. He shall not enter the confined space to carry out any work thereat throughout the period of discharging the duties as the person-in-charge for the confined space works;
        x. Arrange the responsible designated competent person to closely monitor the health and safety of all personnel staying in the confined space;
    b. Designate a competent person for the confined space works and the designated competent person shall –
        i. Attend the Site and shall not leave the Site until all persons entering the confined space have left that space and return to the open atmosphere;
        ii. Have sufficient knowledge and experience in supervising the work in confined space appointed by the Contractor and accepted by the CM;
        iii. Carry out risk assessment of the work environment and the works to be carried out in the confined space and make recommendations on measures to be taken in relation to safety and health of workers when work is to be undertaken in compliance with the Factories and Industrial Undertakings (Confined Spaces) Regulations;

iv. Not enter the confined space throughout the period of discharging the duties as designated competent person in that operation. Should his/her entry into confined space be required, he/she shall designate a competent standby person, who holds a valid Certificate for Certified Worker, to station outside the confined space throughout the duration of his/her absence outside the confined space to perform the duties of the standby person mentioned in the CoP for Safety and Health at Work in Confined Spaces issued by LD. The designated competent person's entry is limited to ad-hoc (not full time) inspection, checking, verification or assessment of the condition in confined space and he/she shall hold a valid Certificate for Certified Worker. A separate risk assessment (not compiled by the designated competent person intending to enter confined space) and permit-to-work shall be prepared prior to the designated competent person's entry;

v. Not act as the person-in-charge or specified responsible person for confined space works in the same shift of confined space works concurrently;

c. Specify the responsible person for confined space works (e.g. site agent or project manager) and the specified responsible person shall -

a. Be responsible for endorsing the risk assessment and issue / void the permit-to-work in the confined space;

b. Determine the continuation / suspension / resuming of confined space operation at the onset of / during / after adverse weather conditions and / or the lowering of adverse weather warning signals;

c. Attend the Site and shall ensure all persons entering the confined space have left that space and returned to the open atmosphere;

d. Not enter the confined space throughout the period of discharging the duties as "specified responsible person for confined space";

e. Not act as the person-in-charge or designated competent person.

d. Arrange the standby person to –

i. Keep in touch with the personnel staying in the confined space via two-way communication device at reasonable intervals, normally not more than every 2 minutes (direct calling / shouting is NOT encouraged and the Contractor is required to explore and formulate alternative more effective two-way communication device before the commencement of confined space operation);

ii. Continuously monitor the worker entering a confined space via direct line of sight or CCTV visual display panel when the direct line of sight between the standby person and the worker entering the confined space is blocked;

iii. Ensure the lifelines are holding firmly on the man-lifting tripod, or other approved lifting equipment, pay out and reel in the lifelines as required, so that at all times the lifeline can be used in an emergency;

d. In the event of a warning being received that working environment is likely to become dangerous, or if they suspect danger themselves, instruct all personnel staying in the confined space to return to the open atmosphere immediately;

e. Hold a valid Certificate for Certified Worker and to be responsible for the lookout for signs of danger including sudden increase in flow, heavy rain falling in the area or upstream, and signs of hot or peculiar smelling discharges;

f. Ensure all confined space including manholes etc. required for ventilation are kept open;

g. Prohibit smoking and ensure that no naked lights, fires and internal combustion engine (e.g. diesel generator set) are located near to the confined space openings;

h. Avoid acting as the person-in-charge or the specified responsible person;

i. Avoid entering the confined space thereat throughout the period of discharging the duties as "standby person" in the same shift of confined space operation.

e. Station a Safety Officer or the designated competent person qualified under the Factories and Industries Undertakings (Confined Spaces) Regulation at the site during the execution of work inside the confined space. The Safety Officer or the designated competent person shall not leave the Site until all persons entering the confined space have left the confined space and returned to the open atmosphere;

f. Implement a permit-to-work system;

g. Notify the CM two full working days in advance of any proposed work in confined space in writing. The Contractor shall also notify the CM the proposed time of commencement for the confined space works. In case of emergency situations where the 2-day advance notification requirement cannot be met, the Contractor shall obtain verbal consent from the CM prior to the commencement of any confined space works. The verbal consent shall be recorded in writing by the CM before noon on the next working day following the granting of verbal consent;

h. Avoid man-entry to sewers or drains with a diameter not greater than 900mm or equivalent. For CCTV survey, avoid man-entry to sewers or drains with a diameter not larger than 1300mm or equivalent. Where man-entry cannot be avoided under anomalous circumstances, obtain prior approval from the CM. The Contractor's attention is drawn to that approval from the CM would not normally be given for man-entry to carry out opening of lateral connections inside a lined pipeline due to lack of robotic cutting machine / equipment or the like;

i. Avoid work to proceed in a confined space located in industrial areas unless the persons working therein are wearing suitable breathing apparatus of approved type;

j. Set up CCTV cameras at manhole or end of pipeline for real-time monitoring of the conditions of the workers staying in the confined space where the direct line of sight between the standby person stationed at the entrance of a confined space and the person entering a confined space is impossible;

k. Take video throughout the whole work duration, including entry to and exit from the confined space. Submit electronic copy of the videos to the CM within two working days for record purpose;

l. Conduct regular rescue drill on confined space works at an interval of not more than six months or a more frequent interval when considered necessary by the risk assessment;

m. Ensure that all persons entering or staying in manholes, sewers, drains and other confined space should-

i. Hold a valid Certificate for Certified Worker;

ii. Wear adequate protective clothing and safety harness with lifeline;

iii. Keep in touch with the standby persons and obey any instructions given by them;

iv. Carry a gas detector with them and perform continuous gas monitoring throughout the period of stay;

v. Wear an audio-visual dead-man type personal alarm maintaining in active operating mode throughout his /her stay in that space, and capable of emitting signals that can alert the standby person stationed at the entrance of that space;

vi. Wear spark-proof / explosion-proof two-way telecommunication equipment to enable communication with the standby person stationed at the entrance of a confined space;

vii. Place safety chains etc. in manholes where facilities are provided for them, in particular, downstream of the area being worked;

viii. Avoid stirring up silt and check frequently for gas when this is unavoidable;

ix. Be on the lookout for signs of danger including sudden increase in flow, signs of hot or peculiar smelling discharges, signs of gas shown by the gas detector equipment, and tiredness, faintness and headaches;

x. Return to the open atmosphere immediately when the working environment become dangerous or weather condition become worsen;

xi. Observe procedures implemented by the person-in-charge of the confined space operation;

xii. Observe instructions and advice from the designated competent person and have already attended relevant safety training course for confined space operation;

xiii. Make full and proper use of, and forthwith report to the person-in-charge of the confined space operation any fault or defect in, any safety equipment or emergency facilities provided.

n. Arrange Confined Space Safety Training:

i. All workers having the qualification of a competent person under Factories and Industrial Undertakings (Confined Spaces) Regulation and involved in the works in confined space in connection with or in the vicinity of underground pipework, drainage or sewage manholes or chambers, or structure alike shall complete the 1-day Confined Space Safety Training Course for Competent Persons Engaged in DSD's Works provided by the CIC or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

ii. All workers having the qualification of a certified worker under Factories and Industrial Undertakings (Confined Spaces) Regulation and involved in the works in confined space in connection with or in the vicinity of underground pipework, drainage or sewage manholes or chambers, or structure alike shall complete the 1-day Confined Space Safety Training Course for Certified Workers Engaged in DSD's Works provided by the CIC or equivalent training provided by other organisations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

iii. Workers having both the qualifications of a competent person and certified worker under Factories and Industrial Undertakings (Confined Spaces) Regulation shall be taken as workers having the qualification of a competent person only for the purpose of the above sub-clauses (i) and (ii);

iv. Safety Officers having the qualification of competent persons under Factories and Industrial Undertaking (Confined Spaces) Regulation and performing the duties of competent person in carrying out confined space works in connection with or in the vicinity of underground pipework, drainage or sewage manholes or chambers, or structure alike shall be taken as workers having the qualification of a competent person for the purpose of the above sub-clause (i) and shall comply with the training requirement.

PRE.B8.220.9 PROVISION OF SAFETY REGULATIONS

Provide on Site for the use of the CM for the duration of the Contract, one set of the latest Construction Site (Safety) Regulations, the Factories and Industrial Undertakings Regulations concerning Safety Officers, Safety Supervisors and any other safety matter. Provide any revisions or new Safety Regulations that may be introduced during the continuance of the Works.

PRE.B8.225.9 CARING OF NEW WORKERS

Provide caring programme for new workers, making reference to the practices recommended by the Guidelines on The Implementation of "P" and "N" Caring Programme issued by CIC, including but not limited to the following:

1. Probationers (workers who newly join the construction industry or with relevant job experience of less than 6 months):
   a. Provide identification with "P" labels;
   b. Assign mentors (with a ratio of 1 mentor to not more than 4 probationers) who possess good experience on the Site to take care of the Probationers and provide guidance on site safety with a caring period not less than 3 months;
   c. Provide a safety orientation programme covering the essential safety aspects related to the Site, guidance for work and arrangement for familiarization of the Site;
   d. Subject to the mentor being satisfied with the Probationer's safety performance, remove identification label from safety helmet after the 3 months' caring period.
2. Newcomers (workers with relevant job experience of more than 6 months but newly arrive at the Site):
   a. Provide identification with "N" labels;
   b. The display of "N" labels shall not be less than 2 weeks;
   c. Provide a safety orientation programme covering the essential safety aspects related to the Site, guidance for work and arrangement for familiarization of the Site.
3. Requirements of labels for Probationers and Newcomers:
   a. Each label shall be adhered on a conspicuous part of a safety helmet;
   b. The size of label shall not be less than 50 mm (L) x 50 mm (H);
   c. The name and telephone number of the mentor shall be shown on the label;
   d. The date on which the worker joined the Site shall be shown on the label.

PRE.B8.230.9 SAFETY POSTERS

Obtain posters, in both English and Chinese, drawing attention to safety on Site and display prominently upon all structures or temporary huts on the Site throughout the duration of the Contract and remove on completion. These posters are obtainable from LD, OSHC and CIC.

PRE.B8.235.B SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF OPERATIVES AND SITE SUPERVISORY STAFF

Option 1

In relation to PRE.B8.210, comply with the particular requirements as follows:

1. Safety helmet: provide each of the operatives and site supervisory staff with safety helmet conforming to the following requirements, and ensure that each of them wears the safety helmet on Site:
   a. Comply with the latest guidance notes on the selection, use and maintenance of safety helmets issued by LD;
   b. With ventilation vents and wears the Y-type chin strap as prerequisite and with sunshade accessories such as brim or neck protector where appropriate;
   c. The Y-type chin strap shall be supplied by the same manufacturer of the safety helmet used and have a clear identification label, the manufacturer name, model number, and a proof that the safety helmet with the chin strap comply with BS EN397 or other current international and national standards recognized by Labour Department. If the manufacturer of safety helmet does not produce Y-type chin strap, then the manufacturer of safety helmet shall produce test certificate and test report issued by a BSI / CSA / or an approved third party accredited laboratory for compatible Y-type chin straps to demonstrate compliance with BS EN397;
   d. Replacement cycle shall not be more than 2 years from date of manufacture unless the manufacturers of safety helmet can provide proof such as BSI test certificate and test report to substantiate a longer life span of their helmets.
2. Clothing and footwear: provide each of the operatives (other than casual workers who are expected to work on Site for not more than an aggregate total of 7 working days throughout the duration of the Contract) and site supervisory staff with the following items and ensure that each of them wears them on Site:
   a. Anti-heat stress uniform comprising polo shirt in short sleeves and long sleeves to suit the weather and trousers;
   b. Reflective vest (for operatives and site supervisory staff involved in lifting operation, roadworks outside Site and controlling vehicular traffic except the tower crane operator);
   c. Wind breaker (to suit the weather);
   d. Safety boots shall comply with ASTM F2413, EN 20345 or equivalent standard (except for bamboo scaffolders, plasterers and tilers).
3. The clothing provided shall be in compliance with specified requirements as follows:
   a. The Contractor shall procure the anti-heat stress uniform designed by the Hong Kong Polytechnic University through Construction Industry Council (CIC) or sign a sub-licence with CIC for procuring the uniform from other supplier / manufacturer based on the design of Hong Kong Polytechnic University as shown in the Drawing No. CIC-SK-01 and CIC-SK-02 in Appendix C to this Specification. The polo shirt shall be made with Coolmax fabric (100% polyester) with minimum weight of 140 grams per square meter (gsm) or other fabric meeting the requirement of anti-heat stress uniform design laid down by CIC. Trousers shall be made with fabric comprising 60% cotton and 40% polyester with minimum weight of 180 gsm or other fabric meeting the requirement of anti-heat stress uniform design laid down by CIC. The yellow standard uniform previously developed / promoted by CIC can also be accepted. For avoidance of doubt, since the yellow standard uniform does not comprise trousers, the Contractor shall ensure that workers wear the trousers of either anti-heat stress uniform or corporate uniform;
   b. Washable retroreflective strips in silver colour with mesh shall be incorporated onto the anti-heat stress uniform and wind breakers. The specification of the retroreflective strips shall comply with EN20471 class 2;
   c. Reflective vests shall conform to Drawing No. RJ-SK-01 in Appendix C to this Specification and the following:

i. High visibility background material with colour complying EN 20471 of specified colour fluorescent yellow, fluorescent orange-red or fluorescent red with minimum area of 0.5 square metre, mesh knitted;

ii. Retroreflective strips:

- 50 mm in silver grey with fabric backing, conforming to photometric performance requirements as mentioned in EN20471 class 2;
- Be durable and can still comply with EN20471 class 2 after washing for a minimum of 25 cycles;
- The supplier shall submit test reports on retroreflective materials for demonstrating compliance with the following requirements under EN20471 class 2: photometric performance (initial), abrasion, flexing, folding at cold temperatures, exposure to temperature variations, washing and influence of rainfall.

d. Wind breaker shall be imprinted with a logo of the construction industry;

e. The fabric for summer clothing should preferably be of light colour and be thin and absorbent to minimise heat absorption and enhance heat and perspiration dissipation.

4. Eye and ear protection: ensure that an operative wears -
   a. goggle when grinding machines and cutting wheels;
   b. goggle when chiselling or drilling rock or concrete;
   c. visors for welders;
   d. ear muffler when percussing tools;
   e. goggles when handling corrosives;
   f. goggle and ear muffler when using hand held cartridge-operated tools ;
   g. goggle when digging operations;
   h. sunglasses when working under direct sunshine. The sunglasses provided shall comply with EN 166 or equivalent standard.
5. Provide and maintain machine guards to dangerous parts of machines. Size of openings in fixed guards shall comply with the 3rd Schedule of the Factories and Industrial Undertakings (Guarding and Operation of Machinery) Regulations;
6. Ensure that operatives using spray paint or similar materials wear suitable protective respirators;
7. Provide operatives with relevant information, instructions, training and supervision, to ensure operatives understand the cause of using and how to use properly the personal protective clothing and equipment;
8. Certain categories / types of personal protective clothing and equipment shall conform to the models and specifications recognised by LD under relevant legislations. Other categories / types not prescribed by LD shall conform to current international and national standards;
9. Keep the safety equipment stipulated in sub-clause (1) to (4) above in good and hygienic conditions;
10. Provision of appropriate fall arresting devices such as waist tool belts and tool straps securely attached to the wrist so that handheld tools are handled securely by workers to avoid the hazard of falling tools from height. The Contractor shall consider and safeguard against the risk of falling heavy portable power tools when it is still connected to the user's body by tool strap. The straps shall comply with ANSI 121-2018 or equivalent standard;
11. Protection for hands: ensure, albeit not exhaustive, that an operative wears-
    a. protective cotton gloves to facilitate better grip of objects by absorbing sweat when handling sharp edges and corners;

b. fire retardant leather gloves during gas welding;
c. cut-resistant gloves during cutting or handling metal trunkings;
d. chemical-proof gloves with high mechanical strength when handling chemicals;
e. plastic gloves when handling corrosives;
f. heat insulating gloves when handling hot objects;
g. leather gloves when handling steel reinforcement or sharp objects;
h. electric insulating gloves when carrying out electrical works and electric welding;
i. anti-shock gloves when operating vibrating machines;
j. anti-slip gloves to facilitate better grip of bamboo sticks when dismantling bamboo scaffolds.

Option 2

In relation to PRE.B8.210, comply with the particular requirements as follows:

1. Safety helmet: provide each of the operatives and site supervisory staff with safety helmet conforming to the following requirements, and ensure that each of them wears the safety helmet on Site:
   a. Comply with the latest guidance notes on the selection, use and maintenance of safety helmets issued by LD;
   b. With ventilation vents and wears the Y-type chin strap as prerequisite and with sunshade accessories such as brim or neck protector where appropriate;
   c. The Y-type chin strap shall be supplied by the same manufacturer of the safety helmet used and have a clear identification label, the manufacturer name, model number, and a proof that the safety helmet with the chin strap comply with BS EN397 or other current international and national standards recognized by Labour Department. If the manufacturer of safety helmet does not produce Y-type chin strap, then the manufacturer of safety helmet shall produce test certificate and test report issued by a BSI / CSA / or an approved third party accredited laboratory for compatible Y-type chin straps to demonstrate compliance with BS EN397;
   d. Replacement cycle shall not be more than 2 years from date of manufacture unless the manufacturers of safety helmet can provide proof such as BSI test certificate and test report to substantiate a longer life span of their helmets.
2. Clothing and footwear: provide each of the operatives (other than casual workers who are expected to work on Site for not more than an aggregate total of 7 working days throughout the duration of the Contract) and site supervisory staff with the following items and ensure that each of them wears them on Site:
   a. Anti-heat stress uniform comprising polo shirt in short sleeves and long sleeves to suit the weather and trousers;
   b. Reflective vest (for operatives and site supervisory staff involved in lifting operation, roadworks outside Site and controlling vehicular traffic);
   c. Wind breaker (to suit the weather);
   d. Safety boots shall comply with ASTM F2413, EN 20345 or equivalent standard (except for bamboo scaffolders, plasterers and tilers).
3. The clothing provided shall be in compliance with specified requirements as follows:

a. The Contractor shall procure the anti-heat stress uniform designed by the Hong Kong Polytechnic University through Construction Industry Council (CIC) or sign a sub-licence with CIC for procuring the uniform from other supplier / manufacturer based on the design of Hong Kong Polytechnic University as shown in the Drawing No. CIC-SK-01 and CIC-SK-02 in Appendix C to this Specification. The polo shirt shall be made with Coolmax fabric (100% polyester) with minimum weight of 140 grams per square meter (gsm) or other fabric meeting the requirement of anti-heat stress uniform design laid down by CIC. Trousers shall be made with fabric comprising 60% cotton and 40% polyester with minimum weight of 180 gsm or other fabric meeting the requirement of anti-heat stress uniform design laid down by CIC. The yellow standard uniform previously developed / promoted by CIC can also be accepted. For avoidance of doubt, since the yellow standard uniform does not comprise trousers, the Contractor shall ensure that workers wear the trousers of either anti-heat stress uniform or corporate uniform;

b. Washable retroreflective strips in silver colour with mesh shall be incorporated onto the anti-heat stress uniform and wind breakers. The specification of the retroreflective strips shall comply with EN20471 class 2;

c. Reflective vests shall conform to Drawing No. RJ-SK-01 in Appendix C to this Specification and the following:

i. High visibility background material with colour complying EN 20471 of specified colour fluorescent yellow, fluorescent orange-red or fluorescent red with minimum area of 0.5 square metre, mesh knitted;

ii. Retroreflective strips:

- 50 mm in silver grey with fabric backing, conforming to photometric performance requirements as mentioned in EN20471 class 2;
- Be durable and can still comply with EN20471 class 2 after washing for a minimum of 25 cycles;
- The supplier shall submit test reports on retroreflective materials for demonstrating compliance with the following requirements under EN20471 class 2: photometric performance (initial), abrasion, flexing, folding at cold temperatures, exposure to temperature variations, washing and influence of rainfall.

d. Wind breaker shall be imprinted with a logo of the construction industry;

e. The fabric for summer clothing should preferably be of light colour and be thin and absorbent to minimise heat absorption and enhance heat and perspiration dissipation.

4. Eye and ear protection: ensure that an operative wears -

a. goggle when grinding machines and cutting wheels;

b. goggle when chiselling or drilling rock or concrete;

c. visors for welders;

d. ear muffler for percussing tools;

e. goggles when handling corrosives;

f. goggle and ear muffler when using hand held cartridge-operated tools;

g. goggle when digging operations;

h. sunglasses when working under direct sunshine. The sunglasses provided shall comply with EN 166 or equivalent standard.

5. Provide and maintain machine guards to dangerous parts of machines, ensure that all machines are fitted with "Dead Man's Handles". Size of openings in fixed guards shall comply with the 3rd Schedule of the Factories and Industrial Undertakings (Guarding and Operation of Machinery) Regulations;

6. Ensure that operatives using spraying equipment or similar wear suitable protective respirators;
7. Provide operatives with relevant information, instructions, training and supervision, to ensure operatives understand the cause of using and how to use properly the personal protective clothing and equipment;
8. Certain categories / types of personal protective clothing and equipment shall conform to the models and specifications recognised by LD under relevant legislations. Other categories / types not prescribed by LD shall conform to current international and national standards;
9. Keep the safety equipment stipulated in sub-clause (1) to (4) above in good and hygienic conditions;
10. Provision of appropriate fall arresting devices such as waist tool belts and tool straps securely attached to the wrist so that handheld tools are handled securely by workers to avoid the hazard of falling tools from height. The Contractor shall consider and safeguard against the risk of falling heavy portable power tools when it is still connected to the user's body by tool strap. The straps shall comply with ANSI 121-2018 or equivalent standard;
11. Protection for hands: ensure, albeit not exhaustive, that an operative wears -
    a. protective cotton gloves to facilitate better grip of objects by absorbing sweat when handling sharp edges and corners;
    b. fire retardant leather gloves during gas welding;
    c. cut-resistant gloves during cutting or handling metal trunkings;
    d. chemical-proof gloves with high mechanical strength when handling chemicals;
    e. plastic gloves when handling corrosives;
    f. heat insulating gloves when handling hot objects;
    g. leather gloves when handling steel reinforcement or sharp objects;
    h. electric insulating gloves when carrying out electrical works and electric welding;
    i. anti-shock gloves when operating vibrating machines;
    j. anti-slip gloves to facilitate better grip of bamboo sticks when dismantling bamboo scaffolds.

PRE.B8.240.A SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF THE CM, HIS REPRESENTATIVES AND VISITORS

1. Provide sufficient safety helmets complying with the latest guidance notes on the selection, use and maintenance of safety helmets issued by LD with ventilation vents and Y-type chin straps as prerequisite and with sunshade accessories such as brim or neck protector where appropriate, reflective vests, rubber boots, breathing respirators (of Approved proprietary type), protective and waterproof clothing and devices such as ear mufflers and protective glasses, sunglasses of normal types as well as specific types suitable for putting over spectacles of the users, torches and the like where appropriate for the use of the CM, his representatives and authorised persons visiting the Site;
2. Replacement cycle of safety helmets shall not be more than 2 years from date of manufacture;
3. The reflective vests provided shall conform to the following with reference to drawing no. RJ-SK-01 in Appendix C to this Specification:
    a. Background material: fluorescent orange-red, mesh knitted;
    b. Retro-reflective strips:
        i. 50 mm in silver grey with fabric backing, conforming to photometric performance requirements mentioned in EN471-2003 (Class 2);

ii. Be durable and can still comply with the requirement in sub-clause 3(b)(i) after washing for a minimum of 25 cycles;

iii. The supplier shall submit test reports on retro-reflective materials for demonstrating compliance with the following requirements under EN471-2003 (Class 2): photometric performance (initial), abrasion, flexing, folding at cold temperatures, exposure to temperature variations, washing and influence of rainfall.

4. The sunglasses provided shall comply with EN166 or equivalent standard;
5. Keep the safety equipment stipulated in sub-clause (1) above in good and hygienic conditions.

PRE.B8.241.B INSPECTION AND CERTIFICATION OF OVERHAUL OF MAJOR CONSTRUCTION PLANT ON SITE

Option 1

1. The major construction plant on Site covered under this Specification include but not limited to the following:
   a. Tower cranes (rented);
   b. Tower cranes (self-owned);
   c. Derrick cranes (used for installing and dismantling tower cranes);
   d. Gondolas;
   e. Material hoists;
   f. Mobile cranes (excluding crawler cranes);
   g. Truck-mounted cranes.

Option 2

1. The major construction plant on Site covered under this Specification include but not limited to the following:
   a. Mobile cranes (excluding crawler cranes);
   b. Truck-mounted cranes;
   c. Crawler cranes (rented);
   d. Crawler cranes (self-owned);
   e. Pile drivers (rented);
   f. Pile drivers (self-owned);
   g. Hydraulic hammers (rented);
   h. Hydraulic hammers (self-owned);
   i. Oscillators (rented);
   j. Oscillators (self-owned);
   k. Rotators (rented);
   l. Rotators (self-owned).

Option 3

1. The major construction plant on Site covered under this Specification include but not limited to the following:
   a. Mobile cranes (excluding crawler cranes);
   b. Truck-mounted cranes.
2. Mobile crane (excluding crawler crane) and truck-mounted crane are defined as follows:
   a. A mobile crane (excluding crawler crane) is a crane mounted on a wheeled chassis for travel as shown in Fig. 1b and 1d on page 14 of the Code of Practice for Safe Use of Mobile Cranes published by the Labour Department;

b. A truck-mounted crane is a loader crane (consisting of a column, a base and a boom system) mounted on a truck or lorry as shown in Fig. 1c (irrespective of the position of mounting of the crane) on page 14 of the Code of Practice for Safe Use of Mobile Cranes published by the Labour Department.

3. Comply with all statutory requirements in relation to the use of the major construction plant on Site. Compliance with this Specification clause does not by itself confer any immunity from legal obligations;
4. Submit a schedule of inspection, examination, testing and maintenance for the major construction plant on Site to the CM in accordance with the manufacturer's recommendation or to suit the actual plant conditions, whichever is more frequent, to ensure that the construction plant is adequately provided and in safe and serviceable conditions. Submit also a schedule of plant deployment and removal. Update such schedules on a quarterly basis for the whole duration of the Works until the date of certified completion of the Works. Submit any updated schedules within one month from the start of each quarter;
5. Appoint a responsible person or persons to perform inspection during and after the erection or re-erection or alteration of the major construction plant on Site. The responsible person or persons shall have adequate training and experience to ensure that the major construction plant under checking are in safe and serviceable conditions;
6. The responsible person or persons shall look out for any signs of material defect in the components of the major construction plant such as fatigue crack or corrosion crack during his inspection. Carry out Non-destructive Test (NDT) to further assess the integrity of those components in question. Any part with damage or defects found shall be repaired or replaced in accordance with the manufacturer's recommendations;
7. Keep on Site all records of inspection, examination, testing, maintenance and breakdown of the major construction plant in a form to the satisfaction of the CM for checking by the CM or his representatives on monthly basis;
8. In addition to the requirements in sub-clauses (3) to (7), overhaul the following major construction plant and provide Certificates of Overhaul which shall be certified and signed by a "Competent Examiner" (CE) as defined under Cap. 59I Construction Sites (Safety) Regulations, Cap. 59J Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations or Cap. 59AC Factories and Industrial Undertakings (Suspended Working Platforms) Regulation at the overhaul ages as defined in the following table:

Major construction plant	Overhaul ages (years)			Ages beyond which the plant is not allowed to be on Site (years)
	1st Overhaul	2nd Overhaul	3rd Overhaul	
1. Tower cranes (rented)	10	17	22	25
2. Tower cranes (self-owned)	14	23	30	35
3. Derrick cranes (used for installing and dismantling tower cranes)	10	17	22	25
4. Gondolas	7	12	15	17
5. Material hoists	10	17	22	25

Major construction plant	Overhaul ages (years)			Ages beyond which the plant is not allowed to be on Site (years)
	1st Overhaul	2nd Overhaul	3rd Overhaul	
6. Mobile cranes (excluding crawler cranes)	12	20	26	30
7. Truck-mounted cranes	10	20	26	30
8. Crawler cranes (rented)	15	25	30	35
9. Crawler cranes (self-owned)	20	30	35	40
10. Pile drivers (rented)	15	25	30	35
11. Pile drivers (self-owned)	20	30	35	40
12. Hydraulic hammers (rented)	15	25	30	35
13. Hydraulic hammers (self-owned)	20	30	35	40
14. Oscillators (rented)	15	25	30	35
15. Oscillators (self-owned)	20	30	35	40
16. Rotators (rented)	15	25	30	35
17. Rotators (self-owned)	20	30	35	40
Any overhaul, regular maintenance, etc. required by the manufacturers should also be met **in addition to** any overhaul requirements above "Overhaul age" means the age at or beyond which overhaul maintenance is required at least in accordance with the specified overhaul procedures including the Checklists of Critical Parts for Overhaul Maintenance of the respective types of major construction plant as specified in Appendix PRE.B8/XI before the plant is put into use on Site again. "Overhaul maintenance" means an overall inspection, examination, repair, renewal and maintenance on critical parts and main components of a plant to be carried out in a depot with good engineering practice throughout by maintenance technicians and plant engineers to ensure that the critical parts and main components of the plant conform to the manufacturers' specifications and reinstate in a fully serviceable condition. "Serviceable condition" means the state of a plant that is fit for use with due regard to the manufacturers' specifications and the relevant national or international standards.				

a. The age of the major construction plant shall be clearly indicated on the plant itself and in the manufacturers' documents, such that it can be verifiable by the CM on Site. The age of renewed / rebuilt plant shall be defined by the age of the oldest part of the plant as declared by the manufacturer and certified by the AS;

b. Provide evidence of the eligibility of the CE responsible for certifying the overhaul at the time of certification;

c. The Certificate of Overhaul of the respective types of major construction plant on Site at Appendix PRE.B8/X shall be used, indicating the following:

   i. The CE has verified and confirms the age of plant based on the manufacturer's records;

ii. The CE has inspected and confirms that overhaul has been done in accordance with the Checklists of Critical Parts for Overhaul Maintenance for the respective types of major construction plant in Appendix PRE.B8/XI where applicable;

iii. The CE has recorded any deviation from the requirements in the checklist with full substantiation;

iv. The CE confirms that the plant is in a safe working condition.

d. The Checklists of Critical Parts for Overhaul Maintenance at Appendix PRE.B8/XI for the respective types of major construction plant is not exhaustive and compliance with which shall not relieve the Contractor from his responsibility and liability under the Contract. NDT in the Checklists of Critical Parts for Overhaul Maintenance refers to such inspection and tests to be carried out by persons specifically qualified to conduct NDT. When both English and Chinese are presented, English takes precedence over Chinese in the Checklists of Critical Parts for Overhaul Maintenance.

9. Provide Certificates of Overhaul for all major construction plant on Site in accordance with sub-clause (8). The age of any major construction plant on Site must at all times within the Contract period be less than or equal to the age due for the next immediate overhaul or the respective ages beyond which the plant is not allowed to be on Site, whichever is lower. Ensure compliance with the overhaul requirements herein throughout the service period of all major construction plant on Site by measures including forecasting the service periods and deploying plant of appropriate ages when first installed;

10. The overhaul ages for the respective major construction plant as referred in sub-clause (8) are defined by the critical parts of the plant or the whole plant itself as tabulated below:

Major construction plant	Definition of overhaul age
Tower cranes (rented and self-owned)	Age of tower crane itself
Derrick cranes (used for installing and dismantling tower cranes)	Age of winches of derrick crane
Gondolas	Age of the climber or arrestor, whichever is greater
Material hoists	Age of winches of material hoist
Mobile cranes (excluding crawler cranes)	Age of mobile crane itself
Truck-mounted cranes	Age of the crane itself only, not the truck on which the crane is mounted
Crawler cranes (rented and self-owned)	Age of crawler crane itself
Pile drivers (rented and self-owned)	Age of pile driver itself
Hydraulic hammers (rented and self-owned)	Age of hydraulic hammer itself
Oscillators (rented and self-owned)	Age of oscillator itself
Rotators (rented and self-owned)	Age of rotator itself

11. Notwithstanding the requirements in sub-clause (8), the following apply to truck-mounted cranes:

a. The overhaul requirements herein for truck-mounted cranes apply to the cranes only but not to the trucks on which the cranes are mounted;

b. Provide Certificates of Overhaul for the cranes mounted on all trucks on Site in accordance sub-clause (8) herein;

c. Prohibit the operation of the cranes mounted on any trucks on Site in case Certificates of Overhaul are not provided for the cranes mounted thereon. In such cases, provide and operate all necessary alternative lifting appliances to perform offloading / uploading from and onto such trucks;

d. Plan ahead for delivery of goods, materials, etc. to ensure the use of trucks for which Certificates of Overhaul is provided for the cranes mounted thereon.

12. "Self-owned" plant mentioned above shall mean plant owned by the Contractor or by the Contractor's parent, sister or subsidiary company for the exclusive use of the Contractor. In case the Contractor sublets part of the Works to a sub-contractor and this sub-contractor is on the appropriate Category of Housing Authority List of Piling Contractors, then "self-owned" plant shall be extended to cover also plant owned by this sub-contractor or by the sub-contractor's parent, sister or subsidiary company for the exclusive use of the sub-contractor. "Rented" plant mentioned above shall mean plant that are not considered as "self-owned" plant;

13. Bear all the additional time and costs arising from compliance with the requirements in sub-clauses (1) to (12) above.

PRE.B8.242.C USE OF TOWER CRANES

1. In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of tower crane operation as recommended in the latest edition of the CoP for Safe Use of Tower Cranes issued by LD and the Guidelines on Safety of Tower Cranes issued by CIC. Examine critically the practices and / or measures as recommended in the said CoP and Guidelines, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said CoP and Guidelines may be proposed for the CM's approval before implementation. The following highlights of the crucial practices and / or measures, albeit not exhaustive, are extracted from the said CoP and Guidelines:

   a. Check critical parts of the tower crane, anchorage and supporting structure before erection of tower cranes;

   b. Enforce close site supervision of tower crane operations;

   c. Specify qualification and experience of the specialist sub-contractor(s), competent person and workers performing erection, dismantling and height alteration of tower crane;

   d. Specify qualification and experience of competent person, tower crane operators, slingers, signallers, inspection and maintenance technicians etc. for tower crane operations, inspections and maintenance;

   e. Comply with the legal requirements prescribed under the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations for the inspections, thorough examination and testing of tower cranes. Practical guidance on the compliance with the said Regulations is available in the Guidance Notes on Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by LD.

2. Engage or arrange through Contractor's sub-contractor(s) the engagement of the following personnel full time on Site during the operation of tower crane (except the personnel under sub-clauses (2)(a), (2)(f) and (2)(g) who need to be on Site for the carrying out of the duties in accordance with the said CoP and Guidelines):

   a. Competent Examiner:

i. The competent examiner shall be a registered professional engineer registered under the Engineers Registration Ordinance within the discipline of Mechanical Engineering or Marine & Naval Architecture or a relevant discipline specified by the Commissioner for Labour.

b. Tower Crane Operator:

i. The tower crane operator shall possess relevant qualification, experience and competency as specified in the said CoP.

c. Slinger (Construction Materials Rigger):

i. The slinger shall possess relevant qualification, experience and competency as specified in the said CoP.

d. Signaller:

i. The signaller shall possess Silver Card of Slinger (Construction Materials Rigger) and have completed Signalman for Hoisting Operations at Construction Sites Course, or possess Silver Card of Rigger and Signaller, relevant qualification, experience and competency as specified in the said CoP;

ii. The role of signaller can be taken up by a slinger possessing relevant qualification and experience in carrying out the duties as specified in sub-clause (2)(d)(i) above;

iii. The safety training courses for Silver Card of Slinger (Construction Materials Rigger), Signalman for Hoisting Operations at Construction Sites Course and Silver Card of Rigger and Signaller are provided by the CIC. Acceptance of training provided by other organisations is subject to verification by the CM that the training is based on course contents of equivalent or higher standards and the appointed signaller has attained the associated qualification. A signaller having completed a training course of signaller and already working in the industry by end of year 2017 is exempted.

e. Responsible Person:

i. The responsible person shall possess relevant training, experience and competency in respect of discharging duties for the proper implementation of the safe system of work and the permit-to-work system as specified in the said CoP.

f. Competent Person:

i. The competent person shall possess adequate training, experience and competency as specified in the said CoP and Guidelines.

g. Competent Mechanical Engineer (CME):

i. The CME shall possess relevant qualification, experience and competency as specified in the said Guidelines;

ii. The role of CME can be taken up by a competent examiner as specified in sub-clause (2)(a) above.

h. Lifting Supervisor for tower cranes:

i. The lifting supervisor shall monitor and supervise lifting process involving tower cranes on the Site in accordance with the lifting plans;

ii. The lifting supervisor shall possess certificate for lifting safety supervisors provided by CIC;

iii. The lifting supervisor shall have a minimum of four-year experience in lifting operation.

3. Ensure all the personnel as specified in sub-clauses (2)(a) to (2)(g), the Safety Supervision Personnel as per PRE.B6.060 sub-clause (16) and the Supervising Engineer (Tower Crane) as per PRE.B6.060 sub-clause (21) shall carry out their respective duties on Site in accordance with the said CoP and Guidelines;
4. Submit particulars of all the personnel as specified in sub-clauses (2)(a) to (2)(g), the Safety Supervision Personnel as per PRE.B6.060 sub-clause (16) and the Supervising Engineer (Tower Crane) as per PRE.B6.060 sub-clause (21), including their names and qualifications, to the CM for approval before their engagement in the Contract;
5. In addition to the above sub-clauses, adopt all the practices and / or measures recommended in the latest edition of the said Guidelines unless otherwise directed by the CM. The following terms used in the Guidelines, however, shall be construed as follows for the purpose of the Specification:

Term used in the Guidelines	Meaning in the Specification
Principal Contractor	the Contractor
Registered Safety Officer	Safety officer
Project Engineer	Registered Structural Engineer

6. Adopt the following key practices on the management of the lifting operation extracted from the said CoP:
   a. Establish and document a safe system of work for every lifting operation whether it is an individual or a series of repetitive operations. The lifting operation shall include any necessary preparation of a site and the siting;
   b. Appoint a responsible person to ensure the implementation of the safe system of work and have an overall control of the lifting operation;
   c. Communicate effectively the safe system of work to all parties concerned.
7. Adopt the following key practices on the planning of the lifting operation extracted from the said CoP:
   a. Plan all lifting operations to ensure that they are carried out safely. Conduct a risk assessment specific to the workplace to identify all foreseeable risks, evaluate and propose mitigating measures;
   b. Develop a detailed method statement from the results of the risk assessment together with the crane manufacturer's instructions for the lifting operation;
   c. Appoint a competent person for the purpose of sub-clauses (7)(a) and 7(b);
   d. Communicate the method statement to the working crew effectively for compliance;
   e. Make reference to the said Guidelines for the purpose of sub-clauses (7)(a) and (7)(b).
8. Comply with the following measures in lifting operations:
   a. Conduct a trial of the lifting operation of large panel formwork, large metal components, precast concrete components and volumetric precast concrete components, as recommended by risk assessment, when the load is lifted not more than 300-500mm off the level where it is originally placed and ensure the load is securely rigged before the load is further lifted;
   b. Ensure all workers to leave the danger zone of lifting operation before the load being lifted is started to be lifted above 300-500mm off the level where it is originally placed;
   c. Work within the safe working load with due considerations on various specific working conditions;
   d. Tie all materials safely and securely;
   e. Take due care to avoid falling objects;
   f. Not to work outside the Site boundary unless obtained the CM's prior approval;

g. Provide Site Personnel to assist the slinger to carry out his work within the lifting zone;

h. Provide interlocking devices or other measures to secure the safety latches of crane hooks. The safety latches shall only be released manually, so as to prevent slipping of lifting gear out of the hooks. Submit details to the CM for approval. Refer to drawing no. REF/SS/ID/SK-01 in Appendix U to this Specification for reference only;

i. Provide secondary brake to handle situations not covered by the primary brake and offer protection when the primary brake fails. The secondary brake shall be located over the hoisting drum so as to brake the shaft, lifting gear and motor effectively. The secondary brake shall be provided with an independent signal system, and it is capable of overriding the primary brake and the motor for braking and cutting the driving system. The braking mechanism shall be as follows:

i. In case of shutdown / no power supply, the brakes shall be locked;

ii. The driving system shall be cut off, the power supply turned off, the primary brake and secondary brake activated if any of the following situations occurs during the operation of the tower crane:

- The hoisting drum continues to rotate (regardless of the direction of motion of the hoisting drum) when the crane operator does not touch the control lever and the control lever is in the neutral position or when the crane operator returns the control lever to the neutral position and the primary brake is activated;
- When the crane operator is lowering or raising the lifting hook, the rotation of the hoisting drum exceeds the allowable speed limit by 10% or changes in direction of motion;
- When the speed of the motor and the hoisting drum do not synchronize and either of them exceeds the allowable speed limit.

j. Implement a work roster and an access control system to limit the maximum working hours of tower crane operator daily to not more than 12 hours including lunch time. No exceedance of the limit is permitted without the prior approval of the CM.

9. Display a currently valid test and examination certificate for all lifting equipment. The certificate shall be in Forms 1, 2, 3 and 5 of the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations where appropriate and duly signed by the competent person (for Form 1 only) and the competent examiner referred to in sub-clauses (2)(f) and (2)(a) respectively;

10. Before the commissioning of a tower crane for its lifting operations, provide and install a CCTV system comprising a camera fixed at each designated lifting zone proposed by the Contractor, a camera fixed on tower crane (for "A" frame or flat top tower crane), a camera fixed inside the tower crane cabin and associated equipment and a video recording system in compliance with the following:

a. CCTV camera at each designated lifting zone and associated equipment in the tower crane cabin:

i. The installation shall consist of a CCTV camera, a transmission unit (if required by the system), a control unit, and a monitor / display unit;

ii. The power, control and video cables connecting the camera shall be of the plug and socket type. 75 ohms BNC type video connectors shall be provided for all cable connections of the video system equipment;

iii. The camera shall be:

- Fixed at a certain tilt angle at not higher than the sixth floor of each block within each designated lifting zone;
- A constant speed camera capable of 360° rotation and tilting from 0-90°;
- A minimum 20X optical zoom with resolution 1920(H) x 1080(V);
- Able to function at 1 lux with automatic iris and focus control which can be manually overridden;
- Provided with camera housing with proper shading against direct sunlight.

iv. The monitor / display unit shall be:

- A colour LCD screen at least 7 inches wide diagonally;
- Provided with an anti-glare surface / coating to the screen;
- Industrial type with a resolution not lower than 1920(H) x 1080(V);
- Equipped with control buttons / knobs to adjust the basic setting, including brightness and contrast.

v. Provide earth connection to all connection panels, equipment mounting brackets, camera housing that are constructed in metal to prevent electric shock.

b. CCTV camera fixed onto tower crane and associated equipment in the tower crane cabin:

i. The installation shall consist of a CCTV camera, a wireless transmission unit, a control unit, and a monitor / display unit;

ii. The system (for "A" frame or flat top tower crane) shall be automatically started as the tower crane trolley leaves the control cabin and automatically stopped as the tower crane trolley returns to the control cabin. The system (for other types of tower cranes) shall be automatically started as the tower crane is in operation;

iii. Its wireless transmission unit shall work on 2.4 GHz, be of a type as approved by the Office of the Communications Authority of Hong Kong and have a transmission distance of 200 m at minimum. There shall not be any obstruction between the transmitter and the receiver units;

iv. The power, control and video cables connecting the camera shall be of the plug and socket type. 75 ohms BNC type video connectors shall be provided for all cable connections of the video system equipment;

v. The camera shall be:

- Fixed onto tower crane saddle and it shall be of wireless type or fixed onto the end of the tower jib / boom when there is no saddle;
- Powered by rechargeable battery that can be charged during the normal operation of the tower crane without any disruption to the tower crane operation;
- A minimum 30X optical zoom with resolution 1920(H) x 1080(V);
- Able to function at 1 lux with automatic iris and focus control which can be manually overridden;
- Provided with camera housing with proper shading against direct sunlight;
- Capable of being controlled on its zooming function by the tower crane operator by joystick or foot pedals in the tower crane cabin.

vi. The monitor / display unit shall be provided with the same specification referred to in sub-clause (a)(iv);

vii. Provide earth connection to all connection panels, equipment mounting brackets, camera housing that are constructed in metal to prevent electric shock.

c. CCTV camera at each tower crane cabin and associated equipment in Contractor's site office:

i. The installation shall consist of a CCTV camera, a transmission unit (if required by the system), a control unit, and a monitor / display unit;

ii. The power, control and video cables connecting the camera shall be of the plug and socket type. 75 ohms BNC type video connectors shall be provided for all cable connections of the video system equipment;

iii. The camera shall be:

- Fixed at a certain tilt angle to capture only the control panel area of the crane operator;
- A minimum 2X optical zoom with resolution 1920(H) x 1080(V);
- Able to function at 1 lux with automatic iris and focus control which can be manually overridden;
- Provided with camera housing with proper shading against direct sunlight.

iv. The monitor / display unit shall be:

- A colour LCD screen at least 7 inches wide diagonally;
- Industrial type with a resolution not lower than 1920(H) x 1080(V);
- Equipped with control buttons / knobs to adjust the basic setting, including brightness and contrast.

v. Provide earth connection to all connection panels, equipment mounting brackets, camera housing that are constructed in metal to prevent electric shock.

d. Video recording system and associated equipment:

i. Provide, operate and maintain, including all necessary cables, wirings, lightings and other accessories, a video recording system connected to the CCTV system:

- Power backup shall be provided to cater for accidental breakdown of the power supply to the system;
- Videos captured by the CCTV system shall be recorded continuously without break unless agreed by the CM;
- Videos shall be captured in a format acceptable to the CM.

ii. Provide the software and hardware for capturing the time and date and the lifting conditions for the CM's viewing and taking photographs immediately or when required. Keep the videos record for at least 60 days and the photographs until such time as required by the CM;

iii. Post sufficient notices at conspicuous positions on Site to notify the workers and staff about the purpose of the video recording system (i.e. all collected personal information / data will be used by the CM to monitor the lifting conditions only and will not be released / issued to irrelevant persons / parties without the permission of the persons / parties being monitored) in accordance with data protection principles set out in the Personal Data (Privacy) Ordinance.

e. Maintenance and Repair:
   i. Check the CCTV system and video recording system daily for its normal functioning;
   ii. Carry out weekly inspection and monthly checking of the CCTV system and video recording system;
   iii. Check the focus of the CCTV camera on a regular basis;
   iv. Clean the camera lens, camera housing and the screen of the LCD display unit on regular basis;
   v. If the CCTV system or video recording system is not functioning, attend to the problem within 24 hours of its failure;
   vi. In case of malfunctioning of the CCTV system or video recording system, immediate action shall be taken to rectify the malfunction and the tower crane operation shall be monitored by the assigned responsible person at all times until completion of the rectification work.

11. Provide a computerized system with monitor in Contractor's site office for full time surveillance of tower cranes as follows:
    a. The computer records of tower crane operations shall be kept and be retrievable for at least within a week of an operation;
    b. The monitor shall be as per sub- clause (10)(a)(iv);
    c. In the event that there are overlapping zones of tower crane operations with adjoining site(s), the computerized system shall be compatible with similar system(s) of those site(s).
12. Special lifting operations:
    a. Apply permit-to-work system to all special lifting operations including:
       i. Lifting in overlapping area where the anti-collision system of tower crane is by-passed;
       ii. Lifting in restricted area in which lifting operations are not normally allowed unless in exceptional circumstances;
       iii. Use of multiple lifting appliances.
    b. Where a special lifting operation is involved, Site Agent shall ensure a block foreman is appointed as the lifting coordinator in addition to the signaller, slinger and tower crane operator for the operation;
    c. Where a special lifting operation is involved, Site Agent shall ensure a foreman is appointed as the lifting coordinator in addition to the signaller, slinger and tower crane operator for the operation;
    d. Before the commencement of the special lifting operation, Site Agent shall ensure the associated risk assessment is completed and the safety procedures are developed by a risk assessment team of which the competent person referred to in sub-clause (2)(f), Safety Officer, Site Agent and lifting coordinator are members;
    e. Site Agents shall ensure the lifting coordinators, signallers, slingers and tower crane operators all have attended the training in safety procedures conducted by Safety Officers at least once for the whole Contract before the commencement of the special lifting operation;
    f. The lifting coordinator shall apply for a permit-to-work from the responsible person referred to in sub-clause (2)(e) when he has completed the lifting preparation work;

g. The responsible person shall only issue the permit-to-work to the lifting coordinator when he has inspected and is fully satisfied with the lifting preparation work. The duration of the permit-to-work should not be longer than one day and should not be extended beyond the end of the lifting coordinator's shift. The permit-to-work needs to be retained by the Contractor for future inspection by the CM;

h. By-pass key for the anti-collision system shall be issued by the responsible person to the lifting coordinator who should return it to the responsible person for custody when signing off the permit;

i. Check and ensure the following for lifting operation:

i. Condition of the lifting gears before lifting operations and ensure that they are free from patent defects;

ii. A load has been correctly slung and well secured to prevent the movement or dislodgment of any part of the load and a tag line shall be used for controlling the load;

iii. The responsible person to monitor the lifting operation at all time until its completion.

j. The location of any proposed unloading area shall be confirmed by the Structural Quality Control Coordinator and checked by the lifting coordinator for suitability before lifting commences.

13. Maintain a log book with key records on special operations including implementation of safety precautionary measures, and hours of service related to the tower crane, for inspection by the CM:

a. Special operations shall include the following:

i. Inspection and maintenance;

ii. Adjustments, insulation checks and renewal of parts;

iii. Emergency repairs during breakdown;

iv. Thorough examinations and repairs;

v. Temporary by-pass of anti-collision system.

b. The special operations shall only be carried out by a working team with qualified and competent team members. The qualification and competence of the team members shall be in accordance with the said CoP and Guidelines. The team leader shall be designated and instructed by the Contractor's Site Agent and seek the permission from the Site Agent for overall implementation of safety precautionary measures;

c. Safety precautionary measures shall at least include the following:

i. Inform all Site Personnel engaged in the tower crane operations about the safety precautionary measures in place before work commences;

ii. Do not allow free suspension of loads on the hook;

iii. If the tower crane is completely stopped for maintenance or repair, lock the main controls, place a warning plate over the main switch and the key to the lock shall be kept by the team leader referred to in sub-clause (13)(b);

iv. If the anti-collision system of tower cranes needs to be temporarily by-passed, the slinging of loads in the overlapping lifting zone and the guiding of tower crane operators shall only be carried out by the concerned lifting coordinators and not by the slingers or signallers;

v. Audio-visual warning devices shall be installed at lifting locations on ground for clear indication of any by-pass effected and other effective communication systems must be in place;

vi. The team leader referred to in sub-clause (13)(b) shall keep the by-pass key and the General Foreman shall monitor the usage of the by-pass key;

vii. The team leader referred to in sub-clause (13)(b) shall keep the by-pass key and the Site Agent shall monitor the usage of the by-pass key.

d. Upon commencement of the special operations, the team leader referred to in sub-clause (13)(b) shall ensure and the Site Agent shall endorse that all protection and safety devices are put into working condition.

14. If a derrick crane is used, ensure that the pre-delivery checking of critical parts of the derrick crane has been carried out in accordance with the procedures provided in the latest edition of the CoP for Safe Use of Tower Cranes issued by LD and the Guidelines on Safety of Tower Cranes issued by CIC;

15. Allow a minimum continuous duration of 2 hours weekly during daytime for inspection and maintenance of the tower crane which shall be stopped for other operation. Maintain and indicate in the master construction programme the time for erection, telescoping, climbing, maintenance and dismantling of tower crane;

16. Provide a direct power supply from the mains to each tower crane if possible. If not, provide a power supply from a generator for each tower crane and do not share the power with other plant;

17. Implement a mentoring programme for tower crane operators under which a junior tower crane operator with less than 1-year post-qualification experience (mentee) is allowed to sit behind an experienced tower crane operator (mentor) inside the cabin to learn the technique unless the Contractor can demonstrate that there is no mentee willing to join the mentoring programme. Allow at least 1 mentee for each tower crane in the contract period. Minimum duration of the programme for each mentee shall be 2 months.

18. Refer to PRE.B10.010 sub-clause (8) for the certification requirement of RSE for derrick cranes and PRE.B10.010 sub-clause (9) for the certification requirement of RSE and ICC for tower cranes.

PRE.B8.245.D USE OF STATIC AND MOBILE CRANES

1. In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and /or measures in respect of mobile crane operation as recommended in the latest edition of CoP for Safe Use of Mobile Cranes issued by LD. Examine critically the practices and / or measures as recommended in the said CoP, especially the applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works and taking care of the safety of all workers involved and other persons who may be affected by the lifting operation. Alternative practices and / or measures which should not be inferior to those recommended in the said CoP may be proposed for CM's approval before implementation. The following highlights of the crucial practices and / or measures, albeit not exhaustive, are extracted from the said CoP:

   a. Develop a checklist for checking Form 1, 3, 5, 6 & 7 and critical parts of the mobile crane, anchorage and supporting structure before operation of mobile cranes. The checklist should cover but not limited to outriggers, jib, oil hoses, hook, safety latch, control lever, automatic safe load indicator, emergency control button, cut-off device, etc.;

   b. Enforce close site supervision of mobile crane operations;

   c. Specify qualification and experience of competent person, mobile crane operators, slingers, signallers, inspection and maintenance technicians etc. for mobile crane operations, inspections and maintenance;

d. Comply with the legal requirements prescribed under the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations for inspections, thorough examination and testing of mobile cranes. Practical guidance on the compliance with the said Regulations is available at the Guidance Notes on Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by LD.

2. Engage or arrange through Contractor's sub-contractor(s) the engagement of the following personnel full time on Site during the operation of mobile cranes (except the personnel under sub-clauses (2)(a) and (2)(f) who need to be on Site for the carrying out of the duties in accordance with the said CoP):

   a. Competent Examiner:

      i. The competent examiner shall be a registered professional engineer registered under the Engineers Registration Ordinance within the discipline of Mechanical Engineering or Marine & Naval Architecture or a relevant discipline specified by the Commissioner for Labour.

   b. Mobile Crane Operator:

      i. The mobile crane operator shall possess relevant qualifications, experience and competency as specified in the said CoP.

   c. Slinger (Construction Materials Rigger):

      i. The slinger shall possess relevant qualification, experience and competency as specified in the said CoP.

   d. Signaller:

      i. The signaller shall possess Silver Card of Slinger (Construction Materials Rigger) and have completed Signalman for Hoisting Operations at Construction Sites Course, or possess Silver Card of Rigger and Signaller, relevant qualification, experience and competency as specified in the said CoP;

      ii. The role of signaller can be taken up by a slinger possessing relevant qualification and experience in carrying out the duties as specified in sub-clause (2)(d)(i) above;

      iii. The safety training courses for Silver Card of Slinger (Construction Materials Rigger), Signalman for Hoisting Operations at Construction Sites Course and Silver Card of Rigger and Signaller are provided by the CIC. Acceptance of training provided by other organisations is subject to verification by the CM that the training is based on course contents of equivalent or higher standards and the appointed signaller has attained the associated qualification. A signaller having completed a training course of signaller and already working in the industry by end 2017 is exempted.

   e. Responsible Person:

      i. The responsible person shall possess relevant training, experience and competency in respect of discharging duties for the proper implementation of the safe system of work and the permit-to-work system as specified in the said CoP.

   f. Competent Person:

      i. The competent person shall possess adequate training, experience and competency as specified in the said CoP.

   g. Lifting Supervisor for mobile cranes:

      i. The lifting supervisor shall possess certificate for lifting safety supervisors provided by CIC;

ii. The Lifting supervisor shall have a minimum of four-year experience in lifting operation;

iii. The lifting supervisor shall monitor and supervise the whole lifting process involving volumetric precast concrete components on the site in accordance with the lifting plans.

3. Ensure all the personnel as specified in sub-clauses (2)(a) to (2)(f), the Safety Supervision Personnel as per PRE.B8.210 shall carry out their respective duties on Site in accordance with the said CoP;
4. Submit particulars of all the personnel as specified in sub-clauses (2)(a) to (2)(f) the Safety Supervision Personnel as per PRE.B8.210 including their names and qualifications, to the CM for approval before their engagement in the Contract;
5. Adopt the following key practices on the management of the lifting operation extracted from the said CoP:
   a. Establish and document a safe system of work for every lifting operation whether it is an individual lift or a series of repetitive operations. The lifting operation includes any necessary preparation of a site and the siting;
   b. Appoint a responsible person to ensure the implementation of the safe system of work, to have overall control of the lifting operation;
   c. Communicate effectively the safe system of work to all parties concerned.
6. Adopt the following key practices on the planning of the lifting operation extracted from the said CoP:
   a. Plan all lifting operations to ensure that they are carried out safely. Take care of the safety of all workers involved and other persons who may be affected by the lifting operation, including fencing off all lifting zones as far as reasonably practicable. Conduct a risk assessment to identify all foreseeable risks, evaluate and propose mitigating measures;
   b. Develop a detailed method statement from the results of the risk assessment together with the crane manufacturer's instructions for the lifting operation;
   c. Appoint a competent person for the purpose of sub-clauses (6)(a) and 6(b);
   d. Communicate the method statement to the working crew effectively for compliance.
7. Comply with the following measures in lifting operations:
   a. Ensure all workers to leave the danger zone of lifting operation before the load being lifted is started to be lifted above 300-500mm off the level where it is originally placed, but the crane operator is an exception if it is not feasible to have remote control of mobile crane by the crane operator;
   b. Conduct a trial of the lifting operation of large panel formwork, large metal components, precast concrete components and volumetric precast concrete components, as recommended by risk assessment, when the load is lifted not more than 300-500mm off the level where it is originally placed and ensure the load is securely rigged before the load is further lifted;
   c. Work within the safe working load with due considerations on various specific working conditions;
   d. Tie all materials safely and securely;
   e. Take due care to avoid falling objects;
   f. Not to work outside the Site boundary unless obtained CM's prior approval;
   g. Provide Site Personnel to assist the slinger to carry out his work within the lifting zone;

h. Mobile cranes having outriggers shall be fully extended, securely held at the extended position, securely levelled and supported before commencing operations. Yellow triangular markings with lateral sides of each at least 75 mm in length shall be marked or painted on the front and rear sides of each outrigger beam to indicate the fully extended position. For use of mobile cranes with safe working load of 70 tonnes or more, conduct firm ground loading capacity testing using a firm ground tester. In assessing the applied bearing pressure, the crane suppliers must be consulted to obtain the load distribution diagram. An average value of bearing pressure cannot be assumed because the maximum pressure will exceed this average value. As lifting is a temporary operation, the absolute magnitude of settlement under the test load is not the prime concern. Measure the trend of settlement using a dial gauge. As long as the ground reaches a plateau in settlement and does not settle further at the test load, the ground is considered firm enough for the lifting operation. The firm ground tester is a designated truck equipped with a set of hydraulic jack and measurement devices (for load and settlement). The hydraulic jack is fixed with a float having a plan size of 316mm x 316mm, giving a contact area of about $0.1m^2$. The testing mechanism is like that of plate loading tests. The kentledge is provided by the self-weight of the truck and the concrete blocks it carries. Once activated for testing, the load in the hydraulic jack can be read from the Force Indicator (unit in tonne). Obtain the specific ground bearing capacity using the conversion of 1 tonne shown in the Force Indicator to 100kPa;

i. Provide interlocking devices or other measures to secure the safety latches of crane hooks. Cranes which are rented and are not expected to be used on Site for more than six months are not subject to this requirement. The safety latches shall only be released manually, so as to prevent slipping of lifting gears out of the hooks. Submit details to the CM for approval. Refer to drawing no. REF/SS/ID/SK-01 in Appendix U to this Specification for reference only.

8. Display a current valid test and examination certificate for all lifting equipment The certificate shall be in Forms 1, 2, 3 and 5 of the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations where appropriate and duly signed by the competent person (for Form 1 only) and the competent examiner referred to in sub-clauses (2)(f) and 2(a) respectively;
9. Maintain a log book with key records on all inspections, tests, repairs, maintenance and hours of service related to the machine, including implementation of safety precautionary measures for inspection by the CM:
    a. Apply permit-to-work system under the control of the responsible person in accordance with the said CoP, for maintenance activities including:
        i. Major repairs, adjustment and inspections of mobile crane;
        ii. Emergency repairs during breakdown;
        iii The responsible person shall only issue the permit-to-work to the crane operator when he has inspected and is fully satisfied with the lifting preparation work after the activities at sub-clauses (9)(a)(i) and (9)(a)(ii). The duration of the permit-to-work should not be longer than one day and should not be extended beyond the end of the crane operator's shift. The permit-to-work needs to be retained by the Contractor for future inspection by the CM.
    b. Safety precautionary measures shall at least include the following:
        i. Inform all Site Personnel engaged in the mobile crane operations about the safety precautionary measures in place before work commences;
        ii. Do not allow free suspension of loads on the hook;

iii. If the mobile crane is completely stopped for maintenance or repair, lock the main controls, place a warning plate over the main switch and the key to the lock shall be kept by the crane operator.

PRE.B8.248.A SAFE USE OF LORRY-MOUNTED CRANES

1. Carry out a full inspection of lorry-mounted cranes once a week by a competent person in accordance with the Factories and Industrial Undertakings (Lifting appliances and Lifting Gear) Regulations Cap. 59J and make reference to LD's "Code of Practice for Safe Use of Mobile Cranes" for using the lorry-mounted cranes safely and properly with a view to preventing accidents;
2. Carry out a pre-use check of lorry-mounted cranes by a competent person / crane operator before starting the lifting operation of each shift or working day. The checklist should cover but not limited to outriggers, jib, oil hoses, hook, safety latch, control lever, automatic safe load indicator, emergency control button, cut-off device, etc. The competent person shall possess adequate training, experience, competency in discharging his duties safely;
3. Cease to use the lorry-mounted cranes and report immediately to the responsible person concerned if any defect such as twisted / broken wires, hydraulic oil leak etc. or abnormality in the crane be found or the cranes be accidentally damaged;
4. Take out of service the lorry-mounted crane with defects or damage until all the defects or damage have been rectified, with endorsement given by the responsible person concerned;
5. The responsible person shall possess relevant training, experience and competency in respect of discharging duties for the proper implementation of the safety of work.

PRE.B8.250.9 GUARDS TO LIFT WELL OPENINGS

Ensure that:

1. Temporary steel gates are provided for all lift well openings as specified in PRE.B10.1020;
2. The temporary steel gates are maintained in a proper, efficient and safe manner for operation;
3. The temporary steel gates are dismantled and cleared away properly and safely.

PRE.B8.251.D PLATFORMS FOR WORKING AT DIFFERENT HEIGHTS

1. Provide the following equipment for working involving a possible fall of:
   a. 2m or more: working platform with guard rails, toe boards and a fall arresting system as warranted after conducting risk assessment;
   b. Less than 2m but more than 900mm:
      i. Light-duty working platform such as hop-up platform or step platform with guard rails, and provide toe boards when the working platform is used near a building edge or floor opening to avoid risk of falling object from height;
      ii. A fall arresting system as warranted after conducting risk assessment for working at a height of 1350mm - 2000mm.
   c. Less than or equal to 900mm: hop-up platform or step platform with or without guard rails;
   d. A height under abnormal circumstances where use of working platform, hop-up platform or step platform is not reasonably practicable: alternative proposal incorporating a fall arresting system after conducting risk assessment.
2. Ensure that the following safety measures are fulfilled:
   a. The right type of light-duty working platform is used for the job;

b. The workers who use the light-duty working platforms have been provided with adequate information, instruction, training and supervision;

c. The workers are fully aware of the risks and control measures;

d. Follow a safe system of work (including a pre-use check) so as to use the platform safely;

e. The workers are not allowed to work on the access steps of a light-duty working platform;

f. The fall arresting system shall comprise a full body harness with double hook lanyard to allow a user to stay linked to at least a rigid anchor point. The anchor point shall be planned in advance, installed and tested.

3. Guard rails shall be situated at 450mm - 600mm and 900mm - 1150mm high from the platform and form a barrier to prevent the worker standing on the platform from falling down;
4. Toe boards shall be not less than 200mm high;
5. Locking device shall be provided to movable working platforms to ensure that the platforms are stable when in use;
6. Step ladders, straight ladders and extension ladders are used purely as a means of access and egress to working platforms;
7. Portable ladders provided shall comply with the safety requirements of at least one of the following standards (the latest version):
   a. BS EN131-7 for portable ladders and mobile ladders with platforms including hop-up platform and step platform, timber, metal and glass fibre reinforced plastic ladder;
   b. EATS 13/1 for glass fibre reinforced plastic ladder;
   c. BS EN14183 for step stools; or
   d. Other international standards approved by the CM.
8. Prevent injuries of manual handling of ladders of varying sizes for providing access to working platforms of a reverse circulation drill to suit different heights of the working platforms. An example of safety measure(s) includes the extendable and adjustable ladder. Submit detail drawings of the extendable and adjustable ladders for the CM's approval. Refer to drawing nos. REF/SS/EL/SK-01 to REF/SS/EL/SK-04 in Appendix U to this Specification for reference only.
9. Implement a visual and audio alarm system for monitoring the clamping device of reverse circulation drill. Refer to drawing nos. REF/SS/CD/SK-01 to REF/SS/CD/SK-03 in Appendix U to this Specification for reference only.
10. Provide extendable reinforcement cage working platform when the platform is used for fabricating different size of reinforcement cage. Submit detail drawings of the extendable reinforcement cage working platform for the CM's approval. Refer to drawing no. REF/SS/WP/SK-01 in Appendix U to this Specification for reference only;
11. A safe system of work shall be developed and implemented for using a mobile elevating work platform (MEWP). The planning of the operation shall include but not limit to the selection, provision and use of a suitable MEWP. Refer to "Guidance Notes on Safe Use of Power-operated Elevating Work Platforms" issued by Labour Department on selection;

12. When a risk of contact with an obstacle in the use of a MEWP is identified by the risk assessment, the Contractor shall consider the need of smart device as secondary guarding device (SGD) for protecting the operator from the risk of entrapment. The SGD shall be one of the SSSS component following the requirements in PRE.B8.267 (wireless communication technologies). The Contractor shall maintain a register to monitor whether all MEWPs on Site are fitted with SGD and the register shall be included in the monthly safety report. Provide the SGD with the following consideration:
    a. If the SGD is not an integral part of the original MEWP from the manufacturer, then the Contractor, who intends to fit SGD as an attachment to existing MEWP shall be liable for the adaptation, addition, modification and safe operation of a MEWP with SGD;
    b. The smart device shall be one of the SSSS component following the requirements in PRE.B8.267 (wireless communication technologies) and an anti-collision sensor fitted at a MEWP for detecting any obstacles around and above the MEWP. When the distance between any operator or worker on the MEWP and any obstacle around or above the MEWP becomes less than 500mm or other distance as pre-determined by the risk assessment, the device is to trigger a warning siren with a minimum of 70 dB noise level and a flashing red light to alert the operator and workers on the MEWP. When the distance between any operator or worker on the MEWP becomes less than the distance as pre-determined by the risk assessment, which poses an imminent danger, the smart device could automatically carry out a function of stopping the MEWP operation at emergency. All warning signal shall be automatically turned off when the MEWP operator resume the plant operation and address the warning signals. The device shall have a minimum battery life of two working days per charge under continuous operation and a lighting display showing its battery is in normal operation mode. All warning signals and the status of the smart device during operation shall be automatically transmitted to a CMP for record where the data transmitted shall be digitalised signal in chronological sequence and marked with the time and date and be available for integration by Open Application Programming Interface (API) format. Conduct all necessary maintenance, repair and / or replacement of smart device within 24 hours upon reporting of any device abnormality, malfunction or damage of the smart device;
    c. Display warning notices at prominent location of all MEWPs on Site to alert all operators and workers to the potential hazards on using MEWPs such as the hazard of entrapment;
    d. The SGD shall only be retracted or collapsed when:
        i. The MEWP is at stationary status;
        ii. The presence of SGD will render works to be carried out not practicable;
        iii. Other types of safety precautionary measures are in place to completely eliminate the risk of entrapment of any operator or workers on MEWP;
        iv. The retract and collapse of SGD shall be done under supervision of a Safety Supervisor / Safety Officer;

13. All workers on a MEWP shall have attended the training course provided by the supplier of the MEWP on the use of the respective type of MEWP. When a trained worker is newly employed for operating a MEWP, the Contractor shall verify the adequacy of the training and relevant experience of such trained worker for the use of respective type of MEWP. Provide the trained workers with all necessary information, instructions, training and supervision regarding the safety of work at heights. Prepare emergency procedures for accidents / incidents arising from or in connection with the use of MEWP. Assign worker(s) to receive the same training so that there is always a trained worker available on Site during the operation of the respective type of MEWP to operate the control set at ground or chassis level of the MEWP to lower the platform of MEWP in an emergency. Maintain the training record of the workers using MEWP provided by the supplier of MEWP on Site for inspection by the CM;
14. The Contractor shall use the permit-to-work system to conduct checking of implementation of all necessary safety precautionary measures for the use of MEWP. Use of MEWP on Site shall be permitted only after the issue of a permit-to-work certification by the Contractor. These certificates shall be made available for inspection upon request by CM;
15. Arrange gangers who will have workers to work on MEWP and foremen to complete the Mobile Elevating Work Platforms Operator Safety Training provided by the OSHC or equivalent training by other organisations. The gangers or foremen who have received training in the said course shall provide talks to workers who are required to operate MEWP. Maintain the record of talks to the workers using MEWP provided by gangers or foremen on Site for inspection by the CM;
16. Unless otherwise agreed by the CM, working platforms for piling works shall be classified as Case 1 Temporary Works under CoPSS clause 4.9 and refer to PRE.B10.010 sub-clause (5) for the certification requirement;
17. Refer to PRE.B10.010 sub-clauses (7) and (9) for the certification requirement for temporary working platforms for the operation of plant and machinery.

PRE.B8.252.9 PROTECTION OF WORKERS FROM PROTRUDED REINFORCEMENT BARS

Identify protruded reinforcement bars on Site and appraise any related potential hazards to the safety and health of workers. Include such hazards in the risk assessment specified in PRE.B8.210. Protect workers from such hazards by providing suitable safety measures to the satisfaction of the CM.

PRE.B8.255.9 PROTECTIVE STEEL RAILING AT SLABS EDGES

In addition to any obligations under GCC Clause 5.11 or any similar obligations under any enactment or regulation to provide guard rails, immediately after removal of slab table-forms or slab formworks, provide protective middle and top steel railings at heights of 600 mm and 1100 mm respectively at slab edges where parapet walls have not yet been constructed. Maintain the same in a proper and efficient manner until the parapet walls are constructed.

PRE.B8.256.9 SAFETY OF REINFORCEMENT BAR BENDING MACHINES

Apply the following safety measure(s) to machines for small reinforcement bars or stirrups (Y16 or below), to avoid striking and trapping by the moving parts of machines or the bending reinforcement bars. Submit details of the safety measure(s) for the CM's approval. Examples include the following and refer to drawing no. REF/SS/BM/SK-01 in Appendix U to this Specification for reference only:

1. Install an interlocking guarding to the rotating part and a timer switch to isolate power supply automatically after a time interval set according to risk assessment conducted by Safety Officer, if the guarding is not closed properly;

2. Install an angle indicator on the top to visually indicate the angle set for the current operation.

PRE.B8.260.9 REQUIREMENTS FOR PRECAST CONCRETE FACADES TO DOMESTIC BLOCKS

Where precast concrete facades are required or proposed for domestic blocks, comply with the following additional safety requirements for manufacture and erection of the precast concrete facades:

1. Provide sufficient safety harness, lifelines and all devices for the attachment of lifelines to all workers who are required to work in or at areas where they are liable to fall;
2. Before installation of the precast facades, barricade all the open sides of buildings where a worker is liable to fall. The barricade must be at least 1200 mm high and have sufficient strength and rigidity;
3. Display warning signs of size 900 mm x 600 mm at strategic locations around the periphery of the building where precast facades are to be installed. Such signs must have the words "DANGER - KEEP OUT" in both Chinese and English painted in red on a white background in gloss finished paint;
4. Provide and maintain a safety net system of sufficient size and strength to catch falling persons or objects located strategically to cover area of possible fall; reposition the safety net system from time to time but in no case more than 6 m below the working level;
5. Provide appropriate and adequate warning signs, guards, fence or barrier around potential places of danger at casting yard to prevent accidents;
6. Comply with PRE.B8.242, PRE.B8.245 and PRE.B8.248 for safe use of cranes and lifting operation. Provide details of cranes regarding the following for the CM's approval:
   a. Maximum allowable wind speed during lifting operation according to the manufacturer's recommendations;
   b. Safety margin for the safe working capacity of crane to allow for various forces acting on the crane during operation. Allowances for wind loading and dynamic forces due to wind specified in sub-clause (6)(a) above on the facade units shall also be included;
   c. Safety precautions to be adopted to secure the facade unit against swinging or spinning during lifting.
7. Provide wind speed measuring device at a suitably elevated position on the crane structure and a read-out unit fitted at the crane driver's cabin to monitor the wind speed during lifting operation. No lifting operation is allowed when the wind speed exceeds the maximum allowable wind speed for the crane;
8. Provide a safety latch to the crane hook. Provide interlocking devices or other measures to secure the safety latches of crane hooks. The safety latches shall only be released manually, so as to prevent slipping of lifting gear out of the hooks. Submit details to the CM for approval. Refer to drawing no. REF/SS/ID/SK-01 in Appendix U to this Specification for reference only;
9. During lifting operations, comply with the following:
   a. Give hand signals and any communication to the crane driver by one signaller at a time;
   b. Provide walkie-talkies assigned with specific channel for the sole use by the tower crane operator and the signaller to ensure safe operation;
   c. Provide video surveillance for crane driver to monitor the lifting operations;
   d. Provide and operate audio-visual warning devices at lifting location(s) during the lifting operations.

10. Provide a permanent working platform on the trailer or other suitable working platform for rigging of precast concrete facades. Refer to drawing nos. REF/SS/PP/SK-01 to REF/SS/PP/SK-03 in Appendix U to this Specification for reference only.

PRE.B8.262.A REQUIREMENTS FOR LARGE PANEL FORMWORK AND WORKING PLATFORMS TO DOMESTIC BLOCKS

Notwithstanding clause PRE.B8.260, comply with the following additional safety requirements for large panel formwork and working platforms:

1. Submit details of the designated storage yard and storage device of accessories certified by QE as specified in PRE.B10.010 sub-clause (6) for large panel formwork for the CM's approval, include but not be limited to the following:
   a. Layout of the designated storage yard with restricted access & warning signs / notices;
   b. Effective measures such as installation of vertical steel guard posts securely fixed on ground to avoid overturning of large panel formwork;
   c. Proper access to large panel formwork for slingers' operation;
   d. Proper device for secure storage of tie rods;
   e. Steel containers with covers and locking devices securely attached to the back of large panel formwork for storage of small parts such as bolts & nuts;
   f. Steel containers of adequate height securely attached to the back of large panel formwork for storage of long bolt and shaft;
   g. Minimum two supports for each panel formwork.
2. Periodical checking of large panel formwork

   Check, make good, clean and remove all loose concrete paste and debris from large panel formwork from time to time to achieve the required quality standard of finished concrete and to avoid falling objects during lifting and assembling of large panel formwork;
3. Requirements for working platforms shall include but not be limited to the following-
   a. Paint steel doors/gates in contrasting colour for clear identification;
   b. Add fall arrest device to prevent movable steel door from falling at height;
   c. Seal up the gaps between the working platform and precast façade by openable metal plate attached to working platform;
   d. Provide protective barrier such as fencing or equivalent at an effective height of 1350mm with mesh infill panel covered with nylon net of minimum 15 core threads with grids in spacing of not more than 12mm or equivalent on the inside, along building edges and gable end wall.

PRE.B8.265.A INSTALLATIONS TO REDUCE RISK OF MANUAL HANDLING AND WORKING AT HEIGHT

Provide installations, or safety measures, to reduce risk of manual handling and working at height. Include, but not limited to, the following implementation:

1. Prevent injuries of wheelbarrow users by providing two-wheel wheelbarrow with braking system. Prohibit the use of single-wheel wheelbarrow for works at paved premises. Refer to drawing no. REF/SS/WB/SK-01 in Appendix U to this Specification for reference only;
2. Provide safety measures to reduce manual lifting of hand-held pneumatic breaker for works at non-domestic premises. Refer to drawing no. REF/SS/BR/SK-01 in Appendix U to this Specification for reference only;

3. Adopt safety measure(s) by mechanical means, certified by Qualified Engineer as stipulated in PRE.B6.060 as necessary, to eliminate releasing shackle for H-pile and sheet pile at height manually and prohibit the use of man-cage. Refer to drawing no. REF/SS/DL/SK-01 in Appendix U to this Specification for reference only;
4. Provide safety measure(s) by mechanical means, certified by Qualified Engineer as stipulated in PRE.B6.060 as necessary, to reduce manual lifting of the reinforcement bars during fabrication of large diameter bored piles. Submit details to the CM for approval. Refer to drawing no. REF/SS/TF/SK-01 in Appendix U to this Specification for reference only. Refer to PRE.B10.010 sub-clause (7) for the certification requirement of QE.
5. Provide bridging chains on the four corners of the steel frame housing generator set to avoid rigging at height. Refer to drawing nos. REF/SS/BC/SK-01 to REF/SS/BC/SK/03 in Appendix U to this Specification for reference only.
6. Provide power-assisted trolley or wheelbarrow with "Dead Man's Switch" and lift dump for carrying load exceeding 50kg. Refer to drawing no. REF/SS/PT/SK-01 in Appendix U to this Specification for reference only.
7. Provide fencing barrier clamp or similar means as a gripping hand tool to lift, carry and / or move big panels. Refer to drawing no. REF/SS/FB/SK-01 in Appendix U to this Specification for reference only.

PRE.B8.266.B SAFETY OF ELECTRIC PORTABLE TOOLS

1. Ensure the use of cordless electric portable tools by operatives, including: circular saws for cutting wood or metal, reciprocating saws, angle grinders, rotary hammers, combination hammers for drilling, impact drivers, impact wrenches, demolition hammers, masonry cutters and jig saws. Prohibit the use of the above tools that are with cords;
2. Inspection records to verify that the cordless electric portable tools are in safe and serviceable conditions shall be kept on site for checking by the CM's representatives. Verification record shall be either:
   a. annual certificates issued by the original manufacturer; or
   b. quarterly records certified by Registered Electrical Worker.
3. Arrange centralised charging facilities to ensure safe use of electricity. Provide at the place of centralised charging facility with at least one 6 kg dry chemical powder (automatic type) fire extinguisher, or its equivalent, and at least one fire detector which will trigger audio and visual alarm with alert to the site office in case of a fire;
4. Ensure that the angle grinders are provided with the following features:
   a. An auxiliary handle;
   b. Double-action switch to prevent accidental start-up and stop the grinder when released;
   c. Electronic brake to stop the wheel in 3 seconds or less; and
   d. Kick back detection to shut down the grinder automatically when rotation of wheel is suddenly forced to stop.
5. Use low spark tools (cold-cut tools) instead of tools fitted with abrasive wheels.

PRE.B8.267.E WIRELESS COMMUNICATION TECHNOLOGIES

1. Implement efficient and effective smart site safety system (SSSS) with aid of wireless communication technologies incorporated with facial recognition system, artificial intelligence system, Radio Frequency Identification (RFID), infrared, Internet of Things (IoT), Ultra wideband (UWB), Long Range (LoRa), etc. for authenticating authorised operation of mobile plant or equipment, controlling access, alerting to unsafe acts or conditions, checking data of personnel, plant, equipment, tools and materials and monitoring health condition of workers and frontline personnel. The operation and collection of data of SSSS shall comply with the Personal Data (Privacy) Ordinance (Cap. 486). Ensure that the SSSS shall have 99.9% uptime during working hours and at other time when the Contractor is working or other time as advised by the CM. Refer to drawing nos. REF/SS/WT/SK-01 to SK-12 in Appendix U to this Specification for reference only. The Contractor shall provide the SSSS for use by all his sub-contractors free of charge;
2. Submit implementation plan of the SSSS to the CM within 14 days from the notified date for commencement of the Works for approval by the CM. The implementation plan shall include:
    a. A general description on overall SSSS setup, including site telecommunication networking, list of individual SSSS components as specified in sub-clause (1), implementation and operation schedule and a management plan with designated key personnel other than safety personnel for SSSS general implementation and maintenance;
    b. Site telecommunication network proposal as specified in sub-clause (6) for supporting SSSS implementation;
    c. Details of all computer hardware and software and the associated furniture for SSSS;
    d. Proposal for each SSSS component to be implemented:
        i. The proposal for each SSSS component specified;
        ii. Each SSSS component proposal shall include, but not limited to the following:
            - Actual body vital sign data shall not be displayed on the platform for privacy protection;
            - Details on the corresponding SSSS component performance specifications;
            - A location plan for the corresponding SSSS devices and sensors setup during the progress of the Works, and the arrangement of video cameras where SSSS components include video cameras;
            - Specification of computer system, including all associated hardware and software supporting the Centralised Management Platform;
            - The format, report and presentation details of the dashboard for the Centralised Management Platform as specified in sub-clause 15(a);
            - Details, layout and furniture for housing the Centralised Management Platform inside the site office;
            - Action plan on Site Personnel’s required actions and responses to SSSS components generated alarm / alert or identified unsafe acts / conditions which shall include details on immediate / follow-up actions required, recommend response time, designate responsible supervising personnel and establish procedures to record all incidents triggered by SSSS components;

- Details on the emergency support services provision for the SSSS components where necessary, which shall also include an alternative monitoring back-up plan for each of the SSSS components in case where malfunctioning of any of the SSSS component cannot be rectified in a short period of time.

3. Review and update the implementation plan on SSSS monthly according to the prevailing site condition. The review of implementation plan on SSSS shall be one of the agenda items of the Site Safety Committee meetings. Unless agreed by the CM, deliver and implement all components of SSSS within 1 month from the date of acceptance of the first implementation plan on SSSS. Deliver and implement any additional components on SSSS as stated in the updated implementation plan on SSSS within 1 month from the date of acceptance of the updated implementation plan on SSSS concerned. Within 5 days of delivery of any component, the Contractor shall arrange the components of SSSS to be installed and tested for demonstrating that the SSSS components are in good working order to the satisfaction of the CM;
4. Ensure uninterrupted operation of all SSSS components installed until the certified date of completion of the Works or for such shorter or longer period as directed by the CM. The SSSS and all its components shall be able to operate automatically 24 hours per day and 7 days per week. The Contractor shall be responsible for:
   a. The cost of servicing, repair and maintenance of all SSSS components as well as the computer hardware and software;
   b. The cost of supplying all consumables of all SSSS components and training of all Site Personnel for SSSS;
   c. The cost for replacement of worn out or defective parts of all SSSS components, and computer hardware and software;
   d. Providing the respective replacement for the period of breakdown in the event of a breakdown of any SSSS components, or computer hardware or software.
5. Implement appropriate security controls and measures to protect the confidentiality, integrity and availability of all data and information obtained, stored, processed or transmitted for the implementation and delivery of SSSS. Review monthly the adequacy of the security control and protection measures. Brief all Site Personnel on the collection of data for SSSS;
6. Provide site telecommunication network which shall support mobile communication with adequate data transmission speed, capacity, coverage, connectivity, stability and cybersecurity to ensure that the real-time data transmission, including any video / audio signals, from any automation / remote sensing devices to their targeted operators / receivers / monitors / data storage devices for efficient implementation of the proposed SSSS components is uninterrupted, reliable and effective. Due consideration on the flexibility and adjustability of the network system with respect to changes in construction work and site progress shall be given in the selection of the telecommunication network;
7. Adopt more than one telecommunication network systems available in the market, including but not limited to Wi-Fi, broadband network, 4G/5G network, Bluetooth, LoRa, Ultra wideband etc., to suit each of the proposed SSSS components and with respect to the progress of the Works. Ensure the accessibility and compatibility among multiple network systems with the corresponding SSSS components and that there shall not be any signal interference between different network systems adopted. Provide all necessary power supply and all associated infrastructures (including hardware and software) for the site telecommunication network;

8. Ensure that any proposed SSSS component that issues automated warning, alarm or alert in the process shall achieve and maintain an adequate accuracy. In any case, no less than 90% in detecting conditions for triggering alert / warning signal shall be maintained on routine operation during the progress of the Works. Ensure that each time when the automated warning system activates, a signal shall be automatically transmitted to a Centralised Management Platform for record, review and data analysis. The warning trigger record shall include but not limited to the involved Site Personnel and machinery identification, the date, time and duration of the warning triggered etc. Review and analyse all the records and submit a summarized report monthly to the CM. Where SSSS components include video cameras, the camera shall have a protective casing. The video cameras resolution shall not be less than 1920(H) x 1080(V) pixels with at least 5X optical zoom and shall be able to continuously transmit wireless encrypted live-streamed video signal to a Centralised Management Platform for recording, viewing and monitoring by the Contractor and the CM;
9. Where interim modification / adjustment to the operating SSSS components are proposed, the corresponding modification / adjustment shall be undertaken with minimum interruption to normal SSSS components operation. Submit the corresponding modification / adjustment proposal to the CM for acceptance before implementation;
10. Provide all necessary power supply for the operation of all SSSS components. Conduct all necessary system maintenance, repair and / or replacement of any SSSS component / unit within 24 hours upon reporting of any system abnormality, malfunction or damage to ensure normal operation of the SSSS components;
11. Ensure that all audio, video, image and data transmitted from SSSS components shall be:
    a. Digitalised signal in chronological sequence and marked with the time and date of the signal transmission and be available for integration by Open Application Programming Interface (API) format; and
    b. Live-streamed to a Centralised Management Platform for storage, viewing and analysis by personnel authorized by the Contractor.

    Allow the CM to access the stored audio, video, image and data upon request. All audio, video, image and data shall be encrypted. Maintain all APIs during system upgrade or maintenance and keep copy of the API library documents after launching of SSSS and major system upgrades.
12. Assign competent personnel with relevant knowledge, experience and training to check and ascertain the proper functioning of the SSSS components, such as correct alarm triggering, real-time transmission and receiving of warning / alert signal between devices and concerned workers, supervisors and stations etc., before commencement of works on each day. Any irregularity observed during daily checks shall be recorded and rectified before conducting any related work activities. The daily check records with the irregularity and rectification records shall be kept on the Site for inspection by the CM upon request;
13. Provide appropriate training to Site Personnel involved in the use of SSSS components to ensure they are familiar with the concerned SSSS components operation before the commencement of the Works;

14. Submit monthly report on implementation of SSSS components on Site to the CM in advance of the monthly Site Safety Committee meeting for record. The monthly report shall include, but not limited to, updates on Site SSSS components setup, operation, malfunction, interruption and modification, etc. The report shall also include a summary of all SSSS components triggered incidents, including false alarm, with details of the incidents, the actions taken and the response time, the consequence of incidents and the follow up actions, and the site monitoring and analysis report on the unsafe practices / behaviours detected on Site and the warning signals / alerts issued and associated measures retrieved from the Centralised Management Platform as specified in sub-clause 15(a);
15. The SSSS shall include, but not limited to, the following implementation:
    a. Centralised Management Platform
        i. Provide and operate a Centralised Management Platform (CMP) to respond, manage and record signals / alerts received from all SSSS components implemented on the Site. The CMP shall be run in automatic mode. The CMP shall be compatible and able to work with the BIM model of the Contract in case one is provided. A trained superintendent of the Contractor shall be assigned to oversee the operation of the CMP during working hour of the Site and promptly attend to the alerts / signals for taking immediate actions to address the alerts / signals or emergency situations;
        ii. Ensure uninterrupted operation of the CMP upon setting up with the necessary backup and support in terms of equipment, device, power supply, data storage, telecommunication connection, maintenance and repair personnel and emergency support;
        iii. Develop a CMP dashboard that can display video, audio, image and data transmitted from different SSSS components on corresponding CMP monitors and ensure the various signals will not interfere with one another or become corrupt. The CMP shall have the capacity to control, monitor, manage and maintain simultaneous operation of all SSSS components under a single platform. The CMP shall also be designed to display various warning signals from different SSSS components with highlighted pop-up notification display on corresponding CMP monitors. Such pop-up notifications shall include details of warning and necessary follow up actions. The CMP shall allow concurrent access by not less than 30 users;
        iv. The CMP shall support real-time distributed event data streaming for large volume and high speed data handling. It shall support real-time video streaming from the safety monitoring system using artificial intelligence;
        v. Develop a CMP dashboard with a unique website link based on signals collected from SSSS. Provide all necessary training for designated Contractor’s superintendent on operating the CMP and on the procedures to handle received warning signal and any emergency situation;
        vi. Provide the access policy of the CMP for acceptance by the CM before the delivery of the CMP. The access policy of the CMP shall cover, but not limited to user accounts control, access for system support personnel and procedures for management of users account created;

vii. Establish a rational and logical filing system for automatic storage of all data, video, audio and images received from SSSS components, with a storage duration of at least 3 months. Ensure that the computer system supporting the CMP has adequate processing power and storage space for storing all data, video, audio and images received from SSSS components. The servers for CMP for storing video, audio, image and data transmitted from different SSSS components shall be hosted at site office or externally in data centre or cloud-based system. Archive all captured data for each construction site quarterly. When requested by the CM or his representatives, the Contractor shall store the data into removable storage media (e.g. USB thumb-drive, DVD-RW, etc) in construction site office or make the archived data available at FTP server for downloading by the CM or his representatives;

viii. The CMP and its server shall be fully accessible via a web-browser by a desktop computer / laptop computer with secured internet connection (Hypertext Transfer Protocols) without physical or geographical limitation. No other software or licenses shall be needed to access CMP;

ix. For CMP servers hosted at site office, it shall be protected and separated from other systems by firewall (e.g. trusted zone, demilitarized (DM) zone, etc.) and / or virtual private network (VPN). Ensure the hosting environment meets the requirements of data confidentiality, system integrity, system availability / accessibility, and data privacy aspect as agreed with the CM;

x. For CMP servers hosted in data centre or cloud-based system, the Contractor shall ensure that the selected hosting solution is configured, deployed and managed to meet the requirements of data confidentiality, system integrity, system availability / accessibility and data privacy aspects and is in compliance with globally recognised industrial security standard, e.g. Telecommunications Industry Association (TIA)-942 certified Tier 3 data centre and International Organization for Standardization (ISO)/ International Electrotechnical Commission (IEC) 27001. Provide an up-to-date independent auditor report for achieving international recognised certification, e.g. ISO/IEC 20000 or ISO/IEC 27017 to demonstrate the cloud service provider has the required capability in security and risk management.

xi. Secure connection of at least 256-bit Secret Socket Layer (SSL) shall be used for any network communication, transaction and data feed;

xii. Implement measures and conduct IT security audits to ensure the security of CMP is in accordance with Chapter IX of the Security Regulations, the Baseline IT Security Policy promulgated by the Office of the Government Chief Information Officer (OGCIO) and the derived Employer's IT Security Policy. Also implement appropriate arrangements for preventing unauthorised access to CMP and its data.

b. Authenticating authorised operation of plant and equipment

For authenticating authorised operation of plant and equipment, implement a digitalised system on mobile plant (including mobile elevating work platforms, forklift trucks, bobcats, excavators, mobile cranes) and a system with RFID and face recognition technology or equivalent for material hoists to allow operation by authorised operators only; and prohibit unauthorised duplication of operation keys;

c. Controlling access to hazardous areas:

i. Implement an automated access control and warning system to prevent unauthorised opening of locked cover, doorway and barrier to hazardous areas within the Site which shall include but not limit to the following:

- Entrance to confined space;
- Storage yard of precast concrete elements;
- Temporary storage of large panel formwork;
- Lift shaft opening;
- Material hoist landing gate;
- Floor opening equal to or larger than 500mm x 500mm; and
- Electrical distribution board cabinet.

ii. The access control and warning system shall include an electronic lock and key system for locking accesses to hazardous areas in the Site. The electronic lock shall only be openable by authorised electronic key with key owner's identity electronically embedded in the key. Review and renew all electronic locks access authority periodically or as necessary and maintain an updated register of all electronic keys issued with the corresponding authority for opening the designated electronic locks. Prohibit unauthorised duplication of electronic keys;

iii. When an unauthorized person attempts to open the electronic lock by using an outdated key or by force, the system shall immediately issue a warning siren with a minimum of 70 dB noise level and flashing red light and the siren can only be turned off when the electronic lock is re-engaged or by an authorized electronic key. Furthermore, every time a warning siren is triggered, an automatically generated alert message shall be sent to the mobile devices of the Site Agent, General Foreman, Block Foreman, Safety Officers, Safety Supervisor, Competent Person for confined space and lifting supervisor and registered electrical worker by means of short message service (SMS) or in-app pop-up notification for immediate actions to check the corresponding electronic lock being tampered with and recorded at the CMP for the Contractor's actions where necessary. The alert message shall include location of electronic lock being tampered with the date and time of the incident and the electronic key identification number;

d. Alerting against unsafe acts or conditions:

i. Tower crane lifting zone

- Implement an automated warning system on tower cranes to alert tower crane operator and any personnel encroaching upon the tower crane loading / unloading danger zone to the risk of being hit by the moving load under the crane hook. The automated warning system shall include an adequate number of sensors installed on or around the tower crane to ensure full coverage of all loading / unloading areas danger zone at all floor levels involved. The loading / unloading danger zones of the tower crane operation shall be determined by the Safety Officer according to risk assessment but in no case shall the extent of the danger zone be less than 7m radius from the crane hook. The minimum clearance between the load being lifted and the loading / unloading area activating the automatic warning system shall be determined by the Safety Officer according to risk assessment but in no case be less than 3m from the crane hook;

- When clearance between the load and the loading / unloading area is less than the minimum clearance for system activation and any one of the sensors detect person encroaching upon the danger zone, a warning light signal shall flash on the plant operating dashboard and an automated warning message shall be delivered via speaker or headphone to the tower crane operator to stop all crane motion. At the same time, siren speaker attached to the crane hook shall automatically turn on with flashing red light and continuous alarm at a minimum of 100 dB to warn away any encroachment of the danger zone. All warning signal shall be automatically turned off when the encroaching person has left the danger zone, the plant operator stopped the plant operation and the workers or Site Personnel concerned addressed the warning signals / alerts. An alert message shall be generated to the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification and be recorded at the CMP for follow up actions. The alert message shall include the date and time of the encroachment upon the lifting danger zone and the video clip capturing 15 seconds before the encroachment of loading / unloading danger zone until 10 seconds after the encroaching person has left the loading / unloading danger zone.

ii. Mobile plant danger zone

- Implement an automated warning system on mobile plant (including but not limited to forklift trucks, bobcats, mobile cranes and loadshifting machines covering bulldozer, loader, excavator, truck, lorry, compactor, dumper, grader, locomotive and scraper) to alert the mobile plant operator and any personnel who enters mobile plant danger zone to the risk of being hit by the plant moving components. The automated warning system shall include an adequate number of sensors installed on the mobile plant chassis and moving components to ensure full 360^0 coverage around the mobile plant danger zone. The danger zones of the mobile plant operation shall be determined by the Safety Officer according to risk assessment but in no case shall the extent of the danger zone be less than 2m from any part of the mobile plant;

- When any one of the sensors detect a person encroaching upon the mobile plant danger zone, a warning light signal shall flash on the plant operating dashboard and an automated warning message shall be delivered via speaker or headphone to the plant operator to stop all plant operation. At the same time, siren speaker attached to the top of the mobile plant shall automatically turn on with flashing red light and continuous alarm at a minimum of 100 dB to warn away any encroachment of the mobile plant danger zone. All warning signal shall be automatically turned off when the encroaching person has left the danger zone, the plant operator stopped the plant operation and the workers or Site Personnel concerned addressed the warning signals / alerts. An alert message shall be generated to the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification and be recorded at the CMP for follow-up actions. The alert message shall include the date and time of the person encroached upon the danger zone of the plant and the video clip capturing the person 15 seconds before the encroachment of the danger zone until 10 seconds after the encroaching person has left the mobile plant danger zone.

iii. Implement a visual and audio alarm system at Site entrance / exit to alert drivers and security guards to stop a mobile plant from entering or leaving the Site when the mobile plant exceeds the height limit of haul road of the Site or the height limit of vehicles regulated by the Transport Department, whichever is the lower;

iv. Implement an automated warning system with adequate number of sensors installed on the safety harness for detection of proper wearing of safety harness which is fixed to a proper anchorage point or fall arrestor of lifeline for workers working at height. The automated warning system shall immediately issue a warning signal with a minimum of 70 dB to the workers working at height when an unsafe act or condition is detected. Furthermore, every time when a warning signal is triggered, an automatically generated alert message shall be sent to the mobile device of the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman by means of SMS or in-app pop-up notification for immediate actions. The automatically generated alert message shall also be sent and recorded at the CMP for follow-up actions;

v. Implement an artificial intelligence (AI) system with internet protocol (IP) cameras and video recording system for collecting videos of all uncovered areas of the Site, working floors and facades of buildings for real-time monitoring of the Site conditions. All IP cameras, sensors and related video recordings shall be managed by the CMP. The proposed AI detection and video analytics shall pass an accuracy test with a testing dataset.

- Conduct a live test with the pre-built AI engine modules to achieve an accuracy of AI detection of at least 80% (true positive) for each type of unsafe acts or conditions required. The testing dataset comprises not less than 10,000 images and it shall be split into half between image data with and without the proposed detecting object (or event) in those images;

- In the first four weeks after deployment of AI detection on Site, provide the CM or his representatives with weekly AI improvement plan (with re-training and other proposed methodology) to achieve the required accuracy of AI detection;
- From the fifth week to the twelfth week after the deployment of AI detection on the Site, provide the CM or his representatives with bi-weekly AI improvement plan (with re-training and other proposed methodology) to achieve the required accuracy of AI detection;
- From the fourth month after the deployment of AI detection on the Site to the date of certified completion of the Works or for such shorter or longer period as directed by the CM, provide the CM or his representatives with monthly AI improvement plan (with re-training and other proposed methodology) to achieve the required accuracy of AI detection;
- Improve and maintain the required AI detection accuracy of at least 90% on average, covering all types of unsafe acts or conditions required to be detected at all times after 4 weeks from the deployment of AI detection on the Site till the date of certified completion of the Works or for such shorter or longer period as directed by the CM;
- Provide a total of two on-site technical training courses (4 hours for each course) for implementing the site monitoring system using AI. The details are as follows:
  - The content of each course shall cover aspects of data acquisition, processing and detection analysis for different types of unsafe acts and conditions relevant to the AI engine modules required at different construction activities;
  - The trainer shall possess extensive knowledge and practical experience in deploying IP cameras for surveillance and analysing data collected from site videos by appropriate AI engine modules;
  - The training course shall be conducted within 2 weeks from the date after deployment of AI detection on the Site;
  - The content of each course, the experience and qualifications of the trainer shall be accepted by the CM prior to commencement of the training course.
- By using the AI system, videos shall be recorded and analysed in real-time by AI engine modules designed to detect, identify and classify different types of unsafe acts and conditions, including but not limited to the following:
  - Unauthorized access to restricted zones, danger zones, lifting zones or vehicular routes (detection zones and alerts should be configurable);
  - Workers near site vehicles or plant;
  - Potential collisions between workers and site vehicles or plant;
  - Outriggers of mobile crane not being fully stretched;
  - Workers and other personnel not wearing the required personal protective equipment, including safety helmet and reflective vest in lifting zone and safety helmet on the Site;
  - Heights of lifting in excess of the authorized limits;

- Workers working at height either without wearing safety harness and fixed to a proper anchorage point of lifeline, or without a proper working platform;
- Monitoring of fatigue, distraction, inattentive behaviours of operators of crawler cranes and tower cranes during operation of the cranes.

- The AI engine shall be able to detect multiple physical events at the same time. The AI system shall allow restricted zones, danger zones and lifting zones to be defined on the screen either by the user or by recognition of a series of plastic barriers placed on the Site;
- When any unsafe act or condition is detected, siren speaker attached to the top of the mobile plant concerned and / or at the incident location concerned shall automatically turn on with flashing red light and continuous alarm at a minimum of 100 dB. All warning signal shall be automatically turned off when the encroaching person has left the danger zone, the plant operator stopped the plant operation and the workers or Site Personnel concerned addressed the warning signals / alerts. In addition, every time a warning siren is triggered, an automatically generated alert message shall be sent to the mobile devices of the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification for immediate actions. The automatically generated alert message shall also be sent and stored in the CMP. All the sound / light signals / alerts mentioned in this sub-clause shall be triggered within 1 second after any unsafe act or condition is detected;
- The duration of the recorded videos for unsafe acts or conditions shall be 1 minute before and 1 minute after the identified unsafe acts or conditions. The videos shall be captured and stored for future analysis;
- The videos, data, warning alerts / signals and response times collected by the AI system shall be live-streamed to the CMP for viewing. All videos or image data shall be encrypted. The display format at the CMP shall be accepted by the CM;
- Record the response time of the follow-up actions triggered by each warning signal / alert and furnish a summary report to the CM, which covers the period from the warning signal / alert triggered to the close of the case. A drill shall be conducted by the Contractor once every 6 months to test the effectiveness of the AI system.

e. Tracking system for information of personnel, plant and equipment

Implement a digitalised system for real-time online tracking of information of personnel, plant and equipment on the Site by mobile device. The Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman, Competent Person for confined space and lifting supervisor shall be able to retrieve such information instantly from the CMP by an electronic mobile device. Set up and update computerised data base regularly. The mobile device shall display an alert message if the corresponding personnel, plant or equipment has an outdated certification or is overdue for examination or renewal of certificate and automatically generate an alert message to the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification and record at the CMP for follow up actions. The alert message shall include details of the date and time of scanning, digital identification number, status and record of the personnel, plant or equipment:

i. Major construction plant, as specified in clause PRE.B8.241 – for the plant checking and updating of the information of the plant including, but not limited to, its type, permit number, owner, model number, serial number / owner's mark, manufacture date, Certificate of Overhaul, photo of the plant for confirmation, list of authorized operators, valid records of test, examination, checking, maintenance and risk assessment;

ii. Workers - for checking and updating of their information, including but not limited to, their names, employers (i.e. the Contractor or sub-contractors that they belong to), their registered trade through reading the data in Construction Workers Registration Cards issued under Construction Workers Registration Ordinance (CWRO), plus records of training attended and safety performance;

iii. Plant and equipment, which involve safe working load, periodic testing and examination under legislation or contractual provision - for checking the data by smart tag and mobile applications, such as safe working load, latest examination date, relevant information of the plant and equipment, capturing the images of the subject or by inputting key words;

f. Smart monitoring devices for workers and Contractor's superintendent

i. Based on the result of risk assessment, provide workers and Contractor's superintendent in need with smart monitoring devices or other equivalent wearable monitoring devices including but not limited to smart wristband and / or smart helmet;

ii. The smart monitoring devices or other equivalent wearable monitoring devices shall include, but not limited to, the following functions:

- Capable of both outdoor and indoor location tracking and visualisation of location in the CMP, and recording of workers and Contractor's superintendent in different areas and time of working. The location data shall be stored in the CMP;
- Real-time detection of any standstill and sending alerts to the CMP; SMS or in-app pop-up notification shall be generated and recorded at the database platform for follow up actions. The period of standstill criteria shall be adjustable;
- Real-time detection of body temperature and heart beat rate and sending alerts to the CMP when the threshold is exceeded. SMS or in-app pop-up notification shall be generated and recorded at the database platform for follow up actions. The threshold of body temperature and heart beat rate shall be adjustable;

- Actual body vital sign data shall not be displayed on the platform for privacy protection;
- Allowing both battery and wireless charging modes and shall have a minimum battery life of 30 hours per charge under continuous operation;
- Wireless connection to cellular, WiFi, NBIoT and/or LoRa networks, or equivalent;
- Warning of entry to restricted area: only authorized workers and Contractor's superintendent could enter the restricted area and any unauthorized entry shall trigger alerts to workers, Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification;
- Capable of broadcasting at least 3 voice messages with continuous light flashing function to alert workers and Contractor's superintendent of various weather conditions, including but not limited to heat stress at work, rainstorm and tropical cyclone warnings.

g. Confined space monitoring system

i. Implement a confined space monitoring system to monitor the locations on the Site which are defined as confined spaces under the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE) and considered necessary to have this confined space monitoring system by the risk assessment. The Confined Space Monitoring System shall fulfil the following functions:

- Real-time site worker counting and location tracking inside confined spaces;
- Confined space environment monitoring including oxygen level, temperature, PM2.5 level, carbon monoxide, carbon dioxide, hydrogen sulphide and methane level, combustible gas;
- Real-time alert if any monitoring parameter exceeds the pre-determined safety levels as mentioned in the Code of Practice on Safety and Health at Work in Confined Spaces issued by Labour Department or any anomaly of workers' conditions is detected.

ii. All sensors and related warning signals / alerts shall be managed by the CMP;

iii. The warning alerts / signals and response times collected by the confined space monitoring system shall be automatically transferred to the CMP for viewing. All warning alerts / signals shall be encrypted. The display format at the CMP shall be accepted by the CM.

h. Digitalised permit-to-work system

Implement a digitalised permit-to-work system to facilitate online real-time application, issuance and tracking of permit-to-work / permit to move and operate. The Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman, Competent Person for confined space and lifting supervisor can access the system using a mobile device to display real-time information on the corresponding permit-to-work / permit to move and operate status. The mobile device shall also display an alert message if the corresponding permit-to-work / permit to move and operate has expired and automatically generate an alert message to the Site Agent, General Foreman, Block Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification and record at a CMP for follow up actions. The alert message shall include details of the permit-to-work / permit to move and operate, date and time of alert message. The activities to be covered under the digitalised permit-to-work system shall at least cover the high risk activities specified in PRE.B8.210 sub-clause (2)(g)(iv).

i. Virtual reality (VR) for safety training

   i. Adopt virtual reality for safety training to simulate the site environment and operation;

   ii. Provide VR safety training to workers as a part of the tool box talks. The VR training shall be attended by workers who are working on the Site and engaged in activities relevant to the topic of that training. The topics and contents of VR training shall be proposed by the Safety Officer having regard to the activities of the Site and the prevailing safety concern at that time. In providing the VR safety training, first priority should be given to the topics related to lifting operation, working at height, use of suspended working platform, erection / alteration / dismantling of bamboo scaffolds and / or truss-out bamboo scaffolds, electrical supply system, heavy machinery operation and working in confined spaces. The VR training kits can be those prepared by the Development Bureau, CIC, HKCA or equivalent.

PRE.B8.270.9 TRAFFIC CONTROL

Comply with all regulations concerning traffic control, signing, lighting and barriers including complying with the Road Traffic (Lighting and Guarding of Road Works) Regulations. Attention is drawn to the minimum requirements contained in the Government publication "Safe Road Working".

PRE.B8.280.9 TEMPORARY TRAFFIC SIGNS

1. Temporary traffic signs, including posts, backing plates and faces, shall comply with all requirements for traffic signs contained in Worksection EXT4;
2. The thickness of backing plates for temporary traffic signs which will be erected for use of less than 6 months may be reduced to 1.5 mm and the thickness requirement as stipulated in sub-clause (2) of EXT4.M320 may not be complied with; the posts for the signs may be constructed of timber or other material provided that in the opinion of the CM the traffic signs will be stable and safe;
3. In addition to the requirements for traffic signs contained in Worksection EXT4 and sub-clause (2) above, temporary traffic signs shall also comply with the following additional requirements:

   a. All corners of a sign plate shall be rounded to a radius of not less than 18 mm unless otherwise stipulated in the relevant standard drawing(s) published by the Transport Department or Highways Department;

   b. All edges of a sign plate shall be grounded to ensure that they are free from sharp edges, burrs, raggedness and tears;

c. When a sign plate is located on a footway, it should be positioned so as to minimise inconvenience or hazard to pedestrians. Particular attention shall be paid to cater for safety of the children, the elderly and the disabled;

d. The arrangement of information contained on sign faces for temporary traffic directional signs shall be designed by the Contractor. The details of the background, borders and legends, including letters, numerals, characters and symbols, shall comply with the requirements of the Commissioner for Transport.

PRE.B8.285.A MANAGEMENT AND MAINTENANCE OF DESIGNATED AREAS OPEN TO PUBLIC ACCESS

1. The Area …. as shown in Drawing No. ……... in Appendix A to this Specification is a temporary pedestrian walkway / vehicular access* with minimum clear width of ……m which runs across the Site with ingress / egress at ……Street to the north and …… Street to the south of the Site;
2. The walkway shall be a thoroughfare for pedestrians of the public / The vehicular access shall be a thoroughfare for vehicles* at all times during the first ……... months from the notified date for commencement of the Works, and such period may be extended for up to ……... months subject to one month's prior written notice of the CM;
3. Management and maintenance of the Area …. open to public access is deemed to be part of the Works. The Contractor shall maintain in good condition and provide all safety measures and lighting as necessary to ensure that the walkway / vehicular access* is safe and convenient for pedestrians / vehicles* to pass through during the aforesaid period including planning and sequencing of the Works, provision of temporary hoarding, gateway and fencing arrangement to separate the pedestrians / vehicles* from the construction activities and associated vehicular traffic of the Works;
4. The Contractor shall take all reasonable measures to prevent the public in the walkway / vehicular access* from entering those parts of the Site where work is in progress or where there exists any potential hazard to the public. Posters, temporary traffic signs and / or warning signs in both Chinese and English drawing attention of the public to the potential hazards in connection with the Works shall be displayed at prominent locations in the walkway / vehicular access*;
5. The Contractor shall take all reasonable precautions to ensure that such access for the public shall not be interfered or obstructed by the construction activities and associated vehicular traffic of the Works and / or by works being carried out by Utility Undertakings or Government departments as may be authorized by the CM for operation, inspection, maintenance, diversion or laying of utilities and services;
6. No part of the walkway / vehicular access* shall be used for storage and erection of any temporary structures other than the hoarding and fencing as required;
7. The Contractor shall indemnify and keep indemnified the Employer against all damages and claims whatsoever that may arise from or in connection with the Contractor's management and maintenance of the Area ….. while it is being used as temporary pedestrian walkway / vehicular access*;
8. The Contractor shall declare to the insurer of third party insurance to be procured under GCC Clause 5.14 of the presence of Area ….. and his management and maintenance responsibilities under the Contract with respect to such area of the Site whilst it is being used as a temporary pedestrian walkway / vehicular access*.

PRE.B8.286.A PROTECTION TO THE PUBLIC AGAINST FALLING OBJECTS

(Guidance Note: This clause is used for building contracts.)

Provide safety measure(s) to protect the public against falling objects from the building under construction, within the area that is out of Site boundary yet within inclined projection plane from the top outer edge of the building at 10 degrees from the vertical at ground level such as, erecting catch fan(s) at appropriate level(s) and providing wall mounted catch fan immediately below the external wall mounted working platform at the gable end wall. Refer to drawing nos. REF/SS/CF/SK-01 to REF/SS/CF/SK-04 in Appendix U to this Specification for reference only. Exemption shall be permitted at the area / part of the area where no public access is allowed. Submit detail drawings of the safety measure(s) to the CM for approval.

PRE.B8.290.C SAFETY OF SITE VEHICLES AND MOBILE PLANT

In addition to any obligations under GCC Clause 5.11 or similar enactment or Regulation, comply with the requirements in the latest edition on the Guidelines on Safety of Site Vehicles and Mobile Plant issued by CIC and the Guidance Notes on Safe Use of Loadshifting Machines for Earth Moving Operations on Construction Sites issued by LD, with special attention to the following:

1. Establish a safe system of work with risk assessment to identify any risks and formulate safe working procedures for the operation of site vehicles and mobile plant;
2. Provide workers with adequate information, training and instruction in respect of the safe system of work;
3. Provide requisite recognised training to Site Personnel to obtain valid certificates to acquire the knowledge and competency on the inspection, operation, maintenance, testing and examination applicable to a particular type(s) of site vehicles and mobile plant;
4. Properly design site layout and traffic circulation routes as follows:
   a. Minimize movements of vehicles and plant through appropriate measures;
   b. Impose speed limits on traffic routes through erecting of speed limit sign and road humps or other similar devices;
   c. Minimize reversing movements of vehicles and plant. Where reversing cannot be avoided, reversing vehicles or plant is not guided by a banksman, provide and install reversing video device (RVD) for vehicles / plant in accordance with the above mentioned Guidelines enabling the operator to have full view of 360^0 around the vehicles or plant;
   d. Provide appropriate facilities for the safe movement of personnel within the Site. Vehicular circulation shall be segregated from pedestrian access with zebra crossing for pedestrians.
5. For forklift truck, provide operator presence sensing system to cease all operations of forklift truck when the operator is not sitting on the seat to control the truck for more than 2 seconds.

PRE.B8.291.N SAFETY OF AIR HOSE CONNECTED TO AIR COMPRESSOR

1. Disconnect air hoses from air compressor if the air hose is not in use, otherwise the valve of the air hose shall be fitted with handle locking device to prevent the handle from being accidentally turned on.

PRE.B8.295.B DELIVERY OF MATERIALS BY VEHICLES TO SITE

1. Suitable types of vehicles shall be used with respect to the loads to be transported;
2. Only vehicles designed for the loadings to be transported in compliance with the requirements stipulated in the Code of Practice for the Loading of Vehicles issued by the Transport Department shall be allowed to enter into the Site;
3. The following safety measures shall be taken for loading / unloading of vehicles:
   a. Planning:

i. Conduct risk assessment of lifting operations by the safety officer or a competent person to identify hazards and risk control measures beforehand;

ii. Prepare statement with substantiation for the extent of danger zone to be fenced off in relation to loading and unloading of vehicles;

iii. Provide appropriate and adequate warning signs, guards, fences or barriers around danger zone to prevent unauthorized entry.

b. Crane Operators and Personnel:

i. Maintain a list of lorry-mounted crane / operators employed by the Contractor and his sub-contractors of all tiers for handling loading and unloading operations on the Site. All operators shall be trained as both qualified riggers & signallers and worker(s) assisting in unloading material from the vehicle on the Site shall be trained in lifting operation;

ii. Provide a lifting supervisor to monitor and supervise the whole lifting process. The lifting supervisor shall possess certificate for lifting safety supervisors provided by CIC. The lifting supervisor shall have a minimum of four-year experience in lifting operation.

c. Operation:

i. Park the vehicle on a level ground as far as possible before loading / unloading. If a level site condition is not available, adjust the vehicle to be level with outriggers fully stretched to rest on pads for stability;

ii. Stretch the outriggers of the lorry-mounted crane fully to rest on pads laid on solid ground.

d. Handling Load:

i. If there is a risk of the load falling down from the vehicle, secure and keep the load to be unloaded from the vehicle in a position by a device or method such as a crane before the strap / chain fastening the load is unfastened;

ii. When the load is higher than the sideboard of the vehicle, provide lateral barriers which may take the form of a metal frame mounted on the vehicle to restrain the position of the load;

iii. When the load comprises layers stacked over one another, add devices between the layers to secure them altogether to avoid risk of sliding;

iv. Tie all loads on the vehicle securely to the vehicle to prevent undue movement during transportation.

PRE.B8.298.9 LOCKOUT AND TAGOUT PROCEDURES FOR ELECTRICAL WORKS

1. Implement "lockout and tagout" procedures on Site when conducting electrical works to keep workers safe from electrical hazard;
2. Isolate and lock out any electrical system and / or equipment from its power source with an assigned lock by a designated individual using a unique key;
3. Each designated individual must place his individual lock and tag on the power source. Use a multi-pad lock if more than one designated individual is required to work on the same equipment / same outgoing circuit on Site;
4. Verify the power supply of the electrical system and / or equipment has been disconnected by using a voltage indicator;
5. Fasten a tag securely at the isolator with a clear and easy to understand prominent warning notice;
6. The name of each designated registered electrical worker shall appear on the tag which shall be signed with date and time;

7. Implement permit-to-work system according to the requirements stipulated in CoP for the Electricity (Wiring) Regulations issued by EMSD.

HEALTH

PRE.B8.300.A HEALTH CARE PLAN

1. The health care plan is one of the sections of the Safety Plan as per PRE.B8.210, where specifies the time of its submission to the CM and the frequency of its updating;
2. The health care plan shall comprise the following:
   a. Health check programme for workers on Site on worker's volunteer basis;
   b. Medical Examination for workers as required under relevant legislations for specific trades of workers. Details of the requirements of the statutory medical examinations are given at Appendix I of the Guidance Notes on Medical Examinations for Workers engaged in Hazardous Occupations in Industrial Undertakings issued by LD;
   c. Recommended medical examinations for certain trades of construction workers given at Appendix II of the Guidance Notes mentioned at sub-clause (2)(b);
   d. Risk assessment and the preventive measures for working under inclement weather conditions as per PRE.B8.1510;
   e. Risk assessment and the caring measures for the prevention of heat stroke as per PRE.B8.1570;
   f. Risk assessment and the caring measures for working in cold weather as per PRE.B8.1575;
   g. Information to the workers on Site about the substances they work with and train them about the risks to their health and the proper way to use any control measures provided;
   h. Health promotion for the well-being of workers on Site.
   i. Provide a self-checking health station with an automatic arm-through blood pressure machine, and a body mass index (BMI) height and weight machine at the Site office to facilitate the body check by workers on their own. Put up a message near the station about the indication of ranges of blood pressure and BMI readings with reference to the information of the World Health Organisation or Department of Health, and healthy diet and life style to prevent cardio-cerebrovascular disease. Provide assistance to the workers to operate the machines as necessary. Maintain record of usage of health station by workers such as log book or photo record;
3. Execute the health care plan throughout the duration of the Contract.

PRE.B8.305.A REST AREAS FOR WORKERS

1. Provide sheltered rest area(s) close to the workplace for all workers employed on the Works or in connection with the Contract. The rest area(s) shall be furnished with drinking facilities, hand washing facilities, chairs, tables, lighting and power, and good mechanical ventilation. The rest area(s) shall be in adequate number taking into account the number of workers and their locations on Site;
2. Maintain the rest area(s) in clean, tidy and functional condition for use of workers throughout the duration of the Contract;
3. Identify a suitable place under shelter as rest area for workers on Site, in liaison with the estate management, or the contractor who manages or possesses the Site, with the assistance of the CM.

PRE.B8.306.9 PROVISION OF AUTOMATED EXTERNAL DEFIBRILLATOR (AED)

1. Provide an automated external defibrillator (AED) for resuscitation at the site office with trained personnel to operate the machine.
2. The AED shall provide the following functions:
   a. Fully automatic or semi-automatic operation to provide basic life support;
   b. Provided with non-polarised and self-adhesive defibrillation pads;
   c. Providing Cantonese voice prompts as well as traditional Chinese display to guide the operator on the use of AED and Cardio Pulmonary Resuscitation;
   d. Meeting AAMI DF80 and American Heart Association recommendations;
   e. Battery level indicator;
   f. Recording the rescue event data and patient analysis decisions;
   g. Complying with the relevant safety and health standard set by the Electrical and Mechanical Services Department and Department of Health.
3. The operator of the AED shall have attained the training course or revalidation training on use of AED organised by the Occupational Safety & Health Council or the Hong Kong St. John Ambulance or equivalent training provided by other organisations subject to verification that the equivalent training is based on course contents of equivalent or higher standard.

PRE.B8.307.X DELETED

FIRE PRECAUTIONS

PRE.B8.310.9 FIRE REGULATIONS

Comply with all regulations to prevent loss or damage from fire with particular regard to the following clauses in this sub-section.

PRE.B8.320.9 STREET FIRE HYDRANTS

Ensure that any existing street fire hydrants are not obstructed by hoardings, vehicles, stockpiles, etc.

PRE.B8.325.A TEMPORARY FIRE SERVICES WATER TANK

1. Within one month from the notified date for commencement of the Works, provide on the Site a temporary fire services water tank of 36 cu.m storage capacity with all necessary accessories and fitted with two 65 mm instantaneous coupling outlets or hydrants to supply water solely for fire fighting at all times, and maintain their continual use until the certified date of completion of the Works or of the last Section in the last completion certificate or a date proposed by the Contractor and accepted by the CM, whichever is the earliest;
2. Submit installation details of the temporary fire services water tank for the information of the CM and for the acceptance by the FSD Officer prior to commencement of the installation;
3. Make arrangements for storage, pumping and distributing the water for fire fighting about the Site;
4. Keep the temporary fire services water tank in full water storage capacity for fire fighting purpose at all times;
5. Provide enhanced fire fighting measures to the satisfaction of the FSD Officer and to the approval by the CM when the accommodation of a temporary fire services water tank of 36 cu.m storage capacity on Site is not feasible due to site constraints.

PRE.B8.330.9 WATER RELAYING FACILITIES

Provide electrical or portable pumps to supply water to all floors 30 m or more above ground level in accordance with FSD requirements.

PRE.B8.340.9 DANGEROUS GOODS STORE

1. Comply with all relevant regulations to prevent the occurrence of fire or damage from fire;
2. Post notices in Chinese and English characters.

PRE.B8.345.9 USE OF DANGEROUS SUBSTANCES

1. In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures mentioned in A Guide to the Factories and Industrial Undertakings (Dangerous Substances) Regulations issued by LD to ensure the safe use of dangerous substances without risk to the health of the workers and to prevent the occurrence of accidents, disasters, fire or explosion and damage arising therefrom;
2. 'Dangerous substance' means any substance that is a listed substance or a dangerous mixture, as listed in the First Schedule under the said Guide;
3. Use non-flammable substituents instead of flammable substances as far as reasonably practicable so as to eliminate fire hazard;
4. Label properly all containers holding chemical substances in the manner and format all in accordance with the said Guide and alert workers of the particular risks and associated safety precautions required;
5. Take the following precautionary measures:
    a. Conduct task specific risk assessments and formulate appropriate safe working procedures and measures to avoid accidents and disasters;
    b. Draw up emergency procedures and set up emergency teams to execute emergency procedures;
    c. Develop and implement an effective monitoring and supervision system;
    d. Provide workers with adequate information, instruction and training;
    e. Provide good ventilation and maintain sufficient fresh air supply;
    f. Provide protective clothing and equipment to the workers;
    g. Provide emergency equipment.

PRE.B8.350.A PORTABLE FIRE FIGHTING APPLIANCES

Provide and properly maintain a sufficient number of portable fire fighting appliances for multi-storey buildings, carpentry workshop, paint stores for:

1. Domestic buildings: minimum 1 fire extinguisher and 2 buckets of sand in each staircase on alternate floors, i.e. one set per floor;
2. Non-domestic buildings: minimum 1 fire extinguisher and 2 buckets of sand in each staircase on each floor, and in close proximity of each entrance or exit of the buildings in case the buildings are only 1-storey.

PRE.B8.360.9 PROHIBITING SMOKING ON SITE

1. Prohibit smoking on Site except in the designated smoking areas;
2. Provide the designated smoking areas with suitable fire-fighting appliances and clean the designated smoking areas daily;
3. Do not designate the following areas as a designated smoking area on Site:
    a. Any area where there is a risk of fire due to the use, intended use or storage of flammable liquid, mixture containing flammable liquid or substances/materials;
    b. Any area where naked lights are prohibited.

PRE.B8.370.N SCREEN FOR WELDING AND FLAME CUTTING

1. Provide and erect fire retardant screen to prevent spread of sparks generated from the welding or flame cutting operation onto other areas;
2. Provide fire-fighting appliances in connection with carrying out welding or flame cutting operation.

GENERAL NUISANCE

PRE.B8.410.9 COMPLIANCE WITH REGULATIONS

Comply with all Regulations concerning the prevention of nuisance arising from noise, water, smoke, dust, accumulation of rubbish, mosquito breeding and all other causes.

PRE.B8.420.A CONTROL OF LIGHT POLLUTION

1. External light control measures shall include, at minimum:
   a. Switching off external lighting (essential light and feature light not included) when not needed or after operating hours;
   b. Switching off feature lighting (e.g. hoarding lighting) immediately after 11p.m. every day;
   c. Maintaining only essential light (e.g. lighting for safety and security) at the acceptable level as required.
2. Automatic controls for lighting
   a. Incorporate automatic control (e.g. timer switch) to switch off the external lighting when not needed or after operating hours.
3. Lighting nuisance control measures
   a. Position and aim the lighting at hoarding properly to avoid overspill of light to the outside area being lit up;
   b. For lighting up vertical structures (e.g. signs & hoarding), direct the beam to the structures and avoid overspill of light;
   c. Provide lighting with appropriate shields, baffles, louvers and cut-off features to prevent light overspill to nearby residence and into the sky, and glare from the light source.
4. Prevention of glare to road users
   a. Ensure the external lighting along Site boundary is appropriately positioned, aimed or shielded so that illumination of nearby roads will not be adversely affected to the detriment of road users.
5. Provide supporting documents as specified in PRE.B8.2820.

AIR POLLUTION CONTROL

PRE.B8.450.9 BONFIRE RESTRICTION

Do not light bonfires on Site for the burning of debris, or of any other matters, arising out of the execution of the Works, or from any other sources.

PRE.B8.455.A DUST CONTROL

1. Take all necessary steps to restrict and/or abate the nuisance caused by dust. Sprinkle dusty areas with water continually or other dust suppression method. Obtain prior Approval of the Director of Water Supplies Department for any proposal to use a dust suppression chemical in the immediate vicinity of water storage or gathering grounds of the Water Supplies Department. In particular, provide and maintain the water supply, including the installation of water tank, pump, or apparatus as necessary for the suppression of dust etc., to the points of action of the demolition works, to the satisfaction of the CM;
2. Cover stockpile of dusty materials entirely with impervious sheeting or place in an area sheltered on the top and the three sides. For stockpile over 50 m^3, cover entirely with impervious sheeting and provide enclosure extending at least 1 m above and beyond the stored materials;
3. Any vehicle with an open load compartment used for transporting any material likely to generate dust while off the Site shall have properly fitted side and tail boards. Do not load dusty materials to a level higher than the tail or side boards. Cover dusty materials with a suitable tarpaulin or other Approved impervious material in good condition before the vehicle leaves the Site. The cover shall be securely tied down and extended at least 300 mm over the edges of the side and tail boards and be properly secured and maintained throughout the journey to the offloading destination;
4. Dump trucks for transporting C&D materials shall be installed with a mechanical cover system as specified in clause PRE.B8.1838;
5. No vehicle or engine driven movable equipment shall have its exhaust directed towards the ground;
6. Impose a vehicle speed limit of 8 km/hour within the Site and display signage showing the vehicle speed limit in a prominent position on Site;
7. Spray all dusty materials with water or a dust suppression chemical immediately prior to any loading, unloading or transfer operation except for cement and pulverized fuel ash and for cases where the moisture content of the dusty materials is a matter of concern;
8. Spray water or dust suppression chemical continuously on the surface where pneumatic or power-driven drilling, cutting, polishing or other mechanical breaking operation that causes dust emission is carried out, unless the process is accompanied by operation of an effective dust extraction and filtering device. If dust extraction and filtering device is used for dust control, clear the dust collector when it is full;
9. Dispose cement, pulverized fuel ash or any other dusty materials collected by fabric filters or other air pollution control system or equipment in totally enclosed containers;
10. Spray the working area for the uprooting of trees, shrubs, or vegetation or for the removal of boulders, poles, pillars or temporary or permanents structures with water or dust suppression chemical immediately before, during and immediately after the operation so as to maintain the entire surface wet;
11. Cover all demolished items including trees, shrubs, vegetation, boulders, poles, pillars, structures, debris, rubbish and other items arising from site clearance that may dislodge dust particles entirely by impervious sheeting or place the demolished items in an area sheltered on the top and the 3 sides within a day of demolition;
12. Operate or implement air pollution control system, equipment or measure properly and effectively. In the event of a malfunctioning or breakdown of any air pollution control system or equipment, stop the plant, process or activity concerned as soon as practicable until such time as the air pollution control system or equipment is restored to proper functioning;
13. Do not use compressed air jet for cleaning or clearing dust from any vehicle, equipment, other materials or person except for cleaning formwork or other surfaces receiving concrete prior to concreting or cleaning of slopes prior to shotcreting;

14. Shut down all vehicles and plant in intermittent use between work periods or throttle down to a minimum idling speed;
15. Spray the area at which demolition work takes place with water or dust suppression chemical immediately prior to, during and immediately after the demolition activities so as to maintain the entire surface wet;
16. For any wall of the building to be demolished that abuts or fronts upon a street, service lane or other open area accessible to the public, enclose the whole wall with impervious dust screens or sheeting to a height of at least 1 m higher than the highest level of the structure being demolished;
17. Wet dusty materials remaining after a stockpile is removed with water and cleared from the surface of roads or streets;
18. Apply appropriate measure(s) to abate dust nuisance caused by cement grout mixing. Submit details of the safety measure(s) to the CM for approval. Refer to drawing no. REF/SS/AC/SK-01 in Appendix U to this Specification for reference only;
19. Portable electric dust control equipment used on Site shall be cordless to improve the working environment and reduce risk of accidents.

PRE.B8.460.9 DEBRIS CONTROL

1. Do not allow debris to fall outside the protective screen;
2. Install debris chutes inside the building in Approved locations unless Approved by CM to be installed outside the building;
3. Openings on floor to convey debris shall not be larger than 25% of the total aggregate floor area. Each opening shall not be larger than 900 x 900 mm unless approved by CM. Do not cut through structural support elements that may affect the stability of any structural components;
4. Install the outlets of the debris chutes in Approved locations and enclose with impervious sheet or equivalent material in such a way that dust or debris escape is kept to a minimum during falling of debris to the satisfaction of the CM;
5. Spray debris with water or a dust suppression chemical to keep it wet before dumping into a refuse chute;
6. Cover debris entirely by impervious sheeting or store in a debris collection area sheltered on the top and the 3 sides;
7. Do not use lift wells as a refuse chute.

PRE.B8.465.9 SCREENS GENERALLY

1. Where work is carried out in, or adjacent to existing buildings, provide protection against the spread of dust and other nuisances by means of dust sheets, tarpaulins, boards and the like;
2. Where work is carried out on the superstructure of the building, provide protection against the spread of dust and other nuisances by means of dust screens, sheeting or netting securely enclosing scaffolding from first floor to the highest level of the scaffolding.

PRE.B8.470.9 AIR POLLUTION CONTROL (VOLATILE ORGANIC COMPOUNDS) REGULATION

Submit written confirmation of the following from suppliers or manufacturers for materials under the control of the Air Pollution Control (Volatile Organic Compounds) Regulation:

1. The types of regulated coatings/paints and their Volatile Organic Compounds (VOC) contents;
2. The VOC contents of the coatings/paints complied with the Air Pollution Control (Volatile Organic Compounds) Regulation.

PRE.B8.475.9 USE OF B5 DIESEL OR EURO V DIESEL / ULTRA-LOW-SULPHUR DIESEL

1. All Constructional Plant powered by diesel fuel, whether they belong to the Contractor or his sub-contractors, shall only be replenished with B5 diesel when working on Site;
2. The B5 diesel shall be Euro V diesel containing a fatty acid methyl ester content of 5%, as determined in accordance with the document published by the European Committee for Standardization commonly known as EN 14078:2003. The Euro V diesel shall be light diesel oil complying with the specifications set out in Chapter 311L Schedule I – Air Pollution Control (Motor Vehicle Fuel) Regulation of the Laws of Hong Kong, all applicable legislation in Hong Kong and the requirements of all relevant regulatory authorities in Hong Kong which are in effect on the date that the B5 diesel is supplied;
3. Notwithstanding sub-clause (1) above, should there be a supply shortage or other difficulties in delivering of B5 diesel to Site, the Contractor or his sub-contractors may propose with justification for the CM's Approval for the use of Euro V diesel / Ultra-low-sulphur diesel (ULSD) instead of B5 diesel. ULSD is defined as diesel fuel containing not more than 0.005% by weight of sulphur;
4. The Contractor shall maintain a summary record of all the delivery notes of B5 diesel or Euro V diesel / ULSD delivered to Site, including those ordered by his sub-contractors, together with the details of consumption of such fuel by the individual Constructional Plant on Site and the date of arrival and departure of the Constructional Plant to and from the Site. The Contractor shall utilise the standard proforma in APPENDIX PRE.B8.APPEND5;
5. All records of fuel deliveries shall be supported by the original delivery notes of the oil companies. All records and delivery notes shall be kept on Site and ready for inspection by the CM upon request.

PRE.B8.480.9 USE OF NON-ROAD MOBILE MACHINERY APPROVED UNDER THE AIR POLLUTION CONTROL (NON-ROAD MOBILE MACHINERY) (EMISSION) REGULATION

In addition to compliance with the statutory requirements of the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation, comply with the following in the execution of the Works:

1. In this clause:
   a. "approved" has the meaning given by section 2 of the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation;
   b. "exempted" has the meaning given by section 2 of the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation;
   c. "kW" means kilowatt;
   d. "non-road mobile machinery" has the meaning given by section 2 of the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation;
   e. "rated engine power output" means the maximum net power of an engine.
2. Subject to sub-clause (4) below, machinery of the types and quantities listed below must be approved non-road mobile machinery:
   a. All generators on the Site;
   b. All air compressors on the Site;
   c. All excavators on the Site;
   d. All crawler cranes on the Site.

   which are powered by internal combustion engines and the rated engine power output of which is greater than 19 kW but not greater than 560 kW;

3. The CM shall have the power to order removal of any generator, air compressor, excavator or crawler crane on the Site which is not approved under the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation (Cap. 311Z). The Contractor shall remove such non-road mobile machinery from the Site forthwith and shall replace as soon as possible such machinery with approved non-road mobile machinery;
4. The CM may permit the use of exempted non-road mobile machinery for any type of machinery listed above in the execution of the Works if he is satisfied that there is no feasible alternative. CM's permission under this sub-clause may cover the whole or part of the quantity specified in sub-clause (2) above in respect of the type of machinery concerned;
5. Nothing in this Clause shall derogate from or in any way affect the obligation of the Contractor to comply with the applicable law in Hong Kong, including the obligation of the Contractor to comply with the Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation (Cap. 311Z) in respect of all non-road mobile machinery on the Site.

CONSTRUCTION DUST MONITORING

PRE.B8.510.A BASELINE DUST MONITORING

1. Submit methodology, equipment, location of monitoring station(s) together with monitoring parameters and frequency meeting the requirements of BEAM Plus New Buildings (Version 2.0) within 7 days prior to the carrying out of the baseline dust monitoring to CM for approval;
2. Proposed locations of monitoring station(s) shall be at nearby representative air sensitive receiver(s) and take into account the prevailing meteorological conditions and practicality;
3. Subject to sub-clause (5), conduct baseline dust monitoring at monitoring station(s) for at least 14 consecutive days prior to the commencement of construction works to obtain 1-hour Total Suspended Particulates (TSP) samples;
4. Carry out 1-hour TSP sampling in compliance with the requirements of BEAM Plus New Buildings (Version 2.0) for at least 3 times per day including the three highest dust impact moments within each day as expected by the Contractor;
5. Subject to the approval of the CM, no major construction or dust generating activities shall be carried out in the vicinity of the monitoring station(s) during the baseline dust monitoring. However, site preparation activities such as site investigation, vehicle transportation and erection of site office etc, which may not significantly generating dust can be permitted on the days of the baseline dust monitoring subject to approval of the CM.

PRE.B8.520.A IMPACT DUST MONITORING

1. Carry out impact dust monitoring during the course of the Works. The monitoring parameters and frequency shall meet the requirements of BEAM Plus New Buildings (Version 2.0). The minimum monitoring parameter and frequency are shown as below:

Monitoring Parameter	Location	Frequency	Period
1-hour TSP	At monitoring station(s)	At least three times per each 6-day rolling period and including the monitoring at the three highest impact moments during each 6-day rolling period	0700 – 1900;

Monitoring Parameter	Location	Frequency	Period
1-hour TSP	At monitoring station(s)	To be assessed by CM	1900-2300 (if evening work undertaken);

Monitoring Parameter	Location	Frequency	Period
1-hour TSP	At monitoring station(s)	To be assessed by CM	2300-0700 (if overnight work undertaken)

2. Record the results and weather conditions including temperature, wind strength and any other local atmospheric factors affecting or affected by Site conditions and operations (reference record sheet at PRE.B8.APPEND7), and submit the record together with photographic records showing all the locations of monitoring stations and monitoring readings to the CM within 24 hours after the day of dust monitoring measurement. The format and size of the photographic records shall be agreed with the CM within 4 weeks from the notified date for commencement of the Works;
3. Submit monthly construction dust monitoring report including the results and findings of the monitoring to the CM within 7 days of the date of the expiry of each month (reference record sheet at PRE.B8.APPEND7).

PRE.B8.530.9 AIR SENSITIVE RECEIVERS (ASRS)

1. Any domestic premises, hotel, hostel, hospital, clinic, nursery, temporary housing accommodation, school, educational institution, office, factory, shop, shopping centre, place of public worship, library, court of law, sports stadium or arts performing centre within 500 m of the Site shall be considered to be an air sensitive receiver;
2. Any other premises or places with which, in terms of duration or number of people affected, has a similar sensitivity to the air pollutants as the above premises and places shall also be considered to be an air sensitive receiver.

PRE.B8.540.9 ACTIONS AND LIMIT LEVELS

The baseline dust monitoring results are to form the basis for determining the air quality criteria for the impact dust monitoring. The following table shows the air quality criteria, namely Action Level and Limit Level to be used.

Monitoring Parameter	Action Level	Limit Level
1-hour TSP (Level in μg/m³)	For Baseline Level < 384 μg/m³ Action Level = (Baseline Level x1.3 + Limit Level)/2 μg/m³ For Baseline Level >384 μg/m³ Action Level = Limit Level	500 μg/m³

PRE.B8.550.9 DUST MONITORING EQUIPMENT

1. Use high volume sampler (HVS) or direct reading dust meter to measure 1-hour TSP level;
2. In using HVS to measure the 1-hour TSP level:
   a. The HVS shall be in compliance with the following specifications:
      i. 0.6-1.7 m³/min (20-60 SCFM) adjustable flow range;
      ii. Equipped with a timing/control device with +/-5 minutes accuracy for 24 hours operation;
      iii. Installed with elapsed-time meter with +/-2 minutes accuracy for 24 hours operation;
      iv. Capable of providing a minimum exposed area of 406 cm²;
      v. Flow control accuracy: +/-2.5% deviation over 24-hour sampling period;
      vi. Equipped with a shelter to protect the filter and sampler;
      vii. Incorporated with an electronic mass flow rate controller or other equivalent devices;
      viii. Equipped with a flow recorder for continuous monitoring;
      ix. Provided with a peaked roof inlet;
      x. Incorporated with a manometer;
      xi. Able to hold and seal the filter paper to the sampler housing at horizontal position;
      xii. Easy to change the filter;
      xiii. Capable of operating continuously for 1-hour period.
   b. Conduct initial calibration of HVS upon installation and thereafter at bi-monthly intervals. The transfer standard shall be traceable to the internationally recognized primary standard and be calibrated annually. All data shall be converted into standard temperature and pressure condition;
   c. A laboratory with constant temperature and humidity control and equipped with necessary measuring and conditioning instruments for handling the dust samples collected by HVS, and available for sample analysis, equipment calibration and maintenance. The laboratory shall be accredited by HOKLAS or other internationally accredited laboratories.
3. In using direct reading dust meter to measure the 1-hour TSP level:
   a. Submit sufficient information such as job references, documents showing the direct reading dust meter is capable of producing comparable results as that by HVS etc. to the CM to prove that the direct reading dust meter is suitable for the 1-hour TSP sampling;
   b. Calibrate annually the direct reading dust meter to ensure suitability for use.
4. Prior to carrying out of dust monitoring, all equipment to be used shall have valid certificate of calibration, be checked to be in good working condition and necessary power supply.

PRE.B8.560.9 NON-COMPLIANCE WITH LIMITS

In case of non-compliance with the air quality criteria as tabled in PRE.B8.540, more frequent monitoring exercise, as specified in the Action Plan of PRE.B8.570 shall be conducted within 24 hours after the non-complying result is obtained. Such additional monitoring shall be continued until the excessive dust emission has ceased to continue or the air quality has at least achieved the criteria as tabled in PRE.B8.540.

PRE.B8.570.A ACTION PLAN

Action Plan for rectification and monitoring of excessive construction dust are given in the following should the 1-hour TSP Level exceeds the Action Level or Limit Level as stipulated in PRE.B8.540:

1. When Action Level is exceeded but below Limit Level:
    a. With the involvement of the Environmental Manager, the Contractor shall take the following actions:
        i. Identify source of dust emission;
        ii. Repeat measurement to confirm findings;
        iii. Carry out investigation;
        iv. Increase monitoring frequency to check effectiveness of remedial actions;
        v. Assess effectiveness of remedial actions and keep Site Agent informed of results.
    b. Contractor shall also take the following actions:
        i. Notify CM on the identification of the air quality failure;
        ii. Submit within 3 working days, proposals for remedial actions to CM;
        iii. Implement agreed proposal within the time scale as agreed with CM;
        iv. Ensure that remedial measures are properly implemented, and assess the effectiveness of those measures with the Environmental Manager;
        v. Report to CM that remedial measures properly implemented and effective in ceasing excessive dust emission.
2. When Limit Level is exceeded:
    a. With the involvement of the Environmental Manager, the Contractor shall take the following actions:
        i. Identify source of dust emission;
        ii. Repeat measurement to confirm findings;
        iii. Carry out investigation;
        iv. Increase monitoring frequency to check effectiveness of remedial actions;
        v. Assess effectiveness of remedial actions and keep Site Agent informed of results.
    b. Contractor shall also take the following actions:
        i. Notify CM on the identification of the air quality failure;
        ii. Take immediate action to cease the continuation of failure in air quality and assess the effectiveness of such action with the Environmental Manager;
        iii. Submit within 3 working days, an investigation report concerning air quality failure together with proposals for remedial actions to CM;
        iv. Implement agreed proposal within the time scale as agreed with CM;
        v. Should air quality failure re-occur, identify which portion(s) of the Work(s) has/have caused the air quality failure;

vi. Stop the execution of that portion(s) of the Works until the air quality failure is abated. Bear all the associated costs and time implication.

3. The Contractor shall bear all associated costs and extra time required arising from any stoppage or reduction in output resulting from compliance with this clause.

MEASUREMENT OF INDOOR AIR QUALITY

PRE.B8.610.9 QUALIFIED AGENT FOR INDOOR AIR QUALITY (IAQ) MEASUREMENT

The BEAM Plus Construction Coordinator specified in PRE.B8.2810 shall engage a Qualified Agent for IAQ Measurement (QAIM) 1 month prior to application for OP to measure the level for each of the airborne contaminants as specified in PRE.B8.620 in normally occupied spaces as specified in BEAM Plus New Buildings (Version 2.0). Obtain CM and BEAM Plus Consultant's (BPC's) approval for the engagement.

1. General duties of QAIM:
   a. Report to BPC on the progress of the IAQ Measurement specified in BEAM Plus New Buildings (Version 2.0) manual;
   b. Provide a final report to summarize all the IAQ Measurement result;
   c. Coordinate with BPC to understand the strategies for the BEAM Plus accreditation;
   d. Identify assessment points and mark all the points on the latest layout plan. Advise the locations for measurement, provide assessment report and photos to demonstrate compliance of BEAM Plus requirements;
   e. Demonstrate in the assessment report that airborne contaminant(s) do not give rise to unacceptable levels of indoor air pollution as specified in PRE.B8.620 in normally occupied spaces;
   f. Demonstrate in the assessment report the compliance of "Good Class" in Table 1 of the "HKSAR IAQ Certification Scheme" (the "IAQ Certification Guide") on the airborne contaminant(s) being tested.
2. Qualification of QAIM:

   Accredited as HKIAS Inspection Body by the HKAS Executive and has been assigned registration number as the Accredited IAQ Certificate Issuing Body.
3. Specific duties of QAIM:
   a. Make an 8-hour continuous measurement or surrogate measurement (an intermittent measurement strategy based on the average of half-hour measurements conducted at four time-slots) for each sampling point in accordance to the IAQ Certification Guide;
      i. The minimum number of sampling points shall be calculated according to the table as below and the IAQ Certification Guide:

Total floor area to be certified (m^2)	Minimum no. of sampling points
< 3,000	1 per 500 m^2
3,000 to < 5,000	8
5,000 to < 10,000	12
10,000 to < 15,000	15
15,000 to < 20,000	18
20,000 to < 30,000	21
≥ 30,000	1 per 1,200 m^2

ii. The measurement methodologies shall be in accordance with PRE.B8.620 and the IAQ Certification Guide.

b. Provide the resources planning, including but not limited to manpower, equipment and programme for BPC's approval prior to the carrying out of IAQ measurement;

c. Prepare reports for BPC's acceptance which identify the measurement protocol, including the measuring equipment used, calibration, duration of measurements, number and details of the sampling points, the measurement results, and overall conclusions from the measurements survey.

PRE.B8.620.9 MEASUREMENT OF AIRBORNE CONTAMINANT(S)

The levels of the following airborne contaminant(s) shall be measured in occupied spaces served by MVAC System (including "normally occupied spaces" and "not normally occupied spaces") in accordance with PRE.B8.610:

BEAM Plus Credit Reference	Airborne Contaminant(s)	8-hour Average Acceptance Limit	Measurement Methodologies
HWB 8 (a)	Carbon dioxide (CO2)	<1800mg/m^3 or <1,000 ppmv	following guidance stated in Step 1 – Step 4 in A Guide on Indoor Air Quality Certification Scheme for Offices and Public Spaces Endorsed by IAQ Certificate Issuing Body (CIB)
	Carbon monoxide (CO)	<7,000 µg/m^3 or <6.1 ppmv	
	Nitrogen dioxide (NO2)	<150 µg/m^3 or <80 ppbv Plus [1 hour] <200 µg/m^3 or <106 ppbv	
	Ozone (O3)	<120 µg/m^3 or <61 ppbv	
	Respirable suspended particulate (PM10)	<100 µg/m^3	
	Radon (Rn)	Less than 167 Bq/m^3	
	Total volatile organic compounds (TVOC)	<600 µg/m^3 or <261 ppbv	
	Formaldehyde (HCHO)	<100 µg/m^3 or <81 ppbv Plus [30 mins] <100 µg/m^3 or <81 ppbv	
	Airborne bacteria	<1000 cfu/m^3	
	Mould	Prescriptive Checklist	

CONTROL OF NOISE - STATUTORY REQUIREMENTS

PRE.B8.710.9 NOISE CONTROL REGULATIONS

Comply with the Noise Control Ordinance and all its subsidiary regulations.

PRE.B8.730.9 CONSTRUCTION NOISE PERMIT

1. Apply, if required, as soon as possible for a Construction Noise Permit under the Noise Control Ordinance. Display the Permit as required and submit to the CM a copy of the Construction Noise Permit. Ensure compliance with any conditions in the Construction Noise Permit in force, take note that neither the Employer nor the CM can influence the issue or terms or conditions of a Construction Noise Permit;
2. Conduct measurement of noise level which shall be taken over any 5-miniutes period according to the relevant Technical Memoranda under the Noise Control Ordinance, if required under the Construction Noise Permit.

PRE.B8.740.N CONSTRUCTION NOISE MANAGEMENT PLAN (CNMP)

1. Submit Construction Noise Management Plan (CNMP) for the CM's agreement no later than one month after the date of the Letter of Acceptance. A CNMP shall contain but not limited to the following information:
   a. Construction works programme and construction methodology;
   b. Powered mechanical equipment (PME) list for the construction work;
   c. Quantitative construction noise impact assessment;
   d. List of noise mitigation measures to be adopted;
   e. Evaluation of technical constraints, if any, that will hinder the use of quieter construction methods and equipment as recorded in the assessment in sub-clause (c), and possible measures or techniques to overcome the constraints;
   f. Implementation schedule listing out the mitigation measures, the implementation party, location and timing of implementation.
2. Verify if there should be any change to the construction noise mitigation measures and / or plant inventory recommended in the CNMP / updated CNMP, subsequent to its agreement by the CM, during the progress of the Works. If there is to be such change, submit an updated CNMP to the CM, no later than one month before the implementation of any of such change, for his further agreement;
3. Implement fully all mitigation measures recommended or changed, and other requirements specified in the CNMP / updated CNMP upon CM's agreement;
4. Prepare the CNMP / updated CNMP by a Certified Noise Modelling Professional as recognized by the Hong Kong Institute of Qualified Environmental Professionals Limited or a Member of Hong Kong Institution of Engineers (Environmental Discipline) or equivalent;
5. Adopt the following general noise mitigation practices as far as possible unless there are genuine insurmountable technical constraints which hinder their use as identified under sub-clause (1)(e):
   a. Use Quality Powered Mechanical Equipment (QPME) recognized by the Environmental Protection Department (EPD) as far as practicable. Details of QPME can be found at EPD's website (https://www.epd.gov.hk/epd/english/environmentinhk/noise/qpme/index.html). Where a QPME is used, the plant shall be registered with EPD, and a valid label issued by EPD from such registration shall be affixed on the plant at all times and kept legible. To facilitate monitoring and control, establish a register to record all QPME used on the Site;
   b. Use of quieter construction methods as far as practicable listed at the EPD's website (https://www.epd.gov.hk/epd/misc/construction_noise/contents/index.php/en/home2/quieter-construction-methods.html).
6. Deploy on Site an Environmental Manager as stated in PRE.B6.060 to oversee the implementation of the CNMP / updated CNMP.

CONTROL OF NOISE - ADDITIONAL REQUIREMENTS

PRE.B8.750.9 ADDITIONAL REQUIREMENTS

In addition to statutory requirements, comply with the additional noise control requirements described in clauses PRE.B8.760 to PRE.B8.898.

PRE.B8.760.9 PNEUMATICALLY DRIVEN DRILLING RIGS

Do not use pneumatically driven drilling rigs.

PRE.B8.770.9 OPERATING RESTRICTIONS

Do not operate the ..... during the period from ..... to ..... in the following locations: .....

PRE.B8.773.9 EQUIPMENT NOISE LEVEL LIMITS

1. This clause is not applicable to percussive piling works;
2. For construction activities other than percussive piling works, do not permit the noise level generated from equipment and tools used in any construction operations when measured at 1 metre from the most affected external facade of the nearby noise sensitive receivers during any 30-minute period to exceed:
   a. An equivalent sound level (Leq) of 75dB(A) if the noise levels as measured in the same locations due to ambient sound alone do not exceed 70dB(A);
   b. An equivalent sound level (Leq) of 70dB (A) during normal school hours in the event whereby the nearby noise sensitive receiver is a school;
   c. By a margin of 5dB(A) above the ambient noise level as measured in the same locations only during the periods when such ambient sound levels exceed 70dB(A).

PRE.B8.775.9 SCHOOL EXAMINATION RESTRICTIONS

1. During school examination hours, do not permit the noise level measured over any 30-minute period due to the Contractor's equipment and construction operations as measured at 1 metre from the most affected external facade of the nearby schools to exceed the greater of the following:
   a. 65dB(A); or
   b. The ambient noise level when such ambient noise level exceeds 65dB(A).
2. Liaise with the schools to ascertain the exact dates and times of all examination periods during the course of the Contract.

PRE.B8.777.9 SOUND LEVEL METER

Provide an Approved integrating sound level meter to IEC 61672 for the exclusive use of the CM at all times. Maintain in proper working order, calibrate as specified in PRE.B8.1490 and provide a substitute when the meter is out of order including when calibration is taking place or otherwise not available.

PRE.B8.830.9 USE OF PERCUSSIVE PILING RIGS

If percussive piling is to be carried out on Site, submit to the CM a copy of the application for Construction Noise Permit and any other information in support to the application, which are to be submitted to the Environmental Protection Department.

PRE.B8.840.9 EQUIPMENT/ACTIVITY AUTHORISATION

Notwithstanding the requirements and limitations set out above, the CM may, upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities, for any duration, provided that it is not in contravention with Ordinances in any respect, adequate noise-mitigation measures have been provided to the noise sensitive receivers being affected, and that such application in the CM's opinion, is:

1. Of absolute necessity; or
2. Of emergency nature.

NOISE MITIGATION

PRE.B8.850.9 NOISE SUPPRESSORS

In addition to complying with all the requirements of the Regulations on noise control, provide throughout the whole period of the Contract and extended period, if any, mufflers or other suitable noise suppressors on all pneumatic drills, compressors and other plant which may create a noise nuisance to the general public. Ensure that all plant and equipment is in good working order and properly maintained.

PRE.B8.855.9 SOUND REDUCTION INSTALLATIONS

Provide, where necessary, sound reduction installations such as effective silencers, mufflers, acoustic linings or shields, acoustic shields or screens in order to reduce noise produced to the acceptable level. Include, but not limited to, the following installations:

1. Plastic cushion for piling final set operation to replace traditional metal cushion. The plastic cushion shall match with the hammer efficiency of the drop hammer and test proofs shall be submitted for approval.

PRE.B8.856.C MOVABLE NOISE BARRIER

1. Design, construct, operate and maintain movable noise barrier(s) of screen type or shed type or a combination of screen type and shed type to mitigate the noise generated by construction works including but not be limited to pile head trimming, rock / concrete breaking, metal hammering and the like. The design of the movable noise barrier shall be in the form of screen type or shed type as referred to in BS 5228:Part 1:2009: Noise - Code of Practice for Noise and Vibration Control on Construction and Open Sites;
2. The movable noise barrier(s) shall be located at positions such that the intensity of noise propagating to the noise sensitive receivers is attenuated on the spot by the noise barrier(s);
3. The movable noise barrier(s) shall also conform to the following:
    a. Fire retardant and minimum 3 m in height for screen type, shed type and a combination of screen type and shed type;
    b. With covers at the top and at least on 3 sides for shed type;
    c. Made of sound insulation material of mean sound reduction index not less than 25 dB (100 Hz to 3150 Hz) unless otherwise approved by the CM, and lined with at least 25 mm (overall) thick sound absorbent material;
    d. With no gaps or openings at joints in the barrier material and the gaps between the sides and the ground shall be closed with a flap of a tough-graded polyethylene sheeting or other similar flexible material;
    e. Structurally stable to prevent overturn and collapse;
    f. For screen type, capable of achieving a minimum noise reduction of equivalent sound level (Leq) 5 dB(A) measured over any 5-minute period (5 min) on the side blocked from the noise source;

g. For shed type, capable of achieving a minimum noise reduction of equivalent sound level (Leq) 5 dB(A) measured over any 5-minute period (5 min) on all covered sides. Design and provide additional noise reduction measures on the open side of the shed type movable noise barrier(s) to achieve a minimum noise reduction of Leq 5 dB(A) (5 min) or such other noise reduction value approved by the CM if the open side is facing the noise sensitive receiver;

h. The sound levels described in sub-clauses (f) and (g) above shall be measured at 10 m away from the noise source and 1.2 m above ground unless otherwise approved by the CM. The noise reductions shall be determined by the noise measurements taken before and after placing of the movable noise barrier(s) with the noise generating source for construction works in operation;

i. Indicate on the outer face of the movable noise barrier(s) with contrast colour paint the Chinese characters "隔音屏障" and English characters "Noise Barrier". The minimum size of the Chinese characters shall be 450 x 450 mm and of the English characters shall be 450 mm high.

4. The movable noise barrier(s) shall be designed to cater for the wind load in accordance with the Code of Practice on Wind Effects in Hong Kong 2019, various ground level differences that may exist amongst the support(s) of the movable noise barrier(s) for blocking the noise produced by various noise sources and in particular, where the concrete / rock breaking machine operates;

5. A schematic sketch of a conceptual design of the movable noise barrier is given in drawing no. CPT/NB/S/SK001 in Appendix U to this Specification. The sketch is for reference only and given in good faith without prejudice to the Contractor's responsibilities and liability under the Contract;

6. Submit the design, calculations and construction method statement certified by the Qualified Engineer as stipulated in PRE.B10.010 sub-clause (7) for the movable noise barrier(s) to the CM for approval not less than 4 weeks prior to the adoption of design and construction of the movable noise barrier(s) or commencement of the construction works which require noise mitigation measures under this clause, whichever is the earlier. Certify completion by QE as stipulated in PRE.B10.010 sub-clause (7) before put in use;

7. Accept responsibility for the design of the movable noise barrier. The submission to the CM of such design or amendment shall not relieve the Contractor of any duty or responsibility under the Contract;

8. Carry out a trial to demonstrate to the CM the effectiveness of the proposed movable noise barrier(s) in complying with the requirements under sub-clauses (3)(f) and (3)(g) above before seeking the CM's approval for its adoption on Site;

9. Submit an annotated layout plan to the CM for information showing the compliance of the specification requirements above;

10. Apart from the compliance with the above sub-clauses, comply also with the noise control requirements as described in PRE.B8.710 to PRE.B8.898.

PRE.B8.860.9 NOISE ABATEMENT MEASURES

Provide noise abatement measures as follows:

1. …….No. of air conditioners;
2. …….

PRE.B8.865.9 HAND-HELD BREAKERS AND PORTABLE AIR COMPRESSORS

Hand-held breakers and portable air compressors to comply with Noise Control (Hand Held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations and to be fitted with Noise Emission Labels when operated.

PRE.B8.870.A DIESEL GENERATORS FOR SITE'S TEMPORARY ELECTRICITY SUPPLY

1. Subject to PRE.B10.1270 sub-clause (3) wherein it states the situations in which the diesel generators shall be adopted, provide diesel generators which shall meet with all relevant requirements under the EU or Japanese system and be certified by an approved body appointed by an European Member States under the European Council Directive 2000/14/EC, designated as Low Noise Emission Construction Equipment by the Ministry of Land, Infrastructure and Transport of Japan (MLIT), or equivalent or better standards with the result that the generators are qualified with the Quality Powered Mechanical Equipment (QPME) label;
2. Affix the diesel generators for site's temporary electricity supply with valid QPME labels to facilitate inspection by the CM or his representatives;
3. Locate the diesel generators away from the noise sensitive receivers as far as practicable;
4. Provide hangers for hanging cables of the diesel generators. Refer to drawing no. REF/SS/CH/SK-01 in Appendix U to this Specification for reference only.

PRE.B8.875.A SPECIAL SCREENS

Provide specially constructed dustproof or sound deadening screens, such as double layer of tarpaulin on substantial scaffolding, for the entire face of all buildings fronting on to road ..... at the .....boundary of the Site.

PRE.B8.880.9 ADMINISTRATIVE NOISE CONTROL MEASURES

Adopt the administrative noise control measures at Section 6.9.4 of the Best Practice Guide for Environmental Protection on Construction Sites 2013 published by the Hong Kong Construction Association Ltd. as listed under "Minimisation of Noise Pollution" at PRE.B8.APPEND9.

CONSTRUCTION NOISE MONITORING

PRE.B8.890.9 BASELINE NOISE MONITORING

1. Submit methodology, equipment, location and photograph of monitoring station(s) together with monitoring parameter and frequency within 7 days prior to the carrying out of the baseline noise monitoring to CM for approval;
2. Conduct baseline noise monitoring at the monitoring stations for at least 14 consecutive days prior to the commencement of construction works to obtain 30-minute noise measurement results;
3. Carry out 30-minute noise measurement at least 2 times per day in covering the morning and afternoon session (0700-1900);
4. During the baseline noise monitoring, no major construction or noise generation activities shall be carried out in the vicinity of the monitoring stations unless otherwise approved by the CM. Site preparation activities such as site investigation, vehicle transportation and erection of site office etc, which may not be significantly generating noise can be permitted on the days of the baseline noise monitoring subject to approval of the CM.

PRE.B8.892.A IMPACT NOISE MONITORING

1. Carry out impact noise monitoring during the course of the Works. The monitoring parameter and frequency shall meet the requirements of BEAM Plus New Buildings (Version 2.0). The minimum monitoring parameter and frequency are shown as below:

   {Table A}

Monitoring Parameter	Location	Frequency	Period
$L_{Leq\ (30\ minute)}$	At monitoring stations	Once per week when noise generating activities are underway	0700 - 1900;

{Table B}

Monitoring Parameter	Location	Frequency	Period
$L_{Leq\ (30\ minute)}$	At monitoring stations	To be assessed by CM	1900 - 2300 (if evening work undertaken);

{Table C}

Monitoring Parameter	Location	Frequency	Period
$L_{Leq\ (30\ minute)}$	At monitoring stations	To be assessed by CM	2300 - 0700 (if overnight work undertaken)

2. Record the results and weather conditions including temperature, wind strength and any other atmospheric factors affecting or affected by Site conditions and operations (reference record sheet at PRE.B8.APPEND8), and submit the record together with photographic records showing all the locations of monitoring stations and monitoring readings to the CM within 24 hours after the day of noise monitoring measurement. The format and size of the photographic records shall be agreed with the CM within 4 weeks from the notified date for commencement of the Works;
3. Submit monthly construction noise monitoring report with the results and findings of the monitoring to the CM within 7 days of the date of completion of each monitoring month (reference record sheet at PRE.B8.APPEND8).

PRE.B8.893.A MONITORING STATIONS

1. At locations:
   a. close to the major site activities which are likely to have noise impacts;
   b. close to the noise sensitive receivers (any domestic premises, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing art centre should be considered as noise sensitive receiver).
2. For monitoring stations located in the vicinity of the noise sensitive receivers, take care to avoid or minimize disturbance to the occupants during monitoring.

PRE.B8.894.9 SOUND LEVEL METER

1. Use sound level meter in compliance with the International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1) specifications for carrying out the noise monitoring;
2. Immediately prior to and following each noise measurement, check the accuracy of the sound level meter using an acoustic calibrator generating known sound pressure level at a known frequency;

3. Accept the measurement as valid only if the calibration level from before and after the noise measurement agree to within 1.0 dB.

PRE.B8.896.9 ACTIONS AND LIMIT LEVELS

The following table shows the construction noise criteria, namely Action Level and Limit Level to be used.

Monitoring Parameter	Action Level	Limit Level
$L_{Leq\ (30\ minute)}$	When one documented complaint is received	75 dB(A) 70 dB(A) for schools and 65 dB(A) during school examination periods

PRE.B8.898.A NON-COMPLIANCE WITH LIMITS

1. Should the limit(s) stated in PRE.B8.730, PRE.B8.773, PRE.B8.775 and PRE.B8.896 be exceeded, stop the construction operation(s) causing the excess(es) and do not recommence until whatever measures acceptable to the CM that are necessary to meet these limits for compliance have been taken;
2. The Contractor shall bear the associated cost and time implications arising from any stoppage or reduction in output resulting from compliance with PRE.B8.710 to PRE.B8.898.

PRESERVATION AND MAINTENANCE OF EXISTING FEATURES

PRE.B8.910.9 EXISTING FEATURES

Protect existing buildings, gates, walls and all other features of the Site, which are to be retained.

PRE.B8.920.A ELECTRICITY SUPPLY HOUSING

Take over existing ..... (temporary power supply pillar box / temporary transformer compound / transformer and switch room compound) within the Site. Protect, repair and maintain the switch room compound and / or protect the temporary power supply pillar box / temporary transformer compound / transformer in good condition. Remove from Site upon completion of the Works or when no longer required for the purposes of the Works.

PRE.B8.930.B EXISTING SLOPES, RETAINING WALLS AND EMBANKMENTS

1. Phase the Works as necessary to maintain the stability of all existing slopes, retaining walls and embankments and to prevent landslips; comply with all reasonable directions from the CM in this respect;
2. Within 28 days after the notified dates for commencement of the Works, carry out initial inspection for all existing slopes, retaining walls and embankments within the Site in accordance with the latest edition of 'Guide to Slope Maintenance (Geoguide 5)' published by GEO, unless otherwise specified;
3. Accept responsibility for maintaining the integrity of all existing slopes, retaining walls and embankments in the periphery of the Site including, where applicable, the staircases thereon, railings to these staircases and along the top of the existing slopes, retaining walls and embankments;
4. Make good at own expense, any damage caused by landslips subsidence etc. arising from the Contractor's negligence, omission or default;

5. Carry out routine maintenance inspection and maintenance works at monthly intervals and a rainstorm inspection after each Red or Black Rainstorm Warning / Tropical Cyclone Warning Signal No.8 or above for all slopes, retaining walls and embankments within the Site in accordance with the latest edition of Geoguide 5, unless otherwise specified. Report to the CM on results of the routine maintenance inspection findings at monthly intervals.

PRE.B8.935.A PROTECTION OF NATURAL STREAMS/RIVERS

1. Isolate the Site, such as by placing of sandbags, to prevent adverse impacts on the stream water qualities of natural streams/rivers in the proximity. Take protective measures to ensure that no pollution or siltation occurs to the water gathering grounds of the Site;
2. Locate and properly cover temporary storage of construction materials (e.g. equipment, filling materials, chemicals, fuel etc.) away from natural streams/rivers;
3. Cover up and properly dispose construction debris as soon as possible to avoid being washed into natural streams/rivers;
4. Locate discharge outlets of wastewater away from natural streams/rivers;
5. Obtain CM's approval prior to carrying out of any works which may cause disturbance to the natural bottom and existing flow in the river or removal of any existing vegetation alongside the riverbanks;
6. When disturbance to riverbed and/or existing vegetation alongside the riverbanks is unavoidable, reinstate all disturbed areas with suitable methods upon completions of works. Submit remedial proposal for CM's approval and bear the cost of all associated works and the extra time involved.

PRE.B8.960.A PROTECTION OF ROADS AND PAVED AREAS FROM OVERLOADING

1. Protect all hard surface areas and access ways to the work area from damage as a result of overloading and make good any damage caused thereby;
2. Obtain details of design loads of such areas from the CM prior to traversing them with plant or equipment;
3. Comply with all regulations and all requirements of Government departments concerning the use and crossing of public roads. Obtain authorisation to cross pavements and similar areas;
4. When using estate roads and emergency vehicular access (EVA) for access purposes, co-operate with the Authority, Government departments, Utility Undertakings and others using such roads and to comply with any requirements for restriction on access;
5. Ensure that all vehicles, irrespective of size and use, deployed for the Works are fitted with pneumatic tyres.

PRE.B8.970.A LOCATION OF EXISTING SERVICES

1. Existing utilities and services that are known to be within the Site are referred to in PRE.B3.060. The Contractor shall satisfy himself that such and any other information provided or available to him regarding existing utilities and services is correct and adequate;
2. Check and confirm the position of all existing utilities and services within the Site and outside the boundary of the Site in accordance with PRE.B3.060 to verify the feasibilities of all proposed connections of utilities and services.

PRE.B8.980.9 PROTECTION OF EXISTING SERVICES

1. Protect and maintain existing electric or telephone cables, (including overhead wires), gas or water mains, sewers, live drains and the like;
2. Make all necessary arrangements for the temporary diversion or alteration of such services as required by and to the satisfaction of the relevant Authority;

3. Do not commence work adjacent to existing services until the necessary diversions or alterations have been completed.

PRE.B8.983.A WORKS IN THE VICINITY OF EXISTING SERVICES

1. This specification clause applies to works carried out in all situations where electric or telephone cables, gas or water mains, sewers, live drains and the like may be found, with particular emphasis on situations where works undertaken involve excavation or any other means of penetrating the ground at or below surface level;
2. Ensure that all reasonable measures are taken to identify the existing services and protect them from damage arising out of the works in the vicinity that would be likely to prejudice safety as follows:
   a. Comply with the relevant requirements of the Regulations, codes of practice or guidelines of the relevant Utility Undertakings;
   b. Take all reasonable steps to ascertain the location and position of the existing services before commencing works in the vicinity;
   c. Obtain plans or other suitable information about the existing services in the vicinity of the works from the relevant Utility Undertakings. Check the information and record plans received to see if any existing services may be affected before commencement of any excavation works;
   d. Use suitable pipe locating devices, in conjunction with any available plans to determine as accurately as possible the alignment and depth of the existing services in or near the works area;
   e. Dig trial holes by hand tools to ascertain the exact position and depths of the existing services before road breaking and excavation. If it is necessary to use road breaking tools or mechanical plant they shall be used with great caution;
   f. Execute the excavation work safely by strictly observing the following requirements:
      i. Submit method statement for the excavation works including risk assessment, methodology, arrangement, programme and details together with precautionary measures on site safety prepared by Safety Officer for Approval before commencement of works;
      ii. Take special care in operating heavy mechanical plants, especially when digging above or close to the existing services;
      iii. All excavation works must be carried out carefully following recognized safe digging practices. Excavation close to or around the existing services shall be carried out by hand digging method;
      iv. Maintain a safety distance clearance between any existing services and the point where a mechanical excavator is used as required by the relevant Utility Undertakings;
      v. Implement all necessary protective measures and seek advice and agreement of the relevant Utility Undertakings on the measures necessary to adequately support and protect the exposed services;
      vi. Provide adequate site supervision and control to ensure that all the above requirements are closely observed. Workers carrying out excavation near the existing services must be adequately trained, instructed and supervised.
   g. Backfill the excavation with suitable materials in layers with adequate compaction to prevent ground settlement adjacent to or below the existing services.

PRE.B8.990.A DISCOVERY OF LIVE SERVICES

In the event of the Contractor discovering any live drain or service line on Site, immediately inform the CM, the relevant Utility Undertakings and relevant Government departments.

PRE.B8.1000.9 RESPONSIBILITY FOR PUBLIC WORKS

Ensure that, no public road or public utility service is damaged during the execution of the Works. Should any damage occur, accept responsibility and notify the CM and the relevant authorities immediately.

PRESERVATION AND PROTECTION OF EXISTING TREES & SHRUBS

PRE.B8.1110.B PROTECTION GENERALLY

Option 1

There are no existing trees or shrubs on the Site, adjoining or outside the Site boundary which are to be retained and protected.

Option 2

Preserve and protect the existing trees and shrubs on the Site, and trees and shrubs adjoining or outside the Site boundary which are being or will be affected by the Works, and conduct yard waste treatment and management in accordance with PRE.B8.1112 to PRE.B8.1180 and Worksection EXT18. The Contractor shall:

1. Carry out a survey to confirm if there are any trees on the Site, and trees adjoining or outside the Site boundary which may be affected by the Works, but are not recorded on the Drawings. Identify them and report the survey result to the CM within 28 days from the notified date for commencement of the Works;

Option A

2. Preserve and protect all existing trees which are on the Site, adjoining or outside the Site boundary as shown on Drawings No(s). ……... in Appendix B to this Specification. Where there are any trees on the Site, and trees adjoining or outside the Site boundary which are being or will be affected by the Works, but are not recorded on the Drawing(s), preserve and protect them in accordance with PRE.B8.1112 to PRE.B8.1180 and as directed by the CM including liaising with the owner / maintenance agents of the trees and / or relevant Government departments / authority if necessary;

Option B

2. Carry out all necessary preservation and protection works to the trees and shrubs on the Site, and the trees and shrubs adjoining or outside the Site boundary which are being or will be affected by the carrying out of the Works including liaising with the owner / maintenance agents of the trees and / or relevant Government departments / authority in accordance with PRE.B8.1112 to PRE.B8.1180 and as directed by the CM. The existing tree(s) and shrub(s) known to be in the vicinity of the Site are as shown on the drawing no(s). …….. in Appendix U to this Specification for reference only. All information as shown on the said drawing(s) is given in good faith without guarantee of its correctness. No responsibility will be taken for its accuracy or sufficiency by the Employer and no claims for costs, time or whatsoever will be entertained on account of any errors, discrepancies, omissions, insufficiency of the said information;

3. Carry out all necessary tree surgery and pruning works for existing trees adjoining or outside the Site boundary with canopies or branches encroached into or trespassed on the Site. Provide method statement for the tree surgery and pruning works, coordinate, liaise and seek advice and / or approval from the tree owner / maintenance agents of the trees and / or relevant Government departments / authority prior to the commencement of the tree survey and pruning works;
4. Where it is found necessary to remove, either by felling or by transplanting, any trees not recorded on the Drawings, the Contractor shall:
   a. Report to the CM the necessity of such tree removal works;
   b. Engage a Registered Landscape Architect or competent person approved by the CM to prepare the tree removal application and to obtain approval of such application. The application shall include a detailed tree survey and the justification(s) for the proposed removal of each tree, with substantiation and necessary details such as site formation plan and architectural or engineering drawings in the format agreed by the CM;
   c. Fell or transplant the tree(s) only after obtaining the CM's approval of the tree removal, which shall normally be given only after approval of the tree removal application by the owner / maintenance agents of the trees and / or relevant Government departments / authority.
5. Provide sufficient site supervising personnel to supervise the tree surgery and pruning works, preservation and protection work for the existing trees and shrubs as referred to in sub-clauses (1) to (4) above, paying particular attention to site safety;
6. Comply with Worksection EXT18 for proper treatment of felled trees and yard waste recycling. The Qualified Arborist (QAr) shall manage and supervise the entire workflow of the implementation of the yard waste treatment and management exercise;
7. Carry out all safety precautions which are necessary for the protection of the public and minimize any inconvenience to the public in connection with or resulting from the carrying out of the tree removal, tree surgery and pruning works, preservation and protection work for the existing trees and shrubs;
8. Indemnify and keep indemnified the Employer against all losses and claims for injury or damage to any person or property including the trees and whatsoever caused to or by the trees in association with the carrying out of the works for the trees, shrubs and other vegetation and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

PRE.B8.1112.B DEFINITIONS

1. "Tree" means a plant with diameter at breast height measuring 95 mm or more. Including plants growing on retaining structures;
2. "Old and Valuable Tree" (hereinafter referred to as OVT) means any tree included in the Register of Old and Valuable Trees established by the Government and published in Development Bureau's website at https://ovt.greening.gov.hk or the Tree Register posted on the Government's website at https://treeregister.greening.gov.hk;
3. "Diameter at breast height (DBH)" means the diameter of the trunk of the plant measured at a height of 1.3m above ground level;
4. "Tree crown spread" means the diameter of the tree crown defined by the outermost branches of the tree;
5. "Tree height" means the height from ground level to the top of the tree;
6. "Dripline" of a tree means the imaginary vertical plumb line that extends downward from the tips of the outermost tree branches and intersects the ground;

7. "Tree protection zone" for OVT (Tree No. shown on Drawings) means the zone encompassing the tree along its dripline and extending vertically to 2 m upward beyond the top of the tree and 2 m downward beyond the ground level at the trunk base of the tree. For an OVT growing on a retaining structure / wall / rock surface, the tree protection zone should encompass the body of the tree itself and 2 m above the tree crown, as well as the vertical and horizontal surfaces of the retaining structure / wall / rock surface covered by the tree roots together with the space up to 2 m behind those surfaces;
8. "Tree protection zone" for non-OVT (tree other than OVT) means an area within the perimeter that is defined by the dripline of the tree. For a non-OVT growing on a retaining structure / wall / rock surface, the tree protection zone should encompass the body of the tree itself, and the vertical and horizontal surfaces of the retaining structure / wall covered by the tree roots;
9. "Preserved tree" means an existing tree, including OVT, not earmarked to be felled, which may be a tree to be retained at its existing location, a tree at its existing location prior to transplanting, or a tree transplanted within the Site;
10. "Arboricultural work" means any work related to the cultivation and care of trees for any purpose other than timber production, including but not limiting to planting, replanting, transplanting, tree surgery work and control of pest and disease;
11. "Aftercare to Old and Valuable Trees" means the regular monitoring and other operations specified to be performed for Old and Valuable Tree (Tree No. shown on Drawings) during the period stated in the Contract for such regular monitoring and other operations.

PRE.B8.1114.B SPECIALIST CONTRACTOR

Engage a specialist contractor and enter into a written sub-contract with the specialist contractor to carry out the arboricultural work to trees within and adjoining the Site, including but not limited to planting, replanting, transplanting, conduct tree risk assessment, tree surgery work and control of pest and disease in accordance with the following:

1. Unless otherwise agreed by the CM, select a specialist contractor from the prevailing "Housing Authority List of Soft Landscape Contractors Group 2";
2. Do not engage or enter into a written sub-contract with a specialist contractor on the prevailing "Housing Authority List of Soft Landscape Contractors Group 2", who is restricted from tendering in respect of the works in that category;
3. Also, the specialist contractor must have been registered under both the trades of "Horticultural Works" and "Arboricultural Works" in the Registered Specialist Trade Contractors Scheme (RSTCS) administered by CIC as specified in sub-clause (1) of PRE.B6.035 to carry out the arboricultural work;
4. At least seven (7) days prior to entering into the written sub-contract with the specialist contractor, submit details of the selected specialist contractor to the CM for checking of compliance with sub-clauses (1) to (3) above;
5. In case the registration status of the specialist contractor under both the trades of "Horticultural Works" and "Arboricultural Works" in the RSTCS administered by CIC has changed e.g. suspension or termination, etc. for whatever reasons during the progress of the arboricultural works, the Contractor shall further provide replacement in accordance with sub-clauses (1) to (4) above within fourteen (14) days of the concerned change of registration status.

PRE.B8.1115.A COMPETENT MEMBER OF SITE SUPERVISORY STAFF TO OVERSEE TREE WORKS

1. Assign a competent member of the site supervisory staff to oversee and supervise tree works related to horticultural operations and preservation of trees on the Site, adjoining or outside the Site boundary, including but not limited to planting, transplanting, tree surgery work and control of pest and disease affecting the preserved and protected trees;
2. The assigned competent member shall comply with the following requirements:
   a. Be working full-time on the Site, but not necessarily working solely on trees;
   b. Have attended relevant training on the subject organised by the training institutes (such as Construction Industry Council), or similar courses as considered appropriate by the CM.
3. Within 28 days from the date of the Letter of Acceptance, submit to the CM for approval particulars of the assigned competent member (including his name, experience and position) together with a copy of the certificate issued by the training institute confirming his satisfactory completion of the relevant course.

PRE.B8.1116.B PRESERVATION AND PROTECTION OF EXISTING TREES AND VEGETATION GENERALLY

Unless otherwise directed or agreed by the CM, comply with the following requirements:

1. Protect all existing trees, palms, bamboos and shrubs as shown on Drawing No(s). …… and / or as required in accordance with PRE.B8.1110;
2. Protect the branch structure, crown and root zone and any overhanging vegetation;
3. Protect and preserve all existing trees and shrubs including any surrounding curbs / dwarf walls except those Instructed to be removed;
4. Be fully acquainted with the location, size, canopy shape, and spread of the existing vegetation shown on the Drawing(s) to the extent that the location of existing trees may affect the programming, method or sequencing, and access to the Works;
5. Identify each tree, palm and bamboo shown on the Drawing(s) that is designated to be retained, transplanted or removed by affixing differently coloured labels (tree identification card) printed with the number shown on Drawing No(s). …… as follows:
   a. Conduct initial tree survey to identify trees that are not recorded under the Contract and their treatment is yet to be instructed by the CM;
   b. Submit the survey record to the CM within 28 days of the notified date for commencement of the Works;
   c. Secure the tree identification card by carefully tying with plastic string and avoid damage to the trunk or bark in accordance with Worksection EXT11;
   d. Provide additional tree identification card(s) or marking to identify the OVT;
   e. Comply with the following in providing the tree identification cards or marking systems:
      i. Tree identification cards shall be made of durable materials that are non-injurious to the trees, placed at a position visible but not easily accessible to the public, and attached in such a manner that allows for the growth of the trees and does not injure the trees;
      ii. Provide Radio Frequency Identification (RFID) label tags as specified in APC.A010, attach to the back of the tree identification cards and secure to all trees included in the Tree Inventory Records;

iii. The tree identification card or marking systems and the on-site status identification of trees, palms and bamboos shall be agreed by the CM and installed prior to the commencement of site clearance, demolition, earth moving, construction of permanent, or other temporary works, and any other site operations which may affect the trees, palms and bamboos;

iv. Reinstate or replace where necessary the tree identification card or marking systems for the preserved trees, and remove these tree identification card or marking systems from the Site upon completion of the Works or earlier if so directed by the CM;

v. Provide photographic record in accordance with EXT11.W060.

f. Liaise and coordinate with other relevant Government departments and Utility Undertakings for the protection and preservation of existing trees, including OVT, adjoining or outside the Site boundary and carry out any necessary measures. The QAr is responsible for preparing the additional tree removal application, obtaining prior approval of the CM, and submission of the tree removal application to relevant Government departments or appropriate authority.

6. Ensure that the QAr shall carry out the following duties in relation to the existing preserved trees, including OVT, on the Site, adjoining or outside the Site boundary as shown on Drawing No(s). ..... and as required in accordance with PRE.B8.1110:

a. Conduct an initial survey of the existing preserved trees, including OVT, and an initial site survey and initial soil tests of the tree protection zone(s) of the existing preserved trees, including OVT, and submit a report on the same comprising the details and within the time frames. The report shall be in the form of an A4-sized, bound document with a report cover indicating the Contract number, Contract title, and date of the report and shall be signed by the QAr. The format of the report shall be agreed by the CM prior to its submission;

b. Prepare the Tree Inventory Records with the use of RFID readers and mobile devices as specified in APC.A010 or as instructed by the CM for all existing preserved trees on the Site, adjoining or outside the Site boundary. All Tree Inventory Records shall be uploaded to the computerised tree inventory and management system, i.e. the Enterprise Tree Management System (ETrMS), the web and mobile application (Apps) of which to be provided by the Employer. The format of Tree Inventory Record should be in accordance with APC.A010;

c. Prepare monitoring reports on the existing preserved trees, including OVT, and submit each monitoring report comprising the details and within the time frames as stipulated in EXT11.W062. Report the progress of yard waste management and update the attributes of tree inventory records in sub-clause (b) in accordance with the changes in tree conditions;

d. Conduct a final survey of the existing preserved trees, including OVT, a final site survey and final soil tests of the tree protection zone(s) of the existing preserved trees, including OVT, and submit a report on the same comprising the details and within the time frames as stipulated in EXT11.W062;

e. Provide arboricultural advice in the preparation of method statements and any reports on repair of damage, supervise arboricultural work, and provide on-site advice in relation to site control within the tree protection zone and at its adjacent areas, for the preservation and protection measures for the existing preserved trees, including OVT, as stipulated in the Contract;

f. Manage and conduct the entire workflow of the yard waste treatment and management plan in accordance with PRE.B8.1110 and Worksection EXT18 or as instructed by the CM. Submit records of the yard waste treatment and management exercise in accordance with EXT18.W040;

g. Carry out any other services or duties specified in the Contract.

PRE.B8.1120.A PROGRAMMING OF PROTECTION WORKS

Allow fully in the programme the effects of preservation and protection of existing trees, the method of operation and construction, and the vehicular access for the Works:

1. Exercise utmost care to avoid damage to all vegetation which is required to be protected throughout the progress of the Works;
2. Complete protection works before any site clearance, demolition, earth moving, construction of permanent, or other temporary works, and any other site operations that are to be carried out in the vicinity of any vegetation to be retained, and allow inspection of the protective works by the CM;
3. Make allowance for any required tree surgery or transplanting operations to be carried out by the Employer's Direct Contractor during works in the vicinity of the vegetation to be retained, including construction of any hoardings and gantries.

PRE.B8.1130.A EXISTING PROTECTIVE FENCING

Where indicated on the Drawings or as Instructed, accept responsibility for protective fencing erected by others for a previous contract. Replace damaged parts as necessary to ensure effective use.

PRE.B8.1140.A PROTECTIVE BAMBOO FENCING

Where indicated on the Drawings or as Instructed, surround existing preserved trees and shrubs around the perimeter of the crown with a 1500 mm high ±50 mm bamboo fence, comprising:

1. 2500 mm long ±50 mm, 30 mm x 30 mm x 5 mm thick galvanized mild steel angle posts driven into the ground at 1500 mm centres ±50 mm and fitted with protective caps with;
2. Top, middle and bottom rails of 70 mm diameter ±5 mm bamboo poles;
3. 1500 mm long ±50 mm 50 mm diameter ±5 mm bamboo vertical poles at 120 mm centres ±5 mm;
4. All firmly fixed with rot proof twine or wire.

PRE.B8.1150.A PROTECTIVE CHAIN LINK FENCING

Where indicated on the Drawings or as Instructed, surround existing preserved trees and shrubs around the perimeter of the crown with chain link fencing to BS 1722:Part 1:1986:

1. Fence type: GLS 180 (Table 1 of BS 1722:1986);
2. Height above ground: 1800 mm ±50 mm;
3. Materials:
    a. Zinc coated chain link, 1800 mm wide roll, 50 mm mesh size, 3 mm nominal wire diameter;
    b. Zinc coated mild steel line wire, 3.55 mm nominal wire diameter;
    c. Rolled mild steel angle iron posts and struts in accordance with Table 4 of BS 1722:1986:
        i. Intermediate posts:
            2600 mm long ±50 mm
            45 x 45 x 5 mm section
        ii. Straining posts:
            2600 mm long ±50 mm
            60 x 60 x 6 mm section
        iii. Struts:
            2000 mm long ±50 mm
            45 x 45 x 5 mm section

4. Erection:

   In accordance with Section 3 of BS 1722:Part 1:1986 drive posts or set in concrete as necessary to obtain firm base.

PRE.B8.1160.A ALIGNMENT OF PROTECTIVE FENCING

Where indicated on the Drawings or as Instructed, align the protective fencing along the outer limit of the canopy ("drip line") of all trees and palms to be retained, to protect from damage.

PRE.B8.1162.A PROTECTION FROM CHANGE IN GROUND LEVEL

1. Unless explicitly required in the Contract, do not change the existing ground levels within the tree protection zones of the preserved trees without the prior approval of the CM;
2. Where it is necessary for the completion of the Works to reduce the existing ground level around a preserved tree which will result in a lowering of the existing ground level within the tree protection zone, comply with the following requirements:
   a. Construct a retaining wall as shown on Drawing No. ……. install tree supporting devices as shown on Drawing No. …… or similar measures as agreed by the CM to accommodate the reduction in the existing ground level around the tree;
   b. Before commencing the construction of the measures to accommodate reduction in the ground level pursuant to sub-clause (2)(a) above, submit method statements including construction details for the measures for the CM's approval;
   c. Commence the construction of the measures only after obtaining the CM's approval for the method statements;
   d. Follow the requirements stipulated in PRE.B8.1163, regarding excavation and cutting of tree roots;
   e. Maintain balanced moisture content in the tree and in the soil after construction of the measures, by carrying out necessary precautionary measures such as crown thinning, watering and mulching.
3. Where it is necessary for the completion of the Works to raise the existing ground level around a preserved tree which will result in a rise in the existing ground level within the tree protection zone, comply with the following requirements:
   a. Construct a dry well and soil aeration system as shown on Drawing No. ……. or similar measures as agreed by the CM to accommodate minor to moderate rise of up to 300 mm in the existing ground level around the tree;
   b. Construct a dry well and soil aeration system as shown on Drawing No. …… or similar measures as agreed by the CM to accommodate major rise of more than 300 mm in the existing ground level around the tree;
   c. Before commencing the construction of the measures to accommodate rise in the ground level pursuant to sub-clauses (3)(a) and (3)(b) above, submit method statements including construction details for the measures for the CM's approval;
   d. Commence the construction of the measures only after obtaining the CM's approval for the method statements.

PRE.B8.1163.B PROTECTION FROM EXCAVATION INCLUDING TRENCHING

1. Unless explicitly required in the Contract, do not carry out excavation within the tree protection zones of the preserved trees without the prior approval of the CM;
2. For the Approved excavation work within the tree protection zones, comply with the following requirements:
   a. Obtain agreement from the CM to the detailed locations and extent of the excavations before commencing any excavation work;

b. Carry out the following before commencing any cutting work to the aerial roots or underground roots of the preserved trees:
   i. Determine the locations of the major roots and the bulk of their absorbing roots so as to keep the cutting of tree roots to a minimum and to preserve the tap roots, sinker roots and support roots of the trees in any circumstances;
   ii. Obtain agreement from the CM to the extent of root cutting on the Site;
   iii. Where the stability of the trees is likely to be jeopardised, comply with the requirements stipulated in PRE.B8.1165.
c. Submit to the CM the photographic records showing the condition of the affected trees and the agreed extent of excavations and root cuttings as marked on the Site prior to commencement of the excavation work and root cutting work. Thereafter, submit photographic records showing the condition of the affected trees and the progress of the excavation work and root cutting work at weekly intervals until backfilling of the excavations is complete;
d. Excavate the service trench on the paved side of the tree if one exists;
e. Pile the excavated materials outside the tree protection zones to reduce soil compaction;
f. Carry out the excavations carefully so as not to damage the bark and root collars of the preserved trees;
g. Maintain balanced moisture content in the trees and in the soil after backfilling of the excavations by carrying out necessary precautionary measures;
h. Move the temporary protective fencing stipulated in PRE.B8.1130 to PRE.B8.1150 to the edge of the intended excavation area, between the excavation area and the rest of the tree protection zone, during the duration of excavation work, and move back the same to its original location after backfilling.

3. Where the Approved excavation works within the tree protection zone will involve cutting of the roots of the preserved trees, take the following precautions:
   a. Carry out excavation by using only hand-held tools such as hoe and spade, but not mechanical diggers or bulldozers in any circumstances;
   b. Whenever roots are encountered and before root cutting is carried out, fork away soil from the roots carefully by using hand-held tools up to the edge along which root cutting is required;
   c. Carry out root cutting carefully by using sterilised hand-held pruning tools, and prune roots greater than 25 mm in diameter carefully so as not to result in shattered and frayed roots;
   d. Cut back cleanly with sharp tools to undamaged tissue of any roots damaged during excavation and treat it with an Approved fungicidal dressing prior to backfilling;
   e. Prevent all cut and exposed roots from drying out during excavation by adopting the following measures until backfilling, unless otherwise agreed by the CM:
      i. Wrap the tap roots, sinker roots, support roots, and roots with diameter exceeding 50 mm, which shall not be cut with hessian, straw or other porous absorbent fabric once they are exposed;
      ii. Hang thick hessian or other porous absorbent fabric from top of the cut surface over the exposed roots and soil immediately after root cutting;
      iii. Mist the hessian or fabric in a frequency that keeps the roots and the soil at the cut surface moist all the time.
   f. Remove immediately before backfilling the hessian, straw or other porous absorbent fabric stipulated in sub-clause (3)(e)(i) above and the hessian or fabric stipulated in sub-clause (3)(e)(ii) above;

g. Backfill excavations with soil mix incorporated with slow release fertiliser at a rate of 500g/m³ or at a rate as directed by the CM to a level not higher than the original soil level at the root collar.

4. Based on the result of sub-clauses (2)(b)(i) & (2)(b)(ii) above, if in the opinion of the CM that the trenching works within the tree protection zone will involve cutting of a significant part of the roots of the preserved trees, adopt tunnelling in lieu of trench excavation in the following manner and as shown on Drawing No……. close to the tree trunk on one side:
   a. Excavate a trench as narrow as possible directly towards the tree along a radius to not closer than 1.0 m from the trunk or where roots larger than 25 mm in diameter are encountered, whichever distance is farther away from the trunk;
   b. Tunnel straight beneath the tree at a depth of not less than 750 mm and in a way to avoid damaging any tap root, sinker roots or support roots;
   c. Exit on the opposite side along another radius;
   d. Sleeve the service where it passes beneath the tree to reduce the risk of damage to the service and facilitate future servicing and repair;
   e. Hand-dug tunnelling shall comply with the latest Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department. The following terms used in the Guidance Notes shall be construed as follows for the purpose of the Specification:

Term used in the Guidance Notes	Terms in the Specification
the proprietor	Direct Contractor
project engineer	Qualified Engineer
contractor	Contractor

PRE.B8.1164.A PROTECTION FROM DRILLING

1. Unless explicitly required in the Contract, do not carry out drilling such as soil nailing and drilling for bore holes, rock bolts or dowels, within the tree protection zones of the preserved trees without the prior approval of the CM;
2. For the Approved drilling work within the tree protection zones, comply with the following requirements:
   a. Obtain agreement from the CM to the detailed locations and extent of the drill holes before commencing any drilling work, bearing in mind that the drill holes shall be located in such a way that the structures to be placed into the drill holes, including the surface elements of the structures such as soil nail heads, are at a minimum distance of 500 mm from the trunks of the preserved trees unless otherwise agreed by the CM in exceptional circumstances;
   b. Carry out the following before commencing any cutting work to the aerial roots or underground roots of the preserved trees:
      i. Determine the locations of their major roots and the bulk of their absorbing roots so as to keep the cutting of tree roots to a minimum and to preserve the tap roots, sinker roots and support roots of the trees in any circumstances;
      ii. Obtain agreement from the CM to the extent of root cutting on the Site;
      iii. Where the stability of the trees is likely to be jeopardised, comply with the requirements stipulated in PRE.B8.1165.
   c. Carry out the drilling work carefully so as not to damage the branches, foliage, trunk, bark and root collars of the preserved trees when gaining access for supporting, mobilising, positioning and operating the drilling rig;

d. Maintain balanced moisture content in the trees and in the soil after the drilling work by carrying out necessary precautionary measures such as crown thinning, watering and mulching.

3. Take the following precautions when carrying out drilling work that involves cutting of the roots of the preserved trees:
   a. Carry out the drilling work and root cutting work carefully;
   b. Prune roots greater than 25 mm in diameter carefully in order to prevent the roots from shattering and fraying;
   c. Cut back cleanly with sharp tools to undamaged tissue of any roots damaged during drilling and treat it with an Approved fungicidal dressing.

PRE.B8.1165.B PROTECTION FROM INSTABILITY

1. Where the Works involve cutting of any major roots or other major parts of the preserved trees or any other works that may jeopardise the stability of the preserved trees, comply with the following:
   a. Install all necessary physical support for the preserved trees to ensure their stability;
   b. Pay particular attention to the stability of the OVT and all other preserved trees that grow on retaining structures in order to prevent the trees from being dislodged from their positions as a result of inadequate support.
2. Comply with the following in installing the physical support measures for the preserved trees:
   a. Before commencing the installation of the physical support, submit method statements endorsed by the QAr for the support measures to the CM for approval;
   b. Commence the installation of the physical support only after obtaining CM's approval for the method statements;
   c. Install the physical support securely prior to commencement of the root cutting, tree pruning or any other works that may affect the stability of the trees;
   d. Securely found the physical support in footings independent of existing walls or building structures or in other supporting systems as appropriate, without interfering with other works, other existing features, and the preserved trees;
   e. Where the affected tree is an OVT or any other tree that grows on a retaining structure, make a detailed assessment to estimate the weight of the tree and to identify the best position of supporting the tree in relation to its overall spread and centre of gravity. The method statements for the support measures in respect of the OVT or other trees that grow on retaining structures shall include the following information:
      i. Details of the form of construction and where requested by the CM structural design calculation for the support measures, demonstrating the bearing capacity of each element;
      ii. Details of the foundation of the support measures, demonstrating that the support measures shall not interfere with other works, other existing features, and the preserved trees and, in the case of the tree growing on a retaining structure, shall not affect the stability of the retaining structure;
      iii. Means of securing the tree to the structure of the support measures, including detail design of how cups and ties are adjusted to the form of the tree;
      iv. Method of fabrication and erection on the Site.
   f. Remove the physical support for the preserved trees from the Site upon completion of the Works, or earlier if so directed by the CM. Do not remove or relocate the physical support for the trees without the prior agreement of the CM.

PRE.B8.1170.A PRESERVATION AND TREATMENT / REPLACEMENT OF EXISTING TREES AND SHRUBS

As Worksection EXT11.

PRE.B8.1180.B TREE INVENTORY REPORT

Option 1

1. No later than 14 days from the completion of foundation works or 28 days from the commencement of the building works of the Site (whichever is the earlier) or otherwise instructed by the CM, provide written Tree Inventory Report and Tree Topographic Survey with information of all existing trees, palms, conifers and bamboos as indicated in the drawings and schedules as shown on Drawing No(s). …… and trees identified from the survey as specified in PRE.B8.1110 for the CM's approval. In particular, attention is drawn to the following requirements:
   a. Provide tree information including location stored in Geographic Information System (GIS) digital files, dimensions including trunk girth at 1.3m above ground level, crown spread, overall height, current conditions of tree such as form and health, and tree identification number to trees, palms and conifers as indicated on Drawing No(s). …… and trees identified from the survey as specified in PRE.B8.1110;
   b. Install tree identification card with RFID label tag attached at the back to individual tree, palm or conifer with the tree identification (ID) number based on the tree layout plan and the survey result as specified in PRE.B8.1110. The tree identification card and the RFID label tag should bear the project name / code and the number of individual tree. Format of the tree identification card and the numbering system are given in APC.A010 to be approved by the CM. Consult the CM for the exact project code;
   c. Take and complete the Tree Inventory Record for each tree, palm or conifer in accordance with APC.A010, with a photo showing the whole tree, palm or conifer;
   d. Simultaneously, provide Tree Topographical Survey for all existing and identified trees, palms and conifers which are tagged according to sub-clause (1)(b) above. The requirements of Tree Topographic Survey are detailed in the "Technical Specification of Tree and Planting Area Survey" provided by the CM;
   e. The undertaking of Tree Topographic Survey shall be supervised by a Land Surveyor. The Land Surveyor shall be competent and experienced and shall possess a diploma / higher certificate in land surveying or a higher diploma in geomatics from a Hong Kong technical institute / polytechnic or university; or an associate membership of the Hong Kong Institute of Surveyors in the Land Surveying Division; or equivalent qualification appropriate to the nature of the survey work required for the Contract, plus a minimum of 2 years of relevant experience in engineering surveying.

Option 2

1. No later than three (3) months from the certified date of completion of Section A, provide written Tree Inventory Report with information of all existing and newly planted trees, palms and conifers as indicated on drawings and plant schedules for preparation of record plan of soft landscape works. In particular, attention is drawn to the following requirements:
   a. Install tree identification card with RFID label tag attached to the back of the card, to individual tree, palm or conifer with the tree identification (ID) number based on the tree layout plan. Details of the tree identification card are specified in APC.A010. The numbering system and estate code are to be approved by the CM;

b. Take and complete the Tree Inventory Record for each tree, palm or conifer in accordance with APC.A010, with a photo showing the whole tree, palm or conifer;

c. Use of Radio Frequency Identification (RFID) readers and mobile devices as required or as instructed by the CM. Data shall be uploaded to the computerised tree inventory and management system, i.e. the Enterprise Tree Management System (ETrMS), the web and mobile application (Apps) of which to be provided by the Employer. The specifications of the associated RFID label tags, RFID readers and mobile devices shall be referred to APC.A010.

2. No later than two (2) months before the date for completion of Section B, replace missing tree tag(s), update and submit the Tree Inventory Report to the CM.

TREE RISK ASSESSMENT AND INSPECTION

PRE.B8.1210.A TREE RISK ASSESSMENT AND ARBORICULTURAL WORKS

Provide the following services in relation to tree risk assessment and arboricultural works:

1. Carry out tree risk assessment for the trees as shown on Drawing No(s). ..... in Appendix B to this Specification and those other trees as designated by the CM through on-the-ground or aerial inspections as approved by the CM;
2. Tree risk assessments shall include but without limitation to the following:
   a. assessment in accordance with the latest version of the Guidelines For Tree Risk Assessment and Management Arrangement as issued by the Greening, Landscape and Tree Management Section (GLTMS) of the DEVB posted at website:

      http://www.greening.gov.hk/en/home/index.html

   b. assessment on internal decay of the main trunk and other locations being considered with structural defects;

   c. conditions of installations, if any, such as cable, bracing road and propping structure so as to identify any visual damage and other irregularities.
3. Submit tree risk assessment reports, using Form 1 and / or Form 2 as appropriate, with recommendations of arboricultural works for risk abatement to the CM, details and format of the report have to be approved by the CM;
4. Adopt the use of RFID readers and mobile devices, as specified in APC.A010, or as instructed by the CM, for conducting tree risk assessment and uploading tree data and assessment reports to the ETrMS;
5. Carry out and complete the arboricultural works as recommended in the assessment reports and approved by the CM, and keep records of supervision and work done;
6. Provide one Qualified Arborist ("QAr") to carry out tree risk assessment, preparation and presentation of assessment reports, supervise the execution of the arboricultural works recommended in the assessment reports and approved by the CM including preparation of records on supervision and work done.

PRE.B8.1220.B TIMING FOR CARRYING OUT OF TREE RISK ASSESSMENT AND ARBORICULTURAL WORK

1. Carry out and complete tree risk assessment and the related arboricultural work as approved by and to the satisfaction of the CM during the course of the Contract as described below:

Length of the service period	……. months
Covering period	From (Date) ……. to (Date) …….

2. In general, each tree as identified in PRE.B8.1210 or instructed by the CM shall be subject to tree risk assessment by QAr within each twelve (12) months period commencing from the notified date for commencement of the Works with the exact date to be instructed by the CM; in any case no two assessments shall be separated by more than twelve (12) months within the duration of Contract;
3. Carry out additional tree risk assessments as instructed by the CM on trees which are subject to emergency situations including but not limited to failure of major branches or trunk, blooming of fungal fruiting bodies, accident causing tree injury, acute pest problem and other situation causing imminent danger;
4. Use Tree Risk Assessment Form 1, Form 2, and / or Tree Failure Report Form as appropriate, or as directed by the CM to conduct the above tree risk assessment exercise.

PRE.B8.1230.C QUALIFICATION AND EXPERIENCE REQUIREMENTS OF THE QUALIFIED ARBORIST

1. Each QAr must have registered as "Arborist" and maintained a valid registration status under the Registration Scheme for Tree Management Personnel (RSTMP) of Development Bureau (DEVB) during the progress of the Works.
2. Within seven (7) days of the date of the Letter of Acceptance, nominate a candidate to be the QAr according to sub-clause (1) above for the approval of the CM. In case the employment of the QAr with the Contractor is terminated or his registration status under the RSTMP of DEVB has changed i.e. suspended or terminated for whatever reasons, the Contractor shall further provide replacement in accordance with sub-clause (1) above within fourteen (14) days of the termination or change of registration status.

PRE.B8.1240.A PRACTICE ON TREE RISK ASSESSMENT AND MANAGEMENT

1. Practice and Procedures on Tree Risk Assessment and Management (TRAM)
   a. The QAr shall use proper equipment such as wood decay detection equipment and drilling resistance measuring equipment, for checking internal decay and take photos for major defects or irregularities spotted;
   b. The QAr shall not cause any unnecessary damage to any tree parts or excessive soil compaction during assessment;
   c. The Contractor shall provide all necessary equipment and machineries for assessments to be conducted by the QAr;
   d. The Contractor shall cordon-off the Site during the aerial inspection and make all arrangements for site cordon-off or road closure, if necessary;
   e. The Contractor shall ensure that all their staff and the QAr are provided with and properly used all appropriate equipment and measures in carrying and assisting in carrying out of assessments;
   f. The Contractor shall also take every safety precaution to avoid injury to its staff, the QAr, the general public and to avoid damage to property of others during tree assessments.
2. Tree Risk Assessment Report
   a. The QAr shall complete and sign a full comprehensive assessment report for each tree as shown on Drawing No(s). ……, using Form 1 and / or Form 2 as appropriate, or as instructed and provided by the CM from time to time, which shall include but not limited to the following:
      i. General information of the tree(s);
      ii. Observations;
      iii. Views on risk caused by defects with justifications;

iv Recommended measures for risk abatement which shall, without limitation, include:

- A proposal of arboricultural works for risk abatement to each tree assessed. The proposal shall have taken into account avoidance of permanent blockage of vehicular or pedestrian traffic;
- Annotated plans, photos, sketches, or drawings for clear indication in the proposal in respect of the following pruning works or installations may be provided in the report to illustrate or elaborate the recommended measures:

	Pruning / Installation	Required details
i	Crown Reduction	Overall crown reduction: recommended percentage; or Selected branch reduction: location of major limbs (direct connection to the trunk), position of the cut and percentage of reduction.
ii	Crown thinning	Location of major limbs (if any) to be removed and position of the cut.
iii	Crown lifting	Location of major limbs (if any) to be removed and position of the cut.
iv	Cabling	Exact location of each limb involved. Position of each cable and its connection points on approximate position of related limbs. Submit fixing details / shop drawings of cable and end-connection between the limb and the cable for the CM's approval. Exact location and the limb position of another tree if involved in cabling.
v	Bracing	Exact location of each limb involved. Position of each bracing rod, its passing through angle and the approximate installation position of related limbs. Submit fixing details / shop drawings of bracing rod for the CM's approval.
vi	Guying	Exact location of each limb involved. Position of each cable and its connection point on approximate position of related limb and that of the ground / other surface. Submit fixing details / shop drawings of cable and end-connection between the limb for the CM's approval. Proposed specification of the ground support.

vii	Propping	Exact location of each limb involved. Position of each prop and its connection point on approximate position of related limb and that of the ground / other surface. Submit detail design of the propping structure and fixing details / shop drawings of the prop and its foundation for the CM's approval. The connection details between the prop and the main trunk or the limb, and between the prop and the ground / other surface.

- As regards to chemical treatment for nutrition problem or pests and diseases, a proposal of the specific chemicals to be used together with potential chemical suppliers, application method and schedule;

v. Attachments for witnessing the content of the report ……..

3. Presentation of proposal;
   a. After submission of the tree risk assessment report to the CM, using Form 1 and / or Form 2 as appropriate, the QAr shall present the proposals as and when called upon to do so by the CM. The QAr shall, if necessary, revise the recommendations by incorporating further detailed elaboration as required by and up to the satisfaction of the CM. The amended proposals shall be re-submitted to the CM by one week.

PRE.B8.1250.B INSPECTION AFTER INCLEMENT WEATHER

Ensure the QAr shall carry out inspection on trees as shown on Drawing No(s). …….. in Appendix B to this Specification and those instructed by the CM and submit preliminary tree damage report to the CM within 48 hours after cessation of all Typhoon Signals at No.8 or above or cancellation of Black Rainstorm Warning Signal. The inspections shall focus on the damage, the stability and potential hazard. The preliminary tree damage report shall include number of tree fallen, uprooted and / or with trunk and / or branches broken, the tree identification number and the species. For cases where tree damages are identified, the QAr shall also submit recommendations for any arboricultural remedial works within one week after cessation of all Typhoon Signals at No. 8 or above or cancellation of Black Rainstorm Warning Signal for Contractor's submission to the CM for approval, and supervise the execution of the arboricultural works as approved by the CM.

PRE.B8.1260.C ARBORICULTURAL WORKS IN RELATION TO TREE RISK ASSESSMENT AND INSPECTION AFTER INCLEMENT WEATHER AS APPROVED BY THE CM

1. Schedule for Work Completion

   All arboricultural works in relation to tree risk assessment and inspection after inclement weather as approved by the CM shall be completed within the time limit as instructed by and to the satisfaction of the CM.

2. Pruning
   a. Pruning including crown cleaning, crown lifting, crown thinning and crown reduction shall comply with any one of the following standards (the latest version):
      i. American National Standard for Tree Care Operations (ANSI A300 (Part 1)) – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning); or
      ii. British Standard for Tree Work (BS 3998:2010); or

iii. Other international standards approved by the CM.

b. As regards emergency pruning against imminent danger, prior verbal consent should be obtained by the QAr from the CM;

c. The Contractor shall provide all necessary equipment and machineries including chainsaws, rigging ropes, lifting platform for carrying out and completion of the pruning works;

d. The QAr shall arrange for secure lowering of cut limbs to avoid causing injury to person and damage to property when free falling onto the ground;

e. The pruning operation shall not cause damage to the nearby planting or structure. All cut branches carrying diseases or insects have to be bagged in a recyclable polythene bag and properly disposed to avoid contamination.

3. Cabling, Bracing and Guying

a. Cabling, bracing and guying shall comply with any one of the following standards (the latest version):

i. American National Standard for Tree Care Operations (ANSI A300 (Part 3)) – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Support Systems a. Cabling, Bracing, and Guying); or

ii. British Standard for Tree Work (BS 3998:2010); or

iii. Other international standards approved by the CM.

b. In case the CM approve to connect a cable to another tree or object, the Contractor shall ensure the proper preparation of anchorage and the connection of cable;

c. The Contractor shall provide all necessary equipment to facilitate the cabling, bracing and guying work as approved by the CM and comply with all safety requirements;

d. The CM may direct the removal by the Contractor of any equipment which is considered to be unsafe and unfit for the cabling, bracing and guying work. Bear all associated costs and the extra time required in relation to such removals.

4. Tree Removal

a. Do not remove any tree without the confirmation of the CM that tree felling approval has been obtained from relevant Government departments;

b. Rigging and removal of trees shall comply with any one of the following standards (the latest version):

i. American National Standard for Arboricultural Operations (ANSI Z133) – Safety Requirements; or

ii. British Standard for Tree Work (BS 3998:2010); or

iii. Other international standards approved by the CM.

c. Provide all necessary equipment and machineries including chainsaws, rigging ropes, lifting platform for removal of trees;

d. Ensure that the QAr has arranged for secure lowering of cut limbs and stumps to avoid causing injury to person and damage to property;

e. Clear away the remaining stump and removal of tree debris, cut pieces of limbs and refuse generated from the tree removal work;

f. Manage and conduct the entire workflow of the yard waste treatment and management plan in accordance with PRE.B8.1110 and Worksection EXT18 or as instructed by the CM;

g. Prepare a Tree Failure Report as required by the CM.

5. Application of Fertilizers and Pesticides

a. Provide and apply fertilizers and pesticides in accordance with the recommendation approved by the CM;

b. Application of fertilizers shall comply with any one of the following standards (the latest version):
   i. American National Standard for Tree Care Operations (ANSI A300 (Part 2)) – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Fertilization); or
   ii. British Standard for Tree Work (BS 3998:2010); or
   iii. Other recommendations or international standards approved by the CM.

c. Where chemical method is engaged for pest and disease control, only Approved equipment and chemicals shall be used, and could only be carried out by trained personnel. Pesticides could only be applied by trained personnel who possessed all relevant licence under statutory requirements. Detail records (including but not be limited to name of the pesticide, its formulation, registration number, time and location of application, the particulars of the applicator) shall be submitted to the CM for information prior to each operation;

d. No application of pesticides shall be carried out unless with the prior approval of the CM on the time and location of application so as to reduce the disturbance to the public to the minimum; No chemical pest control shall be conducted unless under suitable weather condition and with safety measures implemented. The Contractor shall ensure that the Site is suitably cordoned off and warning notice is displayed to keep off people and animals when chemical is applied. Warning notices should be put up at prominent positions of the Site after each operation of pest control chemical has been applied;

e. The Contractor shall ensure that all personnel in carrying out pesticide application is equipped with and wear the proper protective clothing and working gears during each operation;

f. The Contractor shall ensure that all pesticides to be used shall be in compliance with the Pesticides Ordinance (Cap. 133), amended by the Pesticides (Amendment) Ordinance 2013, and approved by the CM before use and application of pesticide shall be performed in accordance with the manufacturer's recommendations;

g. The Contractor shall dispose of any unwanted pesticides in accordance with the requirements laid down in the Waste Disposal Ordinance (Cap. 354).

6. Work Record

   Records on arboricultural works on each tree shall be signed by the QAr, the format of such records shall be as approved by the CM.

7. Safety Requirements

   a. The Contractor shall provide proper climbing equipment and protective clothing for its QAr and at all times ensure that all workers shall wear safety boots, goggles, protective clothing and reflective safety vests of a conspicuous colour;

   b. The Contractor shall ensure that all workers involve in tree climbing must have registered as “Tree Climber” and maintained a valid registration status under the RSTMP of DEVB when carrying out the works;

   c. The Contractor shall ensure that all workers undertaking tree pruning works involving the use of chainsaw must have registered as “Chainsaw Operator” and maintained a valid registration status under the RSTMP of DEVB when carrying out the works;

d. The Contractor shall remind all personnel working on highway structures (including footbridges, non-expressway bridges and bridge columns) that they have a statutory duty to take reasonable care of their own health and safety as well as that of others their actions or omissions at work may affect. The hazards associated with personnel working on highway structures shall include working at height, falling objects and traffic accidents. All personnel working on highway structures shall wear reflective belts, safety belts, safety harnesses or lifelines as appropriate which should be connected to stable anchorage points;

e. The Contractor shall carry out safety precautions to prevent injury to persons and damage to property as against its workers and the general public. The Contractor shall fulfil the safety requirements of at least one of the following standards (the latest version):

   i. American National Standard for Arboricultural Operations (ANSI Z133) – Safety Requirements; or

   ii. British Standard for Tree Work (BS 3998:2010); or

   iii. Other international standards approved by the CM.

f. Before commencing tree pruning or climbing works, the Contractor shall ensure that there is no overhead high voltage cable near the working area and that pruning operation will not cause damage to the nearby planting or structure. Safety measures must be taken to ensure the safety of the public. The Contractor shall ensure that neither unrelated person nor animal stays nearby during operation and coordinate with relevant authorities regarding any special pruning equipment and / or lighting requirements which may interrupt traffic. Warning signs shall be put up to keep public away from the pruning operation;

g. The Contractor shall ensure that all chainsaws or other machineries used have fulfilled the statutory safety requirements;

h. The CM may direct the removal by the Contractor of any equipment which is considered to be unsafe and unfit for arboricultural works, and the Contractor shall bear all associated costs and the extra time required in relation to such removals;

i. The Contractor shall ensure arboricultural works are carried out in compliance with the Occupational Safety and Health Ordinance (Cap. 509) and its regulations.

8. Collection and Disposal of Refuse

   a. The Contractor shall be responsible for the picking up and removal of tree debris, cut pieces of wood, refuse generated from tree assessment / inspection and arboricultural works. The Contractor shall also clear away all debris or refuse, such as joss sticks, incensed idols, construction debris, etc. within the dripline;

   b. The Contractor shall provide recyclable polythene bags and transport the refuse collected to the controlled tips at its own cost using wheeled handcarts or any other appropriate equipment in properly covered containers;

   c. No damage should be caused to the planting in the working sites when carrying out cleansing duties by the Contractor;

   d. The Contractor shall strictly prohibit its employees or agents from sweeping or dumping the refuses onto the adjoining pavements, surface channels or gullies, or other area or sites at which refuse dumping is not allowed.

9. Work Arrangement along Carriageways

   a. The Contractor shall at its own expense make all arrangements for road closure so as to carry out tree assessment / inspection and arboricultural works;

b. Where lane closure is necessary, the Contractor shall liaise with lane closure sub-contractor from approved list of the Highways Department and obtain the necessary approvals from Commissioner for Transport, the Commissioner of Police, the Director of Highways and any other relevant authority for temporary traffic arrangements. The Contractor shall ensure that its workers shall strictly follow the requirements for temporary traffic arrangements as stipulated in the latest version of Code of Practice for the Lighting, Signing and Guarding of Road Works issued by the Highways Department;

c. The Contractor shall also comply with any other conditions and restrictions imposed by the Commissioner for Transport, the Commissioner of Police and the Director of Highways.

SITE ORGANISATION AND SUPERVISION PLAN

PRE.B8.1405.9 SUBMISSIONS OF ORGANISATION CHART AND SP

1. Submit to the CM for approval within seven days from the notified date for commencement of the Works, and re-submit any change for the CM's further approval, the following:
   a. Site organisation chart including the names of the project director, the Contractor's superintendents as required in PRE.B6.060 and safety officer;
   b. Names of sub-contractors for foundation works, if any, including the names of the project directors, Authorized Signatory, Technical Director, TCPs and site representatives of the sub-contractors;
   c. Written declaration together with supporting documents (e.g. employment contract, bank payroll record, MPF contribution record) stating that the Contractor's superintendents and the Contractor's Management Team as required in PRE.B6.060 and other personnel as shown on the site organisation chart are directly employed by the Contractor. The employment terms for the staff of the Contractor's superintendents and the Contractor's Management Team shall include a "consent to disclosure" clause in accordance with the data protection principles set out under the Personal Data (Privacy) Ordinance (Cap. 486). Personal data (e.g. HKID number, salary amount) within the supporting documents can be blanked out or covered up when submitted by the Contractor.
2. Within three days after the date of the Letter of Acceptance, the Contractor shall submit a SP for Building Works to the CM as follows:
   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
   b. Complete and submit Form ICU 206 for the SP.
3. Submit a SP for Building Works (except pile installation, pile cap and footing construction) to the CM at least 22 days before the commencement of the Building Works as follows:
   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
   b. Complete and submit Form ICU 206 for the SP.
4. Submit a SP for foundation works to the CM at least 22 days before the commencement of the foundation works as follows:
   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
   b. Complete and submit Form ICU 206 for the SP;
   c. The supervision provided by the RSC stated in the SP shall cover all stages of works stated in the above documents, including those works required to be carried out by the RSC(GIFW) as stated in PIL1.G460 & PRE.B9.250.

5. When the foundation work is executed by the Piling Sub-contractor as required by PIL1.G515, comply with the following requirement:
   a. Submit the following to the CM at least 22 days before the commencement of the foundation work:
      i. A SP prepared by the Piling Sub-contractor. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
      ii. Form ICU 206 for SP which shall be completed by the Piling Sub-contractor.
   b. The supervision provided by the RSC stated in the SP shall cover all stages of works stated in the TMSP and CoPSS, including those works required to be carried out by the RSC(GIFW) as stated in PIL1.G460 & PRE.B9.250.
6. Submit a SP for ELSW to the CM at least 22 days before the commencement of the ELSW as follows:
   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
   b. Complete and submit Form ICU 206 for the SP.
7. Submit a SP for Site Formation Works to the CM at least 22 days before the commencement of the Site Formation Works as follows:
   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
   b. Complete and submit Form ICU 206 for the SP.
8. Submit a SP for Site Formation Works to the CM within three days after the date of the Letter of Acceptance:
   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
   b. Complete and submit Form ICU 206 for the SP.
9. When the construction of footing is executed by the Contractor, submit a SP for construction of footing to the CM within three days after the date of the Letter of Acceptance as follows:
   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
   b. Complete and submit Form ICU 206 for the SP.
10. When the construction of footing is executed by the sub-contractor as stated in PIL1.G520, submit the following to the CM within three days after the date of the Letter of Acceptance:
    a. A SP prepared by the sub-contractor for construction of footing. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
    b. Form ICU 206 for the SP, which shall be completed by the sub-contractor for the construction of footing.
11. Submit a SP for demolition works to the CM at least 22 days before the commencement of the demolition works. Comply with the requirements for the submission as detailed in DEM1.W110.

SITE ADMINISTRATION

PRE.B8.1407.9 PROBITY AND CODE OF ETHICS

The Contractor shall uphold its company code of ethics and associated code of conduct (which the Contractor had submitted to the Employer for admission to the HA Lists of Works Contractors) and shall also ensure its employees, sub-contractors, suppliers and agents to comply with the same probity and integrity requirements as stated in the company code of ethics and code of conduct in execution of the Works.

PRE.B8.1410.9 SITE MEETINGS

1. Attend site meetings when required by the CM. Inform Nominated Sub-contractors, Direct Contractors and Utility Undertakings when their presence is required. Report on items of work as directed by the CM;
2. Arrange regular site meetings with Nominated Sub-contractors, Direct Contractors and Utility Undertakings. Provide the CM with a copy of the minutes of such meetings.

PRE.B8.1420.B COORDINATION OF SERVICES

1. Generally the Drawings for services are schematic and only indicate the approximate location of the various services;
2. Ensure the compatible integration and coordination of the works to be undertaken by Nominated Sub-contractors both with one another and with the remainder of the Works and the works by Direct Contractors and Utility Undertakings, propose a solution for the CM's approval if there is any conflict or incompatibility discovered during the course of the above coordination process;
3. Supply to Nominated Sub-contractors, Direct Contractors, Utility Undertakings all dimensions and other information necessary to ensure the correct and timely execution of the Works;
4. Coordinate with Nominated Sub-contractors, Direct Contractors and Utility Undertakings in the preparation of the schedules of submissions for installation drawings and materials, the programme of works and the testing and commissioning programme;
5. Verify and endorse the installation drawings, including MiMEP proposals if any, prepared by Nominated Sub-contractors before submitting them to the CM for approval;
6. Monitor and report the progress of Nominated Sub-contractors' submission and installation activities;
7. Prepare a delivery method statement for all items of plant and equipment provided by Nominated Sub-contractors, Direct Contractors and Utility Undertakings, including the identification of all temporary access requirements;
8. Verify and endorse that the material delivered to Site and installed by the Nominated Sub-contractors are approved by the CM and in full compliance with the Contract requirements, in accordance with PRE.B12.280;
9. Verify and endorse the test reports prepared by the Nominated Sub-contractors upon completion of the Sub-contract Works that the installations are completed and in compliance with the Sub-contract requirements;
10.
    a. For the following Section(s) of the Works containing building / structures, prior to the commencement of the building services installation, prepare Combined Services Drawings for the CM's approval to ensure that all services included in the Works, the Direct Contractors' Works and utilities installations are coordinated with each others and with the structural and architectural elements of the Works.
        i. Section of the Works: ……..
    b. The Combined Services Drawings shall be completely coordinated with due regard to for the sequencing of works, constructability, the final equipment selection and future maintenance requirement. Details to be shown shall include but not be limited to:
        i. The size, type and location (setting out and level) of all services, utilities, including supporting brackets, and the interrelationships with the structure, architectural design and other systems provided by Direct Contractors;

ii. Sections and elevations, where plan view alone cannot demonstrate spatial relationship between services, with setting out dimensions from finished floor / soffit / wall;

iii. Fully dimensioned structural beams in all areas;

iv. Structural and finished floor levels in all areas;

v. Finished ceiling levels and dimensioned ceiling services zone in all false ceiling areas;

vi. All air ducts and those piping, cable containment system with external dimension greater than 100 mm (including insulation where required) to be shown in double line to scale with direction of flow and fall. Outside dimensions to be shown for all services drawn;

vii. Valves, strainers, pressure / flow measuring tappings, thermostats, sensors, switches, motors, actuators, dampers etc. that require access;

viii. Access panels allocated for installation, commissioning and testing, maintenance;

ix. Light fittings, grilles, diffusers, heat / smoke detectors, sprinkler heads, PA speakers, CCTV cameras, access control & security equipment, EAS equipment etc.;

x. The drawing reference with the exact revision number of the architectural / structural drawing on which the Combined Services Drawings are based.

c. The spatial design and alignment of services shall be parallel to the lines and levels of the building structure so as not to be visually unpleasant and shall be such as to facilitate the performance of maintenance work on any of the services;

d. The scale of the Combined Services Drawings shall be not less than 1:50 for layout plans while the scale of the sectional plans shall not be less than 1:25. Other drawing scales may be required as and when considered necessary for the purpose of clarity by the CM.

11. Verify against the Combined Services Drawings that the following conditions pertaining to safety and good engineering practice are met:

a. Cable routes not to be accessible by the public;

b. Fresh air intake to be at least 1.5 m from generator / kitchen flue exhaust;

c. Ventilation exhaust to be free from obstruction;

d. Communal gas pipe to be separated from tenants' areas;

e. Routing for internal gas pipe shall be well ventilated by natural means.

PRE.B8.1425.A QUALITY CONTROL SYSTEM

1. Submit to the CM for approval the setup of a Quality Control System (QCS) for ensuring the compliance of materials and tests with the Specification and Drawings, together with a programme of audits to be conducted in compliance with sub-clause (6) * and sub-clause (7), within 7 days from the notified date for commencement of the Works;

2. The QCS shall also cover the Contractor’s proposed control measures and checking mechanism for material compliance which satisfy the requirements and contain such detailed information as required under the “Guidelines on Scope and Contents of the Quality Control System” in APPENDIX PRE.B8/XII to this Worksection. Provide and maintain sufficient manpower and resources to implement the Contractor’s proposed control measures and checking mechanism for material compliance under the "Guidelines on Scope and Contents of the Quality Control System” in APPENDIX PRE.B8/XII to this Worksection and the QCS approved by the CM. Keep digitized records and submit the records to the CM when required;

3. For implementation of the QCS during the progress of the Works, employ at least one Quality Control Manager (QCM) and the following number of Quality Control Coordinators (QCCs):
   a. …… Number of Architectural Quality Control Coordinator (AQCC);
   b. …… Number of Structural Quality Control Coordinator (SQCC).
4. Designations, qualifications, responsibilities and duties of the QCM, QCCs and BSEs are specified in PRE.B6.060;
5. Demonstrate that the requirements of the approved QCS have been incorporated into the Contractor's Quality Management System (QMS) as required under PRE.B9.610;
6. Subject the QCS implemented in the Contract to audits conducted by the Certification Body (CB) certifying compliance of the QMS of the Contractor with the requirements of ISO 9001 quality management system standard. The audit of QCS of the Contract shall be conducted annually until the certificate of completion of the Works is issued by the CM under GCC Clause 8.7. The Contractor shall require the CB to record the audits on QCS in the audit reports of ISO 9001 quality management system;
7. Subject the QCS implemented in the Nominated Sub-contracts to audits conducted by the CB certifying compliance of the QMS of the Nominated Sub-contractors with the requirements of ISO 9001 quality management system standard. Unless otherwise stated, the audit of QCS of the Nominated Sub-contractors shall be conducted annually until the certificate of completion of the Works or the last Section of the Works is issued by the CM under GCC Clause 8.7. The Nominated Sub-contractors shall require the CB to record the audits on QCS in the audit reports of ISO 9001 quality management system;
8. For the purpose of sub-clause (7), if at the time of each annual audit a Nominated Sub-contractor is engaged in the capacity as a nominated sub-contractor concurrently for not more than five HA nominated sub-contracts whereof the last certificate of completion of each associated main contract works has not been issued by the corresponding contract managers, audit conducted on the QCS of any one of these nominated sub-contracts of the Nominated Sub-contractor shall be deemed to be in compliance with the requirements of sub-clause (7). If the Nominated Sub-contractor is engaged concurrently for more than five HA nominated sub-contracts in the aforementioned, audits conducted on the QCS of at least two of these nominated sub-contracts of the Nominated Sub-contractor shall be deemed to be in compliance with the requirements of sub-clause (7);
9. When requested by the CM, submit to the CM within 14 days the following:
   a. Updated programme of annual audits on QCS;
   b. Findings of audits pursuant to sub-clause (6) and follow-up action by the Contractor for addressing the audit findings;
   c. Findings of audits pursuant to sub-clause (7) and follow-up action by Nominated Sub-contractors for addressing the audit findings.

PRE.B8.1430.9 PROGRESS AND RECORD PHOTOGRAPHS

1. Provide at weekly intervals or as and when directed by the CM for the duration of the Contract one set of photographs showing progress of the Works taken from locations as directed by the CM;
2. Submit sample(s) for Approval prior to the submission of the first set of photographs;
3. Submit, within fourteen days after taking the photographs a set of photographs comprising a minimum of eight, or such number as may be required by the CM, 8R size colour prints together with their soft copies. Before submission, mark or stamp on the reverse side of each print the layout of the Site, the title of the project, the date and the view point from which the photograph was taken.

PRE.B8.1435.A PUBLIC RELATIONS PLAN

1. Comply with PNAP APP-137 and Code of Practice for Foundations 2017 in devising the Public Relations (PR) Plan. The PR Plan aims to establish an effective communication system with the nearby occupants, concerned groups and district councillor etc. of the forthcoming site operations, to facilitate communication between the affected parties and the Contractor, to minimize possible complaints, and to enable the CM or his representatives and the Contractor to handle complaints in a timely and effective manner;
2. Provide all necessary personnel, resources, services and facilities for the implementation of PR Plan as required by the CM which shall include but not be limited to the following:
   a. Provide all necessary assistance to the PR Officers to carry out their duties;
   b. Assign a responsible person and deploy facilities for assisting the PR Officers to handle all PR works and communication with the nearby occupants, concerned groups and district councillor etc.;
   c. The responsible person shall be Site Agent / Project Manager and has adequate training and experience on PR skills;
   d. Inform the nearby occupants, concerned groups and district councillor etc. about the scope of project, operation type and extent, daily operation time, works programme, monitoring plan and pre-construction condition survey if applicable;
   e. Inform the nearby occupants, concerned groups and district councillor etc. about the progress of works regularly;
   f. In case of incidences of cracks, settlement of buildings or lands and the like causing complaints from the nearby occupants, concerned groups and district councillor etc., follow up the case with the complainant(s) by providing investigation report and remedial / rectification action plan (if any) to the affected parties;
   g. Report the progress and completion of remedial / rectification works to the affected parties.
3. Attend meetings with the nearby occupants, concerned groups and district councillor etc. when required by the CM for handling of public enquiries and / or complaints. The Contractor's TCP T4 officer responsible for the works, Safety Officer and / or Environmental Manager shall attend the meetings if the nature of the complaints involving action related to their disciplines;
4. Produce internal Complaint Handling System for matching with the PR Plan.

PRE.B8.1440.A AS-BUILT DRAWINGS AND DOCUMENTATION

1. On certified completion of the Works or any Section and within 28 days from the date of certified completion of the Works or any Section unless otherwise instructed by the CM, submit as-built drawings and documentation for architectural works which include but not limited to the following certificates, warranties, user manuals and drawings with clearly shown dimensions and levels of the Works as it was constructed and at an appropriate scale as agreed with the CM:

a.	Drawings	A1-size tracing paper	A1-size print
i.	As-built drawings including drawing lists for architectural, plumbing and drainage works	5 Sets plus electronic copy plus one set of microfilm	-
ii.	Key Schedule	5 Sets	-

iii.	Vertical plumbing line diagram for individual block and building for Fresh water supply with water meter schedule; Flush water supply; Floor washing.	3 Sets	4 Sets
iv.	Plumbing layout plan for fresh water supply, flush water supply and floor washing for ground, typical floor, and roof of individual block and building	3 Sets	4 Sets
v.	Plumbing layout plan for each flat type unit of individual block	3 Sets	2 Sets
vi.	Layout plan with manhole schedule for underground drainage system (foul water and storm water)	3 Sets	3 Sets
vii.	Layout plan and vertical line diagram for above ground drainage disposal system (soil / waste and rainwater water)	3 Sets	3 Sets
viii.	Layout plan for all underground drainage system with manhole location	5 Sets	1 Set
ix.	Detailed drawings of the following components: - Window showing the edge jointing of window frame and structure; - Prefabricated components such as external cladding / façade; - Fire resistance door	3 Sets	-
x.	External work drawings including road, kerb and flower bed	3 Sets	-
xi.	Underground pipe layout plan for fresh and flush water and fire services (including street hydrants) for whole estate	5 Sets	3 Sets

b.	User manuals	Copy of document
i.	Highlights on special precautions / procedures / methods required on the use, cleaning, servicing, maintenance, repair and replacement of any proprietary material and equipment / component (such as covered walkway and skylight) installed. Requirements on proper use, durability, safety and statutory side shall also be stated clearly.	5 Nos.
ii.	Playground equipment user manual	5 Nos.
iii.	Gondola / gantry user manual	5 Nos.

iv.	Installation manual and method statement for uPVC lined G.I. water pipes	5 Nos.
v.	Installation manual for panel wall partition system	5 Nos.
vi.	Play / fitness equipment information including as-built layout plan, official catalogue and list of equipments, 3-dimensional technical drawings of all equipments, maintenance manual, and maintenance tools itemized etc.	5 Nos.
vii.	Operation and maintenance manuals for plumbing installations	5 Nos.
viii.	Brand name and model no. of the acrylic paint for stainless steel pipe brackets for drainage pipes and water pipes specified in FIN7.M584	2 Nos.
c.	Certificate / warranty / reports	Copy of document
i.	Certified true copy of fire certificate of fire resistance elements installed	1 No.
ii.	CCTV survey reports & tapes, and pipe testing reports for underground drainage system	3 Nos.
iii.	Work Completion Certificate for electrical installation	1 No.
iv.	Deeds of Warranty as required in the Special Conditions of Contract Clause SCC7.3 for the roofing installation, refuge floor installation and/or other waterproofing system installation. #	As required under SCC7.3.
v.	Deeds of Warranty as required in the Special Conditions of Contract Clause SCC7.6 for the play / fitness equipment and impact absorbing and surfacing materials.	As required under SCC7.6.
vi.	Warranty for any other proprietary materials, equipment and installation with warranty period longer than two years. Names, addresses and contact telephones of the suppliers shall be stated clearly. In case there is no such certificate, the CM shall be informed.	1 No.
vii.	Inspection Certificate for the permanent anchorage(s) adjacent to lift landing doors at the lowest landing floor for access to lift pits in PRE.B12.430.	1 No.
viii.	Test reports for plumbing installations	1 No.

2. On certified completion of the Works or any Section and within 28 days from the date of certified completion of the Works or any Section unless otherwise instructed by the CM, submit as-built drawings and documentation for structural works which include but not limited to the following reports and drawings with clearly shown dimensions and levels of the Works as it was constructed and at an appropriate format and scale as agreed with the CM:

a.	Drawings	A1-size tracing paper	A1-size print
i.	As-built drawings for works that had been designed by the CM and had been modified by the Contractor to suit other works or actual site conditions	-	1 Set plus electronic copy
ii.	As-built drawings for works that had been designed by the Contractor	1 Set plus electronic copy	2 Sets
b.	Reports	Copy of document	
i.	Construction reports including as-built plans and record photographs of the construction activities at various stages for cantilevered slabs with a span exceeding 750 mm and exposed to weathering in accordance with PNAP APP-68	3 Nos.	
c.	Documentation	Copy of document	
i.	Documentation on the inspection and maintenance of the cantilevered slab canopy for regular maintenance and repair in future. The documentation shall include routine inspection and maintenance works, such as cleaning of clogged drain pipes and drainage channel as well as inspection of waterproofing systems and finishes, which shall be carried out regularly and particularly during the rainy seasons	3 Nos.	

3. On certified completion of the Works or any Section and within three months from the date of certified completion of the Works or any Section unless otherwise instructed by the CM, verify and submit as-fitted drawings and documentation prepared by the Nominated Sub-contractors for building services installations as specified in the Specification, which include but not limited to the following user manuals, reports and drawings with clearly shown dimensions and levels of the Works as it was constructed and at an appropriate format and scale as agreed with the CM:

a.	Drawings	A1-size tracing paper	A1-size print
i.	As-fitted drawings for building services installations	-	2 Sets
b.	User manuals	Copy of document	
i.	Operation and maintenance manuals for building services installations	2 Nos.	
c.	Reports	Copy of document	

i.	Test reports for building services installations	2 Nos.

PRE.B8.1445.9 CONFIRMATION OF VERBAL INSTRUCTION (CVI)

1. In accordance with Clause 4.2(4) of the GCC, the Contractor shall give adequate notice in writing to the CM of any other Drawings or Specification that may be required for the execution of the Works. CVI is an interim measure for the CM and the Contractor to confirm construction details usually minor in nature, which have to be determined promptly for immediate resolution of construction problems encountered, in order not to affect the progress of works;
2. The Contractor shall use the standard template for CVI in APPENDIX PRE.B8/XIII when submitting CVI;
3. Any variation to the Works arising from the information in CVI shall be separately covered by written instruction by the CM with variation drawings incorporating changes confirmed by the CM;
4. If CVI involves abortive works, the Contractor shall use the standard template for Abortive Works Record Sheet in APPENDIX PRE.B8/XIV for recording the abortive works and submit for the CM's checking;
5. CVI is not a notice of claims for extension of time or additional expenditure under the Contract and no time or cost claim shall be implied under CVI. Any such claim shall be submitted separately in accordance with the Contract provisions;
6. The Contractor shall use the standard template for CVI Summary Table for Monthly Site Meetings in APPENDIX PRE.B8/XV to report the status of CVI in the site meeting;
7. Unless otherwise approved by the CM, the CVI, Abortive Works Record Sheet and CVI Summary Table for Monthly Site Meetings submitted by the Contractor shall be in accordance with the standard templates in APPENDIX PRE.B8/XIII, XIV and XV.

PRE.B8.1450.A WAGE BOOKS

Option 1

1. In addition to the requirements of GCC Clause 5.25, keep wage books for monitoring the payment of wages and MPF contribution paid by the Contractor and the sub-contractors of all tiers to all Site Personnel and identify each Site Personnel by the data as specified in PRE.B8.2650. The wage books shall give a full and up-to-date account of the payment of all wages and MPF contribution paid to all Site Personnel for the duration up to and including the month in which the maintenance certificate or where applicable the last partial maintenance certificate (whichever is the later) is issued, or up to an earlier date as otherwise agreed by the CM. For Contracts with more than one Portion of the Site, the Contractor shall keep wage books for all Site Personnel of each particular Portion of the Site. The wage books shall contain the following:
   a. A complete set of copy of the executed employment contracts of all Site Personnel on Site as required in PRE.B6.550;
   b. A complete set of signature specimens of all Site Personnel complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;
   c. A complete set of verified daily attendance records as required in PRE.B8.2610;
   d. A complete set of copy of the schedules of wages and the respective records of transactions for payment of wages and MPF contribution as required in PRE.B6.550;

e. A complete set of copy of the written declaration that all wages of the Site Personnel have been paid and all MPF contributions have been made as required in PRE.B6.550.

2. Make wage books available for inspection by the CM or LRO. Maintain and update an additional copy of wage books in the office of LRO for record;

3. All documents kept in the wage books shall be duly certified by the Contractor or the respective sub-contractors that they are the true copy of the original documents;

4. Provide information of daily wages on the daily returns submitted in accordance with GCC Clause 5.25(3). Provide information for each of the separate classes of labour and in accordance with any requirements of the CM and the Census and Statistics Department of the Hong Kong SAR Government;

5. Keep wage books in a secure place in the site office, such as a room or cabinets with locking device, before the date of removing the access control device of the entrance/exit control unit in ACRS as stipulated in PRE.B8.2660 and thereafter keep the wage books in other secure place as agreed by the CM up to the date of issue of maintenance certificate or where applicable the last partial maintenance certificate (whichever is the latest) or up to an earlier date as otherwise agreed by the CM. The respective keys shall only be held by the members of Contractor's management team as stipulated in PRE.B6.060. After the date of issue of maintenance certificate or where applicable the last partial maintenance certificate (whichever is the later) and with the consent of the CM, all the documents kept in the wage books including the additional copy in the office of LRO shall be destroyed and disposed properly without disclosing any information contained in them;

6. Provide cabinets with locking device in the office of Contractor to nominated sub-contractors for keeping their wage books;

7. The above requirements stipulated in sub-clauses (1) to (6) may be exempted subject to the compliance with all relevant criteria and procedures stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time or as Approved by the CM on individual case basis.

Option 2

1. In addition to the requirements of GCC Clause 5.25, keep wage books for monitoring the payment of wages and MPF contribution paid by the Contractor and the sub-contractors of all tiers to all Site Personnel and identify each Site Personnel by the data as specified in PRE.B8.2650. The wage books shall give a full and up-to-date account of the payment of all wages and MPF contribution paid to all Site Personnel for the duration of the Contract, up to and including the month in which the operation of ACRS is terminated as stipulated in PRE.B8.2660. For Contracts with more than one Portion of the Site, the Contractor shall keep wage books for all Site Personnel of each particular Portion of the Site up to and including the month in which the operation of ACRS is terminated as stipulated in PRE.B8.2660, or up to an earlier date as otherwise agreed by the CM, to be consisting of the following:

   a. A complete set of copy of the executed employment contracts of all Site Personnel on Site as required in PRE.B6.550;

   b. A complete set of signature specimens of all Site Personnel complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;

   c. A complete set of verified daily attendance records as required in PRE.B8.2610;

   d. A complete set of copy of the schedules of wages and the respective records of transactions for payment of wages and MPF contribution as required in PRE.B6.550;

   e. A complete set of copy of the written declaration that all wages of the Site Personnel have been paid and all MPF contributions have been made as required in PRE.B6.550.

2. Make wage books available for inspection by the CM or LRO. Maintain and update an additional copy of wage books in the office of LRO for record;
3. All documents kept in the wage books shall be duly certified by the Contractor or the respective sub-contractors that they are the true copy of the original documents;
4. Provide information of daily wages on the daily returns submitted in accordance with GCC Clause 5.25(3). Provide information for each of the separate classes of labour and in accordance with any requirements of the CM and the Census and Statistics Department of the Hong Kong SAR Government;
5. Keep wage books in a secure place in the site office such as a room or cabinets with locking device during the whole contract period and keep in other secure place as agreed by the CM after the date of terminating the operation of ACRS as stipulated in PRE.B8.2660, or up to an earlier date as otherwise agreed by the CM. The respective keys shall only be held by the members of Contractor's management team as stipulated in PRE.B6.060. After at least 12 months from the date of terminating the operation of ACRS as stipulated in PRE.B8.2660 and with the consent of the CM, all the documents kept in the wage books including the additional copy in the office of LRO shall be destroyed and disposed properly without disclosing any information contained in them;
6. The above requirements stipulated in sub-clauses (1) to (5) may be exempted subject to the compliance with all relevant criteria and procedures stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time or as Approved by the CM on individual case basis.

Option 3

1. In addition to the requirements of GCC Clause 5.25, keep wage books giving a full and up-to-date account of wages paid to each worker employed on the Works and identify each worker by his name, trade and serial number of Site Pass. Specify the dates on which each worker is employed on the Works and the amounts paid in wages and allowances in respect of each day's work in accordance with any requirements of the CM and the Census and Statistics Department of the Hong Kong SAR Government;
2. Make wage books available on Site for inspection by the CM.

PRE.B8.1455.N RETURN OF SITE LABOUR DEPLOYMENT AND EMPLOYMENT TO CENSUS AND STATISTICS DEPARTMENT

1. Submit the following site labour deployment/employment returns using prescribed forms to the CM for onward submission to Census and Statistics Department:
   a. Monthly Return of Site Labour Deployment and Wage Rates for Construction Works (Form GF527);
   b. Monthly Return on Construction Site Employment (Form GF527A);
   c. Quarterly Return on Employment Survey.

PRE.B8.1460.9 RECORDS OF PLANT AND MATERIALS

In compliance with GCC Clause 5.25(3) provide the CM with the following information to enable him to keep and maintain site records of plant and materials:

1. Submit the material control record;
2. Daily records of all plant and materials delivered to Site, including plant, tools and materials delivered by Nominated Sub-contractors and Direct Contractors. Identify each item of plant by serial number, description, photograph or similar method;
3. Records of items of plant or materials stored or removed from Site;
4. Copies of invoices, certificates, submissions, vouchers or receipted accounts for materials as specified or as requested by the CM;

5. Records of ownership details of the following piling plants, where applicable, together with documentary proof of ownership and indicate whether such piling plants have been registered with the Counterparty List Management Section of the Housing Department for the purpose of listing for the Housing Authority's List of Piling Contractors:
   a. Crawler crane;
   b. Hammer grab;
   c. Oscillator / rotator;
   d. Rock chisel;
   e. Reverse circulation drill;
   f. Hydraulic hammer;
   g. Piling rig;
   h. Pre-boring rig.

PRE.B8.1470.9 REMOVAL OF MATERIALS FROM SITE

Where Approval is given in accordance with GCC Clause 13.2, or instructions issued pursuant to GCC Clause 7.5(1), to remove materials off-site:

1. Serve 24 hours advance written notice to the CM, quoting the Approval or instruction, as the case may be;
2. Give details of the scheduled hour, lorry loads, etc. of the removal. Such scheduled hour shall be within the normal working hours of the CM on Site;
3. Allow the CM to check and record the loads of materials before removal off-site at the Site entrance;
4. Obtain the endorsement of the CM before the materials leave the Site.

PRE.B8.1480.A CALIBRATION OF EQUIPMENT

1. Accept responsibility for the calibration of the equipment used for the Contract against the appropriate national standards upon commencement of the Works and at intervals as specified in PRE.B8.1490;
2. Provide evidence to demonstrate that any equipment used on Site for carrying out required test has not exceeded the calibration interval each time before use;
3. Ensure that the equipment is capable of the accuracy and precision necessary to carry out the inspection, measuring and test;
4. Carry out the calibration at own expense;
5. Attach an identification label and a calibration status label to each item of equipment;
6. Provide Calibration Certificates as required;
7. Submit monthly records of calibration results to the CM within 7 days of the expiry date of each monitoring month. (reference record sheet at APPENDIX PRE.B8/XXI).

PRE.B8.1490.B EQUIPMENT CALIBRATION SCHEDULE

Option 1

Equipment Description	Calibration Certificate upon Commencement of the Works	Calibration Interval
Total Station	Required	1 year
E.D.M.	Required	1 year
Level	Required	Two-peg test before use

Theodolite	Required	1 year
Rebound hammer	Required	1 year
Levelling staff	Not required	1 year
Steel measuring tape	Required	1 year
Steel measuring tape, pocket size	Not required	1 year
Linen measuring tape	Not required	6 months
Steel carpenter level	Not required	Reversible test before use
Minimum / maximum thermometer	Not required	6 months
Thermograph	Required	6 months
Sound level meter	Required	6 months
Digital measurement probe	Required	1 year
Engineer's try square	Required	1 year
Feeler gauge	Required	1 year
Portable dial thermometer	Required	1 year
Pressure gauge	Required	1 year
Vernier calliper	Required if the measuring tape is not brand new	--
Speedy' Moisture Tester	Required	6 months
Weighing machine	Required	(a) Three years - full calibration by a HOKLAS Accredited Calibration Authority (b) Six months - repeatability check (c) One month - one-point check using known mass close to balance capacity
Terrestrial laser scanner	Required	1 year
Mobile mapping system	Required	1 year

Option 2

Equipment Description	Calibration Certificate upon Commencement of the Works	Calibration Interval
Total Station	Required	1 year
E.D.M.	Required	1 year
Level	Required	Two-peg test before use
Theodolite	Required	1 year

Levelling staff	Not required	1 year
Steel measuring tape	Required	1 year
Steel measuring tape, pocket size	Not required	1 year
Linen measuring tape	Not required	6 months
Steel carpenter level	Not required	Reversible test before use
Sound level meter	Required	1 year, plus sound level calibrator check before and after use

Option 3

Equipment Description	Calibration Certificate upon Commencement of the Works	Calibration Interval
Total Station	Required	1 year
E.D.M.	Required	1 year
Level	Required	Two-peg test before use
Theodolite	Required	1 year
Levelling staff	Not required	1 year
Steel measuring tape	Required	1 year
Steel measuring tape, pocket size	Not required	1 year
Linen measuring tape	Not required	6 months
Steel carpenter level	Not required	Reversible test before use
Minimum / maximum thermometer	Not required	6 months
Thermograph	Required	6 months
Sound level meter	Required	1 year, plus sound level calibrator check before and after use
Calliper	Required	1 year
Galvanizing check meter	Required	1 year
Vibration meter	Required	1 year
Terrestrial laser scanner	Required	1 year
Mobile mapping system	Required	1 year

PRE.B8.1495.F DEVELOPMENT AND CONSTRUCTION SITE MOBILE SYSTEM (DCSMS)

Option 1

1. The Development and Construction Site Mobile System (DCSMS) shall be adopted from a date within one month after the notified date for commencement of the Works to the end of the Maintenance Period of the last Section. The Contractor shall login the DCSMS system with his HOMES accounts and use the following mobile application (App) and / or web application (Web), if applicable, of the DCSMS:
   a. Building Works (BW) Inspection App and Web for the BW in-process inspections, and for receiving the Site Inspection Guide for BW (DASM) forms that show the inspection results. Printing and submission of signed hard copy of the DASM forms with hard copy attachments to the CM is required;
   b. Request for Inspection (RFI) App and Web for submission of inspection request excluding foundation works, and followed by submission of signed hard copy of the completed documents to the CM;
   c. Site Direction / Site Memo Web for receiving of and responding to site direction / site memo. Printing and submission of signed hard copy of site direction / site memo with hard copy attachments to the CM is required;
   d. Safety Alert App and Web for reporting and recording accidents / incidents, and followed by submission of completed documents to the CM;
   e. Site Alert App and Web for communicating with Site Staff by receiving and responding to site alerts;
   f. Structural Works (SW) Inspection App and Web for the structural in-process inspections of building works at Site and off-site casting yard, and for receiving the Engineering Site Inspection Guide (DEI) forms and PCC-F01 form that show the inspection results. Printing and submission of signed hard copy of the DEI forms and PCC-F01 form with hard copy attachments to the CM is required;
   g. Building Works (BW) Final Flats Inspection App and Web for the BW final flat-to-flat inspections, and for receiving the Site Inspection Guide for BW (DASM) forms that show the inspection results. Printing and submission of signed hard copy of the DASM forms with hard copy attachments to the CM is required;
   h. Building Services Works (BS) Final Flats Inspection App and Web for the BS final flat-to-flat inspections, and for receiving the Site Inspection Guide for BS (DBSI) forms that show the inspection results. Printing and submission of signed hard copy of the DBSI forms with hard copy attachments to the CM is required;
   i. Materials Testing Request App and Web for the requests of material testing and sample collection, and for receiving the Engineering Site Inspection Guide (DEI) forms and Materials Testing Management Procedural Guide (DCMM) forms that show the request results. Printing and submission of signed hard copy of the DEI and DCMM forms with hard copy attachments to the CM is required;
   j. Foundation Works Inspection App and Web for the in-process inspections of foundation works, and for receiving the Foundation Inspection Guide (DFI) forms that show the inspection results. Printing and submission of signed hard copy of the DFI forms with hard copy attachments to the CM is required;
   k. Defect Rectification Module for receiving Defect Report Forms and reporting on the completion of defect rectifications;
   l. Site Operation Module Web for agreement of Site Diary as referred to in GCC Clause 5.25(2), and submission of Contractor's Daily Report as stipulated in GCC Clause 5.25(3) and Monthly Labour Return as stipulated in sub-clause (1)(a) of PRE.B8.1455.
2. Ensure the availability of computer systems and / or mobile devices, if applicable, that connect to and login the DCSMS, and bear all costs for the computer systems, mobile devices and the connection of the computer systems and the mobile devices to DCSMS through web browser (internet connection). The mobile devices and computer systems shall fulfil the minimum requirements as specified in sub-clauses (3) and (4) below respectively;

3. The minimum requirements of the mobile devices to access DCSMS are tabled as follows:

a. Operating System	Android 11.0 or above Non-rooted
b. Screen Size	6.0 inches or above
c. Display	Resolution (pixel): 2200 x 1080 – 2340 x 1080 Capacitive and Multi-touch
d. Dimension	Height <= 6.4 inches Width <= 3.1 inches Thickness <= 0.4 inches
e. Weight	190 g or below
f. CPU	CPU core: 8 or above Frequency: 1.8 GHz or above
g. Memory (RAM)	4 – 6 GB
h. Memory (Storage: ROM)	64 – 128 GB
i. Primary Camera	Image Resolution: 12M pixel or above Features: Autofocus, Flash
j. Network	Cellular Network: 4G LTE 1800 / 2300 / 2600 UMTS 850 / 900 / 2100 GSM 900 / 1800 Wi-Fi: 802.11 b/g/n/ac or more Bluetooth: 4.0 or above
k. Tracking / Positioning	A-GPS
l. Battery	Can serve > 10 hours (3G Talk time) Spare battery for battery detachable smartphone or External battery pack as required
m. Accessories	With protection case With Anti-glare Screen Protector

4. The minimum requirements of the computer systems to access DCSMS are tabled as follows:

a. CPU	Intel Core i5-650 3.20GHz or above
b. Memory	4 GB RAM or above
c. Hard disk	500 MB or above free space
d. Operation System	Microsoft Windows 10 or above
e. Browser	Best viewed by Chrome with 1280 x 1024 resolution

5. Coordinate with Nominated Sub-contractors who are DCSMS users for proper and timely execution of the functions in DCSMS.

Option 2

1. The Development and Construction Site Mobile System (DCSMS) shall be adopted from a date within one month after the notified date for commencement of the Works to the date of six months after the date of certified completion of the Works. The Contractor shall login the DCSMS system with his HOMES accounts and use the following mobile application (App) and / or web application (Web), if applicable, of the DCSMS:
   a. Foundation Works Inspection App and Web for the in-process inspections of foundation works, and for receiving the Foundation Inspection Guide (DFI) forms that show the inspection results. Printing and submission of signed hard copy of the DFI forms with hard copy attachments to the CM is required;
   b. Structural Works (SW) Inspection App and Web for the structural in-process inspections of building works, and for receiving the Engineering Site Inspection Guide (DEI) forms that show the inspection results. Printing and submission of signed hard copy of the DEI forms with hard copy attachments to the CM is required;
   c. Request for Inspection (RFI) App and Web for submission of inspection request, and followed by submission of signed hard copy of the completed documents to the CM;
   d. Site Direction / Site Memo Web for receiving of and responding to site direction / site memo. Printing and submission of signed hard copy of site direction / site memo with hard copy attachments to the CM is required;
   e. Safety Alert App and Web for reporting and recording accidents / incidents, and followed by submission of completed documents to the CM;
   f. Site Alert App and Web for communicating with Site Staff by receiving and responding to site alerts;
   g. Materials Testing Request App and Web for the requests of material testing and sample collection, and for receiving the Engineering Site Inspection Guide (DEI) forms and Materials Testing Management Procedural Guide (DCMM) forms that show the request results. Printing and submission of signed hard copy of the DEI and DCMM forms with hard copy attachments to the CM is required;
   h. Site Operation Module Web for agreement of Site Diary as referred to in GCC Clause 5.25(2), and submission of Contractor's Daily Report as stipulated in GCC Clause 5.25(3) and Monthly Labour Return as stipulated in sub-clause (1)(a) of PRE.B8.1455.
2. Ensure the availability of computer systems and / or mobile devices, if applicable, that connect to and login the DCSMS, and bear all costs for the computer systems, mobile devices and the connection of the computer systems and the mobile devices to DCSMS through web browser (internet connection). The mobile devices and computer systems shall fulfil the minimum requirements as specified in sub-clauses (3) and (4) below respectively;
3. The minimum requirements of the mobile devices to access DCSMS are tabled as follows:

a. Operating System	Android 11.0 or above Non-rooted
b. Screen Size	6.0 inches or above
c. Display	Resolution (pixel): 2220 x 1080 – 2340 x 1080 Capacitive and Multi-touch
d. Dimension	Height <= 6.4 inches Width <= 3.1 inches Thickness <= 0.4 inches

e. Weight	190 g or below
f. CPU	CPU core: –8 or above Frequency: 1.8 GHz or above
g. Memory (RAM)	4 – 6 GB
h. Memory (Storage: ROM)	64 – 128 GB
i. Primary Camera	Image Resolution: 12M pixel or above Features: Autofocus, Flash
j. Network	Cellular Network: 4G LTE 1800 / 2300 / 2600 UMTS 850 / 900 / 2100 GSM 900 / 1800 Wi-Fi: 802.11 b/g/n/ac or more Bluetooth: 4.0 or above
k. Tracking / Positioning	A-GPS
l. Battery	Can serve > 10 hours (3G Talk time) Spare battery for battery detachable smartphone or External battery pack as required
m. Accessories	With protection case With Anti-glare Screen Protector

4. The minimum requirements of the computer systems to access DCSMS are tabled as follows:

a. CPU	Intel Core i5-650 3.20GHz or above
b. Memory	4 GB RAM or above
c. Hard disk	500 MB or above free space
d. Operation System	Microsoft Windows 10 or above
e. Browser	Best viewed by Chrome with 1280 x 1024 resolution

Option 3

1. The Development and Construction Site Mobile System (DCSMS) shall be adopted from a date within one month after the notified date for commencement of the Works to the date of six months after the date of certified completion of the Works. The Contractor shall follow the Housing Construction Management Enterprise System (HOMES) accounts creation procedures, which will be provided by the CM, to create HOMES account for Site Agent to access DCSMS. The Contractor shall login the DCSMS system with his HOMES accounts and use the following mobile application (App) and / or web application (Web), if applicable, of the DCSMS:
   a. Safety Alert App and Web for reporting and recording accidents / incidents, and followed by submission of the completed documents to the CM;
   b. Site Operation Module Web for agreement of Site Diary as referred to in GCC Clause 5.25(2), and submission of Contractor's Daily Report as stipulated in GCC Clause 5.25(3) and Monthly Labour Return as stipulated in sub-clause (1)(a) of PRE.B8.1455.

2. Ensure the availability of computer systems and / or mobile devices, if applicable, that connect to and login the DCSMS, and bear all costs for the computer systems, mobile devices and the connection of the computer systems and the mobile devices to DCSMS through web browser (internet connection). The mobile devices and computer systems shall fulfil the minimum requirements as specified in sub-clauses (3) and (4) below respectively;
3. The minimum requirements of the mobile devices to access DCSMS are tabled as follows:

a. Operating System	Android 11.0 or above Non-rooted
b. Screen Size	6.0 inches or above
c. Display	Resolution (pixel): 2220 x 1080 – 2340 x 1440 Capacitive and Multi-touch
d. Dimension	Height <= 6.4 inches Width <= 3.1 inches Thickness <= 0.4 inches
e. Weight	190 g or below
f. CPU	CPU core: –8 or above Frequency: 1.8 GHz or above
g. Memory (RAM)	4 – 6 GB
h. Memory (Storage: ROM)	64 – 128 GB
i. Primary Camera	Image Resolution: 12M pixel or above Features: Autofocus, Flash
j. Network	Cellular Network: 4G LTE 1800 / 2300 / 2600 UMTS 850 / 900 / 2100 GSM 900 / 1800 Wi-Fi: 802.11 b/g/n/ac or more Bluetooth: 4.0 or above
k. Tracking / Positioning	A-GPS
l. Battery	Can serve > 10 hours (3G Talk time) Spare battery for battery detachable smartphone or External battery pack as required
m. Accessories	With protection case With Anti-glare Screen Protector

4. The minimum requirements of the computer systems to access DCSMS are tabled as follows:

a. CPU	Intel Core i5-650 3.20GHz or above
b. Memory	4 GB RAM or above
c. Hard disk	500 MB or above free space
d. Operation System	Microsoft Windows 10 or above
e. Browser	Best viewed by Chrome with 1280 x 1024 resolution

TRAINING OF WORKERS

PRE.B8.1500.9 CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES

1. The Contractor shall provide or ensure the provision of the necessary training to trainees employed by the Contractor or his sub-contractor(s) in accordance with the Construction Industry Collaborative Training Schemes (hereinafter referred to as "CICTS") and the requirements specified in this clause;
2. The CICTS comprises the following training schemes administered by CIC for on-the-job training of construction workers:
   a. Intermediate Tradesman Collaborative Training Scheme (hereinafter referred to as "ITCTS");
   b. Advanced Construction Manpower Training Scheme (hereinafter referred to as "ACMTS");
   c. Construction Industry Council Approved Technical Talents Training Programme (hereinafter referred to as "CICATP").
3. The Contractor and/or his sub-contractor(s) shall join at least one of the training schemes of the CICTS for provision of the necessary training to the employed trainees under the Contract (hereinafter referred to as "CICTS Trainees"). Submit to the CM a copy of CIC's approval(s) to undergo the CICTS training within 12 months from the notified date for commencement of the Works;
4. Provide, supervise and monitor the necessary training to the CICTS Trainees for them to complete training in accordance with this clause;
5. Arrange sufficient qualified trainers in accordance with CICTS for the CICTS Trainees. Observe and comply with the requirements on trainers in accordance with the CICTS;
6. Ensure that at least a total of …… number of CICTS training quotas is fulfilled, with at least 50% of such training quotas met by ITCTS, before the certified date of completion of the Works;
7. For the purpose of sub-clause (6), a CICTS Trainee who is employed and trained by the Contractor and/or his sub-contractor(s) excepting Nominated Sub-contractor(s) shall be counted towards the number of CICTS training quota(s) fulfilled as stipulated below:
   a. Each CICTS Trainee shall only be counted under one contract at any one time;
   b. One CICTS training quota will be counted after a CICTS Trainee has completed the ITCTS training in accordance with sub-clause (11);
   c. Two CICTS training quotas will be counted after a CICTS Trainee has passed the mid-term assessment under the ACMTS or CICATP for the designated trade division(s) under the CIC's approval as referred to in sub-clause (3) above;
   d. Two CICTS training quotas will be counted after a CICTS Trainee under ACMTS or CICATP has registered as a registered skilled worker under the Construction Workers Registration Ordinance (Cap. 583) (hereinafter referred to as "CWRO") for the designated trade division(s) under the CIC's approvals as referred to in sub-clause (3) above.
8. In programming the CICTS training, the Contractor and/or his sub-contractor(s) shall employ and train the CICTS Trainees as early as practicable. Unless with the consent of the CM, the Contractor shall ensure that the training for the CICTS Trainees of a trade division shall start within 3 months from the commencement on the Site of works of such trade division;
9. Subject to the terms and conditions of the CICTS, the Contractor or his sub-contractor(s) as the employer(s) of the CICTS Trainees may arrange part of the CICTS training to be carried out outside the Site;

10. Submit a training plan to the CM within 3 months from the notified date for commencement of the Works. Update the training plan and submit the updated training plan to the CM on monthly basis. The training plan shall include:
    a. The Contractor's programme to train the CICTS Trainees of different trade divisions, and to meet the minimum total number of CICTS training quotas to be fulfilled as specified in sub-clause (6) above; and
    b. A register recording using the form at APPENDIX PRE.B8/XVI, for each CICTS Trainee, the date of the CIC's approval to undergo the CICTS training and the trade division(s) being trained, the attendance records, the date of passing the mid-term assessment (for CICTS Trainee under the ACMTS or CICATP training), the date of completion of the training, the date of passing end-of-training assessment of trained trade division(s) and, if applicable, the CICTS Trainee's CWRO registration number when the CICTS Trainee has been registered as a registered semi-skilled worker or skilled worker of the relevant trade division(s) under CWRO.
11. If CICTS Trainees who receive ITCTS training (hereinafter referred to as "ITCTS Trainees"), the training of each ITCTS Trainee is completed when the ITCTS Trainee has completed training in accordance with the ITCTS and registered as a registered semi-skilled worker of a relevant trade division under CWRO, or if there is no relevant trade division or the trade division does not have the level of registered semi-skilled worker for registration under CWRO the training is deemed to have been completed when the ITCTS Trainee has passed the end-of-training assessment (i.e. the Intermediate Trade Test or Certification Test) under the ITCTS. The trade division to be registered under CWRO shall match with the trade division of the ITCTS training;
12. Report the status of CICTS training at the monthly site meetings;
13. Provide further training to the CICTS Trainees who have failed the mid-term assessment or the end-of-training assessment, and replenish any drop-out CICTS Trainees for fulfilling the CICTS training quotas under sub-clause (6);
14. For the avoidance of doubt, all CICTS Trainees under training in accordance with this clause and ITCTS Trainees who have completed training in accordance with sub-clause (11) above shall be excluded from the total workforce under this Contract for the purpose of calculating the percentage of Skilled / Semi-skilled Workers of relevant trade division pursuant to PRE.B6.065;
15. The Employer shall not be liable for any matter, dispute or claim between (a) the Contractor and his sub-contractor(s); (b) the Contractor / his sub-contractor(s) and any CICTS Trainee under training or completed training under this Contract; and (c) the Contractor / his sub-contractor(s) and the CIC, in connection with or in respect of any matter or issue in relation to the CICTS or the employment or training of any CICTS Trainee under training or completed training under this Contract.

PROTECTION

PRE.B8.1510.A PROTECTION FROM WEATHER

1. In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working under inclement weather conditions as recommended in the latest edition of the CoP in Times of Adverse Weather and "Extreme Conditions" issued by LD and the Guide on Safety at Work in Times of Inclement Weather jointly issued by LD and OSHC. Examine critically the practices and / or measures as recommended in the said CoP and Guide, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said CoP and Guide may be proposed for CM's approval before implementation. The following highlights of the crucial practices and / or measures, albeit not exhaustive, are extracted from the said CoP and Guide:
    a. Conduct risk assessment on working under inclement weather conditions, identify and analyse the hazards;
    b. Establish practical safety measures and emergency plans with documented procedures on communication of weather information, warning system, traffic arrangement, work arrangement, use of appropriate personal protective equipment, evacuation route, safe shelters, first aid facilities and back up services etc.;
    c. Formulate training programme with regular drills for all emergency situations to all site personnel to become knowledgeable to all hazards, and all necessary precautions to take under inclement weather conditions;
    d. Resume work after the occurrence of inclement weather conditions only after a thorough examination and completion of all necessary repairs to ensure the safe working condition of lifting appliances, scaffolds, suspended working platforms, electrical installations and other plant.
2. Appoint an emergency standby team as per PRE.B8.1520 to monitor changes in weather conditions and take appropriate actions as per sub-clause (1);
3. Follow the advice and practical guidelines on work arrangements in times of typhoons and rainstorms as given at the said CoP, taking into account the applicability and suitability to the Works on account of actual site conditions and the specific safety hazards of the Works;
4. Cover up, protect and secure the Works and the Direct Works from damage by inclement weather, including providing sufficient staff, adequate plant and any other requirements necessary to ensure protection during typhoon and heavy rainstorm conditions.

PRE.B8.1520.9 EMERGENCY STANDBY TEAM

1. Provide emergency communication and standby team for the execution of any emergency work on Site warranted necessary by the Contractor for the safety of the Works and/or the public, in accordance with the following:
    a. Within seven days from the notified date for commencement of the Works establish an emergency contact telephone number and submit the said telephone number to the CM;
    b. Man the emergency contact telephone at all times during which the Tropical Cyclone Warning Signal No: 3 or above is hoisted, with a competent English-speaking person. All information received to be immediately conveyed to the Contractor;

c. Make available the emergency standby team comprising suitable staff, labour and plant at all times during which the said signal is hoisted. The standby team to be sufficient in size for any emergency work required to be carried out on Site. In the event that the standby team is not stationed at the Site, ensure that the team can be mobilized within the shortest possible time.

2. The provision of the emergency contact telephone number and the emergency standby team will in no way relieve the Contractor of his obligations, responsibilities and liabilities under the Contract.

PRE.B8.1540.9 DRYING THE WORKS

Provide temporary equipment, fuel and attendance for drying and controlling the humidity of the Works for the following operations and demonstrate compliance when required:

1. .....
2. .....

PRE.B8.1550.9 PROTECTION FROM OVERLOADING

1. Protect the Works from damage due to overloading;
2. Obtain details of design loads from the CM;
3. Do not use areas in partially completed buildings for storage unless Approved;
4. Ensure that imposed loadings from storage of new or waste materials do not exceed the design loading of the supporting structural members;
5. Accept sole responsibility for making good any damage arising from the storage to the satisfaction of the CM, irrespective of whether Approval has been given or not.

PRE.B8.1560.A PROTECTION TO LIFT LOBBIES

Provide and maintain plywood protective linings to the walls and floors of the ground floor lift lobbies as indicated in the drawing no(s) ..... at Appendix C to this Specification, from the completion of the internal building finishes of ground floor lift lobbies to certified completion of the Works in accordance with Clause 8.7 of the General Conditions of Contract.

PRE.B8.1570.B PROTECTION OF WORKERS FROM HEAT STROKE

In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working in hot weather as recommended in the latest edition of the Guidelines on Site Safety Measures for Working in Hot Weather issued by CIC, the Guidance Notes on Prevention of Heat Stroke at Work and the leaflet on Prevention of Heat Stroke at Work in a Hot Environment issued by LD. Examine critically the practices and / or measures as recommended in the said Guidelines, Guidance Notes and leaflet, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guidelines, Guidance Notes and leaflet may be proposed for the CM's approval before implementation. The following highlights the crucial practices and / or measures, albeit not exhaustive, extracted from the said Guidelines, Guidance Notes, leaflet and measures required:

1. In relation to PRE.B6.070, ensure that a safe system of work including the risk assessment and the caring measures for prevention of heat stroke are incorporated in the Safety Plan as per PRE.B8.210;
2. Make reference to the said Guidelines issued by CIC and the Guidance Notes issued by LD for the purpose of conducting the risk assessment as per sub-clause (1); review and adopt as appropriate in the light of applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works;

3. Set up sunshade to block away sunlight at exposed work areas and provide good mechanical ventilation as far as reasonably practicable;
4. Ventilate the workplace by means of fans / blowers / chillers or any other form as appropriate;
5. Where working in enclosed area with poor ventilation, in addition to the provision at sub-clause (4), exhaust the hot air by exhaust pipes or other suitable measures;
6. Keep heat-generating machinery (e.g. diesel air compressors or generators) away from workers or use insulating materials to minimize heat dissipation as far as reasonably practicable;
7. Use mechanical aids for execution of works where appropriate to minimise workers' physical exertion;
8. Establish administration control measures with trained supervisors to take heed of hot weather report and if necessary, to reschedule outdoor work or to arrange job rotation or suitable rest breaks to avoid prolonged working in hot environment;
9. Assign a lower workload or shorter working duration as a start to the workers new to a hot environment, with the workload increased gradually over a number of days to help them acclimatize to the hot environment;
10. Avoid assigning workers who may have difficulties in coping with heat to work under hot environment. Consider the advice of their attending doctors if necessary;
11. Arrange rest periods to reduce the duration of exposure to the hot environment to let the workers cool down in accordance with the risk assessment conducted in sub-clause (2) above;
12. Provide relevant training and site safety information to supervisors and workers in understanding the potential risks for working in hot environment inclusive of the knowledge in recognizing symptoms of heat-related disorders, the precautionary measures and the emergency response actions etc.;
13. Provide sheltered rest areas as per PRE.B8.305 with cooling aids and cool potable water close to the workplace;
14. In addition to sub-clause (13), provide easily accessible drinking points with cool potable water for all workers employed on the Works or in connection with the Contract;
15. Encourage workers to take plenty of water or other appropriate beverages to replenish the fluid and electrolytes lost through sweating;
16. Prohibit consumption of alcoholic drinks;
17. Pursuant to PRE.B8.235, encourage workers wear proper clothing and safety helmet in light colour, wide brim and with ventilation vents to suit the weather. Provide sun protection arm sleeves (upon request by workers and not required for workers with long sleeves clothing). The sun protection arm sleeves shall be made of thin and vapour permeable fabric allowing effective sweat evaporation and having a ultraviolet protection factor of at least 50;
18. Provide misting machines and regularly change the water in water tank of misting machine for hygiene;
19. Provide air-conditioners or cooling facilities in the cabins of tower cranes or other plant where the operator is likely to be exposed to high temperature;
20. Subject to measures recommended in risk assessment, monitor periodically the body temperature of workers working under direct sunshine during the very hot weather warning issued by the Hong Kong Observatory. The frequency of measurement required shall be recommended in the risk assessment. For the mode of measurement, the reading may be taken manually and recorded in paper format. Alternatively, artificial intelligence body temperature measuring device with recording function may be used for monitoring the temperature of workers.

PRE.B8.1575.9 PROTECTION OF WORKERS WORKING IN COLD WEATHER

In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working in cold weather as recommended in the Health Guide for Working during the Cold Weather issued by LD. Examine critically the practices and / or measures as recommended in the said Guide, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guide may be proposed for CM's approval before implementation:

1. In relation to PRE.B6.070, ensure that the risks of working in cold weather to the workers and the caring measures are incorporated in the Safety Plan as per PRE.B8.210;
2. Take heed of weather report. Inform workers of the necessary safety and health precautions to take and remind workers to wear appropriate warm clothing at work;
3. Reschedule outdoor work or work in remote areas to warmer periods in daytime where practicable;
4. Make arrangements for work shifts to rotate from outdoor to indoor or sheltered work sites where practicable;
5. Provide hot drinking water or other beverages for all workers employed on the Works or in connection with the Contract;
6. Provide workers working alone in remote areas with effective communication or other suitable measures for calling for assistance in case of emergency.

CLEANLINESS

PRE.B8.1610.9 SITE PRESENTATION

1. Keep the Site and the Works clean and tidy. Remove rubbish and debris as they accumulate and at the end of each working day. Carry out a general tidying up at the end of each week;
2. Remove debris and rubbish in the vicinity of the Site, if the debris and rubbish are in connection with the Works or disposal of by the persons working on the Site.

PRE.B8.1620.9 STORAGE OF NEW MATERIALS AND PLANT

1. Stack and protect unused materials and plant properly and neatly;
2. Store materials in a properly designated area separated from waste;
3. Store permanent materials, including all proprietary components, off a levelled, well-drained and maintained hard-standing ground, and protect from damage and contamination;
4. Do not store materials in corridors or staircases or in other areas that cause obstructions.

PRE.B8.1630.A DISPOSAL OF WASTE MATERIALS

1. Stack waste materials neatly and remove from Site within one day after completion of each operation and before next trade commences. Use refuse chutes as specified at PRE.B10.060;
2. Avoid obstruction where more than one trade is operating simultaneously;
3. Do not permit accumulated waste material piles to exceed 2000 mm generally or to exceed 450 mm high adjacent to refuse chutes;
4. To maintain site cleanliness, provide sufficient waste disposal points and all necessary receptacles to store waste material prior to removal from Site.

PRE.B8.1640.9 CLEANING WORKS ON COMPLETION

Option 1

Clean the Works thoroughly inside and out, without damage and ready for occupation on completion, including polishing floors, windows and similar finishes.

Option 2

Clean the Works thoroughly inside and out, without damage and ready for use.

PRE.B8.1650.9 DISPLAY OF POSTERS - PREVENTION OF MOSQUITO BREEDING

Provide and display prominently upon all structures or temporary huts on the Site throughout the construction period and remove on completion, posters, in both English and Chinese, drawing attention to the dangers of allowing the breeding of mosquitoes. These posters may be obtained free of charge from the Food and Environmental Hygiene Department, Health Education Exhibition and Resource Centre of the Government of the Hong Kong Special Administrative Region.

PRE.B8.1655.A PREVENTION OF MOSQUITO PROLIFERATION ON SITE

1. Prepare a list of potential mosquito problematic areas, and map their locations on a site plan or floor plan. Identify such locations / areas after carrying out a site inspection on the next working day following a rainfall. Conduct thorough inspection of the Site and its surroundings with the CM or his representatives and carry out precautionary and follow-up actions:

<table>
<tr><td>Level 1
(AGI < 5%)</td><td>Level 2
(5% ≤ AGI < 20%)</td><td>Level 3
(20% ≤ AGI < 40%)</td><td>Level 4
(AGI ≥ 40%)</td></tr>
<tr><td colspan="2">Inspect at least once per week</td><td>Inspect at least twice per week</td><td rowspan="4">Implement and intensify the requirements as mentioned at AGI Level 3</td></tr>
<tr><td colspan="2">Examine all potential locations and eliminate objects likely to collect water</td><td rowspan="3">Review critically any stagnant water remaining on the Site, and adopt all reasonably practicable measures to reduce or eliminate the stagnant water or apply larvicide where appropriate</td></tr>
<tr><td colspan="2">Inspect the list of potential mosquito problematic areas within the Site and ensure that all potential black spots are covered to prevent collection of stagnant water</td></tr>
<tr><td colspan="2">Report to the CM or his representatives if stagnant water is observed on the Site, and carry out follow-up action promptly</td></tr>
</table>

Note: AGI = Area Gravidtrap Index for Aedes albopictus published by FEHD

2. Check all gully traps, roof gutters, surface channels and drains at least once a week to prevent blockage;
3. Level all defective ground surfaces before the rainy season;
4. Remove and prevent standing water and cover all containers that hold water to prevent mosquito breeding;
5. Scrub and clean floor drains, roof gutters, sand traps, manhole covers and surface channels with an alkaline detergent compound at least once a week to remove any deposited mosquito eggs;
6. Clean and dry the saucers of flower and plant pots for site greening completely at least once a week;
7. Fill up or wrap up the vertical poles of the bamboo to prevent accumulations of stagnant water;
8. Provide and apply pesticide or larvicide to stagnant water at potential black spots;

9. Provide and apply pesticide or larvicide by fogging in appropriate areas for killing adult mosquitoes;
10. Only pesticides and larvicides as per PRE.B8.1680 and in compliance with the Pesticides Ordinance Cap (133) shall be used;
11. Provide and install mosquito screens on windows and doors of site offices without air conditioning;
12. Identify potential mosquito breeding places within the Site and at the adjoining areas and eliminate such places. Report to FEHD for investigation if such areas fall outside the Site boundary;
13. Ensure that workers take personal protective measures such as wearing light-coloured, long-sleeved clothes and trousers. Provide and apply insect repellent containing DEET on the clothing and exposed parts of the body of workers according to the label instructions. If this is not possible in hot summer to wear long-sleeved clothes and trousers, the workers shall apply insect repellents on their exposed skin;
14. Carry out inspections on Site to ensure adequate alertness and preventive measures in place;
15. Appoint professional pest control contractors to implement anti-mosquito measures as necessary and in compliance with the Environmental Management Plan as specified in PRE.B8.2520;
16. Carry out investigation and submit the situation report and corrective measures when the conviction of mosquito breeding was found by FEHD.

PRE.B8.1660.9 REMOVAL AND TREATMENT OF STANDING WATER

Prevent or remove standing water from disused tyres, uneven floors, lift wells and pits, refuse areas or any other water receptacle location. Where removal of water is not possible, treat any standing water on the Site with an Approved oil at least once per week.

PRE.B8.1670.9 TREATMENT OF WATER RECEPTACLES

Store, cover or treat all items on the Site, including Constructional Plant, capable of retaining water to prevent the collection of water in them.

PRE.B8.1680.B PESTICIDES AND LARVICIDES

Only pesticides and larvicide that have been registered in Hong Kong shall be used. To protect environmental and human impacts, pesticides and larvicides must be used in accordance with the manufacturers' instructions. For enquiries on the procurement and use of pesticides, contact the Agricultural, Fisheries and Conservation Department.

PRE.B8.1690.9 PREVENTION OF RODENT INFESTATION ON SITE

1. Remove and eliminate food sources for rodents with, including but not limited to, the following measures:
   a. Store all food properly in covered containers; and
   b. Dispose of food remnants and refuse properly in covered rubbish bin which should be cleared daily.
2. Prevent rodents from entering the Site, voids beneath container offices, site offices and storerooms, etc. with, including but not limited to, the following measures:
   a. Reduce the gaps between or under the hoardings, particularly those facing side lanes or rear lanes, to not more than 6mm wide where practicable;
   b. Screen the footings of container offices with material as appropriate so that the openings are less than 6mm wide;
   c. The threshold clearance beneath the doors of site offices and storerooms should be less than 6mm.
3. Inspect unloaded building materials to ensure no rodents are brought into the Site;

4. Carry out regular inspections on Site and ensure adequate alertness, preventive and control measures in place;
5. Appoint pest control companies for inspections and control as necessary and in compliance with the Environmental Management Plan as specified in PRE.B8.2520.

PROTECTION OF PERSONAL DATA

PRE.B8.1710.X DELETED

DISPOSAL OF CONSTRUCTION AND DEMOLITION (C&D) MATERIAL

PRE.B8.1810.A DISPOSAL OF INERT C&D MATERIALS

1. Inert C&D materials refer to the inert portion (e.g. soil, broken rock and concrete, etc.) of the C&D materials that can be used as fill materials for reclamation and earth filling projects. In order to make use of inert C&D materials generated by the Site, use best endeavours to identify recycling facilities or other construction sites as alternative disposal grounds where such materials can be used. Obtain Approval where such a site has been identified, which can be used as an alternative disposal ground as specified in PRE.B8.1850. If there is no such a site as an alternative disposal ground, dispose inert C&D materials as specified in sub-clauses (2) and (3) below;
2. Subject to sub-clause (1) above on alternative disposal ground, dispose inert C&D materials at the public fill reception facilities as designated by Public Fill Committee (PFC) of CEDD, and comply with their acceptance requirements;
3. Subject to sub-clause (1) above on alternative disposal ground, the public fill reception facility as designated by CEDD is ..... Allow for adoption of other public fill reception facility that may be subsequently designated by CEDD due to reasons such as closure of the designated public fill reception facility by CEDD. Bear all associated costs and the extra time required due to switching to the alternative designated disposal facility;
4. If it is confirmed by PFC that there is no public fill reception facility being available, submit a disposal plan for inert C&D materials for the CM's agreement. The disposal plan shall include information as specified in sub-clauses (1)(a) to (1)(f) of PRE.B8.1850.

PRE.B8.1820.A DISPOSAL OF NON-INERT C&D MATERIALS

1. Non-inert C&D materials refer to the portion of the C&D materials other than the inert portion. In order to make use of non-inert C&D materials generated by the Site, use best endeavours to identify recycling facilities or other construction sites as alternative disposal grounds where such materials can be used. Obtain Approval where such a site has been identified, which can be used as an alternative disposal ground as specified in PRE.B8.1850. If there is no such a site as an alternative disposal ground, dispose non-inert C&D materials as specified in sub-clauses (2) and (3) below;
2. Subject to sub-clause (1) above on alternative disposal ground, dispose non-inert C&D materials at the landfill or outlying islands transfer facility as designated by EPD, and comply with their acceptance requirements;
3. Subject to sub-clause (1) above on alternative disposal ground, the landfill or outlying islands transfer facility as designated by EPD is ..... Allow for adoption of other landfill or outlying islands transfer facility that may be subsequently designated by EPD due to reasons such as closure of the designated landfill or outlying islands transfer facility by EPD. Bear all additional time and cost incurred due to switching to the alternative designated disposal facility;

4. If it is confirmed by EPD that there is no landfill or outlying islands transfer facility being available, submit a disposal plan for non-inert C&D materials for the CM's agreement. The disposal plan shall include information as specified in sub-clauses (1)(a) to (1)(f) of PRE.B8.1850.

PRE.B8.1830.9 TRIP-TICKET SYSTEM FOR DISPOSAL OF C&D MATERIALS AT PUBLIC FILL RECEPTION FACILITIES/LANDFILLS/OUTLYING ISLANDS TRANSFER FACILITIES

1. Provide the account number of the billing account for disposal of construction waste under the Waste Disposal (Designated Waste Disposal Facility) Regulation (Cap. 354L) for overall monitoring of the Trip Ticket System;
2. Maintain a daily record of disposal of C&D materials from the Site including CHIT numbers, vehicle registration numbers, approximate volume, C&D materials type, designated disposal ground, departure time from the Site, actual disposal ground and arrival time at disposal ground, using the Daily Record Summary (DRS) at Appendix PRE.B8/II;
3. Submit the duly completed Part 1 of the DRS in duplicate before departure of the truck;
4. When leaving the Site, each and every vehicle transporting C&D materials including both the inert and non-inert portion, must bear a CHIT. The CHIT shall be duly completed;
5. Carry the CHIT on board the vehicle at all times throughout the vehicular trip to the designated disposal ground as stipulated in the CHIT;
6. For each vehicular trip after disposal of C&D materials, obtain a Transaction Record Slip and a stamped return of the CHIT from the operator of the designated disposal facility;
7. Check the information recorded in the DRS against available information including the Contractor's own records and data from EPD's web-site, then complete Part 2 of the DRS form and submit it to the CM within 1 working day after the records are posted at the EPD's web-site;
8. Where an irregularity is observed or where requested by the CM under special circumstances (e.g. a CHIT has been issued but there is no disposal record at the disposal ground), submit to the CM within 5 working days after the recorded date of disposal the supporting evidence such as duly stamped CHIT and/or the Transaction Record Slip (where relevant) to confirm proper completion of the delivery trip(s) in question, or within 2 working days after the CM has requested for such evidence, whichever is later.

PRE.B8.1831.A TRIP-TICKET SYSTEM FOR DISPOSAL OF C&D MATERIALS AT DISPOSAL FACILITIES OTHER THAN PUBLIC FILL RECEPTION FACILITIES/LANDFILLS/OUTLYING ISLANDS TRANSFER FACILITIES

1. Maintain a daily record of disposal of C&D materials from the Site including Disposal Delivery Form (DDF) numbers, vehicle registration numbers, approximate volume, C&D materials type, Approved alternative disposal ground, departure time from the Site, actual disposal ground and arrival time at disposal ground, using the Daily Record Summary (DRS) at Appendix PRE.B8/II;
2. Submit the duly completed Part 1 of the DRS in duplicate before departure of the truck;
3. When leaving the Site, each and every vehicle transporting C&D materials including both the inert and non-inert portion, must bear a DDF. A sample of the DDF is at Appendix PRE.B8/III. The DDF shall be duly completed and authorized by the CM or his representatives;
4. Carry the DDF on board the vehicle at all times throughout the vehicular trip to the Approved alternative disposal ground as stipulated in the DDF;

5. For each vehicular trip after disposal of C&D materials, ensure that the DDF is signed off by a competent person as agreed by the CM at the Approved alternative disposal ground to confirm completion of each trip. Keep a copy of the DDF for inspection by the CM upon request. Complete Part 2 of the DRS form and submit it to the CM within 3 working days after the date of disposal;
6. Where an irregularity is observed or where requested by the CM under special circumstances (e.g. a DDF has been issued but there is no disposal record at the Approved alternative disposal ground), submit to the CM within 5 working days after the recorded date of disposal the supporting evidence such as the signed off DDF to confirm proper completion of the delivery trip(s) in question, or within 2 working days after the CM has requested for such evidence, whichever is later.

PRE.B8.1835.A SITE VIDEO RECORDING SYSTEM

1. Provide, operate and maintain, including all necessary cables, wirings, lightings and other accessories, a video recording system, at each vehicular exit with gate(s), with the following essential features to record all trucks with C&D materials leaving the Site:
   a. The video cameras used in the system shall be suitable for external use, protected from adverse weather and of high resolution, lowlight and colour type;
   b. Power backup shall be provided to cater for accidental breakdown of the power supply to the system;
   c. Videos captured by the system shall be recorded continuously without break unless agreed by the CM;
   d. Videos shall be captured in a format acceptable to the CM;
   e. The registration number of each dump truck leaving the Site shall be captured by the system; and
   f. The loading conditions of the dump trucks including those empty trucks shall also be captured by the system prior to opening of the gate.
2. Securely protect the video cameras from being damaged or blocked;
3. Design and construct all necessary temporary works, including any supporting frames and protections, for mounting the video cameras and their accessories. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE;
4. Provide the software and hardware for capturing the vehicle registration number, the time and date, and the loading conditions of each truck with C&D materials including those empty trucks leaving the Site, and for the CM's immediate viewing and taking of their photographs or viewing the recorded videos and photographs when required. Keep the videos record for at least 60 days and the photographs until such time as required by the CM; and
5. Post sufficient notices at conspicuous positions on Site to notify the workers, drivers and staff about the purpose of the video recording system (i.e. all collected personal information/data will be used by the CM to monitor the loading conditions of trucks with C&D materials leaving the Site only and will not be released/issued to irrelevant persons/parties without the permission of the persons/parties being monitored) in accordance with data protection principles set out in the Personal Data (Privacy) Ordinance.

PRE.B8.1836.A MONITORING OF WEIGHT OF TRUCKS WITH C&D MATERIALS

1. Unless otherwise Approved by the CM, supply and install weighbridge(s) at the site entrance to monitor the weight of each dump truck loaded with C&D materials leaving the Site. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE;

2. The weighbridge(s) shall be installed and put into operation as soon as practicable, and in any case not later than 3 months after the notified date for commencement of the Works, unless otherwise proposed by the Contractor and Approved by the CM;
3. The weighbridge(s) shall be kept functioning till the completion of the Works as far as practicable, and in any case the weighbridge(s) shall not be dismantled in or before the month which is ……. month(s) prior to the date for completion of the Works or its extension thereof and as consented by the CM, unless otherwise proposed by the Contractor and approved by the CM;
4. The weight capacity of the weighbridge(s) shall be at least 24 metric tonnes;
5. The weighbridge(s) shall be calibrated in accordance with the manufacturer's manual / instructions and must be certified as complying with the manufacturer's manual by a Registered Professional Engineer in the Mechanical Engineering Discipline under the Engineers Registration Ordinance;
6. Provide and utilize software and hardware for capturing the total vehicle weight of the dump truck loaded with C&D materials, the vehicle registration number, the time and date of the dump truck loaded with C&D materials leaving the Site, the CHIT form number, the type of C&D materials and the corresponding disposal ground. Summarize the collected data in a format to be agreed with the CM;
7. Keep the collected data for at least 60 days and submit the summary report of such data to the CM upon the CM's request at any time during the Contract.

PRE.B8.1838.9 MECHANICAL COVER SYSTEM FOR DUMP TRUCKS FOR TRANSPORTING C&D MATERIALS

1. Use dump truck with mechanical cover system satisfying the requirements specified in sub-clauses (7) to (10) below;
2. Ensure all dump trucks, which are goods vehicles fitted with a dump bed and of gross vehicle weight equal to or over 16 tonnes for transportation of construction and demolition (C&D) materials, are installed with a mechanical cover system, which is in good service condition to cover the dump bed;
3. Dump truck may not be allowed entering into the Site if sub-clauses (2) and (7) to (10) of this clause have not been complied with;
4. Clean all dust or debris on top of the mechanical cover so as not to obstruct its operation;
5. Loaded dump truck may be required to unload its contents on Site before leaving the Site if the dump bed and the cover of the dump truck do not comply with the requirements specified in sub-clauses (2), (4) and (7) to (10) of this clause after loading;
6. The Approval of the CM for a loaded dump truck leaving the Site shall not relieve the Contractor's obligation to comply with the relevant legislation. The Employer shall not be liable for any loss or damage sustained by the Contractor arising from or in connection with any offence committed by the Contractor or the dump truck drivers or dump truck owners in relation to the transportation of the C&D materials from the Site;
7. The mechanical cover system of a dump truck shall comply with the following requirements:
    a. The cover shall be made of durable material and constructed with suitable components;
    b. The mechanical cover system shall be effective in preventing dust emission from the dump bed of the truck;
    c. The system shall be able to withstand strong winds under normal circumstances;
    d. The system shall be power-operated inside the driving cabin and backup with manual operation outside;

e. When the dump bed is covered by the mechanical cover, any gap between the cover and the dump bed shall not exceed 25 mm wide and shall be sealed up tightly with suitable materials as far as practicable;

f. The mechanical cover system shall be installed with the following control devices to ensure its safe operation:

i. The mechanical cover shall be operated only when the dump truck has been stopped and the hand brake is engaged;

ii. A warning system consisting of flashing amber lights and audible alarm shall be activated automatically when the mechanical cover is being operated inside the driving cabin;

iii. The warning system shall be visible and audible from both inside (by an indicator light associated with alarm system or the like) and outside of the driving cabin;

iv. A locking system shall be provided to prevent accidental opening of the mechanical cover, if applicable;

v. The associated electrical equipment shall comply with the commonly adopted safety standard.

8. The gross vehicle weight and maximum dimensions of the dump truck after installation of a mechanical cover system shall comply with the relevant legislation and such dump truck shall pass the annual inspection and examination by the Transport Department. Submit supporting evidence to the CM to prove that such annual inspection and examination has passed;

9. Unless otherwise Approved by the CM, the mechanical cover system of a dump truck shall be certified by a Registered Professional Engineer in the Mechanical Engineering Discipline under the Engineers Registration Ordinance that the system complies with the requirements as specified in sub-clauses (2), (7) and (8) above. The certification must include a certified true photograph of the mechanical cover in a closed configuration;

10. Dump trucks installed with a mechanical cover system and have been registered under the "Pay for Safety Scheme" or "Pay for Safety and Environment Scheme" of the CEDD are deemed to comply with the requirement of sub-clause (9) above;

11. Vehicles other than 'dump trucks' carrying dusty materials away from the Site may use means other than mechanical covers to cover their dusty materials, provided that the vehicle shall have properly fitted side boards and tailboards, with the dusty materials loaded to a height not exceeding the height of side boards and tailboards, and covered by a tarpaulin or suitably impervious covering materials (as Approved by the CM) in good condition. The covering shall be properly secured and extended at least 300 mm over the side boards and tailboards before leaving the Site.

PRE.B8.1850.A ALTERNATIVE DISPOSAL GROUND

1. Use best endeavours to identify recycling facilities or other construction sites other than the designated public fill reception facilities/landfills/outlying islands transfer facilities, or other public fill reception facilities/landfills/outlying islands transfer facilities as may be required by CEDD/EPD, which can be used as an alternative disposal ground. Obtain Approval for adoption of such a site as the alternative disposal ground. In support of the request for such Approval, submit a disposal plan for CM's agreement. The disposal plan shall include:

a. A detailed description of the alternative disposal ground, including location, lot number (where appropriate), location plan and photographs of the proposed alternative disposal grounds showing the surrounding environment and land use;

b. Where the alternative disposal ground is a private construction site, submit a letter from each of the relevant authorities, such as Agriculture, Fisheries and Conservation Department, Lands Department and Planning Department, providing comment on suitability of the site under their respective purview, and a letter from the Authorized Person (as defined under the Buildings Ordinance) of the private construction site to confirm:
   i. The C&D materials for use in the development is acceptable;
   ii. The land/pond filling in the proposed alternative disposal ground and the use of land so formed by the C&D materials is in conformity with the statutory Outline Zoning Plan and lease conditions;
   iii. The CM or his representatives are allowed to enter the alternative ground to conduct inspections where necessary.
c. Where the alternative disposal ground is a private recycling facility, it shall be on the recyclers' list for C&D materials recognized by EPD, as well as a letter from the recycling facility operator to confirm CM's staff are allowed to enter the recycling facility to conduct inspections where necessary;
d. Where the alternative disposal ground is a construction site of Government (other than a government contract quarry) including those of Housing Authority, or MTRCL, submit written consent from the contract/project manager of the alternative disposal ground to use the C&D materials generated from the Site;
e. Where the alternative disposal ground is a government contract quarry, submit written consent from the Mines Division of CEDD to import the C&D materials generated from the Site;
f. The estimated quantity and type of C&D materials to be used/processed in the alternative disposal ground and the approximate delivery programme, together with the name, post and specimen signature of the competent person to sign the Disposal Delivery Form (DDF).

2. Dispose C&D materials at Approved alternative disposal ground. Disposal of C&D materials in particular on private land or on a private construction site which is not administered by an Authorized Person (as defined under the Buildings Ordinance) is prohibited;
3. Bear all associated costs and the extra time required due to the CM's Approval or disapproval of the Contractor's request for alternative disposal ground.

PRE.B8.1860.A REMOVAL OF C&D MATERIALS FROM UNAUTHORIZED DISPOSAL GROUNDS

1. Where C&D materials from the Site have been dumped at a place other than that designated under the Contract or as Approved, undertake the following remedial actions and bear all associated costs and the extra time required:
   a. Remove the dumped C&D materials from the unauthorized disposal ground to a disposal ground designated under the Contract or as Approved;
   b. Reinstate the unauthorized disposal ground to the condition as before dumping of the C&D materials, or a condition considered satisfactory by the relevant Government authorities as required under the relevant legislation where appropriate.
2. Where the unauthorized disposal ground is a private property, obtain the landowner's consent before removal of the dumped C&D materials.

WASTE MANAGEMENT

PRE.B8.1910.9 CONSTRUCTION WASTE MANAGEMENT - GENERAL

1. In executing the Works, generate the minimum quantity of waste possible;

2. Of the inevitable waste that is generated, sort, salvage for re-use, or recycle on or off Site as much of the material as possible;
3. Minimise the disposal of waste material in landfills.

PRE.B8.1920.9 SPECIAL WASTE MANAGEMENT RESPONSIBILITIES

Be responsible for the following:

1. To ensure that all relevant legislation and the Contractor's duty of care is complied with throughout the duration of the Contract;
2. To minimize waste:
   a. Adopt measures to ensure the proper planning of the Works;
   b. Avoid over ordering of materials;
   c. Avoid cross contamination of materials for use in the Works and for reuse or recycling;
   d. Minimize the use of timber in temporary work;
   e. Optimize the use of reusable metal formwork, falsework, trench supports and the like;
   f. Maximize the use of inert excavated material within the Site;
   g. Save paper and recycle waste paper;
   h. Coordinate the return of pallets used for delivering locally manufactured interlocking concrete blocks to their manufacturers for reuse and / or to recycling contractors.
3. To coordinate waste management on the Site, keep accurate records on waste movement on and off the Site;
4. To segregate and sort different type of waste such as inert waste, non-inert waste, recyclable materials, aluminium cans, plastic bottles, paper, general refuse etc. into different containers, skips or stockpiles to enhance reuse / recycling of materials and their proper disposal and ensure that all containers and storage areas are properly labelled;
5. To obtain a list of potential buyers or collectors of materials to be re-used or recycled;
6. Whenever possible (except when new materials are expressly specified), ensure re-use or recycling of material already on Site before it is carted away or new materials are imported;
7. To investigate potential re-use and recycling opportunities;
8. To maintain and clean regularly the waste storage areas.

PRE.B8.1950.9 HAZARDOUS WASTE

1. Comply with legislation for the storage, collection, transport, treatment and disposal of hazardous materials such as oils, paints and chemicals. Keep these materials in separate secure storage areas in clearly labelled containers. Avoid spillage and waste by evaporation;
2. Disposal of hazardous wastes using licensed contractors in accordance with the manufacturers instructions in so far as that the instructions do not conflict with legislation described in sub-clause (1).

PRE.B8.1960.9 PACKAGING MATERIAL

Unwrap materials only when they are needed. Separate and store packaging material immediately after unwrapping. Return packaging materials to the supplier or his agent as stated in the Waste Management Plan. Where this is not possible, arrange for collection of the material by a recycling company. Such material may only be disposed of at landfill when it is demonstrated that recycling facilities are either not available, impractical or cost effective.

PRE.B8.1970.9 STORAGE AND REMOVAL OF WASTE MATERIAL

Neatly stack and remove from Site within one day after completion of each operation and before the next trade commences all waste material that will not be re-used or recycled.

PRE.B8.1975.9 DISPOSAL OF WATER RECEPTACLES

Provide throughout the construction period, an Approved central collection point on the Site for depositing of all empty cans, oil drums, packing and other receptacles capable of holding water and for the regular collection and removal of such articles from the Site.

PRE.B8.1985.A REMOVAL OF WASTE MATERIALS

Option 1

1. Stack waste materials neatly, and remove from Site as soon as is practical after completion of each operation and before next trade commences all material that will not be reused or recycled;
2. Avoid obstruction where more than one trade is operating simultaneously;
3. Do not permit accumulated waste material piles to exceed 2000 mm generally or to exceed 450 mm high adjacent to refuse chutes;
4. Provide necessary receptacles to store waste tidily prior to removal from Site.

Option 2

1. Stack waste materials neatly and remove from Site as soon as is practical after completion of each operation;
2. Avoid obstruction;
3. Do not permit accumulated waste material piles to exceed 2000 mm generally.

PRE.B8.1990.A ON-SITE SORTING OF C&D MATERIALS

1. Sort all C&D materials arising from or in connection with the Works to recover the inert portion and other materials to be reused or collected or recycled prior to disposal off the Site. Unless otherwise stated in the Specification, all such materials shall become the property of the Contractor;
2. Devise a system to sort C&D materials on-site including the identification of the source of generation, estimated quantity, arrangement for on-site sorting and/or collection, sorting methodology, temporary storage areas, frequency of collection by the recovery/recycling contractors or frequency of removal off the Site;
3. C&D materials shall be sorted into:
    a. Hard rocks and large broken concrete for re-use on the Site where appropriate or for disposal at a designated location as advised by CEDD;
    b. Metals;
    c. Paper, plastics and timber;
    d. Chemical wastes and containers for chemical;
    e. Materials suitable for disposal at public fill reception facilities, sorting facilities and landfills/outlying islands transfer facilities;
    f. General waste;
    g. Materials to be collected or recycled other than materials listed in sub-clauses (3)(a) to (3)(f).
4. Segregate inert C&D materials that is suitable for recycling for aggregates to be used in concrete, sub-base or concrete based products for delivery to a designated recycling facility where specified;
5. Packaging material (cardboard, paper, plastics, foam etc.) shall be properly sorted, segregated and stockpiled in a protected area to prevent contamination.

PRE.B8.1995.9 WASTE REDUCTION TARGETS

1. To facilitate assessment of waste management measures, the following minimum performance targets shall be adopted:
   a. The sorting targets described or specified in PRE.B8.1990;
   b. 100% recovery of inert portion of excavated material and demolition debris from demolition works;
   c. 100% recovery for metallic waste;
   d. 100% recovery for non-contaminated paper and cardboard;
   e. 100% recovery for non-contaminated timber of conditions which fit for construction purposes;
   f. 100% recovery of undamaged pallets used for delivering locally manufactured interlocking concrete blocks.
2. The BEAM Plus New Buildings (Version 2.0) – IDCM 8 (b) - Construction waste recycling, targeting at least 15% of construction waste to be recycled (foundation waste to be included, if any) shall be complied;
3. The Contractor may set higher recovery targets providing that such targets are realistic and achievable. The Contractor may add targets for other C&D waste material that may be applicable to the Contract.
4. Other targets set for this Contract are as follows:

   ……..

PRE.B8.1997.9 GOOD HOUSEKEEPING PRACTICE FOR WASTE MANAGEMENT

Adopt good housekeeping practice for waste management at Appendix 8.2 of the Best Practice Guide for the Environmental Protection on Construction Sites 2013 published by the Hong Kong Construction Association Ltd. as listed under "Waste Management" at PRE.B8.APPEND9.

PRE.B8.1998.9 CONSTRUCTION & DEMOLITION MATERIALS DISPOSAL TRACKING SYSTEM (CMDTS)

1. Use the Construction & Demolition Materials Disposal Tracking System (CMDTS) provided by the Direct Contractor of CMDTS to monitor the disposal of inert C&D materials;
2. Utilize the software and hardware of CMDTS provided by the Direct Contractor of CMDTS to capture the information to the CMDTS including the total vehicle weight of the dump truck loaded with inert C&D materials, the time and date of the dump truck loaded with inert C&D materials leaving the Site, CHIT form number, disposal ground, images of loading conditions and vehicle registration number of the dump truck loaded with inert C&D materials;
3. Install Radio Frequency Identification (RFID) Tags (provided by the Direct Contractor of CMDTS) on all dump trucks serving the Site for implementation of CMDTS;
4. Liaise with and provide necessary information to the Direct Contractor of CMDTS when the record is found not properly captured to CMDTS including total vehicle weight of the dump truck loaded with inert C&D materials, time and date of the dump truck loaded with inert C&D materials leaving the Site, CHIT form number, disposal ground, images of loading conditions and vehicle registration number of dump truck loaded with inert C&D materials.

DEFECTS RECTIFICATION

PRE.B8.2005.A CUSTOMER SERVICE TEAM (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY)

Assign the Defect Rectification Coordinator specified in PRE.B6.060 to be a member of the Customer Service Team which is established by the CM to monitor the Contractor's performance on rectification of defects of the domestic portions of domestic blocks during the first six months of the Maintenance Period for the Works or, where Sections are applicable to the Works, the first six months of the individual Maintenance Period for each Section with domestic block(s). The Customer Service Team shall comprise the following personnel:

1. Site representative(s) of the CM;
2. Representative(s) from the Employer's property management agent;
3. Defect Rectification Coordinator specified in PRE.B6.060;
4. Intake Ambassador(s) specified in PRE.B8.2020.

PRE.B8.2010.A STANDBY WORKFORCE (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY)

Provide a standby workforce of trade tested workers on Site during the first six months of the Maintenance Period for the Works or, where Sections are applicable to the Works, the first six months of the individual Maintenance Period for each Section with domestic block(s), according to the following arrangement:

1. At the beginning of each month, the Contractor shall propose the composition and the strength of the standby workforce, including those from his Nominated Sub-contractor for Electrical Installation, on the basis of the anticipated Maintenance Works including any works of repair or rectification, or make good any defect, imperfection, shrinkage, settlement or other fault identified within the Maintenance Period for the CM's prior agreement;
2. The standby workforce shall be resident full time on Site under the direct control of the Defect Rectification Coordinator(s) and its presence shall be properly recorded for the verification of the site representative(s) of the CM;
3. The Contractor may adjust the strength or composition of the standby workforce, including those from his Nominated Sub-contractor for Electrical Installation, to satisfy operational needs with the prior agreement of the CM.

PRE.B8.2020.C INTAKE AMBASSADOR (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY)

Employ …… numbers of suitably qualified Intake Ambassador as instructed by the CM to enhance the customer services by coordinating defect rectification works and conducting resident survey during the tenant intake period:

1. The Intake Ambassador must hold the following minimum qualifications:
    a. Form 5 graduate with Grade 'E' or above in Chinese & English (Syllabus B) in Hong Kong Certificate of Education (HKCEE) or equivalent;
    b. Holder of certificate in surveying / building / architecture / civil / structural/ building services engineering from a Polytechnic / Technical Institute or equivalent. Candidate with relevant working experience in customer services is preferable;
    c. Good command of both oral and written English and Chinese;
    d. Knowledge of Putonghua and other dialects such as Hakka or Fukien is preferable;
    e. Hands-on experience in using Microsoft Office applications and Chinese word processing.

2. The Intake Ambassador shall be full time on Site. The Intake Ambassador shall be a member of the Customer Service Team and work independent of the Contractor or sub-contractors and is under the direct instruction and supervision of the CM or his representatives;
3. The duties and responsibilities of the Intake Ambassador shall include but are not limited to the following:
    a. Liaise with the Estate Management Office of Housing Department on the schedule for tenant/owner intake;
    b. Promote effective communication with the tenants/owners. Render assistance as and when necessary to the tenants/owners in defects items submission via Housing Smart Intake (HOST) Webpage, and if the tenants/owners prefer to submit hardcopy of Defects Report Forms, input the data of the Defects Report Forms for the tenants/owners in the HOST Webpage;
    c. Upon receipt of defects items submission from tenants/owners via the HOST System, coordinate with the Site Staff for immediate actions by exporting the defects information to DCSMS for follow up on defects rectification;
    d. Coordinate, arrange and confirm with the tenants/owners and the Contractor on the time schedule for carrying out the defect rectification works;
    e. Upon email issuance to tenants/owners on completion of defect rectification works, request tenants/owners to confirm if all defects have been properly repaired via the HOST Webpage or contact tenants/owners to collect their feedback. Intake Ambassador to follow up if tenants/owners do not agree on completion of rectification;
    f. Identify and request the Contractor to rectify any emerging defects due to long idling time since substantial completion of the Works, including cleaning up of the movable parts of the water closet flushing cistern, lubrication of door ironmongery, etc.. Where appropriate, inform the Contractor to rectify the defects before handing over the flats to the tenants/owners;
    g. Receive complaints from tenants/owners on any matters relating to defects in the domestic flats and check the validity of the complaints with Site Staff;
    h. Carry out random survey on tenants/owners' satisfaction level on the arrangement and the standard of the defect rectification works;
    i. Prepare and submit to the CM or his representatives the monthly reports generated from the HOST System on the number of Defects Report Forms received and the progress of rectification works;
    j. Liaise with the Contractor to carry out adjustment of the fixing level of cooking bench for occupied domestic flats on the date requested by tenants and coordinate with the tenants for access to their flats for the level adjustment work;
    k. Carry out any other duties as assigned by the CM or his representatives.
4. Duration of Intake Ambassador's service:

    Minimum six months or a longer period from the date of appointment of the Intake Ambassador as instructed by the CM.
5. Facilities for Intake Ambassador:

    Provide all necessary facilities including mobile phone, camera, work station at a location as Instructed for the use of Intake Ambassador to carry out the duties.
6. Recruitment of Intake Ambassador:

    Post recruitment advertisement in the following media as instructed by the CM or his representatives with the contents agreed with the CM or his representatives:
    a. Local Chinese newspaper(s) and / or local English newspaper(s);
    b. Interactive Employment Service (iES) of Labour Department;
    c. Any other media as agreed by the CM or his representatives.

7. Terms of appointment of Intake Ambassador:

   Employ the Intake Ambassador selected and instructed by the CM with the following conditions:

   a. Period of employment: minimum six months or a longer period from the date of appointment of the Intake Ambassador as instructed by the CM;

   b. Place of duty: the areas located in the completed Works under this Contract or any locations as confirmed by the CM or his representatives;

   c. Duties: in accordance with sub-clause (3);

   d. Working days & office hours: 6 days work per week and required to work on Saturday, Sunday and all statutory public holidays in accordance with the duty roster assigned by the CM. Day-off to compensate for working on statutory public holidays will be taken in weekdays and arranged within 60 days of that statutory public holiday. The office hours are 8:30 to 18:00 with one hour for lunch. There will be no extra pay for work outside the office hours;

   e. Leave: 3.5 working days upon completion of six months' full employment and the leave shall be taken within the period of employment. Leave shall be pro rata adjusted for period of employment that is shorter or longer than six months;

   f. Salary: a fixed amount of monthly salary as agreed by the CM and without bonus, salary adjustment, over time allowance and other fringe benefit such as medical attention, dental treatment, housing and education allowance, etc.. Once employed, the fixed amount of monthly salary will apply to the entire employment period and will be subject to local taxation and employee's contribution towards the Mandatory Provident Fund (MPF) all payable by the employee. On satisfactory completion of the contract and satisfaction of the CM or his representatives on the Intake Ambassador's performance, the Intake Ambassador will receive a gratuity for the period of service. Such gratuity will be payable at the rate of 15% of total basic salary received during the period of employment;

   g. Termination: one month written notice or one month salary payment in lieu of the notice will be required by either party for termination of the employment.

8. Termination of Intake Ambassador's service:

   a. Do not terminate the employment of the Intake Ambassador without CM's agreement;

   b. The CM shall have the authority to order removal and replacement of the Intake Ambassador.

9. Deployment of Intake Ambassador:

   The CM shall have the authority to deploy the Intake Ambassador to the completed works of other contracts to perform the duties and responsibilities as stated above, or any other duties as instructed by the CM.

PROTECTION AND DAMAGE MITIGATION

PRE.B8.2310.9 DAMAGE BY EROSION

1. Protect and contain the Site against erosion, wash down or collapse, and reinstate any parts of the Site so disturbed, including any adjacent land that may have been affected, and comply with Government requirements as to removal of spoil or debris;
2. Maintain protection and be liable for reinstatement until the issue of the Maintenance Certificate.

PRE.B8.2320.9 MAINTENANCE OF ROADS AND PAVED AREAS

1. Make good or accept responsibility for the cost of making good any damage caused by site traffic or site operations to public, estate or other roads, footpaths and bridges. Keep the aforementioned and the approaches to the Site, borrow site or dump site that is within 30 m of a discernible or designated vehicle entrance or exit clear of dust, mud, debris and all obstructions;
2. Fit vehicles with tight fitting and adequately secured side and tail boards;
3. Carefully and securely stack rock on the vehicle to prevent any dislodging and falling into the road during haulage;
4. Provide and employ at the vehicle exit point of the Site, borrow site and dump site, necessary labour and washing facilities including a high pressure water jet, to clean the wheels and undersides of lorries free from earth and dusty material prior to leaving the Site, borrow site or dump site and, for sweeping out all loose material remaining in all vehicles after dumping. Wash-water shall have sand and silt settled out or removed before discharging into storm drains. Pave the area between the vehicle washing facilities and the exit point with concrete, bituminous materials or hardcores, and with backfall to avoid site run-off from entering public road mains. Employ such labour also in keeping clean the approach roads to the Site, borrow site or dump site.

PRE.B8.2330.9 ADJOINING PROPERTIES

Protect, shore up and in all ways support all adjacent lands, buildings and services which are liable to be disturbed or damaged during the execution of the Works. Take adequate precautions to prevent excavated materials encroaching on to adjoining properties.

PRE.B8.2340.9 ADJOINING PAVING ETC

Protect all adjoining paving and surface channels, maintain the existing drainage system in good working order including providing temporary diversion channels, if necessary, and reinstate any damage caused.

WATER POLLUTION CONTROL AND WATER CONSERVATION

PRE.B8.2410.B REMOVAL OF WATER

1. As far as is practicable, keep the Site and all trenches and excavations thereon free from all water arising from rain, springs, drains, percolating water by pumping or otherwise. Ensure that such removal of water has no detrimental effect on adjacent property. Discharge water via silt removal facilities into the site drainage system. Direct storm water to such silt removal facilities by channels, earth bunds or sandbag barriers. Handling and disposal of construction site discharges shall be in accordance with EPD Pro PECC PN 2/24;
2. Avoid contamination and blockage of association drains and provide measures to meet the Water Pollution Control Ordinance;
3. Provide, maintain and clean regularly temporary channels, ditches, catchpits, sumps, oil interceptors and drainage work to keep the Site clear of water, silt or mud and prevent nuisance due to run-off onto adjacent land;
4. Protect the Works and/or adjoining properties from being washed out by typhoon and/or rain, ensure effective diversion of stormwater and provide earth bunds or sandbag barriers and/or any other necessary temporary measure necessary;
5.
    a. Comply with all instructions and requirements under the Water Pollution Control Ordinance (WPCO) for the discharge of waste water on Site;

b. Obtain a WPCO Licence from EPD not later than three months from the notified date for commencement of the Works and comply with all terms and conditions stipulated in the Licence before waste water is discharged on Site;

c. Submit a copy of valid WPCO Licence to the CM for inspection as soon as it has been issued by EPD;

d. Install, operate and maintain a continuous flow measuring device to monitor the flow rate of waste water as stipulated in the WPCO Licence. The accuracy of the flow measuring device shall be certified by its manufacturer to be within plus or minus 3% of the actual flow and shall be calibrated regularly according to manufacturer's recommendations. If no such device is installed, the Contractor shall determine the flow rate through using calculation methods agreed by EPD, by making reference to the amount of water used on Site being served by mains supply and other sources, less process consumption and any other losses;

e. Collect samples of discharge at sampling points and measure the determinand in accordance with the sample type and measurement frequency as stipulated in the WPCO License:

i. Determinand: pH value, Suspended Solids, Chemical Oxygen Demand (COD) and others as specified in the WPCO License;

ii. Frequency: As stipulated in the WPCO Licence;

iii. Limitations on discharge: As stipulated in the WPCO License.

f. Prepare and submit the following to the CM for inspection:

i. monthly record for the daily flow rate of the waste water discharged from Site (reference proforma at PRE.B8.APPEND4);

ii. monthly record of the monitoring of the determinand of the waste water discharged (reference proforma at PRE.B8.APPEND6).

g. Provide temporary silt traps as may be required and keep from blocking.

6.

a. Submit details of all proposed drainage diversion systems and temporary stormwater drainage system for Approval at least one month before the relevant work is due to commence;

b. Remove diversions and temporary drains, including the removal of any obstructions to flow, as soon as practicable after the works are complete.

7. When heavy rain is anticipated, protect and cover stockpiles of construction material and exposed slope surfaces from erosion and storm wash off.

PRE.B8.2415.A WASTE-WATER RECYCLING FACILITIES

1. Re-circulate and re-use as far as practicable site waste-water, excluding sewage effluent, for housekeeping operations such as dust-control and wheel-washing as detailed in PRE.B8.455 and PRE.B8.2320 respectively. Install waste-water recycling facilities to the satisfaction of CM that meet the following:

a. Waste-water shall be properly treated to meet the discharge standards (other than that for foul sewers discharge) as stipulated in the WPCO Licence issued by EPD before re-use for dust-control and wheel-washing;

b. Warning signs shall be displayed prominently upon all temporary storage tanks, drawing attention to the dangers of allowing the breeding of mosquitoes;

c. Proper and adequate drainage facilities shall be provided to discharge excess treated effluent;

d. Pump sump shall be provided with a standby pump of adequate capacity and with automatic alternating devices to prevent pollution from wastewater overflow.

2. Maintain the waste-water recycling facilities up to the end of the Contract as far as practicable. Obtain CM's approval prior to removal of the waste-water recycling facilities.

PRE.B8.2420.A REUSE OF WATER FROM BORING AND DRILLING

Water used in ground boring and drilling for ground investigation or rock/soil anchoring shall as far as practicable be re-circulated after sedimentation. When there is a need for final disposal, the waste water shall be discharged into site drainage system via silt removal facilities.

PRE.B8.2430.9 REUSE AND DISPOSAL OF BENTONITE SLURRY

1. Bentonite slurry used in diaphragm wall and bored-pile construction shall be reused as far as practicable. If the disposal of a certain residual quantity cannot be avoided, the used slurry may be disposed of at designated marine dumping area subject to obtaining a marine dumping permit from EPD;
2. Disposal of used bentonite slurry into public drainage system, if intended, shall be treated to meet the discharge standards as stipulated in the WPCO Licence issued by EPD.

USE OF TIMBER FOR TEMPORARY WORKS DURING CONSTRUCTION

PRE.B8.2450.9 TIMBER FOR TEMPORARY WORKS DURING CONSTRUCTION

1. Where use of metal formwork system is not practicable, use sustainable timber for temporary works including formwork, protective canopy, catch fan, walkway, toe board, timber mock-up, signboards etc;
2. The timber to be regarded as sustainable shall be originated from a well-managed source which is governed under an internationally recognised, globally applicable, independent certification scheme for sustainable forest management;
3. All timber for temporary works shall carry the label of the following independent certification scheme:
    a. Forest Stewardship Council (FSC); or
    b. Programme for the Endorsement of Forest Certification Schemes (PEFC); or
    c. Other equivalent internationally recognized, globally applicable, independent certification scheme for sustainable forest management in terms of environmental, ecological, biodiversity, social and economic needs.
4. No virgin forest products shall be used for temporary works unless under exceptional circumstances and agreed with the CM;
5. Submit the following documents to demonstrate that the timber from a well-managed source and carrying the label in sub-clause (3) has been purchased and delivered to Site:
    a. Copies of Chain-of-Custody (COC) certification of the vendors;
    b. Shipping documents:
        i. Letter from the vendors stating the timber is originated from the well-managed sources;
        ii. Purchase order of the timber issued by the Contractor to the agent of the timber;
        iii. Invoice issued by the agent of the timber to the Contractor stated with the name and COC number of the vendors;
        iv. Delivery order from the agent stated with the name and COC number of the vendors and quantity delivered to the Site.

c. Photographs taken at the Site showing arrival of the timber carrying the label of the independent certification scheme;

d. Additional documents for timber bearing other label as specified in sub-clause (3)(c):

i. The species and country of origin;

ii. The name of the concessions or plantations from which these timbers originate;

iii. Copies of the forestry policies implemented by these concessions or plantations which confirm that the management of the timber resource is sustainable.

PRE.B8.2460.9 REUSE OF TIMBER FOR TEMPORARY WORKS DURING CONSTRUCTION

1. Reuse timber wherever possible;
2. Submit the proposed maintenance procedures to minimize wastage of timber including the method of recycling of timber etc. within at least four weeks prior to the date of commencement of the relevant work to CM for approval;
3. Submit on monthly basis, the following documentation to demonstrate the implementation of the maintenance procedures as approved by the CM:
   a. Photographs showing recycling of timber for reuse;
   b. Monthly waste flow table showing the quantity of recycled timber.

CARBON ASSESSMENT TOOL

PRE.B8.2480.N CIC CARBON ASSESSMENT TOOL (CAT)

1. Adopt the online CAT maintained by the Construction Industry Council (CIC) for evaluation of carbon emission performance for the project throughout the progress of the Works up to the date of completion as stated in the certificate of completion of the Works or the last certificate of completion (if different certificates of completion are issued for different Sections or parts of the Works) issued by the CM;
2. Assign an employee of the Contractor as CAT Operator to administrate and operate the CAT account. The assigned person shall either:
   a. have satisfactorily completed the training course for "Embodied carbon management and application of CIC carbon assessment tool (CAT)" organized by CIC to use CAT, and the training completion certificate shall be submitted to the CM for his approval; or
   b. have successfully enrolled the training course mentioned in sub-clause (a) above in the event that such training course has not yet started or completed. CIC's acknowledgement of the acceptance of enrollment of the CAT Operator shall be submitted to the CM for his approval. Once the CAT Operator completes the training, the completion certificate shall be submitted for the CM's record.
3. The CAT Operator shall register for the CAT as an account holder and "Create New Project" in CAT with necessary project information within 28 days after the notified date for commencement of the Works; and shall, throughout the progress of the Works up to the date of completion as stated in the certificate of completion of the Works or the last certificate of completion (if different certificates of completion are issued for different Sections or parts of the Works) issued by the CM:

a. Select appropriate materials for “Permanent Works”, “Temporary Works” and “Site Impacts” (including foundation works and demolition works if within the scope of the Contract), input and complete all data fields in CAT for quantities of materials / resources consumed on Site, as long as the required quantities are available to the Contractor. The data shall be input monthly in CAT in an accurate and updated manner to facilitate evaluation of carbon emission arising from embodied carbon of construction materials and operational carbon due to construction activities;

b. Prepare quarterly reports of the carbon emission performance, supplemented with exportable data files and reports from CAT, including but not limited to editable data input excel generated from CAT Data Input page, “ESG Report”, “Report for BEAM Plus FA” and “Carbon Audit Report” generated from CAT Results page. Submit the reports to the CM quarterly for record. If the CAT Operator has not yet completed the training as specified in sub-clause (2)(b) above, the report shall be additionally endorsed by the Environmental Manager or Environmental Supervisor or Building Services Engineer or other personnel in the Contractor’s management team. The reports shall be presented quarterly in the Environmental and Site Hygiene Management Meetings required under PRE.B8.2545 by the Environmental Manager or Environmental Supervisor or CAT Operator for review and discussion. Template of Quarterly Carbon Emission Performance Report is attached in PRE.B8.APPEND22 for reference.

4. Submit all final data generated from CAT, both in hard copy and electronic medium (word, excel or pdf), to the CM at the date of certified completion of the Works or upon notification by the CM;

5 Transfer the project ownership in CAT to the CM at the date of certified completion of the Works or upon notification by the CM.

ENVIRONMENTAL MANAGEMENT PLAN

PRE.B8.2510.A ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES

1. Throughout the progress of the Works, instruct workers, oversee, and document the results of the Project Environmental Management Plan described hereafter. Be responsible and ensure that all Nominated Sub-contractors, Direct Contractors, Utility Undertakings and employees are aware of aims of and the contents of the Environmental Management Plan;
2. Ensure that all relevant legislation and the Contractor’s duty of care is complied with throughout the progress of the Works.
3. For *electrical, fire services, fire services and water pump, air-conditioning and mechanical ventilation, lift and lift and escalator Specialist Sub-contracts Works, ensure that the respective BS Specialist Sub-contractor shall:
   a. Undertake all necessary measures to reduce the environmental impacts and pollution arising from the execution of the respective building services Specialist Sub-contract Works;
   b. Observe and comply with all the legislation relating to environmental protection, pollution control and site hygiene;
   c. Coordinate with the Contractor in the preparation, updating and implementation of a Contractor's Environmental Management Plan (EMP) as described hereafter.
4. Ensure that the Specialist Sub-contractors *electrical works, fire services works, fire services and water pump works, air-conditioning and mechanical ventilation work, lift works and lift works and escalator works in which Integrated Pay for Safety, Environment and Hygiene Scheme is implemented shall follow up on the advice of the Contractor's Environmental Manager and Environmental Supervisor for complying with the environmental management plan.

PRE.B8.2515.9 SUBMISSION AND UPDATING OF ENVIRONMENTAL MANAGEMENT PLAN

1. Prepare and submit to the CM within 21 days of the date of the Letter of Acceptance 3 copies of draft Environmental Management Plan (EMP) containing the information specified or required under PRE.B8.2520. Arrange and hold an ad hoc meeting (or meetings if necessary) with the CM or his representatives to discuss the draft EMP within 7 days from the submission of such plan. If the CM is of the opinion that the draft EMP does not meet the requirements of the Contract, he can request for remedy of the deficiency. Comply with any such CM's request prior to submitting six copies of the EMP to the CM for endorsement within 35 days of the date of the Letter of Acceptance;
2. Throughout the duration of the Contract and any extended contract period, update the EMP at monthly intervals or when required by the CM so that it is at all times a comprehensive and contemporary statement of the policies, procedures and requirements to achieve the environmental management, waste management and site hygiene obligations and responsibilities under the Contract;
3. The CM may by notice in writing require the Contractor to supplement, revise or update the EMP if he is of the opinions that the EMP is insufficient or requires revision of modification in the interest of the environmental management, waste management and site hygiene, whether for the Site or adjacent to the Site or otherwise. Comply with such CM's notice within 7 days of such notice;

Option 1

4. Ensure the EMP has incorporated the Nominated Sub-contractor's environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works. Request the Nominated Sub-contractor to prepare and submit an environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works within 14 days of the letter of acceptance of the Nominated Sub-contractor's tender for agreement and incorporation into the EMP. Ensure consistency between the EMP and the environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works. Submit the agreed environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works to the CM for endorsement. Revise and update the EMP to incorporate the environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works endorsed by the CM when the EMP is due to be revised or updated;
5. Request the Nominated Sub-contractor to revise or update the environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works by virtue of a revision or update of the EMP pursuant to sub-clauses (2) and (3) above. Ensure the revised or updated environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works is consistent with the EMP and submit the revised or updated environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works to the CM for endorsement;
6. Submit and present the EMP to the Environmental and Site Hygiene Management Meetings for comment and endorsement;
7. CM's endorsement, comment or rejection of the EMP, the environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works, and of any proposed revision or update, and the implementation of the EMP by the Contractor including the environmental management, waste management and site hygiene statement in respect of the Nominated Sub-contract Works shall not relieve the Contractor from any obligations or responsibilities under the Contract or any statutory regulations;

8. Appoint on Site an Environmental Manager as stated in PRE.B6.060 to oversee the implementation of the EMP. Comply and ensure all personnel who are responsible for the environmental management, waste management and site hygiene and who are in a position of authority among sub-contractors including Nominated Sub-contractors have access to the EMP. Any Specialist Contractor and other entities (e.g. public utilities) working on the Site shall also be provided with a copy of the EMP and be required to comply with it, report to the CM any failure to do so on their part;
9. Provide all facilities, access and assistance to the CM to periodically check that the EMP is being implemented properly and fully. If the CM is of the opinion that the Contractor fails to implement properly and fully the EMP and the failure does or may adversely affect the environmental management, waste management and site hygiene, whether for the Site or adjacent to the Site or otherwise, the CM will notify the Contractor in writing of the failure. Take action to remedy the failure immediately.

Option 2

4. Submit and present the EMP to the Environmental and Site Hygiene Management Meetings for comment and endorsement;
5. CM's endorsement, comment or rejection of the EMP, and of any proposed revision or update, and the implementation of the EMP by the Contractor shall not relieve the Contractor from any obligations or responsibilities under the Contract or any statutory regulations;
6. Appoint on Site an Environmental Manager as stated in PRE.B6.060 to oversee the implementation of the EMP. Comply and ensure all personnel who are responsible for the environmental management, waste management and site hygiene and who are in a position of authority among sub-contractors have access to the EMP. Any Specialist Contractor and other entities (e.g. public utilities) working on the Site shall also be provided with a copy of the EMP and be required to comply with it, report to the CM any failure to do so on their part;
7. Provide all facilities, access and assistance to the CM to periodically check that the EMP is being implemented properly and fully. If the CM is of the opinion that the Contractor fails to implement properly and fully the EMP and the failure does or may adversely affect the environmental management, waste management and site hygiene, whether for the Site or adjacent to the Site or otherwise, the CM will notify the Contractor in writing of the failure. Take action to remedy the failure immediately.

PRE.B8.2520.9 ENVIRONMENTAL MANAGEMENT PLAN

All Environmental Management Plan (EMP) and draft EMP shall be signed by the Contractor's Managing Director or his representative before submission. Incorporate the Nominated Sub-contractors' input into the EMP and allow the Nominated Sub-contractors to access one copy of the EMP. The EMP shall be subdivided into the following sections containing:

All Environmental Management Plan (EMP) and draft EMP shall be signed by the Contractor's Managing Director or his representative before submission. The EMP shall be subdivided into the following sections containing:

1. General environmental management of the Contract:
   a. A signed environmental and site hygiene policy statement committing the Contractor to environmental protection for the project;
   b. A Contractor's staff organization chart with duties, responsibilities and accountability defined. The Environmental Manager shall oversee the implementation of the EMP. Also, appoint a senior staff member, designated person(s) and experienced person(s) for the implementation of the Trip Ticket System (TTS) as specified in sub-clause (3)(a) below;
   c. Staff awareness and training proposals for Contractors' and Sub-contractors' staff with auditable records of trained persons;

d. Environmental impacts (air, noise, water, light, waste, considerate construction etc.) targets and mitigation objectives to minimize impacts;

e. Monitoring and audit plans for potential environmental impact;

f. Records containing licences, permits, complaints and record of corrective actions where non-compliance has been identified;

g. List of environmental and site hygiene regulations and description of methodology (including testing) to ensure compliance.

2. Waste Management Plan to reduce and minimize the generation of C&D materials in the execution of the Works stating:

a. An analysis of waste likely to be generated from work processes with types of waste identified and quantified with list of each material proposed to be salvaged, and reused or recycled with quantities. The data shall be included in the Waste Flow Table at Appendix PRE.B8/I. The Waste Flow Table shall be reviewed and if necessary revised monthly;

b. A statement of measures taken to reduce, salvage, reuse and recycle waste materials on and off Site;

c. A description of the methods of sorting, segregation, labelling, storing, protecting and disposing of all the various types of waste materials generated. The materials shall be listed in the Waste Flow Table described previously. Various materials may include but are not limited to:

i. Inert C&D materials generated from the Works;

ii. Inert C&D materials to be reused in the Works;

iii. C&D materials to be reused in other projects (including reclamations) or at Contractor's nominated Approved outlets;

iv. Inert C&D materials suitable for recycling into aggregates for concrete or sub-base to be disposed of at an Approved location;

v. Inert C&D materials to be disposed of at a public fill reception facility;

vi. Steel and other metals (including reinforcement bars) for collection by recycling contractors;

vii. Paper and cardboard for collection by recycling contractors;

viii. Plastics (i.e. plastic bottles, containers, sheets, foam);

ix. Timber (plywood boards, joist) for collection by recycling contractor;

x. Pallets used for delivering locally manufactured interlocking concrete blocks for collection by recycling contractors and / or for reuse by the manufacturers;

xi. A list of hazardous wastes (oils, paints and chemicals) together with details of the method of storage and proposals for collection and disposal arrangements for collection by specialist disposal company;

xii. General refuse to be disposed of at a landfill or outlying islands transfer facility.

d. The location, layout and details of designated sorting and storage areas. Describe necessary adaptations as the works progress;

e. Method of handling and removing waste from buildings including details of refuse chutes and ground floor waste holding areas prior to leaving the Site;

f. A method statement of how the Site will be kept clean with debris minimised;

g. Details to minimize the use of timber in temporary works construction;

h. Control measures to ensure that the sorted recyclable materials such as metal, paper, plastics, timber, milled bituminous materials etc. are delivered to a proper recycling outlet for processing;

i. For materials delivered to Site, a statement that reusable and recyclable packaging materials and pallets will be reused, recycled or returned to the supplier. Identify those suppliers who will not accept the return of pallets and reusable and recyclable packaging materials;

j. The Waste Management Plan may be revised from time to time to incorporate Nominated Sub-contractors, Direct Contractors and Utility Undertaking requirements and other party's requirements as and when they are appointed.

j. The Waste Management Plan may be revised from time to time to incorporate Direct Contractors and Utility Undertaking requirements and other party's requirements as and when they are appointed.

3. Site Management Plan for implementation of the TTS with the names of the designated or alternative disposal grounds identified. Submit the Site Management Plan within 45 days of the date of the Letter of Acceptance for Approval before disposing any C&D materials from the Site. If the CM is of the opinion that the Site Management Plan does not meet the requirements of this clause, he shall request the Contractor to revise the plan by notice in writing. Then revise the plan and resubmit it within 7 days of the date of the notice. Review the Site Management Plan on a monthly basis at the meeting with the discussion items as detailed in sub-clause (h) below. Submit the updated section of the plan (if any) for Approval. The plan shall include the following details in sub-clauses (a) to (g) below and the attention of all truck drivers engaged for removal of C&D materials from the Site shall be drawn to the following particular points in sub-clauses (i) and (j) below:

   a. A site organizational chart showing the manpower resources and duties of each staff for implementation of the TTS. The following requirements shall be met:

      i. Appoint a senior staff member (with at least two years experience in site management) fully responsible for implementing and overseeing the operation of the TTS;

      ii. Appoint designated person(s) to fill in and sign Part 1 of the Daily Record Summary (DRS) properly before departure of the truck. A sample of the DRS is given at Appendix PRE.B8/II;

      iii. Appoint experienced person(s) to man each exit from the Site for the purpose of ensuring that every truck carrying C&D materials leaving the Site bears a duly completed CHIT or Disposal Delivery Form (DDF). The CHIT shall be used for disposal of C&D materials at a prescribed facility as defined under the Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap. 354N). The DDF shall be used for disposal of C&D materials at other disposal grounds as designated in the Contract or as directed by the CM, or proposed recycling facilities / construction sites as Approved. The person(s) who man the exit(s) shall record the CHIT / DDF number, the vehicle registration number and the departure time of every truck carrying C&D materials leaving the Site.

   b. Monthly programme for disposal of C&D materials off the Site, and indicate the estimated quantities, types of the C&D materials and corresponding disposal grounds. Update the programme on a monthly basis and submit it to the CM for information by 15th day of each month or the next working day if it is a public holiday, Sunday or Saturday, or a later date as agreed by the CM;

   c. Site procedures to ensure that each truckload of C&D materials leaving the Site will bear a duly completed CHIT / DDF and that Part 1 of the DRS has been filled in and signed properly before departure of the truck. Establish also a recording system to ensure timely retrieval of the CHIT / DDF and / or receipt from the disposal grounds, and make it available for inspection by the CM upon request or where irregularities are observed;

d. Surveillance system within the Site and at any alternative disposal grounds to check that the disposal activities comply with the requirements specified;

e. Recording system with a comprehensive register to ensure timely retrieval of the CHIT / DDF issued and receipt from the disposal grounds, and make it available for inspection by the CM upon request or where irregularities are observed;

f. Control measures to prevent any unauthorized disposal of C&D materials, where trucks need to exit and re-enter the Site for delivery of C&D materials generated. Recyclable materials such as metal, paper, plastics, timber and milled bituminous materials etc., which have been sorted on the Site for the purposes of recycling, shall not be considered as C&D materials for the purposes of the Contract. For such sorted recyclable materials, devise appropriate control measures to ensure that the materials are delivered to a proper recycling outlet for processing. Highlight such control measures in the Environmental Management Plan;

g. A video recording system as specified in PRE.B8.1835;

h. The following items shall be included in the agenda for discussion at every Site Safety and Environmental Management Committee meeting, or other established channels for performance monitoring as agreed by the CM:

i. Review the Site Management Plan and implementation of the TTS, and identify areas for improvement;

ii. Audit the quantity of C&D materials removed from the Site (based on the DRS and survey records) against the quantities of C&D materials delivered to the disposal ground designated in the Contract (e.g. based on the EPD's web-site) or against the quantities of C&D materials delivered to the Approved alternative disposal ground;

iii. Review incidents of non-compliance and discuss the necessary follow-up actions;

iv. Monitor the follow-up action on defects and deficiencies identified.

i. Each truck carrying C&D materials leaving the Site for a disposal ground must bear a duly completed CHIT / DDF, irrespective of the location and nature of the disposal ground;

j. The C&D materials must be disposed of at the disposal grounds specified in the Contract or directed by the CM or at the Approved alternative disposal grounds.

4. Air quality:

a. Measures and methods to control dust and debris on and off Site;

b. Method of constructing screens and refuse chutes;

c. Method of monitoring and reporting on air quality conditions on Site;

d. Method of monitoring and reporting on use of ultra-low-sulphur diesel.

5. Noise control:

a. Acquisition of noise permits;

b. Selection of quiet equipment to be used and their applications;

c. Details of noise restrictions as they affect the Contract;

d. Description of noise mitigation measures which may include but are not limited to the following:

i. Scheduling of work carefully to maximize any required noisy work during less sensitive hours such as lunch time, outside school hours and avoiding examination periods;

ii. Scheduling of work to avoid simultaneous operation of noisy equipment; retain temporary structures (e.g. site office) that can act as a noise barrier until the last phase; erect as early as possible noise source screening structures;

iii. Siting of facilities such that noisy equipment are sited as far as possible from noise sensitive receivers and temporary structures (e.g. site office) can act as noise barrier;

iv. Use of purpose-built acoustic panels and enclosures around Site boundaries.

e. Method of monitoring and reporting on construction noise on Site.

6. Protection and damage mitigation:
   a. Mitigation method to prevent soil erosion, wash down or slope collapse and any method to carry out reinstatement work;
   b. Methods of protecting existing trees, shrubs and other vegetation including protecting fencing provided by others;
   c. Maintenance of roads and footpaths;
   d. Methods to protect adjoining properties, roads, paving, and boundary structures;
   e. Methods to deal with chemical spillage.
7. Water pollution control and conservation:
   a. Measures to conserve water and record on water consumption;
   b. Methods of minimising water consumption including waste water recycling;
   c. Methods to avoid contamination and blockage of public drains and sewers and comply with the Water Pollution Control Ordinance;
   d. Method to prevent flooding and blocking of site drainage system;
   e. List and describe necessary permits, approvals to be obtained and complied with;
   f. Details of necessary drainage diversions and temporary drainage systems;
   g. Method of monitoring and reporting on waste water discharged from Site.
8. Tropical hardwoods:

   A description of proposed alternatives to tropical hardwood which will meet the same performance standards in the construction of all temporary works including site accommodation, storage sheds, covered walkways, hoardings, screens, signboards, excavation supports and formwork and falsework. Tropical hardwoods are not permitted to be used in temporary works without Approval;
9. Site cleanliness, tidiness and hygiene:
   a. Description of a proposed system to maintain cleanliness and tidiness of the Site including details of means to protect materials locations of stockpiles and on-site sorting and disposal areas;
   b. Measures to remove and prevent standing water and prevent mosquito breeding and proliferation;
   c. Measures to prevent rodent infestation;
   d. Method of providing temporary latrine accommodation in multi-storey buildings under construction;
   e. Assign a specific number of dedicated workers for maintenance of site hygiene and amenities provisions on Site which are subject to the IPSEHS as referred to in PRE.B6.060. If required, provide the identity of such workers for verification by the CM or his representatives.
10. Emergency procedures:

    Emergency procedures formulated to deal with any environmental emergency such as typhoons or rainstorms;
11. Environmental and site hygiene promotion:

a. The effort made by different sub-contractors or individuals to maintain cleanliness and tidiness of the Site, to reduce and minimize the generation of waste at work and to protect materials at locations of stockpiles and on-site sorting and disposal areas by the application of soundly based policies, procedures and disciplines to be recognised by the presentation of environmental protection awards. Adopt proactive attitude towards improving environmental management and site hygiene performance and to promote workers' awareness on environmental protection and site hygiene. The site as a whole is encouraged to participate in the following designated environmental protection awards:
   i. "The Hong Kong Awards for Environmental Excellence" [Environmental Labels (Wastewise or Energywise); Green Innovations; or Sectoral Awards] organized by the Environmental Campaign Committee with EPD; or
   ii. "Considerate Contractors Site Award Scheme" (Outstanding Environmental Management and Performance Award) organized by the Development Bureau and the Construction Industry Council.

b. The Contractor is also encouraged to organize site-based awards and competitions to promote participation of his workers and teams in environmental protection and site hygiene theme competitions during the contract period. The adjudicating team shall comprise the site management team, environmental protection personnel and workers' representatives, and shall act openly and fairly in such events.

PRE.B8.2525.N ENVIRONMENTAL MANAGEMENT PLAN FOR SPECIALIST SUB-CONTRACTORS FOR BUILDING SERVICES WORKS

1. The Contractor shall ensure that the Specialist Sub-contractors for *electrical works, fire services works, fire services and water pump works, air-conditioning and mechanical ventilation works, lift works and lift and escalator works shall coordinate with the Contractor and provide with a copy of the environmental management, waste management and site hygiene statements in respect of the building services Specialist Sub-contract Works to the CM for confirmation. The BS Specialist Sub-contractors shall coordinate with the Contractor and compile and submit the necessary subsequent updating of the environmental management, waste management and site hygiene statements to suit the site progress, as determined by the Contractor, or the CM, so that it is at all times a comprehensive and contemporary statement of the BS Specialist Sub-contractor's policies, procedures and requirements for the implementation and fulfilment of the BS Specialist Sub-contractor's obligations as to environmental management, waste management and site hygiene in the respective Specialist Sub-contract Works. The Contractor shall have liberty to amend or modify the BS Specialist Sub-contractor's environmental management, waste management and site hygiene statements in respect of the building services Specialist Sub-contract Works as necessary in his preparation of the Environmental Management Plan including any subsequent revision or update thereto;
2. The environmental management, waste management and site hygiene statements in respect of the building services Specialist Sub-contract Works and their subsequent updates shall contain, but not be limited to the following items:
   a. General environmental management of the building services Specialist Sub-contract Works:
      i. A signed environmental and site hygiene policy statement committing the BS Specialist Sub-contractor to environmental protection for the project;

ii. A BS Specialist Sub-contractor's staff organisation chart with duties, responsibilities and accountability defined together with the name and position of the person to oversee the discharge of BS Specialist Sub-contractor's duties under the environmental management, waste management and site hygiene statements in respect of the Specialist Sub-contract Works. Such person shall work full time on Site and be designated to coordinate with the Contractor in this respect;

iii. Staff awareness and training proposals for BS Specialist Sub-contractor's staff with auditable records of trained persons;

iv. Environmental impacts, targets and mitigation objectives to minimize impacts;

v. Records containing relevant licences, permits, complaint and record of corrective actions where non-compliance has been identified;

vi. List of environmental and site hygiene regulations and description of methodology to ensure compliance.

b. Input to the Contractor's waste management plan:

i. An analysis of construction waste likely to be generated from BS Specialist Sub-contractor's work processes with types and quantity of each waste material identified to be salvaged and reused or recycled;

ii. A statement of measures taken to reduce, salvage, reuse and recycle waste material;

iii. A description of the methods of sorting, segregation, labelling, storing, protecting and disposing of all the various types of waste materials generated;

iv. A method statement of how debris could be minimized;

v. Control measures to ensure that the sorted recyclable materials such as metal, paper, plastics, etc. are delivered to the designated sorting and storage areas on site for disposal by the Contractor for recycling process;

vi. For materials delivered to site, a statement that reusable and recyclable packaging materials and pallets will be reused, recycled or returned to the supplier. Identify those suppliers who will not accept the return of pallets and reusable and recyclable packaging materials.

c. Air quality (if applicable):

i. Measures and methods to control dust and debris on and off site. If dust extraction and filtering device is used for dust control, clear the dust collector when it is full;

ii. Method of monitoring and report on air quality conditions on site.

d. Noise control (if applicable):

i. Type of noise reduction equipment to be used and their applications;

ii. Details of noise restrictions as they affect the building services Specialist Sub-contract Works;

iii. Description of noise mitigation measures.

e. Water pollution control and conservation (if applicable):

i. Measures to conserve water and record on water consumption;

ii. Methods of minimising water consumption;

iii. Methods to avoid contamination and blockage of public drains and sewers and comply with the Water Pollution Control Ordinance;

iv. Method to prevent flooding and blocking of site drainage system;

v. List and describe necessary permits, approvals to be obtained and complied with;

vi. Details of necessary drainage diversions and temporary drainage systems.

f. Site cleanliness, tidiness and hygiene:

Description of proposed measures to maintain cleanliness and tidiness of the site including details of means to protect materials, locations of stockpiles and on-site sorting and disposal areas.

g. Emergency procedures:

Emergency procedures formulated to deal with any environmental emergency such as typhoons or rainstorms.

PRE.B8.2530.9 DISTRIBUTION OF ENVIRONMENTAL MANAGEMENT PLAN

After CM's endorsement to the EMP, distribute copies of the same to the CM, Nominated Sub-contractors and all direct contractors and suppliers. Ensure compliance with the Environmental Management Plan and all relevant statutory regulations.

PRE.B8.2540.9 ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE

Throughout the duration of the Contract carry out to the satisfaction of the Contract Manager all environmental protection/management and site hygiene measures including the discharge of duties as specified in the Environmental and Site Hygiene Checklist shown below:

Environmental and Site Hygiene Issues -Site Management	Spec. PRE	Checking Frequency	Compliance
Noise Control			
Air Quality			
Removal of Water			
Construction Waste Management			
Protection			
Site Cleanliness and Hygiene			

PRE.B8.2545.A ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE MONITORING AND REPORTING

Throughout the duration of the Contract:

1. Carry out environmental inspections to review, monitor and report monthly to the CM (or when so directed by the CM) on the effectiveness of the implementation of the Environmental Management Plan (EMP);
2. Report monthly to the CM for the following received from Environmental Protection Department (EPD) or Food and Environmental Hygiene Department (FEHD) including items related to Nominated Sub-contracts when applicable:
   a. Warning letters or offences notifications;
   b. Convictions during the period under any environmental and site hygiene regulations or legislation;
   c. Abatement Notice.
3. Take all necessary follow-up actions to ensure that any defects or deficiencies are made good;
4. Conduct monthly Environmental and Site Hygiene Management Meetings or when directed by the CM. Submit minutes of the meetings to the CM for verification. The CM may also attend or nominate a representative to attend the meetings. Meetings shall cover the following:
   a. Environmental and site hygiene matters, including disposal of C&D material and implementation of the Trip-ticket System, arising from the Contractor's obligations in executing the Works;
   b. The review on incidents of non-compliance with the EMP;
   c. Discussion and monitoring of the necessary follow-up actions on defects and deficiencies;
   d. Areas for improvement.
5. Report monthly to the CM for the following:
   a. Particulars of workers specially trained and deployed to attend to site hygiene and amenities provisions during the day and have assisted in the tidying up of trade waste at the end of a working day;
   b. Date-marked photos of site amenities conditions before and after tidying up of loose ends on Site;
   c. Photographic evidence in chronological order of such maintenance work.

PRE.B8.2546.N ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE AND REPORTING FOR BUILDING SERVICES WORKS BY SPECIALIST SUB-CONTRACTORS

The Contractor shall ensure that the Specialist Sub-contractors for *electrical works, fire services works, fire services and water pump works, air-conditioning and mechanical ventilation works, lift works and lift and escalator works shall, throughout the progress of the Works:

1. Carry out to the satisfaction of the PSPs and the CM, all environmental protection / management and site hygiene measures as described in the EMP;
2. Carry out environmental inspections to review, monitor and report monthly to the PSPs (or when directed by the CM), via the Contractor, on the effectiveness of the implementation of the EMP;
3. Report monthly to the PSPs and the CM via the Contractor for the following attributable to him from Environmental Protection Department (EPD) or Food and Environmental Hygiene Department (FEHD):
   a. Warning letters or offences notifications;

b. Convictions during the period under any environmental and site hygiene regulations or legislation;

c. Abatement Notice.

4. Take all necessary follow-up actions in collaboration with the Contractor to ensure that any defects or deficiencies are made good;

5. Attend monthly Environmental and Site Hygiene Management Meetings or when directed by the CM.

PRE.B8.2560.B PROVISION OF ENVIRONMENT AND HYGIENE TRAINING

1. Arrange for all skilled workers employed on the Works or in connection with the Contract whether in the employment of the Contractor or his sub-contractors, to attend training on all aspects of environmental management organized by training institutions and / or the Environmental Protection Department (EPD);

2. Set out the level, frequency and estimated staff numbers to attend such training and state the same in the EMP;

3. Develop and provide site specific induction training and tool box talks on all appropriate aspects of environmental protection and site hygiene to promote workers' awareness on environmental management and state the same in EMP, such training and tool box talks are to be carried out by the Environmental Manager, and site specific induction training and tool box talks may be conducted as part of the site safety training regime;

4. At the end of each period of interim certificate, report to the CM the actual number of workers trained as specified and submit Contractor's certified attendance records;

5. A full statement of the Contractor's training proposals shall be stated in the EMP.

PRE.B8.2570.D PAYMENT FOR PRE-DETERMINED AMOUNTS FOR SITE SAFETY, ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE

1. The payment for the "environmental management and site hygiene performance" item in the Bill of Quantities or schedule of rates shall be subject to the Contractor's average score (A) of the items as specified in the checklist stipulated in PRE.B8.2540 and this average score (A) is worked out by the CM or his representatives as follows:

   a. Items of environmental management and site hygiene performance as specified in PRE.B8.2540 are also subject to assessment at the frequency specified therein;

   b. The calculation of the average score (A) only applies to valuation of the items under environmental management and site hygiene performance as specified in PRE.B8.2540. The average score (A) for each monthly valuation shall be derived from the results of the assessment as follows:

$$(A) = \frac{A1 + A2 + A3 + A4 + A5 + A6}{6}$$

whereas

$$A1 = \frac{\text{Total No. of Items of Compliance under Noise Control}}{\text{Total No. of Items of Inspection under Noise Control}}$$

$$A2 = \frac{\text{Total No. of Items of Compliance under Air Quality}}{\text{Total No. of Items of Inspection under Air Quality}}$$

$$A3 = \frac{\text{Total No. of Items of Compliance under Removal of Water}}{\text{Total No. of Items of Inspection under Removal of Water}}$$

$$A4 = \frac{\text{Total No. of Items of Compliance under Construction Waste Management}}{\text{Total No. of Items of Inspection under Construction Waste Management}}$$

$$A5 = \frac{\text{Total No. of Items of Compliance under Protection}}{\text{Total No. of Items of Inspection under Protection}}$$

$$A6 = \frac{\text{Total No. of Items of Compliance under Site Cleanliness \& Hygiene}}{\text{Total No. of Items of Inspection under Site Cleanliness \& Hygiene}}$$

Total number of items of compliance is referring to the number of compliance achieved for the respective item under the respective group for the checking made according to the checking frequency specified in the checklist stipulated in PRE.B8.2540 for a monthly valuation period.

Total number of items of inspection is referring to the number of inspection for the respective item under the respective group for the checking made according to the checking frequency specified in the checklist stipulated in PRE.B8.2540 for a monthly valuation period.

c. Criteria for payment are as follows:

i. If the scores of any element (A1 to A6) is below 85%, no payment for the environmental management and site hygiene performance item incorporated in the Bill of Quantities or schedule of rates will be made for that month;

ii. If the scores of each of the elements (A1 to A6) is 85% or above and the Contractor's average score (A) is within the range of 85% to less than 90%, payment for that month in respect of environmental management and site hygiene performance shall be valued at the pre-determined rate included in the Bill of Quantities or schedule of rates multiplied by 0.7;

iii. If the score of each of the elements (A1 to A6) is 85% or above and the Contractor's average score (A) is 90% or above, payment for that month in respect of environmental management and site hygiene performance shall be valued at the pre-determined rate included in the Bill of Quantities or schedule of rates multiplied by 1.0.

2. The assessment of payment for the "Silver Card compliance" item in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

a. The status of each category of workers of specified trades listed in PRE.B8.210 (4)(b) is subject to assessment on a monthly basis based on the records of the date of record checking as designated by the CM (hereinunder referred to as the 'designated date of record checking') for a month;

b. The payment for the "Silver Card Compliance" item in the Bill of Quantities or schedule of rates shall be subject to the Contractor's score (R). The score (R) for a monthly valuation shall be derived as follows:

$$(R) = P / Q$$

expressed as a percentage rounded to one decimal place

where $P = P1 + P2$

and $Q = Q1 + Q2 – Q3$

with each parameter defined in sub-clauses (2)(c) to (2)(g) below.

c. P1 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') who are on Site and in possession of valid Silver Cards on the designated date of record checking of the month;

d. P2 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') with all of the following attributes:

i. The worker was verified to be on Site on the designated date of record checking of a previous month;

ii. The worker did not possess a valid Silver Card on the designated date of record checking of a previous month but the worker had enrolled in a Silver Card training course / re-validation course run by the CIC;

iii. The worker is not on Site on the designated date of record checking of the month;

iv. The designated date of record checking of the month is more than 90 calendar days from the date of the worker's first appearance on Site;

v. The worker had not been counted under the parameter Q2 in any designated date of record checking of any previous months;

vi. The worker has successfully obtained a valid Silver Card as required on or before the designated date of record checking of the month.

e. Q1 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') on Site on the designated date of record checking of the month;

f. Q2 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') with all of the following attributes:

i. The worker was verified to be on Site on the designated date of record checking of a previous month;

ii. The worker did not possess a valid Silver Card on the designated date of record checking of a previous month but the worker had enrolled in a Silver Card training course / re-validation course run by the CIC;

iii. The worker is not on Site on the designated date of record checking of the month;

iv. The designated date of record checking of the month is more than 90 calendar days from the date of the worker's first appearance on Site;

v. The worker had not been counted under this parameter Q2 in any designated date of record checking of any previous months.

g. Q3 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') with all of the following attributes:

i. The worker is on Site on the designated date of record checking of the month;

ii. The worker does not possess a valid Silver Card but has enrolled in a Silver Card training course / re-validation course run by the CIC;

iii. The designated date of record checking of the month is not more than 90 calendar days from the date of the worker's first appearance on Site.

h. For the avoidance of doubt, the 'date of the worker's first appearance on Site' as referred to in sub-clause (2)(d) to (2)(g) above shall be the day on which the worker first enters into the Site to carry out the work of the specified trades and is regardless of whether or not the worker has left the Site and is returning to work again on the specified trades;

i. The score (R) shall be worked out by the Contractor in accordance with sub-clause (2)(b) above when completing the prescribed form (DASM-DSC-F6211 or DASM-SSC-F6211 as appropriate) and is subject to verification by the CM or his representatives;

j. Criteria for payment for the 'Silver Card Compliance' item are as follows:

i. Where score (R) turns out to be 0/0 for the designated date of record checking of the month, no payment shall be made for the month in which the designated date of record checking falls;

ii. Where score (R) is a percentage other than 0/0 for the designated date of record checking of the month, then payment for the month in which the designated date of record checking falls shall be valued at the pre-determined rate against this item multiplied by this score (R).

3. The assessment for payment of the items for "Safety Audit performance indicators" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

   a. Verified percentage scores for Part A "Safety Management", Part B "Safety Audit Checklist" and verified individual percentage score for designated critical items (collectively referred to as "Verified Safety Audit Percentage Score") are obtained from each safety audit conducted under the Housing Authority Safety Auditing System (HASAS) as specified in PRE.B8.210. These scores shall be verified by OSHC and confirmed by the CM for official record and payment purpose;

   b. The criteria for payment assessment in respect of "Safety Audit performance indicators (overall score)" are as follows:

      i. If the verified percentage score for either Part A or Part B of a safety audit is below 70%, no payment shall be valued and made for this item in respect of that safety audit;

      ii. If the verified percentage scores for both Part A and Part B of a safety audit are each equal to or above 70% but with either one or both of them below 80%, payment for this item in respect of that safety audit shall be valued by multiplying the pre-determined rate of this item as included in the Bill of Quantities or schedule of rates with 0.7;

      iii. If the verified percentage scores for both Part A and Part B of a safety audit are both equal to or above 80%, payment for this item in respect of that safety audit shall be valued by multiplying the pre-determined rate of this item as included in the Bill of Quantities or schedule of rates with 1.0.

   c. Payment assessment in respect of "Safety Audit performance indicators (scores for critical items)" shall take into account the following:

      i. The verified individual percentage score for designated critical items of the safety audit;

      ii. The apportioned percentages for the respective designated critical item as shown in the table below:

Designated critical items	Element / Subsection and reference in safety audit	Apportioned percentage %
Job hazard analysis	Key element 7	20
Working at height	Subsection 14.1.3	20
Housekeeping	Subsection 14.1.4	10
Prevention against falling objects	subsection 14.1.5	20
Lifting	Lifting operation (subsection 14.2.3)	20
	Tower crane (subsection 14.4.1)	
	Mobile crane (subsection 14.4.2)	

Electrical supply system	Subsection 14.3.2	10
	Total of apportioned percentages =	100

Note: The apportioned percentage for each designated critical item shall be referred to as "effective apportioned percentage" when being applied for payment assessment.

d. The criteria for payment assessment in respect of "Safety Audit performance indicators (scores for critical items)" are as follows:

i. If the verified percentage score of a designated critical item {in the table in sub-clause (c) above} of a safety audit is below 70%, no payment shall be valued and made for that designated critical item in respect of that safety audit;

ii. If the verified percentage score of a designated critical item is equal to or above 70% and below 75% the corresponding apportioned percentage as included in the table in sub-clause (c) above multiplied by 0.7 shall become the “payable effective apportioned percentage” for that designated critical item for payment assessment in respect of that safety audit;

iii. If the verified percentage score of a designated critical item of a safety audit is equal to or above 75% the corresponding apportioned percentage as included in the table in sub-clause (c) above multiplied by 1.0 shall become the “payable effective apportioned percentage” for that designated critical item for payment assessment in respect of that safety audit;

iv. Payment for this item “Safety Audit performance indicators (scores for critical items)” in respect of a safety audit shall be valued by multiplying the pre-determined rate of this item included in the Bill of Quantities or schedule of rates with the sum of the “payable effective apportioned percentage” of the critical items in the table in sub-clause (c) above in respect of that safety audit;

v. For the avoidance of doubt, 0.7 and 1.0 of the corresponding apportioned percentage for the critical item of "lifting" as included in the table in sub-clause (c) above shall only become the “payable effective apportioned percentage” applicable for payment assessment in respect of a safety audit if each of the sub-items available for assessment (namely, subsection 14.2.3, 14.4.1 and 14.4.2) has acquired a verified individual percentage score of 70% or above but below 75% and not less than 75% in that safety audit respectively. However, if any one of these sub-items available for assessment has acquired a verified individual percentage score below 70%, no "payable effective apportioned percentage" for the whole critical item of "lifting" shall be applicable for payment assessment in respect of that safety audit.

4. The assessment for payment of the item of "Control of Temporary Works" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

a. The Contractor has submitted quarterly record of satisfactory certification by registered structural engineer or certification by registered structural engineer and independent checking consultant in respect of temporary works that is specified in PRE.B6.060 sub-clauses (8) and (29) and PRE.B10.010 sub-clauses (5), (8) and (9), to require certification of registered structural engineer or certification of registered structural engineer and independent checking consultant;

b. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

5. The assessment for payment of the item of "Smart Site Safety System" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

   a. The Contractor has implemented smart site safety system measures specified in PRE.B8.267 to match with the site progress.

6. The assessment for payment of the items of "Regulatory Compliance Indicator - yearly record check", "Regulatory Compliance Indicator - residual period record check at completion" and "Regulatory Compliance Indicator – final record check" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

Option 1 of sub-clause (6)(a) to (6)(c)

   a. Payment for the item of "Regulatory Compliance Indicator – final record check" shall be valued by multiplying the pre-determined rate of the item as included in the Bill of Quantities or schedule of rates with 1.0 in respect of the record check if the Contractor has confirmed in writing that none of the following is received from the Labour Department (LD) within the assessment period:

      i. One or more letters received subsequent to LD's inspection advising category Part 1 contravention particularly against Construction Site (Safety) Regulations or subsidiary regulations of the Factories and Industrial Undertakings Ordinance;

      ii. Five or more letters received subsequent to LD's inspection advising category Part II contravention particularly against Construction Site (Safety) Regulations or subsidiary regulations of the Factories and Industrial Undertakings Ordinance;

      iii. Suspension Notice.

   b. For the purpose of establishing the Contractor's entitlement to payment for the item of "Regulatory Compliance Indicator – final record check", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities or schedule of rates shall be carried out by the CM or his representatives;

   c. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

Option 2 of sub-clause (6)(a) to (6)(d)

   a. Payment for the items of "Regulatory Compliance Indicator – yearly record check" and "Regulatory Compliance Indicator – residual period record check at completion" shall be valued by multiplying the pre-determined rate of the respective item as included in the Bill of Quantities or schedule of rates with 1.0 in respect of the record check if the Contractor has confirmed in writing that none of the following is received from the Labour Department (LD) within the respective assessment period:

      i. One or more letters received subsequent to LD's inspection advising category Part 1 contravention particularly against Construction Site (Safety) Regulations or subsidiary regulations of the Factories and Industrial Undertakings Ordinance;

ii. Five or more letters received subsequent to LD's inspection advising category Part II contravention particularly against Construction Site (Safety) Regulations or subsidiary regulations of the Factories and Industrial Undertakings Ordinance;

iii. Suspension Notice.

b. For the purpose of establishing the Contractor's entitlement to payment for the item of "Regulatory Compliance Indicator – yearly record check", an assessment shall be carried out by the CM or his representatives at the end of each full 12-month period commencing from the notified date for commencement of the Works. However, no assessment (and hence no payment) shall be made for any full 12-month period which ends on a date beyond the contract / extended contract period as defined in Bill of Quantities or schedule of rates;

c. For the avoidance of doubt, the remeasured quantity in adjustment of account for items of "Regulatory Compliance Indicator – yearly record check" shall not exceed the quantity as stated in the Bill of Quantities or schedule of rates;

d. For the purpose of establishing the Contractor's entitlement to payment for the item of "Regulatory Compliance Indicator – residual period record check at completion", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities or schedule of rates shall be carried out by the CM or his representatives. The assessment period shall be from the first day after the last assessed period of "yearly record check" in (b) above up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

7. The assessment for payment of the items of "Accident indicator - yearly record check" and "Accident indicator - final record check at completion" items in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

Option 1 of sub-clauses (7)(a) to (7)(d)

a. Payment for the item of "Accident indicator – final record check at completion" shall be valued by multiplying the pre-determined rate of the item included in the Bill of Quantities or schedule of rates with 1.0 in respect of the record check if the Contractor has achieved the following results within the assessment period:

i. No fatal accident;

ii. Annualized accumulative accident rate not more than 8 per 1,000 workers.

b. The annualized accumulative reportable accident occurrence rate per 1000 workers (AR) is derived from the following formula with the cut-off date applicable to all variables (i.e. D, N and W) being set at the last date of a quarter of the calendar year, i.e. 31st March, 30th June, 30th September or 31st December, immediately preceding the quarter in which the last date of the assessment period of the record check falls:

$$AR = \frac{N}{W} \times 1000 \times \frac{365}{D}$$

Where

N = Accumulative number of reportable site accidents as defined in the Factories and Industrial Undertakings Ordinance up to the cut-off date. A "reportable accident" shall refer to an accident arising from industrial activities leading to death(s) or injuries which have incurred incapacity of the person injured for more than 3 days.

W = Average daily number of workers on site reported on Labour Return Form GF527 plus number of site management staff collated by CTO site staff starting from the notified date for commencement of the Works up to the cut-off date.

D = Number of calendar days from the notified date for commencement of the Works up to the cut-off date.

c. For the purpose of establishing the Contractor's entitlement to payment for the item of "Accident indicator – final record check at completion", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities or schedule of rates shall be carried out by the CM or his representatives;

d. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Section of the Works) issued by the CM under GCC Clause 8.7.

Option 2 of sub-clauses(7)(a) to (7)(e)

a. Payment for the items of "Accident indicator – yearly record check" and "Accident indicator – final record check at completion" shall be valued by multiplying the pre-determined rate of the respective item as included in the Bill of Quantities or schedule of rates with 1.0 in respect of the record check if the Contractor has achieved the following results within the assessment period:

i. No fatal accident;

ii. Annualized accumulative accident rate not more than 8 per 1,000 workers.

b. The annualized accumulative reportable accident occurrence rate per 1000 workers (AR) is derived from the following formula with the cut-off date applicable to all variables (i.e. D, N and W) being set at the last date of a quarter of the calendar year, i.e. 31st March, 30th June, 30th September or 31st December, immediately preceding the quarter in which the last date of the assessment period of the record check falls:

$$AR = \frac{N}{W} \times 1000 \times \frac{365}{D}$$

Where

N = Accumulative number of reportable site accidents as defined in the Factories and Industrial Undertakings Ordinance up to the cut-off date. A "reportable accident" shall refer to an accident arising from industrial activities leading to death(s) or injuries which have incurred incapacity of the person injured for more than 3 days.

W = Average daily number of workers on site reported on Labour Return Form GF527 plus number of site management staff collated by CTO site staff starting from the notified date for commencement of the Works up to the cut-off date.

D = Number of calendar days from the notified date for commencement of the Works up to the cut-off date.

c. For establishment of the Contractor's entitlement to payment for the item of "Accident indicator – yearly record check", an assessment shall be carried out by the CM or his representatives at the end of each full 12-month period commencing from the notified date for commencement of the Works. However, no assessment (and hence no payment) shall be made for any full 12-month period which ends on a date beyond the contract / extended contract period as defined in the Bill of Quantities or schedule of rates;

d. For the avoidance of doubt, the remeasured quantity in adjustment of account for item of "Accident indicator – yearly record check" is subject to the capping limit which is equal to the quantity as stated in the Bill of Quantities or schedule of rates. Therefore, in case where the remeasured quantity is larger than the quantity as stated in the Bill of Quantities or schedule of rates, the respective quantity stated in the Bill of Quantities or schedule of rates shall be taken as the remeasured quantity for adjustment of account;

e. For the purpose of establishing the Contractor's entitlement to payment for the item of "Accident indicator – final record check at completion", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities or schedule of rates shall be carried out by the CM or his representatives. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Section of the Works) issued by the CM under GCC Clause 8.7.

8. The assessment of payment of the item "Reporting of Accident and Incident" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

   a. The Contractor shall report accidents and incidents, if any, timely to Labour Department under the Factories and Industrial Undertakings Regulations and to the CM according to the accident / incident reporting procedures set out at the Housing Authority Site Safety Website;

   b. Full payment at the pre-determined rate shall be assessed if there is no accident or incident for reporting or the total number of late reporting of accidents and incidents is not more than 3 up to the certified date of completion of the Works (or where phased completion of Sections is specified in the Contract, up to the last certified date of completion stated amongst the different certificates of completion for the Sections);

   c. For more than 3 cases of late reporting, full payment at the pre-determined rate shall be assessed if the project team is convinced that the late reporting is beyond the Contractor’s reasonable control such that the total number of accidents and incidents with late reporting after deducting those cases beyond the Contractor’s reasonable control is not more than 3. Otherwise, no payment for this item "Reporting of Accident and Incident" shall be made.

9. The assessment for payment of the item "Recognition of innovative and functional safety installation or safety measures" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

   a. The Contractor has implemented innovative and functional safety installation or safety measures, including but not limited to innovation in construction technology, application of Building Information Modelling (BIM) or Radio Frequency Identification (RFID) technology etc. for safety, to enhance site safety and health management in terms of hazard analysis, risk assessment, safety training, etc., which shall be new concepts subject to OSHC's assessment under HASAS/HALENSAS and such safety installation or safety measures are not implemented to comply with legal or contractual requirement, not common practices in the construction industry nor proprietary products procured from the market;

   b. The Contractor shall submit the relevant detailed specification and design drawings to the accredited safety auditor for vetting. The innovative and functional safety installation or safety measures has been verified / supported by the OSHC through safety audit and explicitly stated in the Safety Audit reports;

   c. The CM has verified the implementation merits and checked the sufficiency of the relevant detailed specification and design drawings to his satisfaction.

10. The assessment for payment of the items of "Compliance with regulations related to Environmental Protection and Site Hygiene - yearly record check", "Compliance with regulations related to Environmental Protection and Site Hygiene - residual period record check at completion" and "Compliance with regulations related to Environmental Protection and Site Hygiene – final record check" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

Option 1 of sub-clauses (10)(a) to (10)(c)

a. Payment for the item of "Compliance with regulations related to Environmental Protection and Site Hygiene – final record check" in respect of an assessment period shall be valued by multiplying the pre-determined rate of the item as included in the Bill of Quantities or schedule of rates with 1.0 in respect of the record check if none of the following criteria in respect of environmental and site hygiene legislation and regulations are received from the Environmental Protection Department (EPD) or the Food and Environmental Hygiene Department (FEHD) during the assessment period:

   i. One or more warning letters received from the Contract Manager subsequent to inspections;

   ii. One or more warning letters received from EPD or FEHD;

   iii. One or more convictions under any environmental and site hygiene regulations or legislation;

   iv. Abatement Notice.

   Provided that where the criteria (a)(i) to (iv) above are satisfied but there are one or more offence notifications received from EPD or FEHD during any assessment period for which any conviction under any environmental and site hygiene regulations or legislations is yet to be confirmed by EPD or FEHD at the time when the payment assessment is being carried out, payment for this item shall be valued with the quantity provisionally set at zero and which will be adjusted to 1.0 upon confirmation from EPD or FEHD that there is no conviction.

b. For the purpose of establishing the Contractor's entitlement to payment for the item "Environmental Protection and Site Hygiene – final record check", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities or schedule of rates shall be carried out by the CM or his representatives;

c. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

Option 2 of sub-clauses (10)(a) to (10)(d)

a. Payment for the items of "Compliance with regulations related to Environmental Protection and Site Hygiene –yearly record check" and "Compliance with regulations related to Environmental Protection and Site Hygiene – residual period record check at completion" shall be valued by multiplying the pre-determined rate of the respective item as included in the Bill of Quantities or schedule of rates with 1.0 in respect of the record check if none of the following in respect of environmental and site hygiene legislation and regulations are received from the Environmental Protection Department (EPD) or the Food and Environmental Hygiene Department (FEHD) during the assessment period:

   i. One or more warning letters received from the Contract Manager subsequent to inspections;

   ii. One or more warning letters received from EPD or FEHD;

iii. One or more convictions under any environmental and site hygiene regulations or legislation;

iv. Abatement Notice.

Provided that where the criteria (a)(i) to (iv) above are satisfied but there are one or more offence notifications received from EPD or FEHD during any assessment period for which any conviction under any environmental and site hygiene regulations or legislations is yet to be confirmed by EPD or FEHD at the time when the payment assessment is being carried out, payment for this item shall be valued with the quantity provisionally set at zero and which will be adjusted to 1.0 upon confirmation from EPD or FEHD that there is no conviction.

b. For the purpose of establishing the Contractor's entitlement to payment for the items of "Compliance with regulations related Environmental Protection and Site Hygiene - yearly record check", an assessment shall be carried out by the CM or his representatives at the end of each full 12-month period commencing from the notified date for commencement of the Works. However, no assessment (and hence no payment) shall be made for any full 12-month period which ends on a date beyond the contract / extended contract period as defined in the Bill of Quantities or schedule of rates;

c. For the avoidance of doubt, the remeasured quantity in adjustment of account for item of "Compliance with regulations related to Environmental Protection and Site Hygiene - yearly record check" is subject to the capping limit which is equal to the quantity as stated in the Bill of Quantities or schedule of rates. Therefore, in case where the remeasured quantity is larger than the quantity as stated in the Bill of Quantities or schedule of rates, the respective quantity stated in the Bill of Quantities or schedule of rates shall be taken as the remeasured quantity for adjustment of account;

d. For the purpose of establishing the Contractor's entitlement to payment for the item of "Compliance with regulations related Environmental Protection and Site Hygiene - residual period record check at completion", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities or schedule of rates shall be carried out by the CM or his representatives. The assessment period shall be from the first day after the last assessed period of "yearly record check" in (b) above up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

11. The assessment for payment of the item of "Recognition of innovation in environmental management and site hygiene measures" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

    a. The Contractor has implemented innovative and functional environmental protection installation and site hygiene measures which shall be new concepts and such measures are not implemented to comply with legal or contractual requirement, not common practices in the construction industry nor proprietary products procured from the market;

    b. The measures have been supported by an independent vetting panel;

    c. The CM has verified the implementation merits to his satisfaction.

12. The assessment for payment of the items for "Surprise Safety Inspection Programme performance indicators" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

a. Total score and activity scores are obtained from each inspection conducted under the Surprise Safety Inspection Programme (SSIP) as specified in PRE.B8.210. These scores shall be verified by the OSHC and confirmed by the CM for official record and payment purpose;

b. The criteria for payment assessment in respect of Surprise Safety Inspection Programme performance indicators (total score) are as follows:

   i. If the total score or any activity score is below 70%, no payment shall be valued and made for this item in respect of that inspection;

   ii. If the total score and all activity scores are equal to or above 70% but either the total score or any activity score is below 80%, payment for this item in respect of that inspection shall be valued by multiplying the pre-determined rate of this item as included in the Bill of Quantities or schedule of rates with 0.7;

   iii. If the total score and all activity scores are equal to or above 80%, payment for this item in respect of that inspection shall be valued by multiplying the pre-determined rate of this item included in the Bill of Quantities or schedule of rates with 1.0.

c. The criteria for payment assessment in respect of Surprise Safety Inspection performance indicators (activity scores) are as follows:

   The apportioned percentages for the designated critical items are shown in the table below.

Item	Designated Critical Items	Apportioned percentage %
1	Working at height	20
2	Prevention against falling objects	20
3	Housekeeping	20
4	Lifting operations	20
5	Electrical supply system	20

   Note: The apportioned percentage for each designated critical item shall be referred to as “effective apportioned percentage” when being applied for payment assessment.

   i. If the activity score of designated critical items of an inspection is below 70%, no payment shall be valued and made for that critical item in respect of that inspection;

   ii. If the activity score of a designated critical item of an inspection is equal to or above 70% and below 80%, the corresponding apportioned percentage as included in the above table shall become an “effective apportioned percentage” for payment assessment in respect of that inspection. Payment for this item in respect of this designated critical item of the inspection shall be valued by multiplying the pre-determined rate of the item as included in the Bill of Quantities or schedule of rates with 0.7 of the “effective apportioned percentage” of the designated critical item;

iii. If the activity score of a designated critical item of an inspection is equal to or above 80%, the corresponding apportioned percentage as included in the above table shall become an "effective apportioned percentage" for payment assessment in respect of that inspection. Payment for this item in respect of this designated critical item of the inspection shall be valued by multiplying the pre-determined rate of the item as included in the Bill of Quantities or schedule of rates with 1.0 of the "effective apportioned percentage" of the designated critical item.

13. The assessment of payment of the item "Contribution to Safety Campaigns" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:
    a. The Contractor shall be entitled to payment for entry to one of the following safety campaigns:
        i. Construction Safety Promotional Campaign organised by the OSHC;
        ii. Occupational Health Award organised by the OSHC;
        iii. Hong Kong Occupational Safety and Health Award organised by the OSHC;
        iv. Construction Industry Safety Award Scheme organised by the Labour Department; or
        v. Considerate Contractors Site Award Scheme organised by the Development Bureau and the Construction Industry Council.

        One contract can only allow a maximum of 5 such one-off payments.
    b. The Contractor shall also be entitled to payment for winning a prize (any of the Gold, Silver, Bronze or Meritorious prize) in the above campaigns. The Contractor shall only be entitled to a maximum of 5 one-off payments for winning open competitions;
    c. The Contractor shall also be entitled to a maximum of 3 one-off payments for organising site-based safety awards.
14. The assessment of payment of the item "Contribution to Environmental Protection Awards" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:
    a. The Contractor shall be entitled to payment for entry to one of the following:
        i. Environmental Labels (Wastewise or Energywise) organised by the Environmental Campaign Committee (ECC) with Environmental Protection Department (EPD);
        ii. Green Innovations organised by ECC and EPD;
        iii. Sectoral Awards of The Hong Kong Awards for Environmental Excellence organised by ECC and EPD; or
        iv. The Outstanding Environmental Management and Performance Award of the Considerate Contractors Site Award Scheme organised by the Development Bureau with the Construction Industry Council.

        One contract can only allow a maximum of 3 such one-off payments.
    b. The Contractor shall only be entitled to a maximum of 2 one-off payments for organising site-based environmental awards.

SITE ACCESS CONTROL OF PERSONNEL

PRE.B8.2610.9 SITE ACCESS CONTROL AND RECORDING SYSTEM

Provide and operate an Access Control and Recording System (ACRS) to record and verify the information of all personnel (including Site Personnel, Self-employed Workers, Direct Contractors' workers and visitors) entering and leaving the Site as specified in PRE.B8.2612 to PRE.B8.2660 and as per the requirements stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time:

1. Operate the ACRS within two weeks from the notified date for commencement of the Works;
2. After the ACRS is put into operation, issue smart cards to all personnel for identification;
3. Subject to sub-clause (2) above, do not allow any personnel without a smart card to work on the Site;
4. Compile a register for all issued smart cards with detail information of the card holders and submit it to the CM for records at regular intervals as confirmed by the CM. Both hard and soft copies of the register shall comply with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;
5. Compile and maintain daily attendance records of all personnel working on the Site and site access record of all visitors and keep a verified copy in the wage books as required in PRE.B8.1450 as per the timeframe confirmed by the CM;
6. Compile and maintain schedules of wages and MPF contribution as required in PRE.B6.550 and PRE.B8.1450;
7. Compile and print record forms of Silver Card Holders working on Site by respective trades on dates designated by the CM. The record form shall be in the format similar to the Record Form (DASM-F6211) and fields to be entered shall enable the information required in sub-clause (2) of PRE.B8.2570 to be retrieved. The Record Form (DASM-F6211) can be obtained from the CM upon request in writing;
8. Provide training to at least three representatives of the CM and LRO in using the ACRS;
9. At least 2 number of portable pocket personal computers complying with the system requirements as stipulated in PRE.B8.2620 shall be provided for the use of the CM or LRO during the operation period of ACRS.

PRE.B8.2612.9 ARRANGEMENT FOR PRE-OPERATION OF ACRS

1. Within 7 days from the notified date for commencement of the Works, submit to the CM for record the temporary arrangement for pre-operation of ACRS. The temporary arrangement shall include use of log books, card readers or portable pocket personal computers complying with the system requirements as stipulated in PRE.B8.2620 to record the time of entry and departure of all personnel, and issuing temporary passes or smart cards to them;
2. Implement the temporary arrangement to record and verify the information of all personnel as required in the ACRS and their entering and leaving the Site until the ACRS is ready to operate.

PRE.B8.2614.9 DESIGN, OPERATION AND SUBMISSION REQUIREMENTS

Submit the following of the ACRS to the CM for record within 14 days from the notified date for commencement of the Works:

1. Design and operation detail of the system;
2. Format and submission arrangement of the data;
3. Name and details of the service provider;

4. Emergency plan in the event of breakdowns, repairs or regular maintenance.

PRE.B8.2620.A SYSTEM REQUIREMENTS

1. The ACRS shall include the following:
   a. Entrance/Exit Control Unit;
   b. Central Data Computer Unit;
   c. Portable pocket personal computer.
2. The ACRS shall be a system utilising biometric recognition technology for identifying the subject (person entering or leaving the site) in combination with a non-contact type smart card system complying with ISO 14443. The chip inside the smart card shall comply with ISO 14443. The biometric authentication shall be a Handkey II or other products having similar and equivalent functions and performances;
3. The smart card shall be compatible with the Construction Workers Registration Cards issued by the Construction Industry Council (CIC) under the Construction Workers Registration Ordinance (Cap. 583) to registered construction workers. The system's card readers shall be compatible with the smart card and shall be complete with a security access module (SAM) for cryptographic security slot. The Contractor shall obtain the SAM from the CIC;
4. The ACRS shall have sufficient memory to capture and record the information, and produce reports as specified in PRE.B8.2630 to PRE.B8.2650;
5. Adequate and secure backup system shall be provided. In the event of power failure, all memory contained in the data station computer shall be retained;
6. If a personnel (except visitor) is issued with a registration card by the CIC pursuant to the Construction Workers Registration Ordinance (Cap. 583), the card so issued is permitted to be used in lieu of the smart card required under this section;
7. All data stored in the ACRS shall be accessed and retrieved by the microcomputer provided to the LRO. The ACRS shall allow the retrieved data to be printed on paper and exported to electronic files in format of 'Portable Document Format' and 'Microsoft Excel', or other commonly available format acceptable to the CM;
8. The ACRS shall be able to assign an unique Site Personnel Number for each issued smart card complying with the format as stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;
9. The ACRS shall be able to compile, print and export forms, schedules and register as required in PRE.B8.1450 and PRE.B8.2610 complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;
10. The portable pocket personal computer shall be able to synchronize with the data bank of the ACRS and be capable of recording, verifying and updating the information of the personnel (except visitors) including reading their smart cards and registration cards issued by CIC;
11. The ACRS shall be able to maintain all raw data of in/out records of all Site Personnel and highlight all the records input or edited by manual in reports compiled and printed by ACRS as stipulated in sub-clause (9) for checking.

PRE.B8.2630.9 ENTRANCE/EXIT CONTROL UNIT

1. Install sufficient numbers of entrance/exit control unit at all ingress or egress points of the Site and submit the exact locations to the CM for agreement;
2. Each entrance/exit control unit shall be equipped with non-contact type smart card readers with biometric recognition device and access control device, e.g. turnstile;
3. Connect the smart card readers to a secured computer which shall record all personnel's signing in and out of the Site. Provide separate smart card readers with clear labels indicating "IN" and "OUT" for this purpose;

4. Ensure the system can display the photograph of the smart card holder saved in the central data computer unit and the smart card.

PRE.B8.2640.9 CENTRAL DATA COMPUTER UNIT

The secured computer unit must have high availability feature of at least 96% uptime or not more than five hours per month outage and shall be loaded with appropriate software to perform the following functions:

1. Automatic recording of the entry/exit information of the smart card holders passing the entrance/exit control unit;
2. Output and transmit the registration records and the daily entry and exit record, in a format stipulated by Housing Authority (HA), to HA's computer facility electronically on frequency prescribed by HA. The transmitted data including its Intellectual Property Right will be owned by HA. HA shall have the right to keep, analyse, compile and further disclose the transmitted data to any person in such form and manner as HA deems fit;
3. Entry and updating of information on smart card holders;
4. Instant retrieval of picture and information of smart card holder;
5. Automatic printout and alarm message in case of faulty operation.

PRE.B8.2650.9 INFORMATION TO BE CAPTURED AND SAVED IN ACRS

1. Provide clear plastic holders to all personnel (except visitors) for holding their smart cards or registration cards issued by CIC. The plastic holder shall be provided with a means to enable it to be displayed in a conspicuous position of the personnel and affixed with a label with the following information shown:
   a. Site Personnel Number;
   b. Name of personnel in Chinese and English;
   c. Name of personnel's employer in Chinese and English (except Self-employed Worker);
   d. Trade of personnel and, if applicable, the relevant trade no. (refer to the trade list issued by CIC);
   e. Photograph of personnel;
   f. Contract no. and Contract title.

   Background colour of the label for the Contractor's direct employees shall be red, whilst that for all other Site Personnel shall be green, Self-employed Workers shall be blue and Direct Contractors' Workers shall be white.
2. Except for the smart cards which are issued to visitors, the following electronic data shall be contained in smart cards of personnel and the central data unit in encrypt form:
   a. Site Personnel Number;
   b. Name of personnel in Chinese and English;
   c. Hong Kong Identity Card number of personnel;
   d. Details of Construction Worker Registration Card and Trade Test / Intermediate Trade Test Certification Card including card no., expiry date, trade name and trade no., if available;
   e. Name of Personnel's employer in Chinese and English (except Self-employed Worker);
   f. Trade of personnel and, if applicable, the relevant trade no. (refer to the trade list issued by CIC);
   g. Photograph of personnel;
   h. Contract no. and Contract title;

i. Employment contract details of Personnel / personal insurance policy details as agreed with the CM (optional for smart card);
j. Expiry date of the smart card and whether the smart card has been returned or voided;
k. Signature specimen of personnel (optional for smart card);
l. Details of Silver Card (if any) including the card no., expiry date and information required in the Record Form (DASM-F6211) and sub-clause (2) of PRE.B8.2570. The Record Form (DASM-F6211) can be obtained from the CM upon request in writing;
m. Details of Safety Card including the card no. and expiry date;
n. Contact telephone no. of personnel.

3. The following information of all the visitors shall be captured and recorded in the ACRS:
   a. Name of visitor in Chinese or English;
   b. Hong Kong Identity Card number of visitor;
   c. Name of visitor's company / organization;
   d. Contact telephone no. of visitor;
   e. Particulars of staff to be visited:
      i. Name;
      ii. Telephone no.;
      iii. Name of company.
   f. Purpose of the visit;
   g. Site Personnel Number of the smart card issued;
   h. Whether the smart card has been returned.

   The smart card issued to a visitor shall be provided with a means to enable it to be displayed in a conspicuous position of the visitor and in yellow colour.
4. The smart card shall contain sufficient encrypted information for identification of the card holder and access to the master data bank of the system;
5. Comply with the requirements as stipulated in the Personal Data (Privacy) Ordinance for avoiding the abuse of the information collected. Adequate data security control shall be provided to limit the access right to the ACRS on need basis. The usage of the information collected by the ACRS shall be used exclusively for security control and supporting information as required by the Contract e.g. attendance checking;
6. Allow the LRO, the CM or any other persons authorized by the CM to check the accuracy of the records.

PRE.B8.2660.A SYSTEM RUNNING AND TERMINATION

1. Operate the ACRS at all times before termination. Replace any component of the ACRS immediately in the event of breakdowns, repairs or regular maintenance;

Option 1

2. Comply with the following requirements for operation of ACRS:
   a. Maintain the operation of ACRS up to the date of issue of the maintenance certificate or where applicable the last partial maintenance certificate, whichever is the later. Removal of the access control device of the entrance / exit control unit in ACRS may be allowed at least two months after the date of certified completion of the Works subject to the CM's approval. After removal of the access control device of the entrance / exit control unit in ACRS as aforesaid, implement necessary arrangement for maintaining the operation of the ACRS as stipulated in PRE.B8.2620, PRE.B8.2640 and PRE.B8.2650;

b. Allow the foundation contractor of the previous foundation contract to use the ACRS for not less than 6 months after the notified date for commencement of the Works, to record and verify the information of his personnel entering and leaving the Site.

Option 2

2. Maintain the operation of ACRS up to the date of issue of maintenance certificate. Removal of the access control device of the entrance / exit control unit in ACRS may be allowed at least two months after the date of certified completion of the Works subject to the CM's approval. After removal of the access control device of the entrance / exit control unit in ACRS as aforesaid, implement necessary arrangement for maintaining the operation of the ACRS as stipulated in PRE.B8.2620, PRE.B8.2640 and PRE.B8.2650. If handover of the Site to subsequent building contractor before the end of Maintenance Period is required, liaise with the building contractor for the use of the ACRS provided by the building contractor for recording the information of all the Contractor's personnel entering and leaving the Site as directed by the CM. Render all necessary assistance, input and resources to facilitate the building contractor in discharging his duties. Keep separate set of verified daily attendance records of all the Contractor's personnel working on the Site in the wage books as required in PRE.B8.1450 as per the timeframe confirmed by the CM;

Option 3

2. Maintain the operation of ACRS up to and including at least two months after the month in which the date of completion of the Works (or where phased completion of the Works in Sections is specified, the last date of completion stated amongst the different certificates of completion for the Sections) is certified by the CM under GCC Clause 8.7;
3. Seek the CM's prior approval for terminating the operation of ACRS without prejudice to the provisions as specified in sub-clause (2) above;
4. Seek the CM's prior approval for dismantling and removal of each access control device of the entrance / exit control unit in ACRS;
5. Before the ACRS is terminated in accordance with PRE.B8.2660, the Contractor shall comply with the requirements stipulated in PRE.B8.2620, PRE.B8.2640 and PRE.B8.2650.

WORKS ON STREET MAINTAINED BY THE HIGHWAYS DEPARTMENT

PRE.B8.2710.A WORKS ON STREET MAINTAINED BY THE HIGHWAYS DEPARTMENT

1. Carry out works on Street Maintained by the Highways Department at .....
2. Construct run-in and run-out in compliance with Highways Department's standards at the proposed site entrance and exit respectively. When no longer required, remove the run-in and run-out and reinstate the affected road and footpath to CM's satisfaction and bear all associated costs and time.

PRE.B8.2720.A EXCAVATION PERMIT APPLICATION

1. Render all necessary assistance to the Employer in processing any application for an Excavation Permit or any extension in respect thereof including supplying all necessary information to the CM complying with Development Bureau's latest version of "Practitioner's Guidelines" for the application of an Excavation Permit;
2. The information required for processing the Excavation Permit is contained in the Excavation Permit Processing Manual issued by Highways Department. The information includes but not limited to excavation locations, detailed construction programme for permit period assessment, utilities coordination programme, temporary traffic measures and substantiations for extension of permit period etc.;

3. Coordinate with the Utility Undertakings in compiling the utilities coordination programme and obtain approval from relevant Government departments on the temporary traffic measures;
4. Allow sufficient time in the programme for the Employer to obtain the Excavation Permit and such time should include all activities in the application process as outlined in the Excavation Permit Processing Manual issued by Highways Department and any proposed revisions from the Contractor to those proposals already submitted by the Employer to the Designated Authority for applying for the Excavation Permit.

PRE.B8.2730.A SAFETY PRECAUTION

1. Comply with the conditions of the Excavation Permit in the capacity of the Nominated Permittee and assist the Employer and the CM to comply with the same;
2. Ensure all safety precautions are carried out to protect the public and that all works are carried out in such a manner as to cause as little inconvenience as possible to the public;
3. Ensure that existing utilities are not damaged, temporary traffic arrangements are properly implemented, vehicular and pedestrian accesses are maintained, working sites are not left unattended, the Site is kept clean at all times, road works reinstatements and their maintenance are carried out in accordance with the conditions of the Excavation Permit;
4. Carry out all remedial works for road works reinstatements within 12 months from the date of submission of a Completion Notice under the Excavation Permit and bear all associated costs and the extra time required.

PRE.B8.2740.9 SITE SUPERVISION

1. Ensure that sufficient site supervising personnel are provided to supervise the works on Street Maintained by the Highways Department in particular on site safety;
2. At least 4 weeks before commencement of the works on Street Maintained by the Highways Department, submit a supervision plan documenting the supervision system which should include detail information on how to supervise, monitor and prevent the Contractor's personnel from committing an act or making an omission in contravention of the Land (Miscellaneous Provisions) Ordinance (CAP. 28) and the conditions of the Excavation Permit:
    a. The supervision plan shall outline all safety precautions including excavation support details to protect the public from any danger or injury during execution of works on Street Maintained by the Highways Department;
    b. The supervision plan and the information contained in the plan shall be acceptable to the CM. The consent by the CM of any such particulars shall not relieve the Contractor of any duty or responsibility under the Contract and any liability under the Land (Miscellaneous Provisions) Ordinance (CAP. 28).
3. Appoint a competent person to supervise all works on Street Maintained by the Highways Department and to ensure that the supervision plan is adhered to. The competent person shall be:
    a. A registered professional or a safety officer as defined in Section 10T of the Land (Miscellaneous Provisions) Ordinance (CAP. 28);
    b. Full time on Site for supervision of the works on Street Maintained by the Highways Department.

BEAM PLUS ASSESSMENT

PRE.B8.2810.A BEAM PLUS ASSESSMENT

1. Assist the CM to conduct BEAM Plus assessment for the Works according to BEAM Plus New Buildings (Version 2.0) promulgated by the BEAM Society Limited;
2. Satisfy all the target BEAM Plus prerequisites and credits listed in PRE.B8.2820 and provide relevant supporting documents;
3. Assign a BEAM Plus Construction Coordinator (BC) who is familiar with BEAM Plus assessment to coordinate all relevant works of BEAM Plus assessment. The Environmental Supervisor (ES) specified in PRE.B6.060 can be designated as the BC;
4. Two (2) BEAM Professionals accredited for BEAM Plus New Buildings (Version 2.0) shall be appointed to participate in BEAM Plus coordination meeting, prepare, review and endorse BEAM Plus related documents;
5. A BEAM Plus consultant will be appointed by Employer to monitor the implementation of BEAM Plus credits and prerequisites. The Contractor shall coordinate with and provide necessary information to the BEAM Plus consultant to facilitate the BEAM Plus assessment;
6. Attend site inspection with the BEAM Assessor and provide necessary facilities, access and assistance to the BEAM Assessor for the BEAM Plus assessment.

PRE.B8.2820.C BEAM PLUS PREREQUISITES AND CREDITS

The target BEAM Plus prerequisites and credits relevant to the Works are as follows:

1. Carry out the following works:
    a. Environment Management Plan (BEAM Plus prerequisite IDCM P2 refers)
        i. Prepare and implement the Environmental Management Plan covering all environmental monitoring specified in PRE.B8.2510 to PRE.B8.2560.
    b. Sustainability Champions – Construction (BEAM Plus credit IDCM 6 refers)
        i. Engage at least two (2) accredited BEAM Professionals (BEAM Pro) with valid credentials for BEAM Plus New Buildings (Version 2.0) for the project;
        ii. The Construction BEAM Pros shall perform the duties as specified in BEAM Plus New Buildings (Version 2.0) manual and participate in the kick-off meeting and at least 1 review meeting;
        iii. Provide supporting documents showing how the works are handed over and the timeline for their involvement if there is any change of appointed BEAM Pros.
    c. Minimization of Air Pollution (BEAM Plus credit IDCM 7a refers)
        i. Implement mitigation measures for dust and air emissions during construction. Comply with the Air Pollution Control Ordinance. Endeavour to ensure that there shall be no complaint about air pollution from the Site leading to the issue of a fine or prosecution by EPD;
        ii. Provide substantiation record for implementation of all air pollution mitigation measures. The substantiation shall cover the relevant items under "Minimization of Air Pollution " at PRE.B8.APPEND9 where applicable;
        iii. Conduct and report on construction dust monitoring specified in PRE.B8.510 to PRE.B8.570.
    d. Minimization of Noise Pollution (BEAM Plus credit IDCM 7b refers)

i. Implement mitigation measures for construction noise. Comply with the Noise Control Ordinance. Endeavour to ensure that there shall be no complaint about noise from the Site leading to the issue of a fine or prosecution by the EPD or the Police;

ii. Provide substantiation record for implementation of all noise mitigation measures. The substantiation shall cover the relevant items under "Minimization of Noise Pollution" at PRE.B8.APPEND9 where applicable;

iii. Conduct and report on construction noise monitoring specified in PRE.B8.890 to PRE.B8.898.

e. Minimization of Water Pollution (BEAM Plus credit IDCM 7c refers)

i. Implement measures to reduce water pollution during construction. Comply with the Water Pollution Control Ordinance. Endeavour to ensure that there shall be no complaint about water pollution from the Site leading to the issue of a fine and prosecution by the EPD;

ii. Provide substantiation record for implementation of all water pollution mitigation measures. The substantiation shall cover the relevant items under "Minimization of Water Pollution" at PRE.B8.APPEND9 where applicable;

iii. Conduct and report on discharged water monitoring specified in PRE.B8.2410 to PRE.B8.2430.

f. Minimization of Light Pollution (BEAM Plus credit IDCM 7d refers)

i. Implement light pollution control measures as stipulated in PRE.B8.420 and PRE.B8.APPEND9;

ii. Provide supporting documents such as monthly report(s) with records, completed prescribed forms and dated photographic evidences to demonstrate light pollution control measures during construction and application of corrective actions to avoid continuous dissatisfaction of neighbourhood, passers-by and workers / non-compliance of any item(s) of those measures specified in PRE.B8.APPEND9.

g. Construction Waste Recycling (BEAM Plus credit IDCM 8b refers)

i. Prepare and implement the Waste Management Plan specified in PRE.B8.2520;

ii. Provide substantiation record such as monthly report(s) with completed prescribed form and dated photographic evidences to demonstrate all measures for waste management. The substantiation shall cover all the relevant items under "Waste Management" at PRE.B8.APPEND9 where applicable.

h. Considerate Construction (BEAM Plus credit IDCM 10 refers)

i. Provide supporting documents such as valid Considerate Contractor Site Award (CCSA) certificate, monthly report(s) with completed prescribed form and dated photographic evidences to demonstrate the compliance with requirements specified in PRE.B8.2860 and PRE.B8.APPEND9.

i. Operator Training plus Chemical Storage and Mixing Room (BEAM Plus credit IDCM 12 refers)

i. Provide drainage point and water supply point to the designated Chemical Storage / Mixing Room;

ii. Coordinate with Nominated Sub-contractors to provide training for the estate's operations and maintenance staff within 6 months after obtaining the OP;

iii. Provide supporting documents including training records and training program materials to verify that training of the operation and maintenance staff has been undertaken for all commissioned systems and major equipment, using the operations and maintenance (O&M) manual, and the energy management manual (EMM) as the basis for the training.

j. BIM Integration – Coordinated Use of BIM within Design and Construction Teams (BEAM Plus credit IDCM 16b refers)
   i. Comply with all BIM requirements under PRE.B8.4000 to PRE.B8.4090;
   ii. Use of BIM for cost estimation in accordance with PRE.B8.4030.

k. Minimum Landscaping Requirements (submitted by soft landscape sub-contractor) (BEAM Plus prerequisite SSP1 refers)
   i. Submit tree survey and tree assessment schedules highlighting any existing / preserved trees (if applicable);
   ii. Submit site photos / aerial photo showing that there is no existing tree on the project site (if applicable);
   iii. Provide as-built landscape plans and sections showing soft landscape layout, irrigation provisions, maintenance access, soil volumes of at least $12m^3$, soil depths (vertical and horizontal, if applicable) of all planted areas for trees (1.2m), shrubs (0.6m) and grass / groundcover (0.3m), live load calculation of roof (if planting is provided on roof);
   iv. Provide as-built planting plans, planting schedules and extracts of relevant literature or reference demonstrating planting species with shade tolerance are used for any covered greenery;
   v. Submit summary for the total and breakdowns of areas and at least 20% site coverage of greenery of accountable greenery areas and greening features in accordance with Building Department PNAP APP-152 Sustainable Building Design Guidelines;
   vi. Submit as-built drawings and planting schedules for soft landscape works highlighting the locations, areas and dimensions of accountable greenery areas and greening features, plant types and highlighting plant species with shade tolerance that are used for any covered greenery.

l. Conservation of Cultural Heritage (BEAM Plus credit SS3b refers)
   i. Provide supporting documents including site photos to demonstrate proactive approach in implementation of recommendations in heritage impact assessment report.

m. Noise Control of Building Equipment (BEAM Plus credit SS5 refers)
   i. Conduct measurements of both background and impact noise level upon completion of testing and commissioning of all noise-generating building equipment in accordance with the latest Technical Memorandum for the Assessment of Noise issued by the EPD and with paragraph 4.2.13 in Chapter 9 of the latest Hong Kong Planning and Standards Guidelines;
   ii. Submit measurement reports and any supporting documents as specified in BEAM Plus New Buildings (Version 2.0) manual and requested by BEAM Society to prove the compliance of this credit.

n. On-site Outdoor Air Quality (BEAM Plus prerequisite HWB P1 refers)

i. Engage IAQ certified issuing body to carry out site measurement on carbon monoxide (CO), nitrogen dioxide (NO2), ozone (O3), respirable suspended particulate (PM10) before work commencement and submit measurement report to demonstrate compliance of this credit as specified in BEAM Plus New Buildings (Version 2.0) manual.

o. Healthy and Active Living (BEAM Plus credit HWB 1 refers)
   i. Provide supporting documents including as-built drawings, catalogues and photographic evidence to demonstrate the implementation of healthy and active living features.

p. Universal Accessibility (BEAM Plus credit HWB 3a refers)
   i. Provide supporting documents including as-built drawings, catalogues and photographic evidence to demonstrate the implementation of accessibility design measures.

q. Weather Protection and Family Friendly Features (BEAM Plus credit HWB 3b refers)
   i. Provide supporting documents including as-built drawings, catalogues and photographic evidence to demonstrate the implementation of weather protection measures and family friendly features.

r. Indoor Vibration (BEAM Plus credit HWB 7 refers)
   i. Conduct indoor vibration measurements in most sensitive habitable spaces (e.g. the lowest and the topmost floors of domestic flats, offices, etc.) with all building services equipment operating upon the completion of testing and commissioning in accordance to methodology stated in BEAM Plus New Buildings (Version 2.0) manual;
   ii. Submit measurement reports and any supporting documents as specified in BEAM Plus New Buildings (Version 2.0) manual and requested by BEAM Society to prove the compliance of this credit.

s. Indoor Air Quality in Occupied space (BEAM Plus credit HWB 8a refers)
   i. Carry out site measurements on carbon monoxide (CO), nitrogen dioxide (NO2), ozone (O3), carbon dioxide (CO2), respirable suspended particulates (PM10), total volatile organic compounds (TVOC), formaldehyde (HCHO), radon (Rn), Airborne bacteria and mould following the guidelines specified in the latest "A Guide on Indoor Air Quality Certification Scheme for Offices and Public Spaces";
   ii. Prepare and submit IAQ Certificate Issuing Body (CIB) endorsed measurement protocol and measurement report to show the Indoor Air Quality of normal occupied spaces served by MVAC system as specified in BEAM Plus New Buildings (Version 2.0) manual, PRE.B8.610 and PRE.B8.620.

t. Biological Contamination (BEAM Plus credit HWB 12 refers)
   i. Demonstrate compliance with the corresponding sections of the Code of Practice for Prevention of Legionnaires' Disease 2016 / 2021 Edition, if relevant systems are present, e.g. Centralised Hot Water Supply Systems (Section 4.4.1.1), and Cold Water Supply Systems (Section 4.5.1).

u. Twin Tank System (BEAM Plus credit WU 5 refers)
   i. Install twin tank for portable water supply system and flushing water supply system equipped with necessary component as specified in BEAM Plus New Buildings (Version 2.0) manual.

v. Hard-paved Construction (BEAM Plus credit IA1 refers)

i. Pave the areas of the Site with hard concrete elements throughout the Contract duration;

ii. Demonstrate reuse of the intact hard-paving material (e.g. transfer to/from other construction sites);

iii. Provide on-site photos of sample areas of the Site with hard paving and the transfer notes of delivering hard paving material for reuse.

w. Construction and Demolition Materials Disposal Tracking System (BEAM Plus credit IA1 refers)

i. Provide necessary information, such as disposal records and on-site photos, to demonstrate the use of web-based Construction & Demolition Materials Disposal Tracking System (CMDTS) as specified in PRE.B8.1998.

2. Use environmentally friendly materials and provide supporting documents and record on the use of the following materials for the Works:

a. Timber Used for Temporary Works (BEAM Plus prerequisite IDCM P3 refers)

i. Use sustainable timber for temporary works during construction as specified in PRE.B8.2450 and CON2.M080;

ii. Provide supporting documents including chain-of-custody certificate, purchase order, delivery order, site photos etc..

b. Minimum Waste Handling Facilities (BEAM Plus prerequisite MWP1 refers)

i. Provide and install waste handling facilities to collect, sort, store different waste, including metal, plastics, paper and glass and provide necessary documents to demonstrate adequate provisions as required by BEAM Plus New Buildings (Version 2.0) manual.

c. Modular and Standardised Design (BEAM Plus credit MW 2 refers)

i. Implement and demonstrate that not less than 50% (whether by mass, volume, dollar value or surface area) of the major elements (i.e. structural elements, façade elements and architectural / internal building elements) of the Contract adopt modular design;

ii. Provide supporting documents including calculations showing the percentage of precast concrete components, maps showing the distance between the manufacturing factory and the Site, site photos etc..

d. Prefabrication (BEAM Plus credit MW 3 refers)

i. Implement and demonstrate that not less than 40% of the precast concrete components are fabricated off-site and the manufacturing factory is located within 800 km from the Site;

ii. Provide supporting documents including calculations showing the percentages of precast concrete components, maps showing the distance between the manufacturing factory and the Site, site photos etc..

e. Sustainable Forest Products (BEAM Plus credit MW 5 refers)

i. Use timber doorsets and other timber/composite timber product such that at least 30% (for residential) and 50% (for non-residential) of the timber is originated from sustainable sources;

ii. Provide supporting documents including calculations showing the percentages of timber products originated from sustainable sources (such as the Forest Stewardship Council (FSC), the American Forest and Paper Association (AFPA) or Programme for the Endorsement of Forest Certification (PEFC) or other “known licensed sources”), chain-of-custody certificates, purchase orders, delivery orders, site photos etc..

f. Recycled Materials (BEAM Plus credit MW 6 refers)
   i. Implement and demonstrate that at least 10% of all materials used for site exterior surface works, structures and features with recycled content;
   ii. Provide supporting documents including calculations showing the percentages of recycled content originated, summary table with product details, purchase orders, delivery orders, site photos etc..

g. Ozone Depleting Substances - Ozone depleting materials (BEAM Plus credit MW 7b refers)
   i. Use zero ozone depleting potential products for thermal insulation and fire retardant materials in building fabrics and building services;
   ii. Provide supporting documents including catalogues of thermal insulation materials and fire retardant materials etc..

h. Regional Manufactured Materials (BEAM Plus credit MW 8 refers)
   i. Ensure and demonstrate that not less than 20% of all the building materials are manufactured locally within 800 km from the Site;
   ii. Provide supporting documents including maps showing the distance between the manufacturing plants and the Site, documents from the suppliers listing the names of the manufacturers and the locations of the manufacturing plants and delivery orders etc..

i. Additional Recyclables Collection and Additional Facility Provisions to Enable Enhanced Municipal Solid Waste (MSW) Charging Scheme (BEAM Plus credit MW 12a+b refers)
   i. Provide and install additional recycling facilities such as food waste (food waste machine), battery and light bulbs/tubes and other electronic products;
   ii. Provide facilities for collection, sorting, storage and disposal to enable MSW charging;
   iii. Provide necessary supporting documents to demonstrate adequate provisions as required by BEAM Plus New Buildings (Version 2.0) manual.

j. Air-Conditioning (AC) Units - Compliance with Manufacturer's Recommendation (BEAM Plus credit EU 6 refers)
   i. Maintain minimum separation criteria from walls, other AC units and walls at air-intake side, by complying with manufacturer's recommended installation positions for optimal heat rejection.

k. Minimum Water Saving Performance (BEAM Plus credit WU P1 refers) and Annual Water Use (BEAM Plus credit WU 1 refers)
   i. Use water efficient devices specified in PLU2.M510 that lead to an annual saving of not less than 30% of the original consumption of potable water when calculated in accordance with the method described in BEAM Plus New Buildings (Version 2.0) manual;
   ii. Provide supporting documents including catalogues of water efficient devices, calculations showing the percentages of water saving etc..

l. Water Efficient Irrigation (BEAM Plus credit WU 2 refers)
   i. Provide necessary supporting documents of the irrigation system, catalogues of controllers and photogenic evidence of ZIS, to demonstrate compliance of the credits.

m. Water Leakage Detection (BEAM Plus credit WU 4 refers)

i. Install water leakage detection systems in all potable water tank rooms and provide related supporting documents as specified in BEAM Plus New Buildings (Version 2.0) manual.

n. Effluent Discharge to Foul Sewers (BEAM Plus credit WU 7 refers)

i. Use water closets with dual-flush cisterns as specified in PLU2.M110 and urinal of Grade 1 or Grade 2 under the Voluntary Water Efficiency Labelling Scheme on Urinal Equipment by the Water Authority with water flush volume per cycle not greater than 2 litres/cycle that lead to an annual saving by more than 20% of the original discharge of flush water calculated in accordance with the method described in BEAM Plus New Buildings (Version 2.0) manual;

ii. Provide supporting documents including catalogues of efficient discharge devices, calculations showing the percentages of discharge reduction etc..

3. Liaise and coordinate with building services Nominated Sub-contractors to carry out their BEAM Plus related work according to the requirements in the nominated sub-contracts reproduced in Appendix W of the sub-contract specification, monitor their work progress, and consolidate their documents as follows:

a. Monitor the progress of the building services works in the Nominated Sub-contracts relevant to achieving the target BEAM Plus prerequisites and credits stipulated in the Nominated Sub-contracts;

b. Liaise with the Commissioning Agents of the Nominated Sub-contractors, coordinate the testing and commissioning works for the building services Nominated Sub-contracts, and monitor the progress of their testing and commissioning works including the preparation of all necessary documentation;

c. Consolidate the documents to be submitted by the Nominated Sub-contractors for BEAM Plus submission and submit the same to the CM for approval.

4. Liaise and coordinate with Direct Term Contractors to carry out their BEAM Plus related work for BEAM Plus submission.

PRE.B8.2830.9 FILING SYSTEM FOR BEAM PLUS ASSESSMENT

1. Establish and maintain organized filing system to facilitate BEAM Plus assessment for BEAM Plus prerequisites and credits;
2. The filing system shall include supporting documents such as monitoring and implementation records, substantiation and demonstration documents etc. to justify satisfactory compliance with the BEAM Plus prerequisites and credit requirements.

PRE.B8.2840.9 MONTHLY BEAM PLUS MONITORING REPORT

1. Submit the format and framework of the BEAM Plus Monitoring Report within 14 days from the date of commencement of the Works for approval by the CM;
2. Submit monthly BEAM Plus Monitoring Report to the CM and BEAM Plus consultant for review within 7 days after the end of each month;
3. The BEAM Plus Monitoring Report shall cover all BEAM Plus prerequisites and credits in PRE.B8.2820 and include the following:

a. A summary of the key construction activities with record photos for the reporting month, project progress, and the latest construction program;

b. A site facility layout plan showing all the monitoring locations for construction dust and construction noise, and all the environmental mitigation facilities including waste-water recycling facilities, on-site sorting facilities, vehicle washing facilities etc.;

c. All environmental licenses for construction;

d. A summary of the mitigation measures for air pollution, noise pollution, light pollution, water pollution and considerate construction implemented on Site and corresponding substantiation showing that these mitigation measures have been properly implemented;

e. Monitoring results of construction dust, construction noise and discharged water samples, and corresponding monthly monitoring reports, calibration certificates for equipments, certificates of analysis and remedial actions taken to comply with the specified limits;

f. A summary of the waste management measures implemented on Site and corresponding substantiation showing that these measures have been properly implemented;

g. Waste Flow Table specified in PRE.B8.2520 and all the CHIT / DDF and / or receipt from the disposal grounds;

h. Detailed report on water quality test;

i. Supporting documents showing the use of materials for the Works are in compliance with sub-clause (2) of PRE.B8.2820.

4. Consolidate and submit monthly BEAM Plus monitoring report submitted by Nominated Sub-contractors;

5. At completion of the Contract, consolidate all monthly BEAM Plus Monitoring Reports into a final report to facilitate the BEAM Plus assessment.

PRE.B8.2850.9 BEAM PLUS COORDINATION MEETING

1. Attend regular BEAM Plus Coordination Meeting arranged by BEAM Plus consultant to report, discuss, resolve and record BEAM Plus and its related issues;
2. The BC shall be present in the regular BEAM Plus Coordination Meeting;
3. Provide additional supporting information as requested by CM or BEAM Plus consultant to demonstrate the requirements of BEAM Plus prerequisites and credits are met;
4. Submit minutes of meeting to CM and BEAM Plus consultant within 7 days after the date of the meeting.

PRE.B8.2860.9 CONSIDERATE CONSTRUCTION

1. Encourage care of workers, mitigate nuisances to immediate neighbours and passers-by during construction
   a. To implement considerate measures for “neighbourhood and passers-by” and “Care of Workers and Others” during construction;
   b. Protocols shall make reference to the assessment criteria recommended in “Being Considerate to Neighbourhood and Passer-by” and “Care of Workers and Others” of the Considerate Contractors Site Award Scheme Guidelines, which include “Appendix V – Scope of Assessment Criteria” of “Development Bureau and Construction Industry Council - Considerate Contractors Site Award Scheme Guideline for Non-Public Works Site Participation”, and “Appendix V – Scope of Assessment Criteria” of “Development Bureau and Construction Industry Council - Considerate Contractors Site Award Scheme Guideline for Public Works Site Participation”;
   c. Provide supporting documents as specified in PRE.B8.2820 to demonstrate implementation of considerate measures for neighbourhood, passers-by and workers during construction and application of corrective actions to avoid continuous dissatisfaction of neighbourhood, passers-by and workers / non-compliance of any item(s) of those measures in PRE.B8.APPEND9.
2. Promote good practices of tree protection during construction

a. If tree preservation within the Site is required, good tree protection practices shall be implemented;

b. Good tree protection practices shall make reference to the latest "Guideline on Tree Preservation during Development" published by Greening, Landscape and Tree Management Section of Development Bureau, HKSAR Government;

c. Provide supporting documents as specified in PRE.B8.2820 to demonstrate good tree protection practices during construction and application of corrective actions to avoid continuous dissatisfaction of neighbourhood, passers-by and workers / non-compliance of any item(s) of those measures specified in PRE.B8.APPEND9.

WORKS WITHIN THE RAILWAY PROTECTION AREA

PRE.B8.2900.9 GENERAL

Further to the provisions of Clause SCC22.4 / SCC22.8 of the Special Conditions of Contract, comply with PRE.B8.2905 to PRE.B8.2995 for works to be carried out within the Railway Protection Area as defined in the Contract and as shown on the Drawing referred to in PRE.B6.850.

PRE.B8.2905.9 PROCEDURE FOR POSSESSION

Provided the Contractor has completed all his obligations to obtain a Possession and has made satisfactory arrangements with MTRCL in respect of the extent of working area and procedure for such Possession, MTRCL shall before the Possession advise the Contractor of the detailed time, limits and conditions with which the Contractor must comply.

PRE.B8.2910.9 WORKING IN THE VICINITY OF THE RAILWAY TRACK

Except with the prior written approval of MTRCL the Contractor shall not carry out any works in the vicinity of the railway track without the attendance of a MTRCL's Competent Person to take care of track safety.

PRE.B8.2915.9 TRESPASSING ON RAILWAY PREMISES

The Contractor shall be responsible for ensuring that none of his personnel, sub-contractors or other persons employed by him or on his behalf proceed beyond the agreed limits of the working area or access route or trespass upon railway premises.

PRE.B8.2920.9 PREVENTION OF ACCIDENTS

Before entry is made within the railway premises, the Contractor shall consult MTRCL regarding the latest safety requirements for working within the railway premises. The Contractor shall brief each person employed by or on behalf of him, and those employed by or on behalf of any sub-contractor who may work on or above the track, including persons recruited during the progress of the Works. The Contractor shall ensure that all such persons are fully conversant with the requirements and that those requirements are strictly observed. The Contractor shall arrange induction courses for each and every member of staff (including those of the sub-contractors and the CM) before they are allowed to work within the railway premises and he shall arrange for all personnel to wear identification cards to facilitate control if required by MTRCL.

PRE.B8.2925.9 WORKS DESIGNED BY CONTRACTOR

Where the Contractor is required to carry out any design works for permanent or temporary works, the Contractor shall prepare the design works with reference to the DEVB TC(W) No. 1/2019 on Railway Protection and shall in addition to the requirements specified in other relevant contract documents:

1. Hold early preliminary discussions, through the CM, with MTRCL and make provisional arrangements so that the works can be carried out with the minimum interference to railway traffic and within the extent of Restriction, Possession and Isolation periods that MTRCL can make available. The actual dates for any Restriction, Possession or Isolation previously agreed may, depending on the railway traffic requirements, be subject to amendment by MTRCL when the firm program is drawn up. If MTRCL agrees that such works do not require a Restriction, Possession or Isolation then no early provisional arrangements are necessary;
2. Submit full details, drawings and calculations of such works for consideration by MTRCL. No examination by MTRCL of any document submitted by the Contractor or of any Contractor's drawings of such works or agreement expressed by MTRCL shall absolve the Contractor of his responsibility for the adequacy of the design;
3. Bear in mind that there are certain restraints on the design of and making alteration to properties in close proximity to a railway vent shaft to minimize the possibility of contamination by fire or smoke. Openings of the new structure such as an openable or fixed window, doorway, building ventilation system intake or exhaust and the like in any building shall be located not closer than 5 m to any railway vent shaft, irrespective of whether such vent shaft is free-standing or is accommodated in a building. The distance may be reduced to 2.5 m if the exhaust air from the railway vent shaft is directed away from and is not likely to affect the opening by natural convection.

PRE.B8.2930.A METHOD OF CARRYING OUT THE WORKS AND USE OF PLANT

1. At least six weeks prior to the commencement of those part of the Works within the Railway Protection Area, full details, including calculations, drawings and construction method statements on such permanent works, temporary works, slope works, drainage works, tree planting works, ground investigation works, hoarding works, fire protection measures, lifting operations, construction sequence and program and the likes shall be submitted to MTRCL for comments and agreement. MTRCL's agreement with such submission shall not relieve the Contractor of any of his duties or responsibilities under the Contract;
2. All works and plant operations within the Railway Protection Area shall be carried out in such manner as to avoid risk of danger to the railway traffic facilities and to passengers or to persons entitled to be within the railway premises and so as to avoid (except to the extent previously agreed in writing) any interference with or obstruction of the free movement of the railway traffic or any such passengers or persons;
3. Detailed plans and sections showing the relationship amongst the proposed works, plant operations, railway structures and tracks shall be provided for MTRCL's prior comments and agreement;
4. All works shall be arranged and carried out in compliance with the requirements as stipulated in the "Technical Notes for Guidance in Assessing the Effects of Civil Engineering Construction / Building Development on Railway Structures and Operations" in APPENDIX PRE.B8/XVII to this Specification and the "Key industrial safety precautions for Contractors working within railway premises" in APPENDIX PRE.B8/XVIII to this Specification respectively;
5. Prior to the commencement of any structural works in connection with railway structure, if agreed by MTRCL, a structural compatibility check certified by the original designer of the railway structure or by a Registered Structural Engineer shall be submitted to MTRCL for comments and agreement. As built information of the railway structure can be viewed in MTRCL;

6. Assessment to check the effects induced in railway structures / installations arising from the works in accordance with the "Technical Notes for Guidance in Assessing the Effects of Civil Engineering Construction / Building Development on Railway Structures and Operations" in APPENDIX PRE.B8/XVII to this Specification shall be carried out and submitted to MTRCL for prior comments and agreement;
7. Any damage done to railway structures / installations or any works done which affect the safe operation of the railway shall be repaired and reinstated by the Contractor to the satisfaction of MTRCL;
8. Prior to the commencement of any works within the Railway Protection Area, a survey to record the condition of the railway structures / installations constructed within 30 m from the works shall be carried out and submitted to MTRCL for comments and agreement;
9. The movement, deformation, change in stress and vibration induced in any railway structures / installations arising from the works shall be monitored by the Contractor. A monitoring proposal shall be submitted to MTRCL for prior comments and agreement;
10. No excavated materials, building materials, debris, containers, sheds of any kind, huts, compressors, power generators, dangerous goods or inflammable materials shall be placed or stored within 6 m of the railway premises;
11. At all times, a safe, fluent and unimpeded passageway must be maintained on the Site for MTRCL staff to all railway structures / installations;
12. The free and unblocked passenger access, maintenance access and emergency vehicle access (EVA) of the railway must not be affected by the works at all times;
13. Working Hours:
    a. Prior comments and agreement from MTRCL shall be obtained on the working hours for the works such as erection of hoarding, working platform, lifting operations and all other works to be carried out within railway premises as well as in the vicinity of the railway structures and installation such as overhead power cables which will in the opinion of MTRCL affect the safe operation of the railway. MTRCL may require these works to be carried out outside the peak railway traffic hours or to be carried out during the non-traffic hours of the railway.
14. Site Representative:
    a. When working within or above the railway premises and/or within 6 m of the railway track and/or overhead power cables, the Contractor shall provide a competent site representative to supervise the proper execution of the works. The site representative shall be a professionally qualified engineer and a member of the Hong Kong Institution of Engineers or the Institution of Civil Engineers, UK or equivalent, and have site management experience appropriate to the nature of works;
    b. The site representative shall have the authority to receive and carry out the directives and instructions from MTRCL. The site representative shall carry a mobile phone at all times and respond to the MTRCL's calls immediately;
    c. The site representative shall be present on Site full time during the construction works carried out within or above the railway premises and/or within 6 m of the railway track and/or overhead power cables. If such site representative is absent, no works shall be allowed to be executed.
15. MTRCL's Competent Persons:

a. All works to be carried out within or above the railway premises and/or the works which have high risk on the safe operation of the railway and are required by MTRCL to be carried out during non-traffic hours of the railway, shall be carried out in the presence of a MTRCL's Competent Person and/or MTRCL's engineer's person-in-charge and/or hand signalman and/or lookoutman depending on the nature of the works and its possible effects on the railway. The Contractor shall be required to make request to MTRCL three weeks in advance for such arrangements.

16. With regard to all works to be carried out within railway premises, the Contractor shall apply for the necessary construction noise permit from the relevant Government departments;
17. For safety and operational reasons, MTRCL shall have the authority to stop the works when required. The Contractor shall stop the works immediately when such an instruction is given by MTRCL and the works shall not be resumed until permission is given by MTRCL;
18. Before the Contractor takes over the Site within the Railway Protection Area, the Contractor shall establish an effective communication channel amongst MTRCL, the CM and the Contractor. Such a communication channel shall be adequate to cover all hours;
19. MTRCL shall be informed at least three weeks prior to the actual commencement of any site works.

PRE.B8.2935.A INTERFERENCE WITH DRAINS AND SERVICES

1. The Contractor shall not interfere with the MTRCL's cables, signals, telegraph wires or any other apparatuses affecting the operations of the railway. The Contractor shall give sufficient notice to MTRCL to enable him to arrange for any diversion, protection or support works which MTRCL considers could be and should be carried out prior to the commencement of any works which may affect such apparatuses;
2. The Contractor shall not interfere with any public utility services within the railway premises. The Contractor shall give sufficient notice to the Utility Undertakings, the MTRCL and/or the relevant Government departments to enable them to arrange for any diversion, protection or support works which they consider could be and should be carried out prior to the commencement of any works which may affect such services;
3. The Contractor shall ensure that no metallic object (including metallic surveying tapes) is allowed to come into contact with two or more running rails nor bridge the gap across insulated rail joints. Failure to do so will cause interference with the signaling system and corresponding delays to traffic;
4. The Contractor shall divert to a suitable outlet, by pipes or other means, water from springs, water courses, or drains which may be affected by the works and every reasonable precaution shall be taken by the Contractor to prevent damage to MTRCL's property. The Contractor shall not be allowed without the prior agreement of MTRCL to make temporary or permanent connections to the railway drains, pipes or other services.

PRE.B8.2940.9 CROSSING THE TRACK

Persons engaged on the Works shall not be allowed to cross or convey material across the tracks except under conditions previously agreed in writing by MTRCL.

PRE.B8.2945.9 OVERHEAD ELECTRICIAL EQUIPMENT

The Contractor's attention is drawn to the presence of the overhead electrical equipment which should be treated live at all times unless it has been isolated and earthed. Overhead electrical equipment is charged at high voltage and the Contractor shall observe the following precautions:

1. Works shall not be carried out, cranes or other plant shall not be erected, operated or dismantled, or materials shall not be stored, within the prohibited space which is within 3 m of a vertical plane from the nearest live overhead electrical equipment including return conductors and all supports to such electrical equipment;
2. The prohibited space in sub-clause (1) above shall be increased by the length of any tool or material being handled. However, works below the overhead electrical equipment on the permanent way, platforms, walkways and the like is permitted without special precautions provided that tools or equipment are not at any time raised or extended above head height;
3. The prohibited space in sub-clause (1) above shall be increased by the length of the longest individual unit of any scaffolding. MTRCL may require the scaffolds or similar apparatuses to be earthed;
4. If a crane or other construction equipment is used, crane stops, protective catch fence and warning notices shall be provided by the Contractor to ensure that there can be no encroachment by the crane, load or other construction equipment on the prohibited space defined in sub-clause (1) above even if such crane, load or construction equipment slips, fails, falls or overturns. The design of the protective catch fence shall be agreed with MTRCL;
5. Portable ladders used shall be of non-conducting material and shall not be reinforced by metal attachments running along the stiles of the ladders. Special precautions must be taken to ensure that the ladder cannot slip and encroach on the prohibited space defined in sub-clause (1) above;
6. Any disturbance of or attachment to any equipment forming part of the overhead electrical equipment system must be carried out by authorized personnel of MTRCL;
7. Provided that where it is impracticable to comply with any of the above requirements, the Contractor shall request MTRCL to arrange any possible special precautions which MTRCL considers could be taken.

PRE.B8.2950.9 USE OF EXPLOSIVES

Explosives shall not be used in connection with the Works without the written consent of MTRCL and the Commissioner of Mines, Hong Kong Special Administrative Region. If approval to blast is given then it shall only be carried out under such conditions as the Commissioner of Mines may impose.

PRE.B8.2955.9 EMERGENCY CREW

The Contractor shall provide an emergency crew during heavy rains and typhoons and, if required by MTRCL, at critical stages of the Works. The name of, and the method of communication with, the person who will be in charge of the crew for the following month shall be forwarded to MTRCL not less than two weeks before the first day of that month.

PRE.B8.2960.9 STACKING OF MATERIAL

The Contractor shall stack and place all materials, plant and appliances in such a manner as to prevent their causing injury or damage to persons or property and at a safe distance both from railway tracks and platform edges, normally not less than 2.8 m from the nearest rail of operating track or 2.5 m from a platform edge, but subject to the requirements as specified in PRE.B8.2945. The Contractor shall also strictly observe any instructions given by MTRCL as to the precautions to be taken and the distance from railway tracks and platform edges within which materials, plant and appliances shall not be stacked or placed.

PRE.B8.2965.9 SCREENING OF LIGHTS

All lights provided by the Contractor shall be placed or screened so as not to interfere with any railway signals and shall not form a source of glare to the train operator. The Contractor shall inform MTRCL and obtain his written permission before commencing any temporary works which might interfere with the railway signals or the sighting of such.

PRE.B8.2970.9 FIRE PREVENTION

The Contractor shall during the performance of the works make adequate arrangements, to the satisfaction of MTRCL, for the protection of the works and any adjacent railway premises from fire and shall comply with MTRCL's requirements, if any, with regard to such protection. The Contractor shall give MTRCL all facilitations to inspect the fire prevention arrangements within the railway premises and within such distance from them as MTRCL may consider necessary and shall remove such materials and take such steps to reduce the fire risk as MTRCL may from time to time require.

PRE.B8.2975.9 NOTICE OF ACCIDENTS

In the case of any accident arising out of the works within the railway premises, the Contractor shall without delay notify MTRCL in addition to any other notification which he is required to make by law and/or under the Contract.

PRE.B8.2980.9 ADVERTISEMENTS

The Contractor shall not permit any advertisement to be displayed within the railway premises.

PRE.B8.2985.A CLEARANCE OF LAND AND PROPERTY WITHIN THE RAILWAY PREMISES

The Contractor shall prevent mud or water falling or draining from the Works on to the land or property within the railway premises and particularly on to the track, ballast or walkways. The Contractor shall not leave any rubbish on the land and property within the railway premises. The Contractor shall clear away and remove all Constructional Plant, surplus materials and temporary works as and when in the opinion of MTRCL these cease to be required for the works being carried out. Any damage to the land or property within the railway premises shall be repaired and reinstated to the satisfaction of MTRCL.

PRE.B8.2990.A CONDITIONS FOR WORKING WITHIN / IN THE VICINITY OF THE RAILWAY PREMISES

The Contractor shall be liable for and shall indemnify and keep indemnified MTRCL against any liabilities, claims or proceedings in respect of any damage or injury arising out of or in connection with his works within/in the vicinity of the railway premises. The Contractor shall complete and provide to MTRCL an indemnity and a letter of undertaking in the form set out in APPENDIX PRE.B8/XIX and APPENDIX PRE.B8/XX to this Worksection respectively.

PRE.B8.2995.9 RATE OF CHARGE FOR SERVICE / INFORMATION PROVIDED BY MTRCL

The Contractor shall be responsible for the payment of service / information provided by MTRCL. The rate of charge for service / information provided by MTRCL is set out in Appendix U to this Specification for reference only.

ROBOTIC CONSTRUCTION

PRE.B8.3000.9 ROBOTIC CONSTRUCTION APPLICATION

1. The Contractor shall be responsible for the design and execution of the robotic construction application as stipulated in the Technical Proposals as referred to in Clauses SCC1.1 and SCC4.2 of the Special Conditions of Contract and shall comply with the implementation programme and details with the CM's comments incorporated as referred to in PRE.B8.3005;
2. The robotic construction application shall comply with all statutory regulations together with any revisions or amendments made thereto;
3. Review with the CM or his representatives on the robotic construction application for the Works throughout the progress of the application.

PRE.B8.3005.B SUBMISSION REQUIREMENTS

1. Submit to the CM the following for each type of the robotic construction application no later than 90 days before the commencement of the area of works for the robotic construction application for comment:
   a. Implementation programme including but not limited to the areas of works for the robotic construction application, the type and number of robots to be deployed, the trials and mock-ups, the application stages and periods in respect of the robotic construction application;
   b. Details of the robotic construction application including but not limited to the design, procurement and operation details, photos, manufacturer's information, country of origin, manufacturing date, specification, job records of the robots to be deployed, arrangement to facilitate lifting, access, and transportation of robots to working floors or the area of works, the method statements and resources allocated for the robotic construction application, the detail of merits in productivity, quality, safety, and environment, and any other information related to the robotic construction application as required under PRE.B8.3010 or by the CM. A schematic sketch of arrangement to facilitate lifting, access and transportation of robots to working floors or the area of works is given in drawing no. REF/RO/S/SK-001 in Appendix U to this Specification. The sketch is for reference only and given in good faith without prejudice to the Contractor's responsibilities and liability under the Contract;
   c. Name and details of the service provider or supplier and operators for the robots;
   d. Emergency plan in the event of breakdowns, repairs or regular maintenance of the robots.
2. Submit to the CM for acceptance a mock up for each type of the robotic construction application no later than 60 days before commencement of the area of work for the robotic construction application to demonstrate the assemblage, workmanship and installation of the Contractor's proposed robotic construction;
3. Submit to the CM the following during the currency of robotic construction application for comment:
   a. Monthly progress report including but not limited to the progress of each type of the robotic construction application, record of any robot / machinery breakdown and any challenge encountered during construction;
   b. Any proposed change in the details of the robotic construction application;
   c. Any other information or mitigation proposal related to the robotic construction application as required by the CM.
4. Submit to the CM the appraisal report on each type of the robotic construction application with the following items for acceptance on completion of each type of the robotic construction application:

a. The resource utilised in comparison with the same works completed manually;
b. Performance in terms of productivity, quality, safety and environment in comparison with the same works completed manually;
c. Running cost during construction in comparison with the same works completed manually;
d. Recommendation / conclusion for future adoption;
e. Any other aspects as required by the CM.

PRE.B8.3010.N OPERATIONAL REQUIREMENTS

1. Ensure the working area is suitably designed and accessible for robotic construction applications, and maintain unobstructed pathways and provide necessary safeguard to workers and operators for safe and efficient robot manoeuvring and operation;
2. All robot(s) applied for robotic construction application shall comply with the following operational requirements, unless agreed by the CM:
   a. A wireless operational device with user interface shall be provided for operation mode, parameter set-up and control. The device shall also display real-time operational parameters, including but not limited to, operating mode and status, path planning and settings, battery level and fault alerts;
   b. Provide a software system which automatically record and store operational data, such as runtime logs, battery status, emergency stop events, and alarm records. The Contractor shall make the data available for download by the CM or his representatives daily during the currency of robotic construction application or upon requested, and shall be kept on-site until the date of certified completion of the Works;
   c. The robot shall be powered by rechargeable battery;
   d. The robot shall comply with the safety provisions and requirements listed below:

Safety Provision	Requirement
Emergency Stop (E-Stop)	Equip with an easily accessible and hardwired E-Stop button which shall immediately halt all robot movements and operations.
Alert System	Implement an alert system that an audible and visual alarm shall be activated in case of collision or malfunctions or abnormal conditions.
Self-Diagnostic Check	Provide a self-diagnostic check on all functional modules upon start-up and display real-time status feedback in wireless operational device.
Secured Parts and Devices	Ensure all parts and auxiliary devices are firmly secured during robot operation.

3. Robotic construction application for internal wall and ceiling painting works shall comply with the following additional operational requirements:
   a. The robot shall be equipped with automatic navigation and motion control function (e.g. LiDAR, SLAM) to enable autonomous movement, positioning and spraying operations;
   b. The operators for robot shall have satisfactorily completed the CIC training course on Certificate in Robotic Painting Application.

PRE.B8.3015.N MINIMUM EXTENT OF ROBOTIC CONSTRUCTION APPLICATION FOR INTERNAL WALL AND CEILING PAINTING WORKS

1. When robotic construction is applied for internal wall and ceiling painting works, the minimum extent of the robotic construction application shall include the first finishing coat of all internal walls and ceilings in all domestic flats excluding kitchens and bathrooms for eight typical floors for every domestic block. Painting works at areas (e.g. corners, electrical fixtures, domestic flats with temporary works), where it is unsuitable for robotic construction application may be completed manually as approved by the CM.

BUILDING INFORMATION MODELLING (BIM)

PRE.B8.4000.9 DEFINITIONS

1. "Design BIM Model" means a BIM model created at design stage for the Works;
2. "Construction BIM Model" means a BIM model developed by the Contractor for the Works at construction stage;
3. "Common Data Environment" means a centralized electronic document management system for sharing and storing the digital data for the project.

PRE.B8.4010.9 GENERAL

The Contractor shall adopt BIM in executing the Works and submit all the deliverables as detailed in this Specification.

PRE.B8.4020.A BIM TEAM

1. BIM Team Set up

   The Contractor shall set up a BIM Team comprising a BIM Manager and BIM Coordinator(s) and Modeller(s) with the qualifications and experiences requirements stated in PRE.B6.060 to complete all BIM tasks and deliverables.

2. Sub-contracting BIM

   If the Contractor does not have the necessary expertise, the Contractor shall engage a competent sub-contractor for the performance of BIM-related tasks. The BIM team of the sub-contractor shall meet the qualifications and experiences requirements stated in PRE.B6.060 to complete all BIM tasks and deliverables. The sub-contracting arrangement shall not relieve the Contractor of any duty or responsibility under the Contract.

PRE.B8.4030.D BIM DELIVERABLES

The Contractor shall submit the following deliverables:

1. BIM Execution Plan (BEP)
   a. The Contractor shall prepare and submit a BEP for the CM's approval in accordance with the requirements of BIM tasks and the BIM Deliverables Programme as stipulated in this clause and PRE.B8.4090 respectively. Full details of the preparation of the Construction BIM Models and collaboration process shall be defined in the BEP and the outline of which shall fulfil the requirements of the BIM Standards and Guidelines stated in PRE.B8.4080;
   b. The BEP shall be reviewed and updated regularly by the Contractor, or as requested by the CM. The Contractor shall bear all associated costs and the extra time required.
2. BIM Models and Uses

Option 1

   a. Development of the BIM Models

Option 1A

i. The Design BIM Models will be provided by the CM. The Contractor may make use of the Design BIM Models to develop the Construction BIM Models for foundation works. No expressed or implied warranty is given on the accuracy of any contents in the Design BIM Models if provided. The Contractor shall be responsible for verifying the information contained in the Design BIM Models before using it to develop the Construction BIM Models for foundation works.

Option 1B

i. The Contractor shall create the Construction BIM Models for foundation works from Drawings.

b. Content of the Construction BIM Models for foundation works

The Construction BIM Models shall be created, developed and updated to the satisfaction of the CM. The Construction BIM Model shall contain but not limited to the following elements:

Structural (foundation)

1.	All superstructure elements which shall include columns, structural walls, screen walls, stud walls etc. 500mm above the footings / pile caps levels.
2.	All foundation elements which shall include footings, piles, pile caps, tie beams and strap beams.
3.	Existing site topography, retaining walls, slopes or other geotechnical features within the Site.
4.	3D rockhead contours for piles and footings prepared based on the ground investigation, the pre-drilling and the post construction proof drilling.
5.	Pre-drilling and post-installation proof drilling G.I. logs data which can be embedded in the BIM model in the form of 3D image or G.I. log family to facilitate the geological section plot.
6.	Temporary works to be handed over to the building contractor such as steel platforms, sheet piles, pipe piles, king posts, strutting and waling etc.
7.	Hyperlinks embedded in each model elements of piles / pile caps / footings and other elements which enable the retrieval of construction records, if provided by the CM.

Option 2

a. Development of the BIM Models

Option 2A

i. The Design BIM Models will be provided by the CM. The Contractor may make use of the Design BIM Models to develop the Construction BIM Models for different works trades and / or professional disciplines. No expressed or implied warranty is given on the accuracy of any contents in the Design BIM Models if provided. The Contractor shall be responsible for verifying the information contained in the Design BIM Models before using it to develop the Construction BIM Models for different works trades and / or professional disciplines.

Option 2B

i. The Contractor shall create the Construction BIM Model for different works trades and / or professional disciplines from Drawings.

b. Content of the Construction BIM Model

The Construction BIM Models of different works trades and / or professional disciplines shall be created, developed and updated to the satisfaction of the CM. The Construction BIM Model shall contain but not limited to the following elements:

i. Architectural

1.	Existing and new retaining walls, slopes, services, drainage, buildings, surroundings, trees, access to Site and site topography.
2.	Building elements such as internal and external walls and columns, floor slabs, ramps, roofs, staircases, doors, windows, louvres, ironmongery, finishes, raised floors, false ceilings with access openings, sanitary fittings, balustrades, parapets, railings, architectural features, signage, furniture, play / fitness equipment, planters, covered walkways, roads and footbridges.
3.	Rooms, spaces, corridors, voids and openings (all with area).
4.	Schedules (Finishes, doors, windows, louvres, ironmongery, signage, etc.).
5.	Hard and soft Landscape such as tree / landscape plan including existing preserved trees / trees to be transplanted / planting plan / planting schedule.

ii. Structural (superstructure)

1.	All superstructure elements which shall include columns, beams, structural walls, screen walls, stud walls, slabs, staircases, transfer structures, water tanks, etc.
2.	All Modular Integrated Construction (MiC) elements (if any) and precast elements such as volumetric precast bathrooms / kitchens, precast tie beams, semi-precast slabs, precast water tanks, precast staircases, precast façades, etc.
3.	External works (structural-related) such as refuse collection points, carpark covers, lift-towers, footbridges and bearings, covered walkways, etc.
4.	Proposed and existing site topography, retaining walls, soil nails, man-made and natural slopes, surface channels, catch-pits, slope drainage systems and other geotechnical features within the Site.

iii. Mechanical, Electrical and Plumbing (MEP)

1.	Air Conditioning and Mechanical Ventilation Installation including but not limited to chillers, pumps, cooling towers, air handling units, A/C units, ventilation fans, water tanks, air duct systems, water / refrigerant pipes and the corresponding power and control signal system with their exposed cable containment and accessories.
2.	Fire Services and Water Pump Installation including but not limited to water pumps, pipework and associated fittings, control panels, hydrant / hose reel system, street fire hydrant system, sprinkler and drencher system, gas extinguishing system, fire alarm system, all other fire services equipment and the corresponding power and control signal system with their exposed cable containment and accessories.

3.	Electrical Installation including but not limited to switchboards, switchgears, circuit breakers, generating sets, busbar chambers and trunkings, all exposed cables and cables containments, switches, sockets, lightings, lamp poles, carpark control and management facilities with their accessories and exposed equipment for earthing and lightning protection system, CABD system, Fixed Telecommunication Network Services (FTNS) system, security & CCTV system, public address system, photovoltaic system, electric vehicle chargers, automatic meter reading (AMR) system for water supplies and smart meter monitoring and energy information display system.
4.	Lift, Machine-room-less (MRL) Lift and Escalator Installation including but not limited to lift, MRL lift and escalator equipment and the corresponding power and control signal system with their exposed cable containment and accessories.
5.	Plumbing and Drainage Installation including but not limited to all pipework and associated fittings and valves of all sizes, pipework and meter arrangement inside master water meter room / cabinet and accessories.
6.	All underground / aboveground cable ducts, pipeworks and drainage with associated manholes, cable and valve pits structure.
7.	All concealed installations at the congested areas (e.g. precast elements for corridors at typical floor) as specified by the CM.

Option 3

a. Development of the BIM Models

Option 3A

i. The Design BIM Models will be provided by the CM. The Contractor may make use of the Design BIM Models to develop the Construction BIM Models for different works trades and / or professional disciplines. No expressed or implied warranty is given on the accuracy of any contents in the Design BIM Models if provided. The Contractor shall be responsible for verifying the information contained in the Design BIM Models before using it to develop the Construction BIM Models for different works trades and / or professional disciplines" if appropriate.

Option 3B

i. The Contractor shall create the Construction BIM Models for different works trades and / or professional disciplines from Drawings.

b. Content of the Construction BIM Model

The Construction BIM Models of different works trades and / or professional disciplines shall be created, developed and updated to the satisfaction of the CM. The Construction BIM Model shall contain but not limited to the following elements:

i. Architectural

1.	Existing and new retaining walls, slopes, services, drainage, buildings, surroundings, trees, access to Site and site topography.
2.	Building elements such as internal and external walls and columns, floor slabs, ramps, roofs, staircases, doors, windows, louvres, ironmongery, finishes, raised floors, false ceilings with access openings, sanitary fittings, balustrades, parapets, railings, architectural features, signage, furniture, play / fitness equipment, planters, covered walkways, roads and footbridges.

3.	Rooms, spaces, corridors, voids and openings (all with area).
4.	Schedules (Finishes, doors, windows, louvres, ironmongery, signage, etc.).
5.	Hard and soft Landscape such as tree / landscape plan including existing preserved trees / trees to be transplanted / planting plan / planting schedule.

ii. Structural (foundation)

1.	All foundation elements which shall include footings, piles, pile caps, tie beams and strap beams.
2.	Existing site topography, retaining walls, slopes or other geotechnical features within the Site.
3.	3D rockhead contours for piles and footings prepared based on the ground investigation, the pre-drilling and the post construction proof drilling.
4.	Pre-drilling and post-installation proof drilling G.I. logs data which can be embedded in the BIM model in the form of 3D image or G.I. log family to facilitate the geological section plot.
5.	Hyperlinks embedded in each model elements of piles / pile caps / footings and other elements which enable the retrieval of construction records, if provided by the CM.

iii. Structural (superstructure)

1.	All superstructure elements which shall include columns, beams, structural walls, screen walls, stud walls, slabs, staircases, transfer structures, water tanks, etc..
2.	All Modular Integrated Construction (MiC) elements (if any) and precast elements such as volumetric precast bathrooms / kitchens, precast tie beams, semi-precast slabs, precast water tanks, precast staircases, precast façades, etc..
3.	External works (structural-related) such as refuse collection points, carpark covers, lift-towers, footbridges and bearings, covered walkways, etc..
4.	Proposed and existing site topography, retaining walls, soil nails, man-made and natural slopes, surface channels, catch-pits, slope drainage systems and other geotechnical features within the Site.

iv. Mechanical, Electrical and Plumbing (MEP)

1.	Air Conditioning and Mechanical Ventilation Installation including but not limited to chillers, pumps, cooling towers, air handling units, A/C units, ventilation fans, water tanks, air duct systems, water / refrigerant pipes and the corresponding power and control signal system with their exposed cable containment and accessories.
2.	Fire Services and Water Pump Installation including but not limited to water pumps, pipework and associated fittings, control panels, hydrant / hose reel system, street fire hydrant system, sprinkler and drencher system, gas extinguishing system, fire alarm system, all other fire services equipment and the corresponding power and control signal system with their exposed cable containment and accessories.

3.	Electrical Installation including but not limited to switchboards, switchgears, circuit breakers, generating sets, busbar chambers and trunkings, all exposed cables and cables containments, switches, sockets, lightings, lamp poles, carpark control and management facilities with their accessories and exposed equipment for earthing and lightning protection system, CABD system, Fixed Telecommunication Network Services (FTNS) system, security & CCTV system, public address system, photovoltaic system, electric vehicle chargers, automatic meter reading (AMR) system for water supplies and smart meter monitoring and energy information display system.
4.	Lift, Machine-room-less (MRL) Lift and Escalator Installation including but not limited to lift, MRL lift and escalator equipment and the corresponding power and control signal system with their exposed cable containment and accessories.
5.	Plumbing and Drainage Installation including but not limited to all pipework and associated fittings and valves of all sizes, pipework and meter arrangement inside master water meter room / cabinet and accessories.
6.	All underground / aboveground cable ducts, pipeworks and drainage with associated manholes, cable and valve pits structure.
7.	All concealed installations at the congested areas (e.g. precast elements for corridors at typical floor) as specified by the CM.

Option 1

c. BIM Uses

i. The Contractor shall implement the following BIM uses for carrying out the Works (excluding Government Entrusted Works, which shall comply with the requirements stated in sub-paragraph (ii) below):

1.	Design Authoring	To use BIM authoring tools for developing the items where the design responsibility is borne by the Contractor.
2.	Design Review	To use BIM for design review.
3.	Existing Conditions Modelling	To create a BIM model of the existing site conditions (including area within the Site boundary and surrounding area cover an area of 50m radius measured from the Site boundary) for facilitating construction planning.
4.	Site Analysis	Not used.
5.	3D Coordination	To use BIM model in conducting design coordination process including but not limited to identifying design clashes and eliminating design errors and conflicts before construction.
6.	Cost Estimation	To make use of the Design BIM Models (where available) to substantiate the Contractor's quotations for Variations as far as practicable.
7.	Engineering Analysis	Not used.
8.	Facility Energy Analysis	Not used.

9.	Sustainability Evaluation	To fulfill the requirement of BEAM Plus New Buildings (Version 2.0) IDCM 16 (b) BIM Integration - Coordinated Use of BIM within Design and Construction Teams.
10.	Space Programming	Not used.
11.	Phase Planning (4D Modelling)	To utilise an interactive 4D model (3D models with the added dimension of time) for Phase Planning, and to visually demonstrate and communicate project construction sequence based on proposed design and requirements, as far as practicable. The Contractor shall export the BIM models in an open format and utilise the 4D modelling software to link the updated construction programme with the appropriate sets of model geometry to visualise the works progress. 4D modelling shall also be used to compare and track the planned start date and the actual start date of critical construction activities to mitigate the potential delay of the works.
12.	Digital Fabrication	Not used.
13.	Site Utilization Planning	To use BIM models for site layout planning including reviewing space planning, site logistics, sequencing requirements, temporary works and site safety.
14.	3D Control and Planning	Not used.
15.	As-Built Modelling	To handover a full set of as-built models (excluding asset management data) reflecting actual physical conditions of the foundation works with Level of Development (LOD) in accordance with Housing Authority BIM Standards and Guidelines (HABIMSG) – LOD Responsibility Matrix. The required format, folder structure, inventory lists, etc. shall be in accordance with HABIMSG – Project Archive. The as-built models shall contain as-built piling records / schedules which shall include but not limited to the duration of each construction activity, concrete / grout casting dates and volumes of concrete / grout for each pile / footing etc.
16.	Project Systems Analysis	Not used.
17.	Maintenance Scheduling	Not used.

18.	Space Management and Tracking	Not used.
19.	Asset Management	Not used.
20.	Drawing Generation (Drawing Production)	To utilise BIM for generating foundation works related construction and as-built drawings unless justified that it is technically impracticable.

ii. Government Entrusted Works

For works entrusted by other Government departments as demarcated on Drawing No. …… in Appendix …… of the Specification, the Contractor shall comply with Development Bureau (DevB) Technical Circular (Works) No. 1/2025or subsequent revisions on the Adoption of Building Information Modelling for Capital Works Projects in Hong Kong, and the Project Administration Handbook for Civil Engineering Works published by CEDD or subsequent revisions on the collation of survey, mapping and geospatial data.

The Contractor shall comply with the requirements in relation to Intellectual Property Rights under the Contract and shall indemnify and keep indemnified the Employer from and against all claims on infringement of Intellectual Property Rights for utilising the Construction BIM Models submitted by the Contractor.

Option 2

c. BIM Uses

i. The Contractor shall implement the following BIM uses for carrying out the Works (excluding Government Entrusted Works, which shall comply with the requirements stated in sub-paragraph (ii) below):

1.	Design Authoring	To use BIM authoring tools for developing the items where the design responsibility is borne by the Contractor. Such items are selected by the CM from the list stated in PRE.B6.085.
2.	Design Review	To use BIM for design review.
3.	Existing Conditions Modelling	To create a BIM model of the existing site conditions (including area within the Site boundary and surrounding area cover an area of 50m radius measured from the Site boundary) for facilitating construction planning.
4.	Site Analysis	Not used.
5.	3D Coordination	To use BIM model in conducting design coordination process including but not limited to identifying design clashes and eliminating design errors and conflicts before construction.
6.	Cost Estimation	To make use of the Design BIM Models (where available) to substantiate the Contractor's quotations for Variations and to make use of BIM to substantiate the estimated amount of the Contractor's Requested Variation Proposal as far as practicable.

7.	Engineering Analysis	Not used.
8.	Facility Energy Analysis	Not used.
9.	Sustainability Evaluation	To fulfill the requirement of BEAM Plus New Buildings (Version 2.0) IDCM 16 (b) BIM Integration - Coordinated Use of BIM within Design and Construction Teams.
10.	Space Programming	Not used.
11.	Phase Planning (4D Modelling)	To utilise an interactive 4D model (3D models with the added dimension of time) for Phase Planning, and to visually demonstrate and communicate project construction sequence based on proposed design and requirements, as far as practicable. The Contractor shall export the BIM models in an open format and utilise the 4D modelling software to link the updated construction programme with the appropriate sets of model geometry to visualise the works progress. 4D modelling shall also be used to compare and track the planned start date and the actual start date of critical construction activities to mitigate the potential delay of the works.
12.	Digital Fabrication	To digitalise the construction details of mass customized components which are of large quantities and variety in dimensions, shapes, geometries, etc. and modular construction units as requested by the CM in order to facilitate the fabrication of construction materials or assemblies.
13.	Site Utilization Planning	To use BIM models for site layout planning including reviewing space planning, site logistics, sequencing requirements, temporary works and site safety.
14.	3D Control and Planning	To ensure that the proposed Works are accurately positioned according to the design intent reflected in the BIM model before construction through the use of appropriate surveying instruments and verify after construction that the BIM model truly reflects the as-built conditions.

15.	As-Built Modelling	To handover a full set of as-built models (excluding asset management data) reflecting actual physical conditions of the Works with Level of Development (LOD) in accordance with Housing Authority BIM Standards and Guidelines (HABIMSG) – LOD Responsibility Matrix. The required format, folder structure, inventory lists, etc. shall be in accordance with HABIMSG – Project Archive. The as-built models shall contain as-built records / schedules which shall include but not limited to the duration of each construction activity, concrete / grout casting dates and volumes of concrete / grout for each pile / footing (if any) etc..
16.	Project Systems Analysis	Not used.
17.	Maintenance Scheduling	Not used.
18.	Space Management and Tracking	Not used.
19.	Asset Management	Not used.
20.	Drawing Generation (Drawing Production)	To utilise BIM for generating drawings including but not limited to Combined Services Drawings (CSD), Combined Builder's Works Drawings (CBWD), construction and as-built drawings unless justified that it is technically impracticable.

ii. Government Entrusted Works

For works entrusted by other Government departments as demarcated on Drawing No. …… in Appendix …… of the Specification, the Contractor shall comply with Development Bureau (DevB) Technical Circular (Works) No. 1/2025or subsequent revisions on the Adoption of Building Information Modelling for Capital Works Projects in Hong Kong, and the Project Administration Handbook for Civil Engineering Works published by CEDD or subsequent revisions on the collation of survey, mapping and geospatial data.

The Contractor shall comply with the requirements in relation to Intellectual Property Rights under the Contract and shall indemnify and keep indemnified the Employer from and against all claims on infringement of Intellectual Property Rights for utilising the Construction BIM Models submitted by the Contractor.

3. BIM Progress Report

a. The Contractor shall make use of BIM to indicate work progress, construction method, coordination of works between different project participants, checking of clashes with proposed solutions to the CM in regular site meetings as stipulated in PRE.B8.1410;

b. Any conflict, clash and coordination issue identified shall be documented in the format of clash reports as part of the BIM progress report;

c. The Contractor is required to make use of BIM and link the activities in the up-to-date programme referred to in GCC Clause 5.7 to conduct 4D model simulation in accordance with the BIM Deliverables Programme as stipulated in PRE.B8.4090. The 4D simulation report and 4D animated video shall be included as parts of the BIM progress report showing work progress since the last report;

d. A summary of the key construction activities shall be recorded and supported with date-marked site photos and reference snapshots of the relevant portions of BIM models to demonstrate the progress of the Works in regular site meetings. The Contractor shall use the latest Work in Progress (WIP) BIM to facilitate discussion at the site meetings.

PRE.B8.4040.B QUALITY ASSURANCE

1. Quality Control Document

   a. The Contractor shall establish quality assurance plan for BIM and include it into BEP to ensure appropriate checks on information and data accuracy, including compliance with the requirements set out in the BIM Standards and Guidelines as listed at PRE.B8.4080.

   b. The Contractor shall ensure all the BIM Models have complied with the quality assurance plan before handover to the CM. The Contractor shall be responsible for the accuracy of the BIM Models and BIM deliverables, including but not limited to that of dimensions, levels and all graphical and non-graphical information, etc.

   c. The Contractor shall submit a BIM Quality Assurance Report in accordance with the BIM Standards and Guidelines Documents as listed at PRE.B8.4080. The Contractor shall aware that the acceptance of the BIM Quality Assurance Report by the CM shall in no way relieve the Contractor of the responsibilities and obligations under the Contract.

2. BIM Objects

   a. All BIM objects created by the Contractor shall comply with the applicable version of BIM Standards and Guidelines Documents as listed at PRE.B8.4080. The Contractor shall use or make reference to Housing Department's standard BIM objects in creating the Construction BIM Model(s) as appropriate. These standard BIM objects will be released to the Contractor or accessible through the Housing Department's computer system. When necessary, Housing Department will provide an access account to the Contractor to get access to the Housing Department's computer system and retrieve the standard BIM objects.

   b. The standard BIM objects were provided for reference only. The Contractor shall be responsible for verifying the information contained in the standard BIM objects and make their own judgement in making necessary amendments for performing this Contract. The Employer accepts no liability for any use of the standard BIM objects or reliance placed on the information contained in them.

3. BIM Update Frequency

   The Contractor shall provide the first set of Work in Progress (WIP) BIM in accordance with the BIM Deliverables Programme as stipulated in PRE.B8.4090 and update monthly thereafter by making WIP BIM and other relevant files available on the Common Data Environment.

4. Collaboration and Model Sharing

   The CM shall continue to use the Design BIM Model for design, variation and statutory amendment submissions during the construction stage. The Contractor shall in parallel work on the Construction BIM Model and ensure that his model is synchronised monthly with the Design BIM Model whenever changes are made and informed by the CM.

PRE.B8.4050.X DELETED

PRE.B8.4060.B HARDWARE AND SOFTWARE REQUIREMENTS

1. Hardware Requirements

   The Contractor shall provide at least 2 workstations complying with the minimum requirements of specification shown in the below table and software requirements as listed in sub-clause (2) below for exclusive use by the CM and his representatives throughout the progress of the Works until issue of the maintenance certificate.

a.	Multi-core CPU with performance benchmark score[1] of 20,000 or above depending on modelling details and complexity of the projects.
b.	64GB RAM.
c.	2TB SSD M.2 (1st Hard Drive).
d.	2TB SSD M.2 (2nd Hard Drive).
e.	Video performance benchmark[2] score ranging from 15,000 to 26,000 depending on modelling details and complexity of the projects; At least 8 GB GDDR6 GPU Memory; At least two Display Ports.
f.	Windows 10 (or newer) Professional Edition 64-bit Operating System.
g.	2 x 27" inches or larger and use of 4K monitors.
h.	Comply with Energy Star, or obtained an Energy Label under the Energy Efficiency Labelling Scheme of EMSD; Product components should comply with Restriction of Hazardous Substances (RoHS).

[1] High End CPU score - https://www.cpubenchmark.net/high_end_cpus.html

[2] High End Video Card score - https://www.videocardbenchmark.net/high_end_gpus.html

2. Software Requirements

   The software used for creating BIM models and components/families shall be compatible with that used by the CM and his representatives. The software is considered compatible when the CM and his representatives are able to open and edit the files with their own software without any data loss. The Contractor shall demonstrate to the CM's satisfaction that the aforementioned requirement can be met by the software proposed to be used.

   BIM software types should include the following:

   a. BIM modelling software (including architecture, structure, MEP, civil and geotechnical);

   b. BIM viewer software;

   c. Any other software required to deliver the various BIM uses listed above.

3. Software Upgrade

   The Contractor may be required to provide more than one version of the software within the course of the Contract. The Contractor is required to upgrade the final BIM deliverables to the version specified by the CM at his own cost.

PRE.B8.4070.C COMMON DATA ENVIRONMENT (CDE)

Option 1

1. Use of CDE

a. A CDE, as a BIM common data collaboration platform (BIM CDCP), shall be provided by the Contractor in accordance with the approved BEP for collaboration and model sharing. Access right shall be granted to the CM or his representatives. The Contractor shall provide CDE licenses for approximately 30 to 60 project team members (including the CM, CM's Representative and Contractor). The Contractor shall consult the CM or his representatives for the actual number of CDE licenses required and bear all associated costs and the extra time required;

Option 2

1. Use of CDE
   a. A CDE, as a BIM common data collaboration platform (BIM CDCP), shall be provided by the Contractor in accordance with the approved BEP for collaboration and model sharing. Access right shall be granted to the CM or his representatives. The Contractor shall provide CDE licenses for approximately 50 to 80 project team members (including the CM, CM's Representative and Contractor). The Contractor shall consult the CM or his representatives for the actual number of CDE licenses required and bear all associated costs and the extra time required;
   b. The Contractor shall continuously use his best endeavors to protect the data on the CDE from any cyber risks and regularly back up and archive the files on the CDE. The Contractor shall bear all consequences if he fails to do so;
   c. The Contractor shall assist the CM or his representatives to install the CDE mobile applications (App) or alternatively access the CDE through the web browser in the smartphones as stipulated in PRE.B10.465.
2. Time Limit for Setting Up CDE

   The CDE shall be implemented within 1 month from the notified date for commencement of the Works and be utilised throughout the progress of the Works until submission of final as-built BIM model, handover of the CDE's files or 6 months after the date of certified completion of the Works, whichever is the latest.
3. CDE Requirements

   The CDE provided by the Contractor shall achieve the following functional requirements:
   a. Provide a user-customizable access right control and folder structure;
   b. Support uploading, downloading, navigating BIM models and retrieving the attributes and information from the BIM models in an open format (not limited to IFC) on the CDE;
   c. Provide file version / revision control;
   d. Provide a feature for comparing BIM models from different versions / revisions and automated identification of differences;
   e. Provide a feature for linkage between different BIM models, 2D drawings and project documents within the CDE;
   f. Allow access from portable devices and web applications;
   g. Contain encryption, installed with anti-virus software and maintained with updated security patches for data security;
   h. Provide sufficient capacity to store all files throughout the contract period;
   i. Provide dashboards for presenting the BIM progress information to different levels of users;
   j. Provide a user customizable workflow for document submission and approval;
   k. Provide an issue tracking system including the issue registration, logging, update and email notification to selected user accounts;
   l. Provide off-site backup of all project BIM models, documents and data;

m. Provide a workflow for managing information process with reference to ISO 19650-2:2018;

n. Provide project archive feature;

o. Allow electronic signature (e-signature);

p. Provide audit trail of the information stored in the CDE.

4. The Contractor shall provide any support to the project team about the use of CDE such as user manual and / or coaching workshop.

PRE.B8.4080.B BIM STANDARDS AND GUIDELINES

1. BIM Standards and Guidelines Documents

The Contractor shall refer to the following BIM Standards and Guidelines Documents and adopt in the Works unless otherwise instructed by the CM:

a. Housing Authority BIM Standards and Guidelines (HABIMSG) (version ……..……...)

The applicable version of the HABIMSG could be downloaded from HA's website;

(link:https://www.housingauthority.gov.hk/en/business-partnerships/resources/building-information-modelling/)

b. Latest version of BIM Standards and Guidelines as specified by the client department / bureau for projects with Government Entrusted Works;

c. Latest version of BIM-related guidelines and practice notes issued by Buildings Department and / or Independent Checking Unit of the Hong Kong Housing Authority.

2. Level of Development

The BIM models developed by the Contractor shall comply with the appropriate LOD requirements as stipulated in the BIM Standards and Guidelines Documents as listed in sub-clause (1) above.

3. File Size of Models

BIM models created shall be maintained at reasonable file size. Guidelines contained in BIM Standards and Guidelines Documents as listed in sub-clause (1) above shall be followed.

PRE.B8.4090.D CONTRACTOR'S RESPONSIBILITY

1. Make Reference to BIM-related documents in Design Stage

At an agreed date with the CM after the notified date for commencement of the Works, the Contractor may obtain a set of BIM-related documents used in the design stage including but not limited to an up-to-date design stage BEP, Design BIM Models, registration lists with descriptions of the models, etc. if available. The Contractor shall:

a. Create his initial Construction BIM Model based on the given BIM-related documents. The said design stage documents shall be used by the Contractor for reference only without limiting the Contractor's obligations and liabilities under this Contract. No claim for cost, time or whatsoever will be entertained on account of any errors, discrepancies, omissions, insufficiency of the said information;

b. Review, verify the given BIM-related documents, issue queries and seek the CM's clarification within 2 months of receipt of the said documents in case of any ambiguities or discrepancies found in or between the Design BIM Model and the Contract documents.

2. Services to the CM and his representatives and Site Staff

The Contractor shall allow sufficient competent staff resources to provide support to the CM and his representatives and Site Staff in relation to any BIM-related matters throughout the progress of the Works until submission of final as-built BIM model or 6 months after the date of certified completion of the Works, whichever is later, including but not limited to the following:

a. Provide guidance in BIM model building;
b. Input and update data in BIM model;
c. Highlight identified design conflicts or clashes;
d. Resolve model building difficulties and provide on-site technical support.

3. BIM Deliverables Programme

The Contractor shall submit BIM deliverables to the CM or other relevant parties as instructed by the CM, in accordance with the following schedule:

	Deliverables	Time for submission
1.	BIM Execution Plan (BEP)	Within 30 days from the notified date for commencement of the Works
2.	Existing Conditions Modelling	According to the project programme
3.	BIM Progress Report including but not limited to clash analysis	In regular site meeting as stipulated in PRE.B8.1410
4.	Work in Progress (WIP) BIM	Within 30 days from the notified date for commencement of the Works Submit and update the WIP BIM monthly to the Common Data Environment during construction period
5.	Phase Planning (4D Modelling)	At 4 months intervals (included in BIM Progress Report)
6.	Combined Services Drawings (CSD), Combined Builder's Works Drawings (CBWD) BIM models together with required drawings	Within 9 months from the notified date for commencement of the Works
7.	As-built BIM models	First submission of as-built BIM models within 3 months after the date of certified completion of the Works Revised as-built BIM models within 1 month from the issuance of comments from the CM Final as-built BIM models within 6 months after the date of certified completion of the Works
8.	Drawing Generation (Drawing Production)	According to the project programme
9.	Quality Assurance Plan for BIM and BIM Quality Assurance Report	According to the BIM Standards and Guidelines Documents as listed at PRE.B8.4080

10.	Common Data Environment files	Within 6 months from the date of completion of the Works as certified by the CM

Remarks:

1. In addition to the above schedule, the Contractor shall submit BIM model(s) / drawing(s) generated from BIM as requested by the CM in electronic format and hard copy at anytime. Bear all associated costs and the extra time required.
2. The Contractor shall also fulfill the requirement of submission and updating the BIM Deliverables as stated elsewhere in the Contract.

REALITY CAPTURE

PRE.B8.4200.N DEFINITIONS

1. "Reality Capture" is a process of scanning an object, asset, build or natural environment to create a digital representation. The output from the scanning process is the creation of a digital snapshot using image or laser scanning devices;
2. "Laser Scanning" is a process of capturing precise, three-dimensional information using a laser as a light source to collect high density point cloud from a real-world object, a group of objects, or an environment;
3. "Terrestrial Laser Scanner" means a stationary device that is capable of acquiring point clouds of distant objects, surfaces, buildings and landscapes in millimetre accuracy by Laser Scanning;
4. "MMS" stands for mobile mapping system. It means an integrated system of navigation and remote sensing sensors that is mounted on a moving platform to collect geospatial data by Laser Scanning and / or high-resolution cameras;
5. "Scan-to-BIM" is a process of digitally capturing a physical building, landscape or site as point cloud, and then using it for the creation and development of a BIM model;
6. "Point cloud" is a set of data points in a three-dimensional coordinate system. Each point represents a single spatial measurement on the object's surface. Taken together, a point cloud represents the entire external surface of an object;
7. "3D photo-realistic model" is a collection of vertices, edges, and textured faces that together form a three-dimensional object.

PRE.B8.4210.N GENERAL

Conduct all the Reality Capture tasks and submit all deliverables as detailed in this Specification.

PRE.B8.4220.N INSTRUMENTS

Calibrate all instruments used for the Reality Capture tasks according to the manufacturers' specifications upon commencement of the Reality Capture tasks and related works and at regular intervals as specified in PRE.B8.1490. The Contractor shall submit the calibration certificates to the CM for record after calibration.

PRE.B8.4230.N EXTENT AND SCOPE OF REALITY CAPTURE TASKS

1. Extent and scope of Reality Capture tasks for domestic block(s):
   a. Extent of Reality Capture tasks for domestic block(s):
      i. The extent is demarcated in Drawing No(s). …… stated in Appendix …… of the Specification;
      ii. The extent include:
         - Block no. ……. , at …… stage;
            • Main entrance floor at Floor no. …….;

- Floor no. …….;
- Floor no. …….;
- Main roof floor, lift machine room floor and/or upper roof floor;

- Block no. ……..;
- ……...

b. Scope of Reality Capture tasks for domestic blocks(s):

i. Use MMS, or an equipment approved by the CM, to document the condition of the following areas:

- Main Entrance floor including entrance lobby, floor, wall, ceiling (excluding the void above false ceiling), tactile, door, counter, refuse storage and material recovery chamber (RS&MRC), refuse collection point (RCP) (if applicable), junk collection point (if applicable), electrical and mechanical services rooms such as telecommunications and broadcasting equipment (TBE) room, pump rooms, FS control room, main switch room, emergency generator room, electrical meter rooms, etc., and exposed building services installation such as fire services manual actuating point, fire hydrant, exit / directional sign, lift call button, etc, and interior of all rooms;
- Two domestic floors including domestic flats, wall, ceiling (excluding the void above false ceiling, if any), common corridor, lift lobby, temporary refuge spaces (TRS), wheelchair manoeuvring spaces at corridor end, refuse storage and material recovery room (RS&MRR), upper and lower staircase flights and landings, and interior of all rooms;
- Main roof floor, lift machine room floor and / or upper roof floor (if applicable) including floor, floor metal platform (excluding the void below floor metal platform), wall and ceiling (excluding the void above false ceiling), photovoltaic panels (if any), and interior of all rooms.

ii. Commence the scanning works within 5 working days from receipt of CM's notification for Reality Capture tasks, and submit the deliverables within …… working days after commencement of the scanning works;

iii. Create, edit and update the point cloud and submit the deliverables stated in sub-clause (2) of PRE.B8.4240 to the satisfaction of the CM.

2. Extent and scope of Reality Capture tasks for non-domestic facilities:

a. Extent of Reality Capture tasks for non-domestic facilities:

i. The extent is demarcated in Drawing No(s). …… stated in Appendix …… of the Specification;

ii. The extent include, at …… stage:

- Carpark at floor no. ……;
- Retail at floor no. ……;
- Welfare facilities at floor no. ……;
- ……..;
- ……

b. Scope of Reality Capture tasks for non-domestic facilities:

i. Use MMS, or an equipment approved by the CM, to document the condition of the following areas:

EITHER

- Non-domestic areas including entrance lobby, floor, wall, ceiling (excluding the void above false ceiling), tactile, door, counter, refuse rooms, refuse collection point (RCP), junk collection point, common corridor, lift lobby, toilets, electrical and mechanical services rooms such as telecommunications and broadcasting equipment (TBE) room, pump rooms, FS control room, main switch room, emergency generator room, electrical meter rooms, etc., and exposed building services installation such as fire services manual actuating point, fire hydrant, exit / directional sign, lift call button, upper and lower staircase flights and landings, etc, and interior of all rooms;
- Main roof floor, lift machine room floor and upper roof floor (if applicable) including floor, floor metal platform (excluding the void below floor metal platform), wall and ceiling (excluding the void above false ceiling) and interior of all rooms.

OR

- The following areas are to be documented by the Contractor:
  - ……. ;
  - ……. .
- Commence the scanning works within 5 working days from receipt of CM's notification for Reality Capture tasks, and submit the deliverables within …… working days after commencement of the scanning works;
- Create, edit and update the point cloud and submit the deliverables stated in sub-clause (2) of PRE.B8.4240 to the satisfaction of the CM.

3. Extent and scope of Reality Capture tasks for record of existing and / or as-built building elements or objects:
   a. The extent of Reality Capture tasks is demarcated in Drawing No(s). …… stated in Appendix …… of the Specification;
   b. Scope of Reality Capture tasks for record of existing and / or as-built building elements or objects:
      i. Use Terrestrial Laser Scanner, or an equipment approved by the CM, to document the existing and / or as-built building elements or objects as stated in the above sub-clause (3)(a);
      ii. The following building elements and / or objects are required to be documented by the Contractor:
         - ……..……;
         - ……
      iii. Commence the scanning works within 5 working days from receipt of CM's notification for Reality Capture tasks, and submit the deliverables within …… working days after commencement of the scanning works;
      iv. Create, edit and update the point cloud and submit the deliverables stated in sub-clause (2) of PRE.B8.4240 to the satisfaction of the CM.
4. Extent and scope of Reality Capture tasks for Scan-to-BIM:
   a. The extent of Reality Capture tasks is demarcated in Drawing No(s). …… stated in Appendix …… of the Specification;
   b. Scope of Reality Capture tasks for Scan-to-BIM:
      i. Use Terrestrial Laser Scanner, or an equipment approved by the CM, to document the existing condition of building elements and / or objects, and convert the point cloud into an as-built BIM model and building plans;

ii. The following building elements and / or objects are required to be scanned and modelled by the Contractor:

- ……;
- ……

iii. Commence the scanning works within 5 working days from receipt of CM's notification for Reality Capture tasks, and submit the deliverables within …… working days after commencement of the scanning works.

iv. Create, edit and update the point cloud and submit the deliverables stated in sub-clause (2) of PRE.B8.4240 to the satisfaction of the CM.

5. Extent and scope of Reality Capture tasks for existing tree(s):
   a. The extent of Reality Capture tasks is demarcated in Drawing No(s). …… stated in Appendix …… of the Specification;
   b. Scope of Reality Capture tasks for existing tree(s):
      i. Use Terrestrial Laser Scanner or MMS, or an equipment approved by the CM, to document the specified existing tree(s), including all visible part(s) of the tree(s) and / or all exposed parts of external works features, such as planter kerb, etc., adjacent and related to the specified existing tree(s);
      ii. Commence the scanning works within 5 working days from receipt of CM's notification for Reality Capture tasks, and submit the deliverables within …… working days after commencement of the scanning works;
      iii. Create, edit and update the point cloud and submit the deliverables stated in sub-clause (2) of PRE.B8.4240 to the satisfaction of the CM.

PRE.B8.4240.N REALITY CAPTURE DELIVERABLES

1. Method statement and work schedule
   a. Submit the following deliverables within 30 days from the notified date for commencement of the Works of the contract, or at a time agreed by the CM, for the CM's approval:
      i. Method Statement

         Prepare a method statement showing all the Reality Capture tasks including instrument specifications, full details of the field procedures, processing parameters, collaboration process, file format of deliverables and validation method shall fulfil the requirements as given in the Specification and the Reality Capture Standards and Guidelines Documents stated in PRE.B8.4260.

      ii. Work Schedule

         Prepare a detailed work schedule showing the Reality Capture tasks in the above method statement with the respective scheduled completion dates.
2. Other Deliverables
   a. Prepare and submit the following in relation to the Reality Capture tasks in the above method statement, as approved by the CM, according to the approved work schedule and to the satisfaction of the CM:
      i. File(s) including but not limited to the following:
         - Images from MMS with at least 4 x 20 mega pixel camera in HDR mode, and stitch a 720° or spherical panoramic images 100% cover front, left, right, back and top views with at least 8K resolution in Tiff, JPEG or other formats as agreed by the CM. The scale, position and orientation of the 720° or spherical panoramic images shall match the processed point cloud without misalignment;

- Raw point cloud captured by at least 2 x 32-layer Class 1 lidar sensors with at least 1,280,000 point per second.

ii. Images from Terrestrial Laser Scanner with at least 1 x 12 mega pixel camera in HDR mode or 1 x 16 mega pixel panoramic camera in HDR mode, and stitch a 720° or spherical panoramic images with at least 4K resolution in Tiff, JPEG or other formats as agreed by the CM. The scale, position and orientation of the 720° or spherical panoramic images shall match the processed point cloud without misalignment;

iii. Projection file(s) that contains the scale, position and orientation parameters of each 720° or spherical panoramic images in txt, JSON or other formats as agreed by the CM;

iv. Processed point cloud containing the coordinates, elevation, intensity values and Red-Green-Blue Colour (RGB) values with at least 5 mm point cloud density in LAS, E57, RCP or other formats as agreed by the CM. The point cloud shall be geo-referenced to an appropriate coordinate system as agreed by the CM;

v. Registration report to prove the quality of the processed point cloud;

vi. Field verification report with at least 8 check points evenly distributed around the site and agreed by the CM, and site photos to prove the accuracy of the processed point cloud;

vii. As-built BIM model and building plans as stated in sub-clause (4) of PRE.B8.4230;

viii. Report for tree works including but not limited to the following:

- Tree information with dimensional indication for tree(s) extracted by crown segmentation of point cloud of tree(s). Tree information shall include tree-tag numbers, coordinates in northing and easting, tree height, diameter at breast height (DBH), crown spread and crown volume, crown density and live crown ratio, etc., in .CSV format;
- 3D photo-realistic model of the tree(s) and external works feature(s) adjacent and related to the tree(s) in interchangeable formats compatible with the BIM software used by the CM and his representatives;
- Clash analysis integrating the point cloud, 3D photo-realistic model with the BIM model of the design;
- At least 3 numbers of 3D images and / or 2D drawings with dimension demarcation for each tree and related external works features illustrating the impact and effect of the works and tree works;
- 3D animation / video of about 20 seconds for presentation in .AVI and MP4 format.

b. All the deliverables and a free for use viewer software shall be submitted in a storage media such as portable hard disk or by other means as agreed by the CM with the following functional requirements:

i. Support the hosting of 720° or spherical panoramic images, projection file(s) and processed point cloud;

ii. Support the view of 720° or spherical panoramic images and processed point cloud together in one view with layer on-off control;

iii. Provide 2D and 3D viewer with different viewer layout (e.g. one single view, side-by-side view, mini-map view, etc.);

iv. Provide mark-up, measurement and transparent functions as agreed by the CM.

PRE.B8.4250.N QUALITY ASSURANCE

1. Sample Check

   Upon request of the CM, facilitate the CM in surveillance checks on all survey records, computations and instruments in relation to the Reality Capture tasks. The percentage of sample check for quality assurance of the deliverables is subject to the direction of the CM.

2. Quality Control Document

   a. Establish a quality assurance plan for the as-built BIM model to ensure appropriate checks on information and data accuracy including:

      i. Compliance with the requirements set out in the Reality Capture Standards and Guidelines Documents as listed at PRE.B8.4260;

      ii. Format, such as software version and extension;

      iii. Naming, such as name of the files and their corresponding folders;

      iv. General settings, such as line style, levels, grid, survey point, project base point, shared coordinates and coordinate system, shared parameters, attributes;

      v. Compliance of geometry of the model components with the required LOD-G level at the corresponding project stage as stipulated in the Reality Capture Standards and Guidelines Documents as listed at PRE.B8.4260;

      vi. BIM model cleanliness checked to ensure that there are no unintended model components and the actual site condition has been documented;

      vii. Clash detection carried out to detect and resolve any interference / clashes between building components virtually;

      viii. Consistency of documentation such as drawings and reports generated from the as-built BIM model being a single source of truth.

   b. Ensure the as-built BIM model has complied with the quality assurance plan before handover to the CM. The Contractor shall be responsible for the accuracy of the as-built BIM model and as-built BIM deliverables, including but not limited to that of dimensions, levels and all graphical and non-graphical information, etc.;

   c. Submit a BIM Quality Assurance Report in accordance with the Reality Capture Standards and Guidelines Documents as listed at PRE.B8.4260. The Contractor shall be aware that the acceptance of the BIM Quality Assurance Report by the CM shall in no way relieve the Contractor of his responsibilities and obligations under the Contract.

3. BIM Objects

   a. All BIM Objects created by the Contractor shall comply with the applicable version of Reality Capture Standards and Guidelines Documents as listed at PRE.B8.4260. Make use of or make reference to Housing Department's standard BIM objects in creating the as-built BIM model as appropriate. These standard BIM objects will be released to the Contractor or accessible through the Housing Department's IT system. When necessary, the Employer will provide an access account to the Contractor to get access to the Housing Department's IT system and retrieve the standard BIM objects;

   b. The standard BIM objects are provided for reference only. The Contractor shall be responsible for verifying the information contained in the standard BIM objects and exercise his own judgement in making necessary amendments to them for performing this Contract. The Employer accepts no liability for any use of the standard BIM objects or reliance placed on the information contained in them.

PRE.B8.4260.N REALITY CAPTURE STANDARDS AND GUIDELINES

1. Standards and Guidelines Documents

   Refer to the latest version of the following standards and guidelines and adopt in the Reality Capture tasks as far as practicable unless otherwise instructed by the CM:

   a. Land and Engineering Survey Board's Engineering Survey Practice Guides for Works Projects. Details may be found at Civil Engineering and Development Department's website (https://www.cedd.gov.hk);

   b. Housing Authority BIM Standards and Guidelines (HABIMSG) as stipulated in sub-clause (1)(a) of PRE.B8.4080.

MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MiMEP)

PRE.B8.5010.N SCOPE OF WORK

1. The Specification in this Worksection is only applicable to off-site prefabricated modules integrating equipment, components, pipework, fittings and the associated supporting frame / hanger system;
2. The Contractor shall adopt wider use of MultiTrade Integrated Mechanical, Electrical and Plumbing (MiMEP) approach to improve site safety, more efficient and better quality control, shortened construction period, less construction waste, less demand for on-site labour, less disturbance and nuisance to the neighbourhood, etc. as far as practicable.

PRE.B8.5020.N SITE COORDINATION

1. The Contractor shall ensure proper site provisions, including but not limited to the following, are in place at suitable time for the smooth execution of the whole MiMEP construction process:
   a. Sufficient loading and unloading area;
   b. Hoisting / Lifting facilities;
   c. Vehicular access;
   d. Barrier-free logistic route;
   e. Temporary openings and ramps for delivery;
   f. Working space.
2. The construction sequences of builder's works such as erection of wall, metal gate or cabinet etc. at relevant working locations shall be coordinated and adjusted as appropriate to suit the on-site assembly and installation of MiMEP modules;
3. The detailed production cycle and the on-site installation and assembly programme of MiMEP modules and its relation with the relevant builder's works schedule shall be well coordinated and illustrated in the master construction programme.

PRE.B8.5030.N DESIGN REQUIREMENTS

1. The Contractor shall coordinate with sub-contractors to verify the following design considerations in their proposal of individual off-site prefabricated MiMEP modules, prior to submission to CM for approval:
   a. Layout and configuration of MiMEP modules shall be well planned and coordinated in a fashion of an effective modular design to ease on-site delivery, assembly and installation with minimisation of pipework joints as far as practicable;

b. The volumetric size and geometry of individual MiMEP modules shall be optimized to suit the particular site environment for proper transportation, hoisting, delivery and assembly on Site;

c. Adequate access to the system components for inspection, operation and maintenance shall be allowed after the assembly of MiMEP modules.

PRE.B8.5040.N DELIVERY AND SITE STORAGE

1. The Contractor shall make available a proper logistic route and associated builder's works provisions to enable the seamless delivery of individual MiMEP modules of different dimensions and weight;
2. Construction sequences of builder's works such as water tank, wall, metal gate or cabinet etc. at respective working locations / plant rooms of assembly and along the logistic route shall be adjusted as appropriate to suit the delivery programme.

APPENDIX PRE.B8/I

PRE.B8.APPEND1.9 WASTE FLOW TABLE

Sheet 1 of 4

Contract Title and No.: _____

Monthly Summary Waste Flow Table for Year / Year

Month	Estimated Quantity of Inert C&D Materials (in '000 m³)													
	Total Quantity Generated		Suitable for Recycled Aggregates			Reused in the Contract		Reused in Other Projects				Disposed as Public Fill		
	(a)		(b)			(c)		(d)				(e = a – b – c – d)		
	Est.	Act.	Est.	Act.	Location of Recycling	Est.	Act.	Est.	Act.	Project Name		Est.	Act.	
Month 1														
Month 2														
Month 3														
Month 4														
Month 5														
Month 6														
Month 7														
Month 8														
Month 9														
Month 10														
Month 11														
Month 12														
Total														

Notes: (1) The performance targets are stated in PRE.B8.1995.

(2) The waste flow table shall also include C&D materials that are specified in Contract to be imposed for use at Site.

(3) Plastics refer to plastic bottles / containers, plastic sheets / foam from packaging material

	Name	Signature	Date
Recorded by			
Checked by			

Contract Title and No.: _____

Monthly Summary Waste Flow Table for Year / Year

Month	Estimated Quantity of C&D Wastes (in ' 000 kg)														
	Metals					Paper / cardboard packaging					Plastics (Note 3)				
	Est.		Act.			Est.		Act.			Est.		Act.		
	Recycled	Disposal to landfill	Recycled	Disposal to landfill	Name of Recycling Haulier	Recycled	Disposal to landfill	Recycled	Disposal to landfill	Name of Recycling Haulier	Recycled	Disposal to landfill	Recycled	Disposal to landfill	Name of Recycling Haulier
Month 1															
Month 2															
Month 3															
Month 4															
Month 5															
Month 6															
Month 7															
Month 8															
Month 9															
Month 10															
Month 11															
Month 12															
Total															

Notes: (1) The performance targets are stated in PRE.B8.1995.

(2) The waste flow table shall also include C&D materials that are specified in Contract to be imported for use at Site.

(3) Plastics refer to plastic bottles / containers, plastic sheets / foam from packaging material.

	Name	Signature	Date
Recorded by			
Checked by			

Contract Title and No.: _____

Monthly Summary Waste Flow Table for Year / Year

Month	Estimated Quantity of C&D Wastes (in ' 000 kg)														
	Chemical Waste					Others, e.g. general refuse					Timber				
	Est.		Act.			Est.		Act.			Est		Act		
	Recycled	Disposal to landfill	Recycled	Disposal to landfill	Name of Recycling Hauler	Recycled	Disposal to landfill	Recycled	Disposal to landfill	Name of Recycling Hauler	Recycled	Disposal to landfill	Recycled	Disposal to landfill	Name of Recycling Hauler
Month 1															
Month 2															
Month 3															
Month 4															
Month 5															
Month 6															
Month 7															
Month 8															
Month 9															
Month 10															
Month 11															
Month 12															
Total															

Notes: (1) The performance targets are stated in PRE.B8.1995.

(2) The waste flow table shall also include C&D materials that are specified in Contract to be imported for use at Site.

(3) Plastics refer to plastic bottles / containers, plastic sheets / foam from packaging material.

	Name	**Signature**	**Date**
Recorded by			
Checked by			

Contract Title and No.: _____

Yearly Summary Waste Flow Table for (Grand Summary)

Year	Estimated Quantity of Inert C&D Wastes (in ' 000 m³)										Estimated Quantity of C&D Wastes									
	Total Quantity Generated		Suitable for Recycled Aggregates		Reused in the Contract		Reused in other Projects		Disposed as Public Fill		Metals		Paper/cardboard packaging		Plastics (see Note 3)		Chemical Waste		Others, e.g. general refuse	
	(a)		(b)		(c)		(d)		(e = a-b-c-d)		(in ' 000 kg)		(in ' 000 kg)		(in ' 000 kg)		(in ' 000 kg)		(in ' 000 kg)	
	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.
Year 1																				
Year 2																				
Year 3																				
Year 4																				
Year 5																				
Year 6																				
Year 7																				
Year 8																				
Year 9																				
Year 10																				
Grand Total																				

Notes: (1) The performance targets are stated in PRE.B8.1995.

(2) The waste flow table shall also include C&D materials that are specified in Contract to be imported for use at Site.

(3) Plastics refer to plastic bottles / containers, plastic sheets / foam from packaging material.

APPENDIX PRE.B8/II

PRE.B8.APPEND2.9 DAILY RECORD SUMMARY

"Daily Record Summary" to record daily disposal of C&D materials from the Site

"每日運載記錄撮要"記錄每日由地盤所傾卸的拆建物料

(1) Contract no. & title 合約編號及名稱: _____

(2) Date of disposal 傾卸日期: _____

(3) Disposal ground (s) designated in the Contract or directed by the Contract Manager 合約指定或合約經理指示接收設施: (a) _____

(b) _____

Others 其它

(4) Approved alternative disposal grounds 另可接受的接收設施 _____

CHIT/ DDF no. 載運人帳票/拆建物料運載記錄票編號	**Vehicle registration mark** 車輛登記號碼	**Approx. vol (e.g. Full/Three Quarter/Half/One quarter)** 大約承載量 (例如全、3/4、半、1/4)	**C&D materials type (e.g. inert or non-inert)** 建築廢料種類 (例如慚性或非慚性)	**Disposal ground** 接收設施	**Signature & Name of the Contractor's Designated person before departure** 於離開地盤前，承建商的指定人仕姓名及簽名	**Departure time from Site** 離開地盤時間	**Signature & name of the Contract Manager's supervisory staff before departure or other time as agreed between the Contract Manager's Representative and the Contractor** 於離開地盤前或其它經承建商與合約經理代表同意的時間，合約經理監管人員姓名及簽名	**Actual disposal ground** 真正接收設施	**Arrival time at disposal ground** 抵達接收設施時間	**Remarks** 備註

← Part 1[1] 甲部 → ← Part 2[2] 乙部 →

Submitted by 呈交 : *[Name of Contractor's Designated Person*

Signature 簽名 : _____

Date 日期: _____

Received by 接收 : _____ *[Name and signature of the Contract Manager's staff] 合約經理監管人員姓名及簽名*

Post 職位 : _____

Date & Time 日期及時間 : _____

---

[1] Part 1 甲部 - The Contractor shall complete Part 1 in duplicate and a copy should be kept by the Contract Manager's Representative. 承建商填寫甲部兩份，副本由合約經理代表持有

[2] Part 2 乙部 - The Contractor shall complete Part 2 and submit the whole Summary to the Contract Manager's Representative within 1 working day after the records are posted at the EPD's web-site. 承建商填寫乙部及將整份運載記錄撮要於記錄上載在環境保護署網頁後 1 個工作天內呈交給合約經理代表

APPENDIX PRE.B8/III

PRE.B8.APPEND3.9 DISPOSAL DELIVERY FORM

Sample of the Disposal Delivery Form (DDF) for Disposal of C&D Materials at Disposal Grounds (Other than Public Fill Reception Facilities, Landfills or Outlying Islands Transfer Facilities) as Designated in the Contract or as Directed by the Contract Manager, or at Alternative Disposal Grounds Proposed by the Contractor and Approved by the Contract Manager

Serial No. 0012345678

Date of Use:
使用日期:_____

Disposal Ground:
接收設施:

Vehicle Registration Mark:
車牌號碼:

_____

Issued By:
簽發:

_____

(This part retained by Disposal Ground)
(此部分由接收設施保留)

Chop of Disposal Ground 接收設施蓋印

Serial No. 0012345678

Construction and Demolition Materials
Disposal Delivery Form
拆建物料運載記錄票

Contract No: Contract Title:

合約編號: _____ 合約名稱: _____

Date of Use: Time of departure from site: Vehicle Registration Mark:
使用日期: _____ 離開地盤時間: _____ 車牌號碼:_____

Disposal Ground:
接收設施: _____

Arrival Time/Date:
抵達日期/時間: _____
(This part retained by Contractor/Driver)
(此部分由承建商/司機保留)

Chop of Disposal Ground
接收設施蓋印

Chop of Contract Manager's Representative
合約經理代表蓋印

APPENDIX PRE.B8/IV

PRE.B8.APPEND4.9 MONTHLY RECORDING OF DAILY FLOW RATE OF WASTE WATER DISCHARGED ON SITE

Contract Title : _____

Contract No : _____

Monthly Summary Waste Water Flow Rate Table

Month	Month of the Year	Daily low Rate of Waste Water Discharged on Site (m^3/day)																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Month 1																																
Month 2																																
Month 3																																
Month 4																																
Month 5																																
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Month 29																																
Month 30																																

The Limit of Flow Rate as stipulated in WPCO Licence No. _____ is _____ m^3/day

APPENDIX PRE.B8/V

PRE.B8.APPEND5.9 SUMMARY RECORD OF DELIVERY AND CONSUMPTION OF B5 DIESEL OR EURO V DIESEL / ULTRA LOW SULPHUR DIESEL ON SITE

Summary Record of Delivery and Consumption of B5 Diesel or Euro V Diesel / Ultra Low Sulphur Diesel (ULSD) on Site

Contract No. : _____

Contract Title : _____

*** ' ✓ ' the relevant box**

*** ☐ B5 Diesel / ☐ Euro V Diesel / ☐ ULSD**

Date	Intake		
	Name of Contractor / Sub-contractor	Details of Ordering Fuel	Quantity of Fuel Delivered (in litre)
		- name of oil company - delivery note no. and reference	
		Total Delivered	

Consumption			
Details of Plant belong to the Contractor / Sub-contractor	Date of Arrival	Date of Departure	Quantity of Fuel Consumed (in litre)
- Plant name and serial no.			
		Total Delivered	

Remarks : Reasons for the discrepancy between monthly intakes and monthly consumption is due to:

_____

_____

[N.B. The total for the month is for checking the relative order of quantity of fuel delivered and consumed on Site. The Contractor / Sub-contractor shall provide reasons when there is a discrepancy between monthly intake and monthly consumption, for example, wastage during handling and the like.]

APPENDIX PRE.B8/VI

PRE.B8.APPEND6.9 MONTHLY RECORDING OF DETERMINAND OF WASTE WATER DISCHARGED ON SITE

Monthly Recording of Determinand of Waste Water Discharged from Site

Contract No. : _____

Contract Title : _____

Name of Testing Laboratory : _____

		Suspended Solids (mg/L)	pH Value (pH units)	Chemical Oxygen Demand (COD) mg/L
Limitation Specified in the WPCO License				
Measurement Method				
Sampling Month	**Sampling Date**			

	Name	Signature	Date
Checked by			
Approved by			

APPENDIX PRE.B8/VII

PRE.B8.APPEND7.9 RECORD OF CONSTRUCTION DUST MONITORING

Record Sheet for 1-hour Total Suspended Particulates Monitoring (for each measurement)

Contract No. : _____

Contract Title : _____

Date of Monitoring				
Monitoring Location		**Location A**	**Location B**	**Location C**
Description of the Location				
Measurement Method (Direct measurement or High Volume Sampler)				
Equipment Use (Model and Serial No.)				
Weather Condition	**Temperature (°C)**			
	Wind Strength (m/s)			
Time of Monitoring	**Start**			
	Finish			
Measured 1-hour TSP (μg/m³)				
Action Level (μg/m³)				
Limit Level (μg/m³)		**500**		
Site Construction Activities				

	Name	**Signature**	**Date**
Recorded by			
Checked by			

Monthly Recording of 1-hour Total Suspended Particulates Monitoring

Contract No. : _____

Contract Title : _____

Date	Location A		Location B		Location C		Action Level ($\mu g/m^3$)	Limit Level ($\mu g/m^3$)
	Time of Monitoring	1-hour TSP ($\mu g/m^3$)	Time of Monitoring	1-hour TSP ($\mu g/m^3$)	Time of Monitoring	1-hour TSP ($\mu g/m^3$)		
								500

	Name	Signature	Date
Recorded by			
Checked by			

APPENDIX PRE.B8/VIII

PRE.B8.APPEND8.9 RECORD OF CONSTRUCTION NOISE MONITORING

Weekly Recording of Construction Noise Monitoring

Contract No. : _____

Contract Title : _____

Date of Monitoring				
Monitoring Location		**Location A**	**Location B**	**Location C**
Description of the Location				
Sound Level Meter (Model and Serial No.)				
Weather Condition	**Temperature (°C)**			
	Wind Strength (m/s)			
Time of Monitoring	**Start**			
	Finish			
Measured Noise Level (dB(A))				
Noise Limit Level, Leq, (dB(A))		**75 dB(A)** **70 dB(A) for schools and** **65 dB(A) during school examination periods**		
Site Construction Activities				
Other Noise Sources During Measurement				

	Name	**Signature**	**Date**
Recorded by			
Checked by			

Monthly Recording of Construction Noise Monitoring

Contract No. : _____

Contract Title : _____

Date	Measured Noise Level, Length (30 mins), dB(A)						Limit Level (dB(A))
	Location A		Location B		Location C		
	Time of Monitoring	Measured Noise Level	Time of Monitoring	Measured Noise Level	Time of Monitoring	Measured Noise Level	
							75 dB(A) 70 dB(A) for schools and 65 dB(A) during school examination periods

	Name	Signature	Date
Recorded by			
Checked by			

APPENDIX PRE.B8/IX

PRE.B8.APPEND9.C ENVIRONMENTAL PROTECTION MEASURES

Minimisation of Air Pollution

No.	Checklist Items of Submission Template for IDCM 7a of the BEAM Plus	Clause Reference
	Material Handling	
1*	Watering is undertaken whenever necessary for the following:	PRE.B8.455
	Unpaved areas (e.g. unpaved main haul road)	--
	Access roads	--
	Construction areas	--
	Any dusty materials before loading and unloading	--
	Stockpile of dusty materials	--
	Debris chute	--
2*	Water sprays are either fixed or mobile to allow individual areas to be wetted as and when required.	--
3*	Application of suitable wetting agents (e.g. dust suppression chemicals) is used in addition to water if necessary	PRE.B8.455 (1)
4*	Debris is covered entirely by impervious sheeting or stored in a debris collection area sheltered on the top and the 3 sides	PRE.B8.460 (6)
5*	Every debris chute shall be enclosed by impervious sheeting or similar materials	PRE.B8.460 (4)
6*	Conveyor belts are fitted within windboards	--
7*	Conveyor transfer points and hopper discharges are enclosed	--
8*	Drop heights are minimised from all conveyors	--
9*	Materials that have the potential to create dust are totally enclosed	PRE.B8.455 (9)
10*	Storage time of materials on Site is minimised	--
11*	Bulk crushing and / or material storage takes place inside sheds	--
12*	Skip hoist is enclosed by impervious sheeting	PRE.B10.040 (8)
13*	Debris chute is enclosed by impervious sheeting	PRE.B8.460 (4)
14*	Debris collection area is sheltered on the top and the 3 sides	PRE.B8.460 (6)
	Hoarding / Dust Screen	
15*	Hoarding of not less than 2.4 m high from ground level is provided along the Site boundary	--
16*	Effective dust screens, sheeting or netting is provided to enclose any scaffolding built around the perimeter of the building under construction	PRE.B8.465 (2)
17*	Screening of dust generating activities through the use of wind breaks	--
	Excavation	

18*	Working area of any excavation or earth moving operation is sprayed with water immediately before, during and immediately after the operation	EAR1.W410 (2)
19*	Exposed earth is properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with suitable surface stabiliser within 6 months after the last construction activity on the Site	EAR1.W2110 (3)
20*	Any spoil, debris or material and silt are removed and the affected land and areas are restored to the natural state	--
	Vehicle Dust / Emission	
21*	Control height from which excavated materials are dropped to a practical minimum	EAR1.W410 (3)
22*	Loading / unloading are minimised	--
23*	Three-sided roofed enclosure with a flexible curtain across the entry is provided when dusty materials are discharged to vehicles from a conveying system at a fixed transfer point	--
24*	Surfaces of the areas within the Site where there is regular movement of vehicles are paved and any loose surface material is removed	--
25*	Vehicles within the Site are restricted to a maximum speed of 8 km / hour and speed limit signage is put up at appropriate locations	PRE.B8.455 (6)
26*	Haulage and delivery vehicles are confined to designated roadways inside the site	-
27*	Materials transported off-site by vehicles are covered by tarpaulin, with the cover properly secured and extended over the edges of the side and tailboards	PRE.B8.1838 (11)
28*	Vehicle washing facility(ies) is / are provided at all site exit(s) to wash away any dusty materials from vehicle body and wheels before they leave the Site	PRE.B8.2320 (4)
29*	A hard-surfaced road between any washing facility and the public road is provided	PRE.B8.2320 (4)
30*	Wheel washing facilities are inspected, maintained and cleaned on a regular basis	--
31*	Vehicles are inspected regularly and well maintained to ensure that they are operating efficiently and that exhaust emissions are not causing nuisance	--
32*	Vehicle engines are turned off when they are not in use	--
33*	Settling silt / sediment in wheel washing bays is removed regularly	--
34*	Any earth, mud and debris at the site exit is removed	PRE.B8.2320 (4)
	Demolition Works	
35*	Any area in which demolition work takes place is sprayed with water immediately prior to, during and immediately after the demolition activities to maintain the entire surface wet	PRE.B8.455 (15)
36*	Impervious dust screens or sheeting is used to enclose the whole wall to a height of at least 1m higher than the highest level of the structure being demolished	PRE.B8.455 (16)

37*	Any dusty materials remaining after a stockpile is removed are wetted with water and cleared from road surfaces	PRE.B8.455 (17)
38*	Use of enclosed chutes for dropping demolition materials to ground level and the chutes are dampened regularly	DEM1.W210 (3)(g)
39*	If asbestos is found in the buildings or structure, special procedures as detailed in the Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste must be followed	DEM2.W310 (5)
	Drilling and Blasting	
40*	Spray water during breaking of rock or concrete	PRE.B8.455 (8)
41*	Areas within 30m from the blasting area shall be wetted with water prior to blasting	EAR2.W120 (1)
42*	Blasting operations are well arranged and appropriate precautions are taken (e.g. use of blast nets, canvas covers and watering)	--

* Items 1-42 are requirements under Parts I, III and IV of the Schedule of the Air Pollution Control (Construction Dust) Regulation which is covered by clause PRE.B8.410.

Minimisation of Noise Pollution

No.	Checklist Items of Submission Template for IDCM 7b of the BEAM Plus	Clause Reference
	General	
1*	Scheduling construction work carefully to maximize any required noisy work during less sensitive hours (e.g. lunch time, outside school hours and avoiding examination periods), and for unavoidable night works with a Construction Noise Permit, and carefully scheduling noisy works at locations close to any sensitive receiver so as to minimize sleep disturbance.	PRE.B8.2520 (5)(d)(i)
2*	Minimising the cumulative noise sources from various activities.	PRE.B8.2520 (5)(d)(ii)
3*	Keeping nearby residents informed of what are being planned and done so that they are more likely to accept the inevitable impact noise, resulting in fewer complaints.	--
4*	Establishing a communication channel (e.g. manned hotline) to address concerns from the affected neighbours, so that immediate responsive actions could be taken to reduce adverse noise impact.	--
5*	Limiting the time workers spend in noisy areas by moving them to quiet work before their daily noise exposure becomes excessive.	--
6*	Switching off noisy equipment when not in use.	--
7*	Locating noisy equipment as far away as possible from any noise sensitive receivers (NSRs).	PRE.B8.2520 (5)(d)(iii)
8*	Selecting quieter equipment.	PRE.B8.2520 (5)(b)
9*	Using electricity supply from public utility for all machinery if possible, to avoid generator noise.	--
10*	Using stockpiles of earth as an additional natural sound barrier whenever possible.	--
11*	Providing regular and effective maintenance for all Powered Mechanical Equipment (PME) in order to prolong the life of equipment as well as to reduce noise emission.	--
12*	Undertaking regular site supervision and training to promote good site practice – unnecessary noise disturbance arising from shouting, colliding of materials or striking of steel bars to be avoided.	--
13*	Taking care when loading and unloading vehicles, dismantling scaffolding or moving materials, to reduce unnecessary noise impact.	--
14*	Using alternative methods, such as a totally enclosed conveyor belt system to avoid the use of noisier plant such as dump trucks.	--
15*	Arranging delivery of noisy / bulky equipment / material to avoid disturbance to surrounding NSRs and within permitted hours.	--
16*	Providing adequate planning with contingency to ensure that lengthy operations e.g. concrete pours, can be completed within the permitted hours.	--
17*	Avoiding carrying out noisy operations in early morning. Schedule such operations after 9:00am every working day as far as practicable.	--
18*	Fabricating units off site to minimise impacts on site, when practicable.	--
19*	Planning routes for construction vehicles carefully, to reduce noise to nearby NSRs.	--
20*	Maintain equipment in good condition. Using lubricant to reduce noise impacts.	--

21*	Monitoring noise on site regularly. If there is any exceedance, further mitigation measures may be necessary at the CM's direction.	PRE.B8.890 to PRE.B8.898
22*	Maintaining a good security system especially at the site entrance to avoid unauthorised entry of workers in restricted hours.	PRE.B8.2610
23*	Setting up a restricted hours patrol team to ensure compliance with the Noise Control Ordinance (NCO).	--
24*	Requesting sub-contractors to obtain prior permission (e.g. through a permit-to-work system) before carrying out work during restricted hours.	--
25*	Seek professional advice on noise control measures.	--

* Items 1 to 25 are requirements under Section 6.9.4 Administrative Site Control of the Best Practice Guide for Environmental Protection on Construction Sites 2013 published by the Hong Kong Construction Association Ltd. which is specified in clause PRE.B8.880.

Minimisation of Water Pollution

No.	Checklist Items of Submission Template for IDCM 7c of the BEAM Plus	Clause Reference
	Surfaces Run-off	
1*	Surface run-off from the Site should be discharged into storm drains via adequately designed sand / silt removal facilities such as sand traps, silt traps and sediment basins. Channels or earth bunds or sand bag barriers should be provided on site to properly direct stormwater to such silt removal facilities. Perimeter channels at Site boundaries should be provided where necessary to intercept storm run-off from outside the Site so that it will not wash across the Site. Catchpits and perimeter channels should be constructed in advance of site formation works and earthworks.	PRE.B8.2410 (1)
2*	Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly, at the onset of and after each rainstorm to ensure that these facilities are functioning properly at all times.	PRE.B8.2410 (3)
3*	Construction works should be programmed to minimize soil excavation works in rainy seasons (April to September). If excavation in soil could not be avoided in these months or at any time of year when rainstorms are likely, for the purpose of preventing soil erosion, temporarily exposed slope surfaces should be covered e.g. by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Intercepting channels should be provided (e.g. along the crest / edge of excavation) to prevent storm runoff from washing across exposed soil surfaces. Arrangements should always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm.	PRE.B8.2410 (7)
4*	Earthworks final surfaces should be well compacted and the subsequent permanent work or surface protection should be carried out immediately after the final surfaces are formed to prevent erosion caused by rainstorms. Appropriate drainage like intercepting channels should be provided where necessary.	--
5*	Measures should be taken to minimize the ingress of rainwater into trenches. If excavation of trenches in wet seasons is necessary, they should be dug and backfilled in short sections. Rainwater pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities.	PRE.B8.2410 (1)
6*	Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.	PRE.B8.2410 (7)
7*	Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into foul sewers. Discharge of surface run-off into foul sewers must always be prevented in order not to unduly overload the foul sewerage system.	--
8*	Precautions to be taken at any time of a year when rainstorms are likely to occur, actions to be taken when a rainstorm is imminent or forecast and actions to be taken during and after rainstorms.	--
Wastewater from Concrete Batching Precast Concrete Casting		
9*	Wastewater generated from the washing down of mixer trucks and drum mixers and similar equipment should wherever practicable be recycled. The discharge of wastewater from the washing down should be kept to a minimum.	--

10*	To prevent pollution from wastewater overflow, the pump sump of any water recycling system should be provided with an on-line standby pump of adequate capacity and with automatic alternating devices.	--
11*	Under normal circumstances, surplus wastewater may be discharged into foul sewers after treatment in silt removal and pH adjustment facilities (to within the pH range of 6 to l0). Disposal of wastewater into storm drains shall require more elaborate treatment. Surface run-off should be segregated from the concrete batching plant and the casting yard area as far as possible, and diverted to the stormwater drainage system. Surface run-off contaminated by materials in a concrete batching plant or casting yard should be adequately treated before disposal into stormwater drains.	--
Wheel Washing Water		
12*	All vehicles and plant should be cleaned before they leave the Site to ensure no earth, mud, debris and the like is deposited by them on roads. A wheel washing bay should be provided at every site exit if practicable and wash-water should have sand and silt settled out or removed before discharging into storm drains. The section of construction road between the wheel washing bay and the public road should be paved with backfall to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.	PRE.B8.2320 (4)
Wastewater from Building Construction		
13*	Before commencing any demolition works, all sewer and drainage connections should be sealed to prevent building debris, soil, sand etc. from entering public sewers / drains.	DEM1.W210 (3)(i)
14*	Wastewater generated from building construction activities including concreting, plastering, internal decoration, cleaning of works and similar activities should not be discharged into the stormwater drainage system. If the wastewater is to be discharged into foul sewers, it should undergo the removal of settleable solids in a silt removal facility, and pH adjustment as necessary.	--
Acid Cleaning, Etching and Pickling Wastewater		
15*	Acidic wastewater generated from acid cleaning, etching, pickling and similar activities should be neutralized to within the pH range of 6 to l0 before discharging into foul sewers. If there is no public foul sewer in the vicinity of the Site, the neutralized wastewater should be tankered off Site for disposal into foul sewers or treated to a standard acceptable to storm drains and the receiving waters.	--

* Items 1 to 15 are requirements under EPD's ProPECC PN 2/24 Construction Site Drainage which is specified in clause PRE.B8.2410.

Minimisation of Light Pollution

No.	Checklist Items of Submission Template for IDCM 7d of the BEAM Plus	Clause Reference
	Operating hours for lighting	PRE.B8.420
1*	Switch off external lighting (essential light and feature light not included) when not needed or after operating hours.	PRE.B8.420 (1)(a)
2*	Switch off feature lighting (e.g. hoarding lighting) immediately after 11p.m. every day.	PRE.B8.420 (1)(b)
3*	Maintain only essential lighting (e.g. lighting for safety and security) at the acceptable level as required.	PRE.B8.420 (1)(c)
	Automatic controls for external lighting	PRE.B8.420 (2)
4*	Incorporate automatic control (e.g. timer switch) to switch off the external lighting when not needed or after operating hours.	PRE.B8.420 (2)(a)
	Lighting nuisance control measures	PRE.B8.420 (3)
5*	Position and aim the lighting at hoarding properly to avoid overspill of light to outside the area being lit up.	PRE.B8.420 (3)(a)
6*	For lighting up vertical structures (e.g. signs & hoarding), direct the beam to the structures and avoid overspill of light.	PRE.B8.420 (3)(b)
7*	Use lighting provided with appropriate shields, baffles, louvers and cut-off features to prevent light overspill to nearby residence and into the sky, and to avoid glare from the light source.	PRE.B8.420 (3)(c)
	Prevention of glare to road users	PRE.B8.420 (4)
8*	Ensure the external lighting along Site boundary is appropriately positioned, aimed or shielded so that illumination of nearby roads will not be adversely affected to the detriment of road users.	PRE.B8.420 (4)(a)

* Items 1 to 8 are specified in clause PRE.B8.420.

Waste Management

No.	Checklist Items of Submission Template for IDCM 8 of the BEAM Plus	Clause Reference
	General (Non Construction)	
1*	All work areas are cleaned regularly to remove general litter and refuse	PRE.B8.1610
2*	General refuse and litter are stored in enclosed bins or compaction units separate from construction or chemical waste	PRE.B8.1920 (4)
3*	Collect general waste and litter from Site for disposal	PRE.B8.1990 (3)(f)
4*	No burning of refuse at any construction area	PRE.B8.450
5*	Separately labelled bins are provided to allow segregation of recyclable materials	PRE.B8.1920 (4)
6*	Save paper and recycle waste paper	PRE.B8.1920 (2)(g)
7*	All vehicles carrying waste are properly fitted with side and tail boards, and with tarpaulin covered	PRE.B8.455 (3)
8*	Training is provided to workers on waste management procedures	PRE.B8.2560 (1)
	General (Construction)	
9*	Different types of construction waste generated from the Site are segregated, stored, transported and disposed of separately.	PRE.B8.1990 (1)
10*	Sorting of waste is conducted on-site.	PRE.B8.1990 (2)
11*	All waste materials are segregated into categories covering:	PRE.B8.1990
	Inert portion of construction & demolition (C&D) material for reuse on-site	PRE.B8.1990 (1)
	Inert portion of C&D material to be used as public fill	PRE.B8.1990 (3)(a)
	Remaining waste for landfill	PRE.B8.1990 (3)(e)
	Chemical waste	PRE.B8.1990 (3)(d)
	Packaging waste	PRE.B8.1990 (5)
	General waste	PRE.B8.1990 (3)(f)
12*	Separate compartments for inert (e.g. soil, rubble, sand, stone, etc.) and non-inert (e.g. wood, glass, plastics, steel and metals, organics, etc.) wastes are provided	PRE.B8.1920 (4)
13*	Inert waste is used on Site before disposed of at public fill reception facilities	PRE.B8.1990 (1)
14*	Non-inert waste is sorted for re-use or recycling where possible before disposal at strategic landfills	PRE.B8.1990 (1)
15*	Site fencing, scaffolding and timber for construction works are reused wherever possible	PRE.B8.1920 (2)(e)
16*	Regular maintenance and cleaning of waste storage area	PRE.B8.1920 (8)
17*	Excavated materials are properly treated (re-used / disposed of) according to specified procedures	PRE.B8.1920 (2)(f)
18*	General refuse is stored in specified enclosed bins / compaction units, or reused if possible	PRE.B8.1920 (4)

19*	Ensure the waste collector has full records of dumping	PRE.B8.1998
20*	A barge loading point is provided to facilitate transfer of suitable material to public dumps	--
21*	Records of reuse / recycling / disposal of construction waste are properly kept	PRE.B8.1920 (3)

* Items 1 to 21 are requirements from Appendix 8.2 “Good Housekeeping Checklist” of the “Best Practice Guide for the Environmental Protection on Construction Sites 2013” published by the Hong Kong Construction Association Ltd. which is specified in clause PRE.B8.1997.

Considerate Construction

No.	Checklist Items of Submission Template for IDCM 10 of the BEAM Plus	Clause Reference
	Items for considerate measures to neighbourhood and passers-by (General)	
1	Complaints logged with prompt follow up action	PRE.B8.2520 (1)(e)
2	Provision of netting and catchfans to safeguard the public against falling objects	PRE.B8.286
3	Smoke emission from plant directed away from the public	--
4	Pavements or pedestrian walkways in the vicinity of works cleaned daily and maintained clear and unobstructed with no tripping / slipping hazard	PRE.B8.2730 (3)
5	Provision of clean and proper barriers, traffic cones, road signs and lanterns for guarding, lighting and signing of works or sites	--
6	Plants, materials or spoils properly placed, covered and barricaded without causing obstructions to pedestrians	PRE.B10.920
7	Proper maintenance of channels and watercourses including removal of debris	--
8	Adequate provision of nuisance mitigation measures and monitoring of their effectiveness to protect the environment	--
9	Adequate protection of the public at the site entrance	PRE.B10.740 (1)
10	Participation posters displayed in prominent positions with complaint telephone number provided	PRE.B9.620
11	Measures provided against trespassing	--
	Items for considerate measures to neighbourhood and passers-by (Measures for combating mosquitoes)	
12	Covering all unused buckets and containers or turning them upside down, or disposing of unnecessary containers	PRE.B8.1660
13	Turning upside down or covering up disused carts	PRE.B8.1670
14	Puncturing or disposing of disused tyres	PRE.B8.1660
15	Filling up uneven floors, crevices and holes including uneven areas at rooftops of partly constructed buildings	PRE.B8.1660
16	Disposal of lunchboxes, cans, bottles, etc. regularly	PRE.B8.1660
17	Storing construction materials likely to collect water under cover	PRE.B8.1620
18	Cutting of bamboo poles for bamboo scaffolding close to the point before the node of the pole as far as possible	--
19	Providing anti-mosquito device on site	PRE.B8.2520 (9)(b)
20	Maintaining records of anti-mosquito weekly inspection checklist	--
21	Maintaining channels and watercourse properly including removal of debris	--
	Considerate measures to workers	
22	Regular inspection of the Site and prompt rectification of defects	--
23	Adequate lockers for use by workers	--
24	Provision of uniforms, storage compartments, rest areas and facilities for taking meals for use by workers	PRE.B8.305

25	Provision of adequate supply of drinking water on Site	PRE.B8.305 (1), PRE.B8.1570 (14), PRE.B81575 (5), PRE.B12.860
26	Toilet facilities provided and maintained in clean and odourless condition	PRE.B10.110
27	Provision of adequate hand wash facilities with liquid soap	PRE.B10.120
28	Additional merits for provision of changing and showering facilities on site	PRE.B10.120
29	Adequate illumination to areas of work, access and egress	PRE.B10.110
30	Provision of alternative to reflective vest in hot weather, sheltered work place, sheltered rest area with benches, basic health check and afternoon rest break	PRE.B8.300 & PRE.B8.305
	Care of Utilities	
31	Co-ordination with Utility Undertakings and other authorized contractors / Direct Contractors	PRE.B12.210
32	Digging of trial pit to locate utilities before excavation	PRE.B8.983 (2)(e)
33	Utilities properly supported and protected when exposed	PRE.B8.983 (2)(f)(v)
34	Precautionary measures provided for high tension cables and gas pipes	PRE.B8.983 (2)(f)(i)
35	Competent person engaged to detect existing utilities on Site	-
36	Hand digging method employed in exposing utilities	PRE.B8.983 (2)(e)
	Good tree protection practices	
37	Site inspections to verify that all tree protection measures are in place, followed and observed during the construction works.	PRE.B8.1110 (3)(4)(b), PRE.B8.1116 (5)(a)
38	Regular trees inspections to watch for signs of stresses, such as dieback, leaf loss, or general decline in tree health or appearance and to look for and prevent tree damage with symptoms of construction injury.	PRE.B8.1240
39	Monitoring on landscape installations, e.g. irrigation or lighting installation to prevent tree root damage.	PRE.B8.1163

APPENDIX PRE.B8/X

PRE.B8.APPEND10.9 CERTIFICATE OF OVERHAUL OF MAJOR CONSTRUCTION PLANT ON SITE

CERTIFICATE OF OVERHAUL OF TOWER CRANE

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the tower crane are correct;

b) The tower crane described in this certificate has undergone overhaul and that the critical parts of the tower crane have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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_____

c) The tower crane is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF DERRICK CRANE (USED FOR INSTALLING AND DISMANTLING TOWER CRANES)

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the derrick crane (used for installing and dismantling tower cranes) are correct;

b) The derrick crane (used for installing and dismantling tower cranes) described in this certificate has undergone overhaul and that the critical parts of the derrick crane have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The derrick crane (used for installing and dismantling tower cranes) is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF GONDOLA

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the gondola are correct;

b) The gondola described in this certificate has undergone overhaul and that the critical parts of the gondola have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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_____

c) The gondola is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF MATERIAL HOIST

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the material hoist are correct;

b) The material hoist described in this certificate has undergone overhaul and that the critical parts of the material hoist have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The material hoist is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF MOBILE CRANE (EXCLUDING CRAWLER CRANE)

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the mobile crane (excluding crawler crane) are correct;

b) The mobile crane (excluding crawler crane) described in this certificate has undergone overhaul and that the critical parts of the mobile crane have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The mobile crane (excluding crawler crane) is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF TRUCK-MOUNTED CRANE

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the truck-mounted crane are correct;

b) The truck-mounted crane described in this certificate has undergone overhaul and that the critical parts of the truck-mounted crane have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The truck-mounted crane is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF CRAWLER CRANE

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the crawler crane are correct;

b) The crawler crane described in this certificate has undergone overhaul and that the critical parts of the crawler crane have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The crawler crane is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF PILE DRIVER

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the pile driver are correct;

b) The pile driver described in this certificate has undergone overhaul and that the critical parts of the pile driver have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The pile driver is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF HYDRAULIC HAMMER

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the truck-mounted crane are correct;

b) The hydraulic hammer described in this certificate has undergone overhaul and that the critical parts of the hydraulic hammer have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The hydraulic hammer is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF OSCILLATOR

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the oscillator are correct;

b) The oscillator described in this certificate has undergone overhaul and that the critical parts of the oscillator have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The oscillator is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF ROTATOR

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the rotator are correct;

b) The rotator described in this certificate has undergone overhaul and that the critical parts of the rotator have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

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c) The rotator is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

APPENDIX PRE.B8/XI

PRE.B8.APPEND11.9 CHECKLISTS ON CRITICAL PARTS FOR OVERHAUL MAINTENANCE FOR MAJOR CONSTRUCTION PLANT ON SITE

When both English and Chinese are presented, English takes precedence over Chinese.

Tower Crane

Critical parts for overhaul maintenances of Tower Crane
檢修塔式起重機的重要部件

Critical Parts 重要部件		Method of checking 檢查方法
1	Fixing angles / foundation anchors 固定腳／基礎錨定	Visual inspection 目視檢查
		NDT welded connections, if any 為焊接部分進行無損測試 (如適用)
2	Tower base undercarriage / chassis 塔式起重機底座／底盤	Visual inspection to structural members and welds 就結構構件和焊接進行目視檢查
		Thickness test on main chord sections 在主弦杆部分測量厚度
		NDT welded connections by a random sample check 就焊接部分隨機抽樣進行無損測試
3	Tower mast sections 塔式起重機塔身	Visual inspection to structural members and welds 就結構構件和焊縫進行目視檢查
		Thickness test on main chord sections 在主弦杆部分測量厚度
		NDT welded connections on each mast section by a random sample check 就塔身組件的焊接部分隨機抽樣進行無損測試
4	Slewing ring assembly 回轉總成	Visual inspection 目視檢查
		Measure the backlash between the pinion and ring 量度小齒輪和回轉齒圈之間的後座間隙
		Check condition of seals 檢查油封的狀況
		Check clearance in slew ring at a min. of 4 locations 在回轉支承上選擇最少 4 個位置檢查間隙
		NDT welded connections by a random sample check 就焊接部分隨機抽樣進行無損測試
		Check torque of slewing ring mounting bolts 檢查回轉支承固定螺栓的扭矩
5	Tower top / A-frame 塔頂或 A 字形塔帽	Visual inspection to structural members and welds 就結構構件和焊縫進行目視檢查
		Check and, if necessary, replace worn bearings and spacers 檢查軸承和墊片，如有磨損，按需要予以更換
		Thickness test on main chord sections 在主弦杆部分測量厚度
		NDT head connections to main chords 就主弦杆頂部連接位進行無損測試
		NDT welded connections to main chords 就主弦杆的焊接部分進行無損測試
		NDT lacing welds by a random sample check 就橫綴焊接位隨機抽樣進行無損測試

6	Counter-jib 平衡臂	Visual inspection to structural members and welds 就結構構件和焊縫進行目視檢查
		Visual inspection to tie bars 就拉杆進行目視檢查
		Thickness test on main chord sections 在主弦杆部分測量厚度
		NDT welded connections to main beams / chords 就主樑或主弦杆的焊接部分進行無損測試
		NDT welded connections by a random sample check 就焊接部分隨機抽樣進行無損測試: - tie bars attachment brackets 拉桿連接支架 - butt welds on main chords 主弦杆的對接焊縫 - winch attachment brackets 絞盤連接支架 - lacing welds on each jib section 各吊臂組件的橫綴焊縫
7	Jib 起重臂	Visual inspection to structural members and welds 就結構構件和焊縫進行目視檢查
		Visual inspection to tie bars 就拉杆進行目視檢查
		Visual inspection to sheaves, bearings and circlips 就滑輪、軸承和彈性擋圈進行目視檢查
		Thickness test on main chord sections 在主弦杆部分測量厚度
		NDT connectors to main chords 就主弦杆上的連接器進行無損測試
		NDT welded connections by a random sample check 就焊接部分隨機抽樣進行無損測試: - tie bars attachment brackets and, if luffing cranes, attachment points for pendant ropes 拉桿連接支架及吊架纜索的連接點(只適用於變幅起重機) - butt welds on main chords 主弦杆的對接焊縫 - lacing welds on each jib section 各吊臂組件的橫綴焊縫
8	Ballast blocks 衡重塊	Visual inspection and check ballast blocks for undercarriage / chassis 就底座／底盤的衡重塊進行目視檢查
		Visual inspection and check ballast blocks for counter-jib 就平衡吊臂的衡重塊進行目視檢查
9	Pulleys 滑輪	Visual inspection on pulleys / sheaves 就滑輪進行目視檢查
		Check pins & bushes / bearings 就銷軸及軸套／軸承進行檢查
10		Visual inspection to the drums, motors, brakes, gearboxes 就鼓輪、電機、制動器及變速箱進行目視檢查

	Wire drums (including drums for hoisting, trolley and luffing) 纜筒 (包括起升機構、變幅小車機構和變幅機構的鼓輪)	Check reduction gear connections, shafts, bearings, grooves of the drums, drum flanges, oil contamination 就減速齒輪連接位、軸、軸承、滾槽、鼓輪凸緣及潤滑油污染情況進行檢查
		Check the pinions and measure the backlash 檢查齒輪和量度後座間隙
		Check bearings, gears 就軸承、齒輪進行檢查
		Check hydraulic systems for leakage if fitted 如有裝設液壓系統，檢查有否洩漏
		Check rope end fittings 就纜索末端的配件進行檢查
		Measure air gap, linings 量度空氣間隙、襯墊
11	Wire ropes 鋼纜	Inspect all wire ropes 檢查所有鋼纜
		Measure diameter of wire ropes 量度鋼纜直徑
12	Hook block 吊鈎滑輪組	Visual inspection to hook blocks 就吊鈎滑輪組進行目視檢查
		Check hook sheave bearing and circlips 就吊鈎滑輪軸承和彈性擋圈進行檢查
		Check throat dimensions of hooks 檢查吊鈎尺寸
		Check safety latches 檢查安全扣
		NDT welded connections by a random sample check 就焊接部分隨機抽樣進行無損測試
		NDT hooks 就吊鈎進行無損測試
		Inspect and measure sheave grooves for wear 檢查和量度滑輪繩槽的磨損程度
13	Trolley 變幅小車	Visual inspection to trolley 就變幅小車進行目視檢查
		Check trolley wheels, guide rollers, bearings / bushes, circlips, axle retaining plates 就變幅小車行輪、導向輪、軸承／軸套、彈性擋圈和軸固定板進行檢查
		NDT welds on the trolleys, if any by a random sample check 變幅小車如有焊接部分，隨機抽樣進行無損測試
14	Collars 框架	Visual inspection to climbing collars, climbing ladders for floor climbing, wall tie collars for telescoping, hydraulic assembly 就內爬框架、爬升用的爬梯、頂升的附牆附著框和液壓系統進行目視檢查
		Check the leakage, colour, level and sludge deposits of hydraulic fluid 就液壓油的洩漏、色彩、層次和污泥積聚情況進行檢查

		Check valves and the flow of hydraulic pumps by a flow meter or a time check 利用時間計或流量計檢查閥門和液壓泵的流量
		Check the climbing pressure 檢查爬升壓力
		NDT welded connections by a random sample check 就焊接部分隨機抽樣進行無損測試
15	Telescopic cage (The age of cage will be considered separately from the age of the tower crane) 頂升套架（頂升套袈的使用年期與塔式起重機使用年期分開計算）	Visual inspection to structural members, welded connections, pins / bolts and hydraulic assembly 就結構構件、焊接部分、銷軸／螺栓和液壓系統進行目視檢查
		Visual inspection on guide rollers 就導向輪進行目視檢查
		Thickness test on main chord sections 在主弦杆部分測量厚度
		NDT welded connections by a random sample check 就焊接部分隨機抽樣進行無損測試: - main chords 主弦杆 - lacing welds 橫綴焊縫
16	Connections 連接位	Check pins diameter 檢查銷軸直徑
		Check holes diameter 檢查銷孔直徑
		NDT connection pins / bolts and, if luffing cranes, the boom pivot pins 就連接銷軸或螺栓進行無損測試；如屬變幅起重機，須同時為起重臂樞軸進行無損測試
17	Age of Service 使用年期	Verify the age with appropriate methods including reference to the manufacturers' documents 以適當的方法驗證使用年期，包括參考製造商的文件

Remarks 註:

An overall minimum of 10% of welds should be tested by NDT
整體而言，須為最少 10%的焊縫進行無損測試

Derrick Crane (used for installing and dismantling tower cranes)

Critical parts for overhaul maintenances of Derrick Crane (used for installing and dismantling tower cranes)
檢修桅杆起重機（適用於安裝和拆卸塔式起重機）的重要部件

Critical Parts 重要部件		Method of checking 檢查方法
1	Base frame 底座	Visual check on the conditions of base frame 檢查底座的狀態
		NDT anchorage points for guy wires 就拉線位的錨固點進行無損測試
		NDT connection points for booms and kingposts 就主柱與吊杆的連接點進行無損測試
		NDT connection pins and bolts 就栓釘與螺栓的連接點進行無損測試
2	Boom 吊杆	Visual check on the conditions of all boom sections 就所有吊杆的狀況進行目視檢查
		NDT pins / bolts & check bushes / bearings for booms 就栓釘／螺栓及軸套／「啤鈴」進行無損測試
		NDT derrick head fittings 就桅杆頭配件進行無損測試
		NDT flanges for connection of sections by a random sample check 就「佛冷」連接的部件隨機抽樣進行無損測試
		NDT boom heel swivel fittings & related heel cross-pins 就吊杆底柱配件及有關的十字螺栓進行無損測試
		NDT gooseneck pins (including their fillet welds) 就鵝頸栓釘（包括其三角焊縫）進行無損測試
		Check gooseneck bearings and related assemblies 檢查鵝頸「啤鈴」及相關組件
3	Kingpost 主柱	Visual check on the conditions of kingposts 就主柱的狀況進行目視檢查
		Check pins / bolts & bushes / bearings 檢查栓釘／螺栓及軸套／「啤鈴」
		NDT spiders at kingpost head 就主柱頂部星形輪進行無損測試
		NDT topping swivel assemblies 就頂部旋轉組件進行無損測試
		NDT flanges for connection of sections by a random sample check 就「佛冷」連接的部件隨機抽樣進行無損測試
		NDT footings of kingposts 就主柱底部進行無損測試
4	Back stay 後支撐	Visual check on the conditions of back stays 就後支撐的狀況進行目視檢查
		Check pins / bolts & bushes / bearings 檢查栓釘／螺栓及軸套／「啤鈴」

		NDT welded connections by a random sample check 就焊接部分隨機抽樣進行無損測試
5	Hoisting / Luffing / Lateral Swinging Drive Systems (including motors, winches and gearboxes) 起重／俯仰／側的擺動驅動系統（包括「摩打」、絞盤、「波箱」）	Inspect the drive systems for vibration, fluid leakage and correct operation 就驅動器系統的振動、液體洩漏和正確的操作進行檢查
		Inspect and measure drum grooves 檢查和量度滾槽
		Check line pull limitation by test weights 利用重力測試，就拉力限制進行檢查
		Check braking mechanism (including brake linings, brake discs, brake pads, etc.) for wear, damage and adjustment 就剎車系統的磨損程度、損壞和調整機制進行檢查（包括制動器襯片、制動盤、剎車片等）
		Additional checking if failure of the drive system can result in dropping of a load: *如果驅動系統的故障可能導致載荷下降，須進行以下的額外檢查*
		Remove and strip down all parts of the drive systems to check tolerance and worn components including valves, shafts and bearings 拆裝驅動系統的所有部件，包括閥門、軸和「啤鈴」部件，就公差和磨損的部件進行檢查
		NDT parts of the drive systems that may be prone to crack 就驅動系統容易出現破裂的部件進行無損測試
		Inspect transmission coupling 檢查傳動聯軸器
		Check drum ends 檢查鼓輪兩端
6	Hoisting hooks and hook blocks / Pulley blocks 起重吊鈎及吊鈎組／滑輪組	Check pins / bolts and bushes / bearings 檢查栓釘／螺栓及軸套／「啤鈴」
		NDT hook blocks by a random sample check 就吊鈎組隨機抽樣進行無損測試
		NDT hooks 就吊鈎進行無損測試
		Check throat dimensions of hooks 檢查吊鈎尺寸
		Check safety latches 檢查安全鎖
		Inspect and measure sheave grooves 檢查和量度滑輪槽
		Check bearings in sheaves 檢查滑輪內的「啤鈴」
		Measure diameter of rollers 量度滾筒直徑
		Inspect and NDT side plates and axles 檢查側板和車軸，並進行無損測試
7	Safety device 安全裝置	Check angle indicators 檢查角度指示器
8	Wire ropes 鋼纜	Check wire ropes and rope ends 檢查鋼纜及其末端

9	Age of Service 使用年期	Verify the age of winches with appropriate methods including reference to the manufacturers' documents 以適當的方法驗證絞盤的使用年期，包括參考製造商的文件

Remarks 註:

1. An overall minimum of 10% of welds should be tested by NDT
   整體而言，須為最少 10%的焊接位進行無損測試

Gondola

Critical parts for overhaul maintenances of Gondola
檢修吊船的重要部件

Critical Parts 重要部件	Method of checking 檢查方法
1. Climber 爬升器	
1.1 Electrical motors 電動「摩打」	Check electrical resistance/ functional test/ load test 檢查電阻，並進行功能測試／荷載測試
1.2 Electromagnetic brake 電磁制動器	Functional test/ check thickness of brake pads 進行功能測試，並檢查剎車片的厚度
1.3 Manual brake release 手動釋放器	Functional test 進行功能檢查
1.4 Traction mechanism 牽引機制	
1.4.1 Rope shift 纜索移動裝置	Functional test/ visual inspection 進行功能及目視檢查
1.4.2 Pressure rollers 壓轆	Functional test/ visual inspection 進行功能及目視檢查
2. Safety Device 安全裝置	
2.1 Upper travel limit switch & cam (mechanical & electrical) 上行限位開關及凸輪（機動和電動）	Functional test 進行功能檢查
2.2 Automatic safety devices 自動安全裝置	Visual inspection/ functional test on over-speed and tilting protection 就速度和傾斜保護機制進行目視檢查／功能測試
2.3 Emergency stop switch 緊急煞停開關	Functional test 進行功能檢查
2.4 Motor overload protection 「摩打」超荷防護裝置	Functional test 進行功能檢查
3. Age of Service 使用年期	Verify the age of climbers and safety devices with appropriate methods including reference to the manufacturers' documents 以適當的方法驗證爬升器和安全裝置的使用年期，包括參考製造商的文件

Material Hoist

Critical parts for overhaul maintenances of Material Hoist
檢修物料吊重機的重要部件

Critical Parts 重要部件	Method of checking 檢查方法
1A. Power Pack 動力裝置(適用於液壓機)	
1A.1 Electrical motors 電機	Sound and signs of overheat 檢查有否發出聲響和過熱的跡象
1A.2 Hydraulic System 液壓系統	
1A.2.1 Hydraulic Winch 液壓捲揚機	MSDS and type of oil 檢查物質安全資料表和液壓油的類型
1A.2.2 Hydraulic Oil Tank Level 液壓油缸油位	Leakage test, visual + bubble test 進行洩漏測試，以及目視和氣泡測試
1A.2.3 Pressure Gauge 油壓錶	Dead weight test for calibration before install functional 在安裝之前，以淨荷載測試方式進行較準
1A.2.4 Hydraulic Oil Cooler 液壓油冷卻器	Bubble test 進行氣泡試驗
1A.2.5 Hydraulic Oil Cooler Fan 液壓油散熱風扇	Temperature 進行溫度測試
1A.3 Transmission System 傳動系統 (Transmission gear box 傳動減速箱)	Functional + visual 進行功能及目視檢查
1A.4 Braking System 制動系統	Functional + visual 進行功能及目視檢查
1A.5 Pulleys 滑輪組件	
1A.5.1 Top 頂轆	Functional + visual 進行功能及目視檢查
1A.5.2 Bottom 底轆	Functional + visual 進行功能及目視檢查
1B. Power Pack 動力裝置 (適用於變頻機)	
1B.1 Electrical motors 電機	Sound and signs of overheat 檢查有否發出聲響和過熱的跡象
1B.2 Frequency Converter 變頻系統	
1B.2.1 Winch 捲揚機	Functional + visual 進行功能及目視檢查
1B.2.2 Frequency Converter 變頻系統	Output voltage 檢查輸出電壓
1B.2.3 Frequency Converter Resistor 變頻電阻箱	Resistance 檢查電阻

1B.2.4 Frequency Converter Cooler Fan 變頻散熱風扇	Functional + visual 進行功能及目視檢查
1B.3 Transmission System 傳動系統 (Transmission gear box 傳動減速箱)	Functional + visual 進行功能及目視檢查
1B.4 Braking System 制動系統	Functional + visual 進行功能及目視檢查
1B.5 Pulleys 滑輪組件	
1B.5.1 Top 頂轆	Functional + visual 進行功能及目視檢查
1B.5.2 Bottom 底轆	Functional + visual 進行功能及目視檢查
2. Safety Device 安全裝置	
2.1 Load Cells 稱重傳感器	Calibrate by standard weights or replace 以標準砝碼校準或更換
3. Age of Service 使用年期	Verify the age of winches with appropriate methods including reference to the manufacturers' documents 以適當的方法驗證絞盤的使用年期，包括參考製造商的文件

Note 註:

Only List 1A or 1B should be used depending on the type of hoist.
視乎吊重機的類型，選擇使用列表 1A 或 1B。

Mobile Crane (excluding crawler crane)

Critical parts for overhaul maintenances of mobile crane (excluding crawler crane)
檢修流動式起重機（不包括履帶式起重機）的重要部件

Critical Parts 重要部件		Method of checking 檢查方法
1	Drive systems (including motors, winches, gearboxes and drive shafts) 驅動系統（包括「摩打」、絞盤、波箱和驅動軸）	Inspect the drive systems for vibration, fluid leakage and correct operation 就驅動系統有否振動、液體洩漏和正確操作進行檢查
		Inspect and measure drum grooves 檢查和量度滾槽
		Check line pull limitation using test weights 以重塊測試拉力上限
		Check rope fixing clamps / ends 就纜索固定夾／末端進行檢查
		Additional checking as per items (a) to (c) below if failure of the drive system can result in dropping of a load: *如果驅動系統的故障可能會導致荷載下降，須進行以下(a)至(c)項額外檢查* a) NDT parts of the drive system that may be prone to crack 就驅動系統容易出現破裂的部件進行無損測試 b) Remove and strip down the drive systems where practicable to check shafts, gears, valves, bearings and worn components 在切實可行的情況下，拆裝驅動系統的所有部件，以檢查驅動軸、齒輪、閥門、「啤鈴」和磨損的部件 c) Conduct pressure and performance test to hydraulic motors and valves at maximum working pressure 在最大許可壓力下，就液壓「摩打」和閥門進行壓力和性能測試
2	Limit switch / ASLI (automatic safe load indicator) / Safety devices 限位開關／ ASLI（安全荷載自動顯示器）／安全設備	Check for functionality (such as ASLI, anti-two block devices, cut-out devices, boom overhoist limited switches, emergency stops, etc.) and calibrate ASLI by standard weights 進行功能檢查（例如安全荷載自動顯示器、防滑輪組碰撞裝置、斷路設備、吊臂超重開關、緊急停上制等），並利用標準砝碼校準安全荷載自動顯示器
		Slewing visual & audio warning device, CCTV 轉盤的影音警告設備及閉路電視
3	Braking systems 剎車系統	Remove and dismantle hoist and luffing brakes to check pins, springs, valves and bearings 拆除並解裝吊機和變幅制動器，就栓釘、彈簧、閥門和「啤鈴」進行檢查
		Check oil leakage and replace rubber seals 檢查有否漏油並更換橡膠密封墊
		NDT any welds in braking system that may be prone to crack 就驅動系統容易出現破裂的部件進行無損測試
		Check braking mechanism (including brake linings, brake discs, brake pads, etc.) for wear, damage and adjustment 就剎車系統的磨損程度、破損和調校機制進行檢查（包括制動器襯片、制動盤、剎車片等）
4	Bearings 「啤鈴」	Check any deformation and wear 檢查有否任何變形和磨損

5	Hydraulic systems 液壓系統	Check the flow of hydraulic pumps and motors by a flow meter or a time check 利用時間計或流量計檢查油壓泵的流量
		Check pressure of hydraulic pumps 檢查油壓泵的壓力
		Inspect hydraulic cylinders and systems for leaks at maximum working pressure 在最大許可壓力下，檢查液壓缸及其系統有否洩漏
		Measure housing and ram for distortion, ovality, weardown 量度外罩和推桿的扭曲度、橢圓度及磨蝕程度
		Check and test the functionalities and settings of safety valves, non-return valves and holding valves of hydraulic fluids 進行功能測試，以檢測液壓流體安全閥、止逆閥和保持閥的功能和設定
		Check conditions of hydraulic hoses and replace them every six years from the date of manufacture unless otherwise specified by the manufacturer 檢查液壓軟管的狀況，除非製造商另有規定，否則更換由製造日期開始年齡滿六年的軟管
		Check leakage from hydraulic swivels 檢查液壓旋轉接頭有否洩漏
6	Outrigger 支架	Check hydraulic systems, hoses, oil leakage 檢查液壓系統、軟管有否漏油
		Check proper extension and seating 檢查有否適當伸展，以及是否坐落於適當地方
		Inspect the levelling and physical conditions on slider pads / bearings 就滑塊墊／啤鈴的平水和結構是否完好無損進行檢查
		Check all pins, holes and bushes 檢查所有栓釘、孔眼及軸套
		Inspect outrigger floats 檢查支架有否浮動
		Structural NDT inspections at: 就下列結構進行無損檢測 a) connection between outrigger beams and cylinder housings for outrigger jacks 伸臂樑和支架插孔氣缸外罩之間的連接位 b) outrigger boxes and mounting 支架箱及底座
7	Slewing systems 轉盤系統	Check clearance in slew ring at a min. of 4 locations 在轉盤上選擇最少 4 個位置進行間隙檢查
		Check torque or replace slew ring bolts 檢查扭矩或更換轉盤螺栓
8	Undercarriage and slewing device 底盤和轉盤裝置	Visually check for wear and damage 就磨蝕和破損情況進行目視檢查
		Check gear clearance and any abnormal function 檢查齒輪間隙，並測試其功能有否異常
9	Hooks and hook blocks 吊鈎及吊鈎組	Check pins & bushes / bearings 檢查栓釘及軸套／「啤鈴」

		NDT hooks 就吊鈎進行無損測試
		Check throat dimensions of hooks and safety latches 檢查吊鈎尺寸和安全鎖
		Inspect and measure sheave grooves for wear 檢查和量度輪槽的磨損程度
		Check bearings in sheaves 檢查滑輪內的「啤鈴」
		Inspect, measure and, if required, NDT side plates and axles 檢查、量度側板和車軸，如有需要，進行無損測試
10	Booms (hydraulic booms) 吊臂 (液壓吊臂)	Check boom conditions 檢查吊臂狀況
		Fully dismantle the booms and check hidden mechanisms / parts 完全拆解吊臂並檢查隱藏的機件
		NDT critical areas / welds on boom sections and turret frame 就吊臂部分與框架的關鍵範圍或焊接位進行無損測試
		Check boom straightness (Distortion, waviness, buckling measurement) 檢查吊臂的直線度（量度扭曲度、波紋度及彎曲度）
		Check pins & bushes / bearings, slider pads, boom locking pins if fitted 就栓釘及軸套／啤鈴、滑塊墊和吊臂鎖栓釘（如有）進行檢查
		Inspect wire ropes or chains or screw drives if fitted 就纜、鐵鏈或螺桿驅動器（如有）進行檢查
11	Booms (lattice booms, including fly jibs) 吊臂 (格子吊臂，亦包括飛吊臂)	Check all boom sections 檢查所有的吊臂部件
		Check pin & bushes / bearings, boom connectors and pins, sheaves and ropes 就栓釘及軸套／「啤鈴」、吊臂連接器和栓釘、滑輪和纜索進行檢查
		NDT welds connecting male and female clevises 就凸形與內孔連接的焊接位進行無損測試
		NDT welds on boom butt section 就吊臂底部組件焊接位進行無損測試
		NDT welds on boom head and stress concentrated areas 就吊臂頂和應力集中區的焊接位進行無損測試
		NDT lacing welds by a random sample check 就橫綴焊接位隨機抽樣進行無損測試
		Measure thickness on main chords (ultrasonic) 在主弦杆部分厚度（超聲波）
12	Wire Ropes 鋼纜	Inspect all hoist, luffing and pendant ropes if fitted 檢查所有的吊索、變幅索和吊架纜索（如有）
13	Age of Service 使用年期	Verify the age with appropriate methods including reference to the manufacturers' documents 以適當的方法驗證使用年期，包括參考製造商的文件

Remarks 註:

An overall minimum of 10% of welds should be tested by NDT
整體而言，須為最少 10%的焊縫進行無損測試

Truck-mounted Crane*

Critical parts for overhaul maintenances of truck-mounted crane*
檢修隨車起重機的重要部件

Critical Parts 重要部件		Method of checking 檢查方法	
1	Hydraulic systems 液壓系統	Check the flow of hydraulic pumps by a flow meter or a time check 利用時間計或流量計檢測液壓泵的流量	
		Check the pressure of hydraulic pumps 檢測油壓泵的壓力	
		Inspect hydraulic systems and components for leaks 檢測液壓系統及其組件有否洩漏	
		Conduct a sink rate test at 100% of SWL and at maximum hydraulic outreach (without manual extensions, if fitted) 在吊臂以液壓方式全面伸展的狀態下，以 100%安全工作荷載進行下降率測試（但如有手動裝置，切勿啟動手動伸展）	
		Check and test the functionalities and settings of safety valves, pressure relief valves, non-return valves and holding valves for hydraulic fluids by performance test or as manufacturer's recommendations 就液壓流體的安全閥、洩壓閥、止逆閥和截流閥的功能和設定，檢測其性能，或按照製造商的建議進行檢測	
		Check hydraulic hoses for damage, moist areas, leaks, blistering, unevenness of hose casing, signs of aging, etc. 檢查液壓軟管有否損壞、分泌物範圍、洩漏、起泡、不平整的軟管套管、老化跡象等	
		Check leakage from hydraulic swivels 檢查液壓旋轉接頭有否洩漏	
2	Slewing systems 轉盤系統	Check clearance in slew ring at a min. of 4 locations 在轉盤上選擇最少 4 個位置進行間隙檢查	
		Check torque or replace slew ring bolts 檢查扭矩或更換轉盤螺栓	
3	Hooks and hook blocks 吊鈎及吊鈎組	Check pins & bushes / bearings 檢查栓釘及軸套／「啤鈴」	Alternative option: Replace the entire hooks / hook blocks instead of checking all relevant items as stated 替代方案：更換整個吊鈎／吊鈎組，便無須檢查所有相關的項目
		NDT hooks 就吊鈎進行無損測試	
		Check throat dimensions of hooks 檢查吊鈎尺寸	
		Check safety latches 檢查安全鎖	
		Inspect side plates and axles 檢查側板和車軸	
		Inspect and measure sheave grooves for wear 檢查和量度輪槽的磨損程度	
		Check bearings in sheaves 檢查滑輪內的「啤鈴」	
		Measure diameter of rollers 量度滾筒直徑	

		NDT roller mounts 就滾筒底座進行無損測試	
4	Booms (hydraulic booms) 吊臂 (液壓吊臂)	Check boom conditions 檢查吊臂狀況	
		Functional test all control of the boom for smoothness of operation 進行功能測試，以確保所有吊臂的控制系統操作暢順	
		Check pins by performance test, bushes / bearings, slider pads, boom locking pins if fitted & leaks of cylinders 進行性能測試，以檢查栓釘，以及軸套／「啤鈴」、滑塊墊、吊臂鎖栓釘（如有裝設），同時須一併檢查液壓缸有否洩漏	
		Structural NDT inspections at: 就下列結構進行無損測試 a) top of base around upper column bearing 圍繞上柱「啤鈴」的底座頂部 b) rear of base around slew rack guidance 圍繞指導擺架的底座底部 Visual inspection, and NDT when necessary 就下列部分進行目視檢查，如有需要，亦須一併進行無損測試 a) connection between crane base and pendulum beam 起重機底座和擺樑之間的連接位 b) connection between lift ram and column 提升桿和支柱之間的連接位 c) connection between lift ram and 1st boom 提升桿和第一節吊臂之間的連接位 d) connection between 1st boom and column 第一節吊臂和支柱之間的連接位 e) connection between 1st boom and 2nd boom ram 第一節吊臂和第二節吊臂桿之間的連接位 f) connection between 1st boom and 2nd boom 第一節吊臂和第二節吊臂之間的連接位 g) connection between 2nd boom ram and 2nd boom 第二節吊臂桿和第二節吊臂之間的連接位 h) closing welds on underside of booms 吊臂底部的密封焊接 i) suspension points for hook 吊點鈎	
5	Outrigger 支架	Inspect the levelling and physical conditions on bearing 就「啤鈴」的平水和結構是否完好無損進行檢查	
		Check fully extended 在完全伸展的狀態進行檢查	
		Check leakage from cylinders/ hoses/ pipework 檢查汽缸／軟管／管道有否洩漏	
		Inspect outrigger floats 檢查支架有否浮動	

		Structural NDT inspections at: 就下列結構進行無損測試 a) outrigger housings 支架外罩 b) connection between outrigger jacks and outrigger beams (for swing type) 支架插孔和伸臂樑之間的連接位（只適用於擺動式支架）
6	Limit switch / ASLI (automatic safe load indicator)/Safety devices 限位開關／ ASLI（安全荷載自動顯示器）/安全設備	Check for functionality (such as ASLI and cut-out / safety devices) and calibrate ASLI by standard weights 進行功能檢查（例如安全荷載自動顯示器和斷路／安全設備），並利用標準砝碼校準安全荷載自動顯示器
7	Age of Service 使用年期	Verify the age with appropriate methods including reference to the manufacturers' documents 以適當的方法驗證使用年期，包括參考製造商的文件

* "truck-mounted crane" means a loader crane mounted on a truck or lorry.
"隨車起重機" 指附裝了起重機的卡車或貨車。

Crawler Crane

Critical Parts for Overhaul Maintenance of Crawler Crane
檢修履帶式起重機的重要部件

No. 編號	Critical Parts 重要部件	Method of inspection 檢查方法
A	Structural Parts 結構部件	
1	Boom 吊臂	Measure distortion, inspect main cords and bracings damage 量度扭曲度，檢查主杆和撐杆有否損壞
		Measure pins diameter, check pins, visual inspection of wear and cracks at critical parts, NDT* as determined by RPE 量度栓釘的直徑並檢查栓釘，就吊臂重要部件有否磨損和裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check pulleys, bearings and rope protection 檢查滑輪、「啤鈴」和纜索護罩
		Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
2	Upper Carbody & Slewing Bearing 車身上部和轉向「啤鈴」	Inspect the torque of slewing bearing bolts by torque wrench (refer to manufacturer specification) 利用扭力扳鉗檢查轉向「啤鈴」螺栓的扭力（參閱製造商的規格說明書）
		Inspect slewing bearing clearance (refer to manufacturer specification) 檢查轉向「啤鈴」的間隙（參閱製造商的規格說明書）
		Visual inspection wear, damage and crack, NDT* as determined by RPE 就磨損、損壞和裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Visual inspection the welding of upper carbody critical parts, NDT* as determined by RPE 就車身重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
3	Counterweight 尾跎	Visual inspection for any damage 就有否任何損壞進行目視檢查
		Inspect the torque of the mounting bolts by torque wrench (refer to manufacturer specification) 利用扭力扳鉗檢查固定螺栓的扭力。（參閱製造商的規格說明書）
4	Operator Cabin 操作室	Visual inspection for condition 就有否任何損壞進行目視檢查
5	Pins and Holes For All Connection 所有連接位的栓釘和孔眼	Measure pins and holes diameters 量度栓釘和孔眼的直徑
		Visual inspection for wear and damage 就有否磨損和損壞進行目視檢查
		Visual inspection any crack in pins, NDT* as determined by RPE 就栓釘有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*

6	Undercarriage and Crawlers 底盤和履帶	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Visual inspection for wear and damage 就有否磨損和損壞進行目視檢查
B	Mechanical / Hydraulic / Hoisting Parts 機械／液壓／吊機部分	
1	Wire Rope (Main Hoist, Auxiliary Hoist, Luffing Hoist and Guy Cable) 纜索（主吊機、輔助吊機、變幅吊機和拉索）	Visual inspection for wire rope damage 就纜索有否損壞進行目視檢查
		Measure the rope diameter 量度纜索的直徑
		Visual inspection for wire sockets and rope ends 就纜索套筒接頭和纜索末端進行目視檢查
		Visual inspection for wire rope clips damage and nut tightness 就纜索扣有否損壞和螺帽的鬆緊度進行目視檢查
		Replace guy ropes or pendant ropes every 2 years unless otherwise specified by the manufacturers 除製造商的說明書另有註明外，每兩年更換拉索或吊臂纜索
2	Winch 絞盤	Inspect brakes and clutches mechanism 檢查制動器和離合器的機能
		Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Perform functional test and inspect any damage for the control levers and pedals 進行功能檢查，並檢查控制桿和腳踏有否任何損壞
		Inspect rope fixing ends 檢查纜索固定末端
		Inspect and measure drum grooves 檢查和量度鼓槽
3	Sheaves (Spreader, Luffing, Boom Head and Hooks) 纜轆（伸張器、變幅器、吊臂頂部、吊鈎）	Inspect the pins, bushings / bearings 檢查栓釘、軸套／「啤鈴」
		Inspect the profile of the sheaves' grooves 檢查纜轆鼓槽剖面
		Visual inspection for any crack, NDT* as determined by RPE 就有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check rope guard 檢查導纜器
4	Crawler Power Driving System 履帶驅動系統	Perform functional test 進行功能檢查
		Inspect oil leakage 檢查有否漏油

5	Ball Hook & Hook Block 球形吊鈎和吊鈎滑車	Inspect safety latches 檢查安全扣
		Inspect the pins, bushings / bearings 檢查栓釘、軸套／「啤鈴」
		Visual inspection any crack in the hooks, NDT* as determined by RPE 就有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check all hooks for damage, wear, corrosion and throat opening 就有否損壞、磨損、腐蝕檢查所有吊鈎，並檢查吊鈎保險扣
6	Hydraulic Hoses and Connector 液壓喉管和連接器	Inspect oil leakage 檢查有否漏油
		Inspect coupling tightness 檢查接頭的鬆緊度
		Visual inspection any crack and damage 就有否任何裂痕和損壞進行目視檢查
		Visual inspection for damage and oil leakage. Replace critical hoses every 2 years or 6 years from the date of manufacture unless otherwise specified by the manufacturer. 就有否損壞和漏油進行目視檢查。除製造商的說明書另有註明外，重要喉管在出廠後六年或每兩年更換
7	Operating Pressure 操作壓力	Perform maximum operating pressure test 進行最大操作壓力測試
C	Electrical Parts 電動部件	
1	Control Panel / Lever 控制面板／控制桿	Perform functional test, clear markings 進行功能測試，清除標記
		Inspect any damage 檢查有否任何損壞
2	Electrical Wiring, Connector 電線和連接器	Inspect wire condition and insulation 檢查電線的狀況和絕緣性
3	Lighting, Wiper and Horn 照明系統、水撥和警笛	Perform functional test 進行功能測試
		Inspect any damage 檢查有否任何損壞
D	Safety Devices 安全裝置	
1	Overload & Boom Angle Limited Indicator 超重及吊臂角度限制顯示器	Perform functional test as determined by RPE 按註冊專業工程師的決定進行功能測試

2	Hook Blocks and Boom Overhoist Limited Switches 吊鈎滑車及吊臂防過捲限位掣	Perform functional test and inspect any damage 進行功能測試，並檢查有否任何損壞
3	Slewing Warning Light and Alarm 轉向警告燈號和響號	
4	Emergency Stop 緊急煞停掣	
E	Age of Services 使用年期	
1	Plant Age 裝置使用年期	Verify the age with appropriate methods including reference to manufacturers' documents 裝置使用年期須以適當的方法驗證，包括參閱製造商的文件

* At least 10% of critical part welded joints shall be tested by NDT other than visual inspection.
重要部件須有最少 10% 的焊接位進行無損測試，不得只進行目視檢查

Pile Driver

Critical Parts for Overhaul Maintenance of Pile Driver
檢修打樁機的重要部件

No. 編號	Critical Parts 重要部件	Method of inspection 檢查方法
A	Structural Parts 結構部件	
1	Leader 導架	Measure distortion 量度扭曲度
		Measure pins diameter, visual inspection of wear and cracks at critical parts, NDT* as determined by RPE 量度栓釘的直徑，就重要部件有否磨損和裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check tightening torques of screws for lead joints, replace the screws annually or as per manufacturers' requirements 檢查填鉛接頭的螺絲的收緊扭力，每年或按照製造商的要求更換螺絲
2	Upper Carbody & Slewing Bearing 車身上部和轉向「啤鈴」	Inspect the torque of slewing bearing bolts by torque wrench (refer to manufacturer specification) 利用扭力扳鉗檢查轉向「啤鈴」螺栓的扭力。（參閱製造商的規格說明書）
		Check slewing bearing clearance (refer to manufacturer specification) 檢查轉向「啤鈴」的間隙。（參閱製造商的規格說明書）
		Visual inspection wear, damage and crack, NDT* as determined by RPE 就有否磨損、損壞和裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Visual inspection the welding of upper carbody critical parts, NDT* as determined by RPE 就車身重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
3	Back-Stay and Hydraulic Cylinder With Pivot Joint 後支撐和有轉軸接頭的液壓缸	Visual inspection for wear & crack in pivot joint, NDT* as determined by RPE 就有否磨損、損壞和裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Inspect hydraulic cylinder sealing oil leakage 檢查液壓缸封口有否漏油
		Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*

4	Counterweight 尾跎	Visual inspection for any damage 就有否損壞進行目視檢查
		Inspect the torque of the mounting bolts by torque wrench (refer to manufacturer specification) 利用扭力扳鉗檢查固定螺栓的扭力（參閱製造商的規格說明書）
5	Operator Cabin 操作室	Visual inspection for condition 就操作室狀況進行目視檢查
6	Pins and Holes For All Connection 所有連接位的栓釘和孔眼	Measure pins and holes diameter 量度栓釘和孔眼的直徑
		Visual inspect for wear and damage 就有否磨損和損壞進行目視檢查
		Visual inspection any crack in pins, NDT* as determined by RPE 就栓釘有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
7	Undercarriage and Crawlers 底盤和履帶	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Visual inspection for wear and damage 就有否磨損和損壞進行目視檢查
8	Outrigger 懸臂架	Inspect hydraulic cylinder oil leakage 檢查液壓缸有否漏油
		Inspect the levelling and physical condition on slider pads 檢查外伸支架底板的平水和狀況
		Visual inspection pins, holes & welding for critical parts, NDT* as determined by RPE 就重要部件的栓釘、孔眼和焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
B	Mechanical / Hydraulic / Hoisting Parts 機械／液壓／吊機部分	
1	Wire Rope (Main Hoist and Auxiliary Hoist) 纜索（主吊機和輔助吊機）	Visual inspection for wire rope damage 就纜索有否損壞進行目視檢查
		Measure the rope diameter 量度纜索的直徑
		Visual inspection for wire sockets and rope ends 就纜索套筒接頭和纜索末端進行目視檢查
		Visual inspection for wire rope clips damage and nut tightness 就纜索扣有否損壞和螺帽的鬆緊度進行目視檢查

2	Winch 絞盤	Inspect brakes, clutches mechanism and condition 檢查制動器和離合器的機能和狀況
		Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Perform functional test and inspect any damage for the control levers and pedals 進行功能檢查，並檢查控制桿和腳踏有否任何損壞
		Inspect rope fixing ends 檢查纜索固定末端
		Inspect and measure drum grooves 檢查和量度鼓槽
3	Sheaves (Leader Head and Auxiliary Hoist) 纜轆（導架頂部和輔助吊機）	Inspect the pins, bushings / bearings 檢查栓釘、軸套／「啤鈴」
		Inspect the profile of the sheaves' grooves 檢查纜轆鼓槽剖面
		Visual inspection any crack, NDT* as determined by RPE 就有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check rope guard 檢查導纜器
4	Crawler Power Driving System 履帶驅動系統	Perform functional test 進行功能檢查
		Inspect oil leakage 檢查有否漏油
5	Ball Hook & Hook Block 球形吊鈎和吊鈎滑車	Inspect safety latches 檢查安全扣
		Inspect the pins, bushings / bearings 檢查栓釘、軸套／「啤鈴」
		Visual inspection any crack in the hooks, NDT* as determined by RPE 就有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check hooks for damage, wear, corrosion and throat opening 就有否損壞、磨損、腐蝕檢查所有吊鈎，並檢查吊鈎保險扣
6	Hydraulic Hoses and Connector 液壓喉管和連接器	Inspect oil leakage 檢查有否漏油
		Inspect coupling tightness 檢查接頭的鬆緊度
		Visual inspection any crack and damage, NDT* as determined by RPE 就有否任何裂痕和損壞進行目視檢查
7	Operating Pressure 操作壓力	Perform maximum operating pressure test 進行最大操作壓力測試

C	Electrical Parts 電動部件	
1	Control Panel / Lever 控制面板／控制桿	Perform functional test, clear markings 進行功能測試，清除標記
		Inspect any damage 檢查有否任何損壞
2	Electrical Wiring, Connector 電線和連接器	Inspect wire condition and insulation 檢查電線的狀況和絕緣性
3	Lighting, Wiper and Horn 照明系統、水撥和響號	Perform functional test 進行功能測試
		Inspect any damage 檢查有否任何損壞
D	Safety Devices 安全裝置	
1	Auxiliary Hoist Overhoist Limited Switch 輔助吊機防過捲限位掣	Perform functional test and inspect any damage 進行功能測試，並檢查有否任何損壞
2	Slewing Warning Light and Alarm 轉向警告燈號和響號	
3	Operation Emergency Stop 緊急煞停操作掣	
4	Outreach limit switch 伸展限位掣	
5	Lower limit switch for leader 導架下限開關掣	
E	Age of Services 使用年期	
1	Plant Age 裝置使用年期	Verify the age with appropriate methods including reference to manufacturers' documents 裝置使用年期須以適當的方法驗證，包括參閱製造商的文件

* At least 10% of critical part welded joints shall be tested by NDT other than visual inspection.
重要部件須有最少 10% 的焊接位進行無損測試，不得只進行目視檢查

Hydraulic Hammer

Critical Parts for Overhaul Maintenance of Hydraulic Hammer
檢修液壓樁錘的重要部件

No. 編號	Critical Parts 重要部件	Inspection Item 檢查項目	Method of Inspection 檢查方法
1	Guide Claws (Leader Guide) 導軌爪 （主臂導軌）	Connecting bolts and pins 連接螺栓和栓釘	Visual inspection of pins, NDT* as determined by RPE, tighten bolts by Torque Wrench (refer to manufacturer's instruction manual) 就栓釘進行目視檢查。按註冊專業工程師的決定進行無損測試*。利用扭力扳鉗收緊螺栓。（參閱製造商的規格說明書）
		Welding of structural parts 結構部件的焊接位	Visual inspection and NDT* as determined by RPE 進行目視檢查。按註冊專業工程師的決定進行無損測試*
2	Steel Frame Body 鋼架結構	Welding of structural parts 結構部件的焊接位	Visual inspection and NDT* as determined by RPE 進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Lifting points 提吊點	Visual inspection and NDT* as determined by RPE 進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Ram Block / Ram block lifting eye / Bolts 鎚頭墊塊／鎚頭墊塊吊眼／螺栓	Visual inspection and NDT* as determined by RPE, tighten bolts by Torque Wrench (refer to manufacturer's instruction manual) 進行目視檢查。按註冊專業工程師的決定進行無損測試*。利用扭力扳鉗收緊螺栓。（參閱製造商的規格說明書。）
3	Drive Cap Housing (Helmet) 鎚帽裝置 (鎚帽)	Connecting bolts 連接螺栓	Visual inspection of bolts and tighten by Torque Wrench (refer to manufacturer's instruction manual) 就螺栓進行目視檢查。利用扭力扳鉗收緊螺栓。（參閱製造商的規格說明書。）
		Drive cap (Helmet) 樁鎚鎚帽	Visual inspection of weldings and NDT* as determined by RPE 就焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Drive cap cushion 樁鎚吸震墊	Inspect condition (refer to manufacturer's instruction manual) 檢查狀況。（參閱製造商的規格說明書）
		Rebound ring 樁鎚緩衝回彈環墊	Inspect condition (refer to manufacturer's instruction manual) 檢查狀況。（參閱製造商的規格說明書）

4	Hydraulic Systems (include hydraulic power pack) 檢修液壓椿鎚的重要部件	Hydraulic circuit 液壓環路	Visual inspection of hydraulic oil leakage and test maximum operating pressure 就操作室狀況進行目視檢查
		Hydraulic lines and connections 液壓管路和連接位	Inspect damage and leakage 檢查有否損壞和滲漏
5	Hydraulic Power Pack 液壓動力機組	Welding of structural parts and lifting eyes 結構部件的焊接位和吊眼	Visual inspection of structure weldings and NDT* of lifting eyes as determined by RPE 就結構部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
6	Hydraulic Hammer 液壓椿鎚	Function 功能	Functional test (refer to manufacturer's instruction manual / RPE instruction) 按照製造商的說明書／註冊專業工程師指示，進行功能測試。
7	Plant Age 裝置使用年期	Age of Services 使用年期	Verify the age with appropriate methods including reference to manufacturers' documents 裝置使用年期須以適當的方法驗證，包括參閱製造商的文件。

* At least 10% of critical part welded joints shall be tested by NDT other than visual inspection.
重要部件須有最少 10%的焊接位進行無損測試，不得只進行目視檢查

Oscillator

Critical Parts for Overhaul Maintenance of Oscillator
檢修大口徑磨樁機的重要部件

No. 編號	Critical Parts 重要部件	Method of Checking 檢查方法
A	Structural Parts 結構部件	
1	Oscillator Body 磨樁機機身	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
2	Lifting Points 提吊點	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
3	Oscillating Cylinders Junction Box & Arms 磨樁液壓缸連接箱及連接臂	Inspection for bolts fasten and spherical bearing condition 檢查螺栓是否收緊，以及球形「啤鈴」的狀況
4	Crawler Crane Attachment & Pins 履帶式起重機連接器和栓釘	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
5	Retaining Device 鎖扣裝置	Visual inspection for condition 就狀況進行目視檢查
B	Hydraulic Control / Hydraulic cylinders 液壓控制裝置／液壓筒	
1	Hydraulic Hoses 液壓喉管	Visual inspection for damage and oil leakage. Replace critical hoses every 2 years or 6 years from the date of manufacturer unless otherwise specified by the manufacturer. 就有否損壞和漏油進行目視檢查。除製造商的說明書另有註明外，重要喉管在出廠後六年或每兩年更換
2	Connector & Quick Coupling 連接器和快速接頭	Visual inspection for damage and oil leakage 就有否損壞和漏油進行目視檢查
3	Hydraulic Control 液壓控制裝置	Functional test and visual inspection for oil leakage 進行功能檢查，並就有否漏油進行目視檢查
4	Operating Pressure 操作壓力	Maximum working pressure test 進行最大操作壓力測試
5	Remote Control 遙控裝置	Inspection for electrical remote control cable and functional test 檢查電動遙控電線，並進行功能測試

6	Lifting Cylinders 提吊液壓筒	Perform Functional test, Visual inspection for oil leakage, fittings, pins, bolts and spherical bearing condition 進行功能測試。就配件、栓釘、螺栓和球形「啤鈴」的狀況，以及有否漏油的問題進行目視檢查
7	Retaining Cylinders 鎖扣液壓筒	
8	Vertical Adjusting Cylinder 垂直調整液壓筒	
9	Oscillating Cylinders 磨椿液壓筒	
10	Clamping Cylinder 夾鉗液壓筒	
C	Age of Services 使用年期	
1	Plant Age 裝置使用年期	Verify the age with appropriate methods including reference to manufacturers' documents 裝置使用年期須以適當的方法驗證，包括參閱製造商的文件

* At least 10% of critical part welded joints shall be tested by NDT other than visual inspection.
重要部件須有最少 10%的焊接位進行無損測試，不得只進行目視檢查

Rotator

Critical Parts for Overhaul Maintenance of Rotator
檢修大口徑旋轉樁機的重要部件

No. 編號	Critical Parts 重要部件	Method of inspection 檢查方法
A	Structural Parts 結構部件	
1	Rotary Unit 旋轉機組	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
2	Lifting Points 提吊點	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
3	Upper & Lower Clamping Collars 上層和下層夾鉗套環	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
4	Crawlers & Supporting Frame For Crawlers 履帶和履帶支撐框架	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
B	Power Swivel & Hydraulic System 動力轉環和液壓系統	
1	Hydraulic Hoses 液壓喉管	Visual inspection for damage and oil leakage. Replace critical hoses every 2 years or 6 years from the date of manufacturer unless otherwise specified by the manufacturer. 就有否損壞和漏油進行目視檢查。除製造商的說明書另有註明外，重要喉管在出廠後六年或每兩年更換
2	Connector & Quick Coupling 連接器和快速接頭	Visual inspection for damage and oil leakage 就有否損壞和漏油進行目視檢查
3	Hydraulic Control 液壓控制裝置	Perform functional test and visual inspection for oil leakage 進行功能檢查，並就有否漏油進行目視檢查
4	Power Swivel Gear Box 動力轉環變速箱	Visual inspection for damage and oil leakage 就有否損壞和漏油進行目視檢查
5	Operating Pressure 操作壓力	Perform maximum working pressure test 進行最大操作壓力測試
C	Hydraulic Cylinders 液壓筒	
1	Upper Clamp Cylinders 上層夾鉗液壓筒	Perform functional test, Visual inspection for oil leakage, fittings, pins, bolts and spherical bearing condition 進行功能測試。就配件、栓釘、螺栓和球形「啤鈴」的狀況，以及有否漏油的問題進行目視檢查
2	Lower Clamp Cylinders 下層夾鉗液壓筒	
3	Lifting Cylinders 提吊液壓筒	
4	Leveling Cylinders 平水液壓筒	

D	Power Pack 動力機組	
1	Diesel Engine 柴油引擎	Visual inspection for oil leakage and condition 就有否漏油進行目視檢查，並瞭解引擎的狀況
2	Exhaust & In-let Pipe 排氣管和進氣管	Inspection leakage and damage 檢查有否滲漏和損壞
3	Radiator & Hydraulic Oil Cooler 散熱器和液壓油冷卻器	Inspection coolant and hydraulic oil leakage 檢查冷卻劑和液壓油有否滲漏
4	Operation Emergency Stop 緊急煞停操作掣	Perform functional test 進行功能測試
5	Electrical Wiring & Connector 電線和連接器	Inspection for damage and insulation 檢查有否損壞及其絕緣性
E	Others 其他	
1	Working Platform, Railing & Ladder 工作平台、護欄和梯級	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
F	Age of Services 使用年期	
1	Plant Age 裝置使用年期	Verify the age with appropriate methods including reference to manufacturers' documents 裝置使用年期須以適當的方法驗證，包括參閱製造商的文件

* At least 10% of critical part welded joints shall be tested by NDT other than visual inspection.
重要部件須有最少 10%的焊接位進行無損測試，不得只進行目視檢查

APPENDIX PRE.B8/XII

PRE.B8.APPEND12.B GUIDELINES ON SCOPE AND CONTENTS OF QUALITY CONTROL SYSTEM

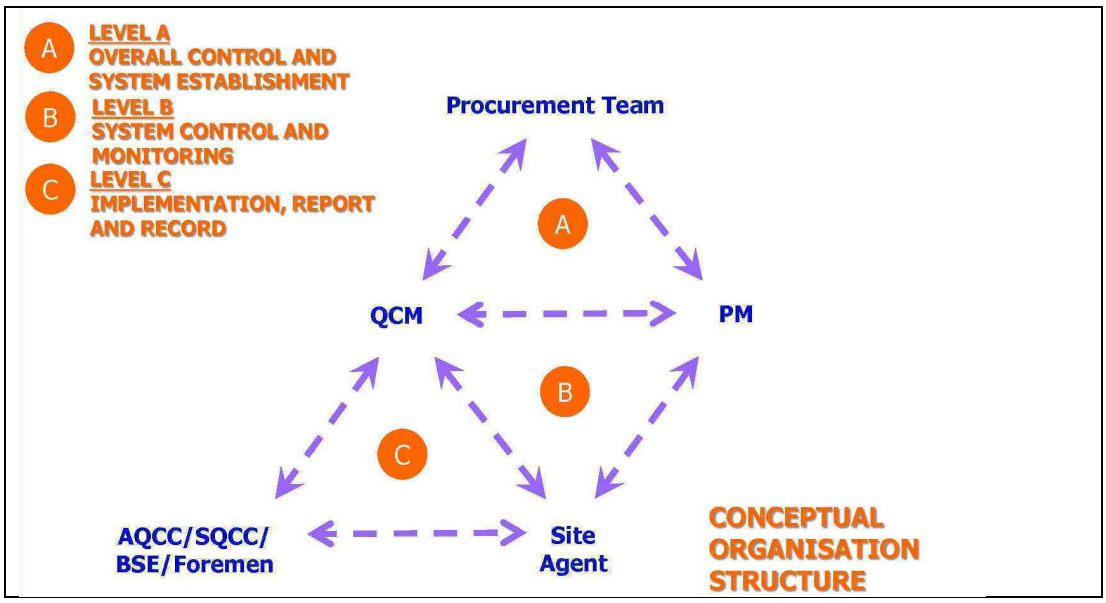
The Guidelines on Scope and Content of Quality Control System (the Guideline) is to provide details on relevant requirements, submission standards and procedures to:

a. Facilitate the Contractor in setting up a Quality Control System (QCS) as required in PRE.B8.1425;

b. Maintain consistency among Contractors for implementing quality control systems for material compliance in HA's contracts.

1. **Organization Structure for implementing the QCS**

Contractor is required to establish and maintain an organization structure as per the below conceptual organization structure throughout the progress of the Works for implementing the Quality Control System.



2. **Duties & Responsibilities of Site Personnel on Materials Checking and Monitoring**

In addition to the requirements as stipulated in the GCC 5.8 – Contractor's Superintendence, Contractor is required to assign the following Site Personnel to take up the duties and responsibilities regarding materials checking and monitoring as detailed below:

	Duties / Responsibilities
Procurement Team*	**Level A Control** 1. Overall material schedule control and maintain records of suitable sub-contractors and suppliers of the Contractor, or sub-contractors of all tiers; 2. Coordinate with QCM / PM in the preparation of purchasing order, system establishment for checking / monitoring at all levels, and conditions of agreement with suppliers and sub-contractors; 3. Periodic review with QCM / PM with formal records on the system.

* Procurement Team: The team of the Contractor's company which negotiates with suppliers and sub-contractors regarding prices and delivery terms.

	Duties / Responsibilities
Project Manager (PM)	**Level A Control** 1. Establish overall control and monitoring system for Level A, B and C; 2. Coordinate with QCM in the formulation of Quality Control Plan and Sub-contractors Management Plan in the four core stages (purchase, delivery, storage and use) of materials at Site; 3. Identify and evaluate project specific risk in material compliance at early stages of project for the establishment of risk control and treatment measures. Project specific risks shall include, but not limited to, new sub-contractors, new suppliers and market trend on the availability and quality of the materials. Compile the overall material schedule with risk assessment and treatment measures based on the Specification requirements and project specific risk identified in coordination with suppliers and sub-contractors including Nominated Sub-contractors. **Level B Control** 1. Overall control of material supply schedule based on updated overall material schedule, works progress and site logistics, and oversee the smooth operation of the four core stages of materials checking and monitoring; 2. Periodic review with QCM and Site Agent on the overall material schedule, with due attention to approval compliance, overall programme and non-compliance reported from level C, and to further enhance the system; 3. Coordinate with QCM and Site Agent in the establishment of document records and endorsement forms for Level B and C.
QCM	**Level A Control** 1. Compile overall material schedule, for submission / comment based on the Specification in risk treatments and programme for use at site; 2. Coordinate with Procurement Team and PM in the preparation of purchasing order, system establishment for checking / monitoring at all levels, and conditions of agreement with suppliers and sub-contractors; 3. Periodic review with Procurement Team and PM with formal records. **Level B Control** 1. Overall control of progress of approval on materials / shop drawings / design proposals (including that for temporary works); 2. Periodic report to PM and Site Agent on the status of the four core stages based on overall material schedule, with due attention on approval compliance and non-compliance reported from Level C, and to propose viable enhanced measures as and when required; 3. Coordinate with PM and Site Agent in the establishment of documentary records and endorsement forms for Level B and C.

	Duties / Responsibilities
QCM	**Level C Control** 1. Oversee the proper execution of the system at site level, periodic review with AQCC / SQCC / BSE / Foreman and sub-contractors (including Nominated Sub-contractors) on the status in all four core stages with formal records, and report any deficiencies at Level B; 2. Be the overall coordinator among the members of the Contractor's Superintendents and sub-contractors including Nominated Sub-contractors for materials checking and monitoring on compliance with the Contract requirements; 3. Coordinate with Site Agent / AQCC / SQCC / BSE / Foreman and sub-contractors (including Nominated Sub-contractors) on delivery schedules and storage locations with formal records and documents; 4. Periodic review with AQCC / SQCC / BSE on the logistics and arrangements in collection of all delivery notes.
Site Agent	**Level B Control** 1. Counter-check on comprehensiveness of the overall material schedule and periodic review with PM and QCM on approval compliance, updated works programme and irregularities reported from Level C; 2. Coordinate with PM and QCM in the establishment and improvement of document records and endorsement forms for Level B and C; 3. Establish control measures on non-conforming materials identified including segregation of materials and works, keeping records and notifying all personnel concerned; 4. Establish checking guidelines and forms for site delivery and storage based on updated site layout plan and logistics. Take part in the checking and endorsement for high risk materials. **Level C Control** 1. Review on the delivery programme and storage status with updated layout plan (with QCM and Site Staff); 2. Establish checking mechanism on material compliance with record forms; 3. Periodic report to Site Staff on the status of the four major areas of materials checking with summary and records at monthly site meeting.
AQCC / SQCC / BSE / Foreman	**Level C Control** 1. Check and record all delivery to site based on formal forms established in Level B; 2. Weekly review and report to QCM on delivery schedules and problems; 3. Plan and update storage plan based on latest delivery schedules and works plan for review with Site Agent and QCM; 4. Coordinate with QCM Team on the periodic checking mechanism and endorse the forms on material compliance at stored locations; 5. Carry out periodic quantity check of material use with formal forms and record.

3. **Materials Checking and Monitoring Measures at the Four Core Stages**

Contractor is required to include materials checking and monitoring measures at the four core stages, i.e. purchase, delivery, storage and use of materials in the Quality Control System as per the following requirements, and review the measures from time to time to suit the actual site operation:

3.1. **Purchase**

a. An overall material schedule to be compiled and submitted to the CM for comment within three months from the date for commencement of the Works including, but not limited to, the following:
   i. All materials as required in the Drawings, Specification and Conditions of Contract;
   ii. Materials, proprietary products, off-site fabricated products, etc. purchased by the Contractor or sub-contractors of all tiers including Nominated Sub-contractors;
   iii. HD's risk assessment and categorization as stated in clause 4.2(a) below;
   iv. Specification requirements in the four core stages (purchase, delivery, storage and use);
   v. Project specific risks to be identified by the Contractor with proposed risk treatments;
   vi. Submission, approval and order schedules as per latest programme;
   vii. Update, report and highlight on any changes at the monthly site meeting thereafter.

b. Establishment of agreed checking / monitoring measures with all suppliers and sub-contractors of all tiers including Nominated Sub-contractors;

c. Designation of responsible officers in the checking and endorsement of forms and records with detailed procedures and guidelines in the checking and reporting system;

d. Refer to the guidelines on the adoption of standard forms 1, 2 and 7 attached in section 4 of this Appendix or other documental records that contain the essential information required, to record checking and inspection with proper endorsement, in the risk treatments considerations. Such forms and records shall be digitized and properly documented. Submit the records to the CM when required.

3.2. **Delivery**

a. Establishment of agreed checking / monitoring measures with all suppliers and sub-contractors of all tiers including Nominated Sub-contractors such measures shall include but not limited to the following:
   i. Written confirmation that the material delivered to Site conforms to the Approved sample submitted;
   ii. Original or certified true copy of the certificate of origin and batch number for every batch of delivery as specified and required. One batch being the material quantity covered under each delivery note;
   iii. Information to be shown on the delivery notes in English as far as possible;
   iv. Logistics in collection of all delivery notes to be agreed with Site Staff.

b. Designation of responsible officers in the checking and endorsement of forms and records with detailed procedures and guidelines in the checking and reporting system;

c. Refer to the guidelines on the adoption of standard forms 3, 7, 8, 9A and 9B attached in section 4 of this Appendix or other documental records that contain the essential information required, to record checking and inspection with proper endorsement, in the risk treatments considerations. Such forms and records shall be digitized and properly documented. Submit the records to the CM when required.

3.3. **Storage**

a. Material storage location plan should be submitted to the CM for comment within …… month(s) from the notified date for commencement of the Works and to be updated from time to time. Logistic proposal (including delivery schedule, batch size and storage area) should be submitted as specified in the Specification, e.g. tile adhesive;

b. Establishment of agreed checking / monitoring measures for storage of materials on the Site with all suppliers and sub-contractors of all tiers including Nominated Sub-contractors;

c. Designation of responsible officers in the checking and endorsement of forms and records with detailed procedures and guidelines in the checking and reporting system;

d. At final construction stage and finishing works stage when material delivery to the Site would be at its peak, special meetings shall be convened with all sub-contractors including Nominated Sub-contractors to agree on viable delivery / storage options for review with Site Staff and the CM;

e. Refer to the guidelines on the adoption of standard forms 4, 5 and 7 attached in section 4 of this Appendix or other documentary records that contain the essential information required, to record checking and inspection with proper endorsement, in the risk treatments considerations. Such forms and records shall be digitized and properly documented. Submit the records to the CM when required.

3.4. **Use**

a. Establishment of agreed checking / monitoring measures for materials used on the Site with all suppliers and sub-contractors of all tiers including Nominated Sub-contractors;

b. Designation of responsible officers in the checking and endorsement of forms and records with detailed procedures and guidelines in the checking and reporting system;

c. Records of the locations of permanent works where the batch of materials will be / has been used shall be kept as far as possible and submitted to the CM for checking upon request;

d. Refer to the guidelines on the adoption of standard forms 6 and 7 attached in section 4 of this Appendix or other documentary records that contain the essential information required, to record checking and inspection with proper endorsement, in the risk treatments considerations. Such forms and records shall be digitized and properly documented. Submit the records to the CM when required.

4. Standard Record Forms and Workflow

Contractor is required to devise standard forms, or other documentary records that contain the essential information required, to record checking and inspection with proper endorsement, and include them in the Quality Control System for effective control. The essential information required for different stages of checking and inspection are listed in the standard sample forms below, and they are the minimum amount of information to be submitted to the CM. In addition, the Contractor shall make reference to the schematic work flow described below for implementation throughout the different stages.

4.1. Schematic workflow at the four core stages of materials purchasing, delivery, storage and use (see Flow Chart at 7.1);

4.2. Overall Material Schedule (see **Form 1** at 7.2). Its features, content to be included and submission requirements are as follows:

a. Incorporate HD's latest risk assessment and categorization obtained from the CM as the baseline reference and include the same risk level stated therein for each material in the Overall Materials Schedule;

b. Incorporate Specification requirements related to the four core stages (purchase, delivery, storage and use);

c. Incorporate the Contractor's project-specific risk assessment and treatments;

d. Key items to be included: specification clauses, HD's risk categorization, the Contractor's own risk assessment and treatment, remarks (substantiation for nil additional risk treatment proposed by Contractor);

e. To be compiled and endorsed by PM and his QCM Team in coordination with all sub-contractors excluding Nominated Sub-contractors for submission to Site Staff and the CM for comment;

f. To be updated as required and reported at monthly site meeting;

g. First submission: within 3 months from the notified date for commencement of the Works;
h. Separate overall material schedules which have been compiled and endorsed by PMs of Nominated Sub-contractors to be endorsed by PM and submitted within 3 months from the commencement of the respective Nominated Sub-contracts Works;
i. Records to be digitized and submitted to the CM when required.

4.3. Material Purchase Requisition Form (see **Form 2** at 7.3)
a. To be adopted when risk treatment is identified in the purchasing stage shown in Form 1;
b. Key items: documental checks (including country of origin, product certificate if available), project specific risk such as change of origin;
c. To be compiled and endorsed by PM and QCM with counter-sign by supplier / sub-contractor as appropriate;
d. Records to be digitized and submitted to the CM when required.

4.4. On-Site Delivery Verification (see **Form 3** at 7.4)
a. To be adopted when risk treatment is identified in the delivery stage shown in Form 1;
b. Key items: documental check, material check against approved sample, project specific risk, additional sampling check / test;
c. To be compiled by AQCC / SQCC / BSE and endorsed by PM / QCM / Site Agent as appropriate;
d. Records to be digitized and submitted to the CM when required.

4.5. Storage of Materials (for Regular Check) (see **Form 4** at 7.5)
a. To be adopted when risk treatment is identified in the storage stage shown in Form 1;
b. Key items: regular check against approval sample, storage location / condition;
c. To be compiled and signed by AQCC / SQCC / BSE / foreman as appropriate;
d. Records to be digitized and submitted to the CM when required.

4.6. Storage of Materials (Inventory Record) (see **Form 5** at 7.6)
a. To be adopted when quantity checking or other risk treatment are identified in the storage stage shown in Form 1;
b. Key item: inventory record;
c. To be compiled and signed by AQCC / SQCC / BSE / responsible personnel as appropriate;
d. Records to be digitized and submitted to the CM when required.

4.7. On-Site Checking on Use of Material (see **Form 6** at 7.7)
a. To be adopted when risk treatment is identified in the use stage shown in Form 1;
b. Key items: check against approved sample before use of the material, compliance with method statement, by qualified tradesman / registered worker;
c. To be compiled and signed by foreman and endorsed by QCM / Site Agent as appropriate;
d. Records to be digitized and submitted to the CM when required.

4.8. Record of Meetings / Briefings on All Risk Treatment Measures (see **Form 7** at 7.8)
a. To be adopted for the formal record of meetings with suppliers and Sub-contractors including Nominated Sub-contractors on risk evaluation and control measures;
b. Key items: record of meetings / briefings on key risk evaluation and treatments in the 4 core stages of materials purchasing, delivery, storage and use;
c. To be signed by attendees and endorsed by PM;
d. Records to be digitized and submitted to the CM when required.

4.9. Record of Truck / Vehicle Delivery (see **Form 8** at 7.9)
a. To be adopted for security and access control at site entrance;

b. Key items: vehicle registration number, delivery time, suppliers if applicable;
c. To be compiled by on-duty personnel and counter-signed by AQCC / SQCC / BSE;
d. Records to be digitized and submitted to the CM when required, and hard copy of the records to be kept in site office for Site Inspection Team's (SIT) inspection.

4.10. Daily Material Delivery Notes Checking Report (see **Form 9A** at 7.10)
a. To be adopted for the formal record of checking delivery note against Form 8 and Approved sample submission;
b. Key items: material description, supplier/manufacturer/domestic sub-contractor or Nominated Sub-contractor etc., delivery note number, total quantity, delivery vehicle included in the in/out register, approved sample or material submission number, details in delivery notes tally with the information on sample / material submission and approval form;
c. To be compiled by AQCC / SQCC / BSE;
d. Records to be digitized and submitted to the CM when required, and hard copy of the records to be kept in site office for Site Inspection Team's (SIT) inspection;
e. Monthly Material Delivery Notes Checking Summary (see **Form 9B** at 7.11) to form part of the Contractor's Report at monthly site meeting.

5. **Risk Assessment and Risk Treatment on Project Basis**

5.1. Conduct risk assessment and risk treatment to ensure materials compliance of the Contract, and include them in the QCS. The Contractor shall make due reference to the latest version of material risk assessment / categorization obtained from the CM which will form the base in the development of their risk assessment and treatment. The Contractor is required to formulate the overall materials checking and monitoring measures via the processes of risk identification, analysis, evaluation, assessment and treatment for all materials specified and / or to be used in the Contract;

5.2. Develop and complete the overall material schedules with Contractor's risk assessment and treatment by stages according to the progress of works on site. The Contractor is required to submit the overall material schedule to the CM for comment / record within three months from the date for commencement of the Works and the submission dates / details of subsequent stages of submission to be agreed with the CM. The overall material schedule will form the basis for checking and monitoring by the Contractor and the CM;

5.3. In the process of risk assessment for different materials, special consideration shall be given to new sub-contractors, new suppliers, the market trend on the availability and quality of the materials as well as other project specific risks. The resulting risk treatment shall be incorporated in the overall material schedule.

6. **Risk Control Measures**

6.1. Set up the comprehensive risk treatment and control measures for ensuring the compliance of materials to be used on Site, both for permanent and temporary works, at the early stage of the Contract;

6.2. Arrange formal briefing meeting with suppliers, fabricator, sub-contractors including Nominated Sub-contractors based on the materials risk assessment and categorization system, contractor's management and monitoring system as well as HD's materials checking and monitoring system with meeting records;

6.3. All suppliers, fabricators, sub-contractors including Nominated Sub-contractors have to be informed on the detailed checking and monitoring system at different stages of materials purchasing, delivery, storage and use;

6.4. Site Staff shall be invited to attend the meeting to give detailed deliberation of materials checking and monitoring system;

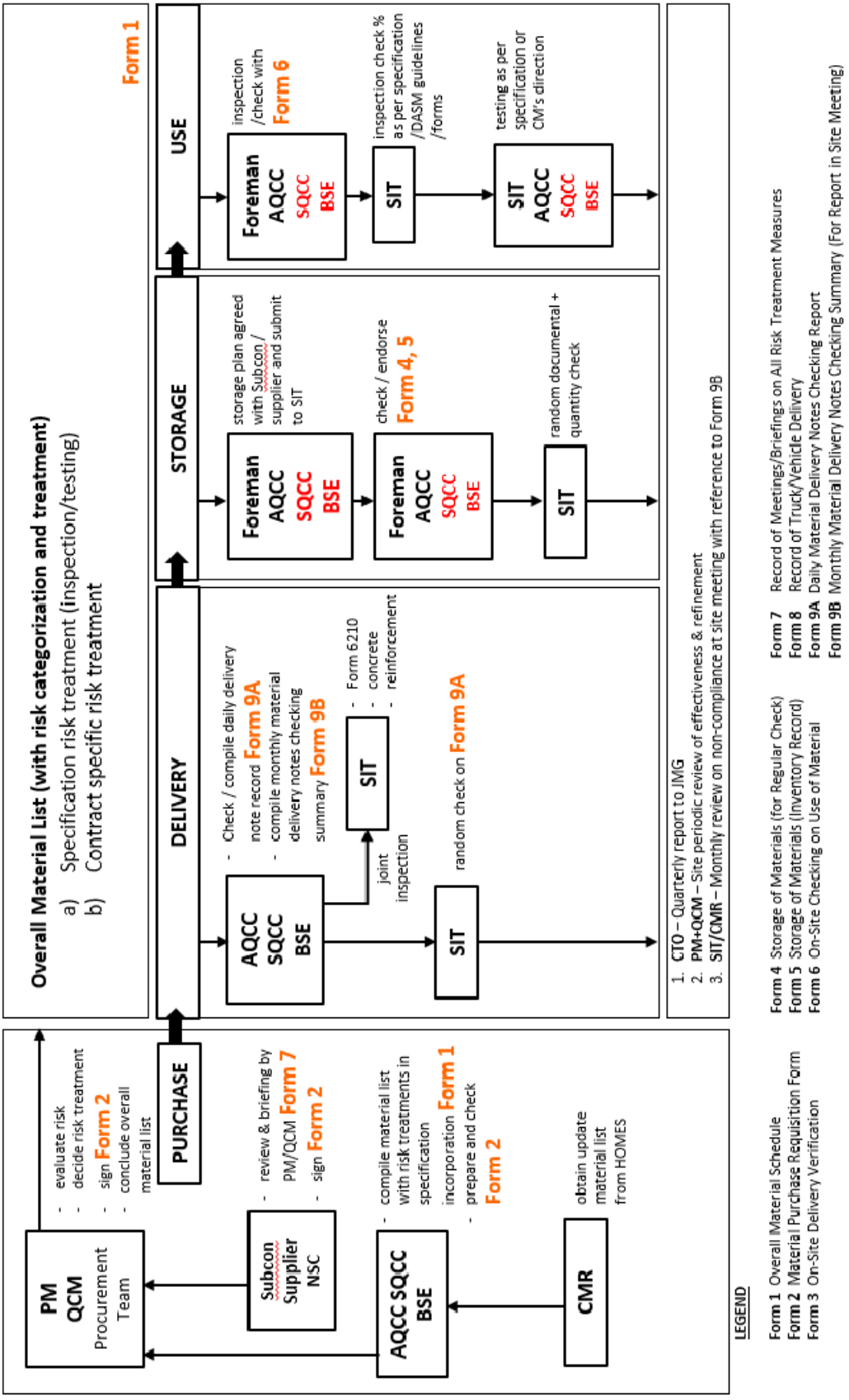
6.5. All comments and feedback from suppliers, fabricators, sub-contractors including Nominated Sub-contractors shall be properly recorded. Difficulties in compliance shall be feedback to Site Staff for further review with the CM;

6.6. Incorporate relevant risk treatment and control measures into the contracts with suppliers, fabricators and sub-contractors agreement as far as possible;

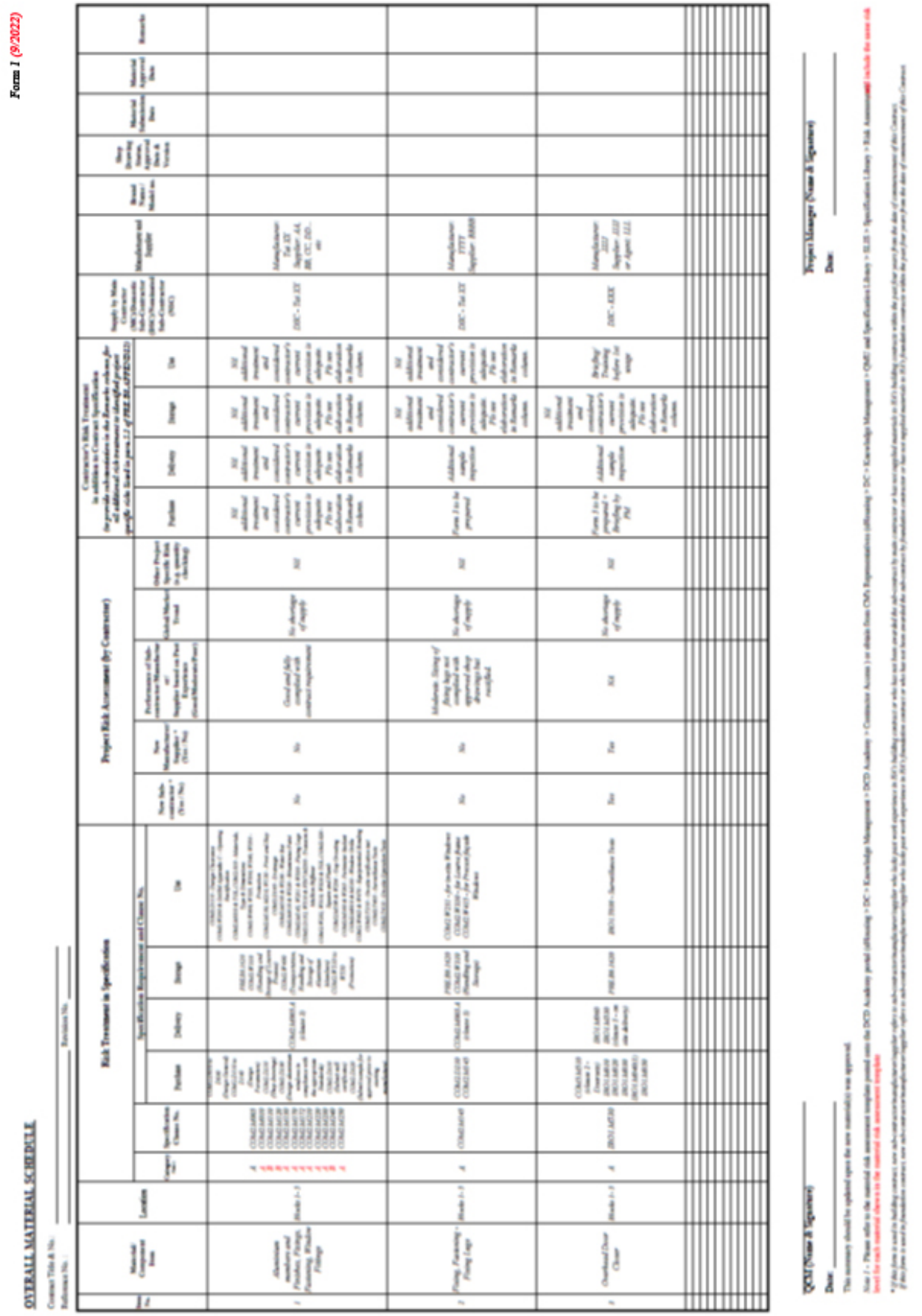
6.7. Arrange periodic review meetings to ensure the proper functioning of the monitoring and risk control measures in the presence of Site Staff. In particular, special meeting shall be conveyed at near completion stage to review and agree on special risk treatment measures when materials delivery, storage and use are at their peak.

7. **Flow Chart and Forms**

7.1. Schematic Workflow at the Four Core Stages of Materials Purchasing, Delivery, Storage and Use.



7.2. Overall Material Schedule **(Form 1 with generic examples)**



7.3. Material Purchase Requisition Form (**Form 2**)

Form 2

MATERIAL PURCHASE REQUISITION FORM

Contract Title & No.	:				
Material	:		**Risk Level as per HD's risk assessment result**	:	**A / B / C**
Material Item No. in Form 1	:		**Name of Main/ Sub-contractor**	:	
Specification Requirement & Clause	:	*e.g. COM2.M005, COM2.M010, COM2.M120, COM2.M130, COM2.M170, COM2.M172, COM2.M210 to COM2.M240, COM2.M410*			
Date of Issue	:		**Required 1st Delivery Date**	:	
			Quantity	:	

Material to be purchased			
Material Description			
Project Specific Risk# :	Shortage of Material	Yes / No	If yes, pls elaborate:
	Change of Origin	Yes / No	If yes, pls elaborate:
	Other	Yes / No	If yes, pls elaborate:
Compliance with Approved Shop Drawings :	Yes / No (Approval Date & Version:)		
PM/QCM's Briefing to Sub-Contractor :	Yes / No *e.g. Arranged with [Name of SC by PM on DD/MM/YYYY & recorded in Form 8*		
Manufacturer and supplier			
Size / Dimension			
Thickness			
Brand Name/Model No.			
Packing			
Accessories			
Country of Origin			
Product Certificate			
Remarks			

Confirmed by Sub-Contractor/Supplier	:			
	(Name & Signature)	**(Company's chop)**	**Date**	

Approved Material Submission/Sample Checked:		**Any deviation found:**	Yes / No
Relevant Drawings/Supporting Document Checked:		**Any deviation found:**	Yes / No
Checking Date	:	**Checked By**	: **(AQCC/SQCC/BSE) (Name & Signature)**

Confirm to Place Order for the above Material

QCM (Name & Signature)	**Date**	**Project Manager of MC *or* Supervising Engineer of NSC (Name & Signature)**	**Date**

 # Details should be recorded in Form 1

7.4. On-Site Delivery Verification (**Form 3**)

Form 3

ON- SITE DELIVERY VERIFICATION

Contract Title & No. : _____

Material : _____

Risk Level as per HD's risk assessment result : A / B / C

Material Submission Ref. No. : _____

Name of Sub-contractor / Manufacturer / Supplier : _____

Specification Requirement & Clause : _____

Country of Origin : _____

Brand Name : _____

Delivery Note No. : _____

Delivery Date : _____

Batch No. : _____

INSPECTION

Description	Compliance (Yes/No)	Remark / Detail of non- conformity
1 **Document Check**		
i) certified true copy of certificate of origin		
ii) delivery note		
iii) document specifying the use of sustainable material (if applicable)		
2 **Material Check (against Approved sample)**		
i) dimension check by measurement*		
a) Size / Overall size		
b) Thickness / Coating Thickness		
c) Shape		
d) Volume		
d) Weight		
ii) surface quality*		
a) Colour and within acceptable colour consistency		
b) Discolouration		
c) Coating		
d) Free of defect/rust/stain/blemish		
iii) brand name/model no.		
iv) packing (marking/logo/label)		
v) accessories*		
a) Checking items (pls elaborate in Remark)		
3 **Other Project Specific Risk Treatment#**		
i) Detailed checklist to item (2) above *(should be provided and attached together with this Form)*		
ii) Additional sample inspection		
iii) Additional test		

Checking by : _____ **Checked Date** : _____

(AQCC/SQCC/BSE)

(Name and Signature)

For this batch of material delivered to site: ☐ ***pls tick as appropriate***

☐ 1. All material delivered to Site accepted

☐ 2. Material delivered to Site but returned _____ % defective items

☐ 3. All returned to Supplier. *Pls specify reason* _____

☐ 4. Submitted to Project Manager for follow-up action. *Pls elaborate* _____

Attached Photo(s) : _____

Endorsed By : _____ **Date** : _____

Project Manager/QCM/Site Agent of MC *or*
Supervising Engineering of NSC
(Name and Signature)

** Pls fill in as appropriate*
 # Details should be recorded in ***Form 1***

7.5. Storage of Materials (for Regular Check) (**Form 4**)

Form 4

STORAGE OF MATERIALS (FOR REGULAR CHECK) [Note 1]

Contract Title & No. : _____

Item	Material Description	Material Submission Ref. No.	Risk Level as per HD's risk assessment result (A/B/C)	Designated Location* (Flat no/Floor no/corridor/ storage zone (external area))	As Approved Sample (Checked and Inputted by AQCC/ SQCC/BSE/ Site Representative) (Yes/No)	Acceptable Storage Condition# (Yes/No**)	Within the Material Shelf Life (Yes/No**)	Checking Date	Signed by Foreman and Name	Signed by AQCC and Name	Signed by SQCC and Name	Signed by BSE and Name	Remarks

7.6. Storage of Materials (Inventory Record) (Form 5)

Form 5

STORAGE OF MATERIALS (INVENTORY RECORD) Note 1

Contract Title & No. : _____

Item	Description of Material	Material Submission Ref. No.	Risk Level as per HD's risk assessment result (A/B/C)	Material IN (Date)	Material IN (Quantity)	Designated Location* (Flat no/Floor no/ corridor/storage zone (external area))	Material-In Record Checked and Signed by (with Post and Name of site personnel)	As Approved Sample (Checked and Inputted by AQCC/ SQCC/BSE) (Yes/No)	Material OUT (Date)	Material OUT (Quantity)	Material-Out Record Checked and Signed by (with Post and Name of site personnel)	Checking Date	Remarks

7.7. On-Site Checking on Use of Material (**Form 6**)

Form 6

ON-SITE CHECKING ON USE OF MATERIAL

Contract Title & No. : _____

Material : _____ **Risk Level as per HD's risk assessment result :** A / B / C

Material Submission Ref. No. : _____ **Name of Sub-contractor / Manufacturer / Supplier :** _____

Location /Block /External Area	Floor	Flat	Corridor	Model	Packing	As Approved Sample (Checked and Inputted by AQCC/SQCC /BSE) (Yes/No)	Date of Inspection	Compliance with Method Statement & Manufacturer's Recommendation (Yes / No/ N/A)*	Qualified Tradesman (Yes/No) & Certificate No.	Construction Worker Registration No.	Remarks

7.8. Record of Meetings / Briefings on All Risk Treatment Measures (**Form 7**)

Form 7

RECORD OF MEETINGS/BRIEFINGS ON ALL RISK TREATMENT MEASURES

Contract Title & No. : _____

Material : _____ **Risk Level as per HD's risk assessment result** : A / B / C

Name of Sub-contractor / Manufacturer / Supplier : _____

Item	Meeting/Briefing Record (Date, Time and Venue)	Main Contractor (Name of Attendee)	Suppliers /Manufacturers /Domestic /Nominated Sub-Contractors (Name of Attendee)	Specification Requirement & Clause no.	Project Specific Risk	Contractor's Risk Treatment	Any Non-conformity in Purchase, Delivery, Storage and Use Stages (Yes / No)*	Remarks

7.9. Record of Truck / Vehicle Delivery (**Form 8**)

Form 8

RECORD OF TRUCK/VEHICLE DELIVERY

車輛送泥出入紀錄

Contract Title & No. :
合約名稱及編號 _____

Item 項目	Vehicle Registration No. 車輛登記編號	Type of Vehicle (pls tick "✓" below as appropriate) 車輛類型 請"剔" 選合適類型				Supplier/Sub-contractors 供應商/分判商	Material Description & Quantity* 物料名稱及數量*	Time IN 入閘時間	Time OUT 出閘時間	Recorded by on-duty personnel 記錄的當值員工	Remarks 備註
		Private Car 私家車	Goods Vehicle 貨車	Motorcycle 電單車	Others 其他						

Counter-signed by AQCC
(Name and Signature)
(姓名及簽署) _____

Date:
日期 _____

* Optional Item 可選項目

7.10. Daily Material Delivery Notes Checking Report (**Form 9A**)

Form 9A

DAILY MATERIAL DELIVERY NOTES CHECKING REPORT

Reference No. _____

Contract Title: _____
Contract No.: _____
Date of Delivery: _____

Item No.	Material Description ^(Including Make & Model and Place of Manufacture)	Supplier/Manufacturer/ Domestic/Nominated Sub-Contractor @(Electrical / FS&WP/ Lift / Escalator / ACMV)	Delivery Note No.	Delivery Note in		Total Quantity Delivered (Unit)	Delivery Vehicle Included in Register of In/Out Yes (V) / No (X) *	Approved Sample Submission / Approved Material Submission No.	Details in Delivery Notes tally with the information on Sample Submission and Approval Form / Material Submission and Approval Form Yes (V) / No (X)* / NA	* Follow-up actions in case of No (X)
				Chinese	English					

Prepared By: _____
AQCC/ SQCC/ BSE (Name & Signature)
Date: _____

Checked By: _____
QCM (Name & Signature)
Date: _____

\# Encl. (Delivery Notes and Record of Truck / Vehicle Delivery-Form 8)
Examine delivery notes against :
(i) Material Approval for Building Materials
(ii) Sample Submission and Approval Form / Material Submission and Approval Form for Building Services Materials
^ Make & Model and Place of Manufacture to be provided for Building Services Materials
@ Delete where not applicable

7.11. Monthly Material Delivery Notes Checking Summary (**Form 9B**)

Form 9B

MONTHLY MATERIAL DELIVERY NOTES CHECKING SUMMARY (FOR REPORT IN SITE MEETING)

Contract Title: _____ Reference No. _____
Contract No.: _____
Month of Delivery: _____

Item No.	Material Description ^(Including Make & Model and Place of Manufacture)	Supplier/Manufacturer/ Domestic/Nominated Sub-Contractor @(Electrical / FS&WP/ Lift / Escalator / ACMV)	Total No. of Delivery Notes Checked	Total Quantity Delivered (Unit)	Approved Sample Submission / Approved Material Submission No.	Details in Delivery Notes tally with Form 8 and the information on Sample Submission and Approval Form / Material Submission and Approval Form Yes (V) / No (X)* / NA	* Follow-up Actions in case of No (X)	Remarks

Prepared By: _____ Checked By: _____
AQCC/ SQCC/ BSE (Name & Signature) **QCM (Name & Signature)**
Date: _____ **Date:** _____

Examine the delivery notes against:
(i) Material Approval for Building Materials
(ii) Sample Submission and Approval Form / Material Submission and Approval Form for Building Services Materials

^ Make & Model and Place of Manufacture to be provided for Building Services Materials

@ Delete where not applicable

APPENDIX PRE.B8/XIII

PRE.B8.APPEND13.9 STANDARD TEMPLATE FOR CONFIRMATION OF VERBAL INSTRUCTION

CONFIRMATION OF VERBAL INSTRUCTION (CVI)

For Housing Department's Use
Project Ref. : _____
Site Instruction Issued : _____

Post	Name	Signed	Date

Contract No. : _____ **CVI No.** : _____

Contract Title : _____

Contractor : _____

Principles :

1. CVI provides quick means for the Contractor to confirm with the Project Team construction details usually **minor** in nature.
2. CVI shall not relieve the Contractor's obligation under relevant clause of the Conditions of Contract to give adequate notice of request for information for execution of the Works.
3. CVI shall **NOT** be used for measurement and adjustment of the final contract sum.
4. Any variation to the Contract arising from the information in CVI **shall be separately covered by Site Instructions (SI)** with variation drawings incorporating changes confirmed by the CMR. CMR and/or Contractor may raise for discussion any particular CVI not yet covered by SI but involves considerable cost implication (say rough indicative cost ±$100,000 or above), and may refer the CVI to the PQS for estimating the cost effect for cost reporting and interim payment as necessary.
5. CVI is **NOT** a notice of claim for extension of time or cost claim under the Contract, and **NO** time or cost claim shall be implied under CVI. Any such claim shall be submitted separately in accordance with relevant clauses of the Conditions of Contract.

Part A *(to be completed by the Contractor)*

A.1 Content of Verbal Instruction

A.2 Location of Works

A.3 Drawings/Sketches attached

Ref. of Drawings / Sketches attached	Drawing No. of Contract Drawings *(if attached Drawings / Sketches are based on Contract Drawings)*

A.4 Details of Verbal Instruction Given

Verbal Instruction given by	
Verbal Instruction given to	
Date of instruction/discussion	

A.5 Associated Abortive Works

☐ No

☐ Abortive works to be separately submitted
(in ABORTIVE WORKS RECORD SHEET for checking and confirmation of liabilities and details by project team)

A.6 Remarks *(if any)*

Post	Name	Signed	Date

Distribution

☐ A/__ ☐ SE/__ ☐ BSE/__ ☐ CE/__
☐ GE/__ ☐ COW/__ ☐ IOW/__ ☐ BSI/__
☐ LA/__
☐ Contractor's team : _____
☐ Other : _____

Part B *(to be completed by Contract Manager (CM) or Representative (CMR))*

B.1 Reply to Part A

☐ Part A is **NOT** confirmed, reasons (if any) :

☐ Part A is confirmed but Site Instruction will **NOT** be issued, reasons (if any) :

☐ Part A is confirmed and Site Instruction will be issued with the condition(s) remarked below :

_____

Post	Name	Signed	Date

Distribution

☐ A/__ ☐ SE/__ ☐ BSE/__ ☐ CE/__
☐ GE/__ ☐ COW/__ ☐ IOW/__ ☐ BSI/__
☐ LA/__
☐ Contractor's team : _____
☐ Other : _____

APPENDIX PRE.B8/XIV

PRE.B8.APPEND14.9 STANDARD TEMPLATE FOR ABORTIVE WORKS RECORD SHEET

ABORTIVE WORKS RECORD SHEET Record Sheet No. : _____

Contract Title : _____ Contract No. : _____

Notes for completing the Record Sheet

1. To be prepared and submitted by Contractor for Main Contractor's Works, or prepared by Nominated Sub-contractor (NSC) and submitted by Contractor for NSC's Works.
2. Abortive works of Main Contractor, NSC, or Main Contractor's abortive works in connection with NSC's works shall be submitted in separate record sheets.
3. This Abortive Works Record Sheet is not a notice of claim for extension of time or cost claim under the Contract. Any claim for extension of time or cost claim shall be submitted separately in accordance with the Contract provisions.
4. Delete as appropriate for items marked with * and select one for items marked with #.
5. The Contractor shall notify the CMR before carrying out any abortive works with photo records and submit the duly completed Abortive Works Record Sheet within 7 working days after completion of the abortive works or any specified period as agreed with site staff.

Part A

To : *PCOW / *PIOW / *PBSI _____ (Name and Post) Date : _____

Subject / Details : _____

Item	Description of Works	Location & Section of Works	Dimension	Labour	Man-day with Start and End Dates	Plant	Materials	Remarks

Cause of the abortive works : _____

Date of carrying out the abortive works : _____

Encl. :

☐ Drawings & Location Plans Ref. No. : _____

☐ Photographs (in ____ No.) :
(Remarks, if any, e.g. photographs showing before and after the completion of the abortive works) _____

☐ S.I. / CVI / Query / Letter Ref. No. :
(with Issue Date) _____

☐ Other Ref. *(if any)* : _____
(e.g. Record sheet of abortive NSC works for submission of related abortive builder's works)

☐ (i)# For Main Contractor's Works

Prepared and Submitted by Contractor : _____ (Name & Post) Signature : _____

☐ (ii)# For NSC's Works

Prepared by NSC : _____ (Name & Post) Signature : _____

Submitted by Contractor : _____ (Name & Post) Signature : _____

Part B *(PCOW / PIOW / PBSI to complete **within 7 working days** on receipt of Part A from Contractor or any specified period as agreed with the Contractor)*

To : *PA / *PSE / *PBSE / *PCE / *PGE / *PLA _____ (Name and Post) Date : _____

☐ (i)# The reported abortive works have been verified against site records. The abortive works arose from *changes in Project Team's requirements / *CVI / *S.I. / *other reasons :

_____

_____

☐ (ii)# The reported abortive works are *not in line with the site records/*not due to changes in Project Team's requirements / *S.I. / *CVI / *other valid reasons.

☐ (iii)# The *Contractor / *NSC is required to clarify and / or provide the following: (please specify if required)

_____

_____

Verified by : _____ (Name and Post) Signature : _____

Part C *(CM's Representative (PA / PSE / PBSE / PCE / PGE / PLA) to complete **within 28 working days** on receipt of Part B)*

To : Contractor _____ Date : _____

Attn : _____ (Name and Post)

☐ (i)# The abortive works submitted in Part A and verified in Part B are agreed. The S.I. concerned *is referred to in Part A / *is to be issued in due course. The *Contractor / *NSC should be entitled to the cost of the abortive works to be assessed by the PQS.

☐ (ii)# The abortive works submitted in Part A are not agreed as stated in Part B(ii). The *Contractor / *NSC shall **NOT** be entitled to any cost due to the abortive works submitted in Part A.

☐ (iii)# The *Contractor / *NSC is required to provide clarification and / or information as detailed in Part B(iii) and resubmit another record sheet if necessary.

Confirmed by : Name _____

Post _____ Signature : _____

c.c.

☐ BSI/
☐ COW/
☐ IOW/
☐ A/
☐ SA/
☐ SE/
☐ SSE/
☐ LA/
☐ QS/
☐ GE/
☐ CE/
☐ BSE/
☐ Others : e.g. NSC

APPENDIX PRE.B8/XV

PRE.B8.APPEND15.9 STANDARD TEMPLATE FOR CVI SUMMARY TABLE FOR MONTHLY SITE MEETINGS

Contract Title:

Contract No.:

CVI Summary Table for Monthly Site Meetings

Architectural *(including drainage work and roadworks*)*

CVI Ref. No. (CVI-A-xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

** for the project that PCE is not the CMR*

Contract Title:

Contract No.:

CVI Summary Table for Monthly Site Meetings

Structural

CVI Ref. No. (CVI-SE-xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

Contract Title:
Contract No.:

CVI Summary Table for Monthly Site Meetings
Building Services

CVI Ref. No. (CVI-BS-xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

Contract Title:
Contract No.:

CVI Summary Table for Monthly Site Meetings
Geotechnical

CVI Ref. No. (CVI-GE-xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

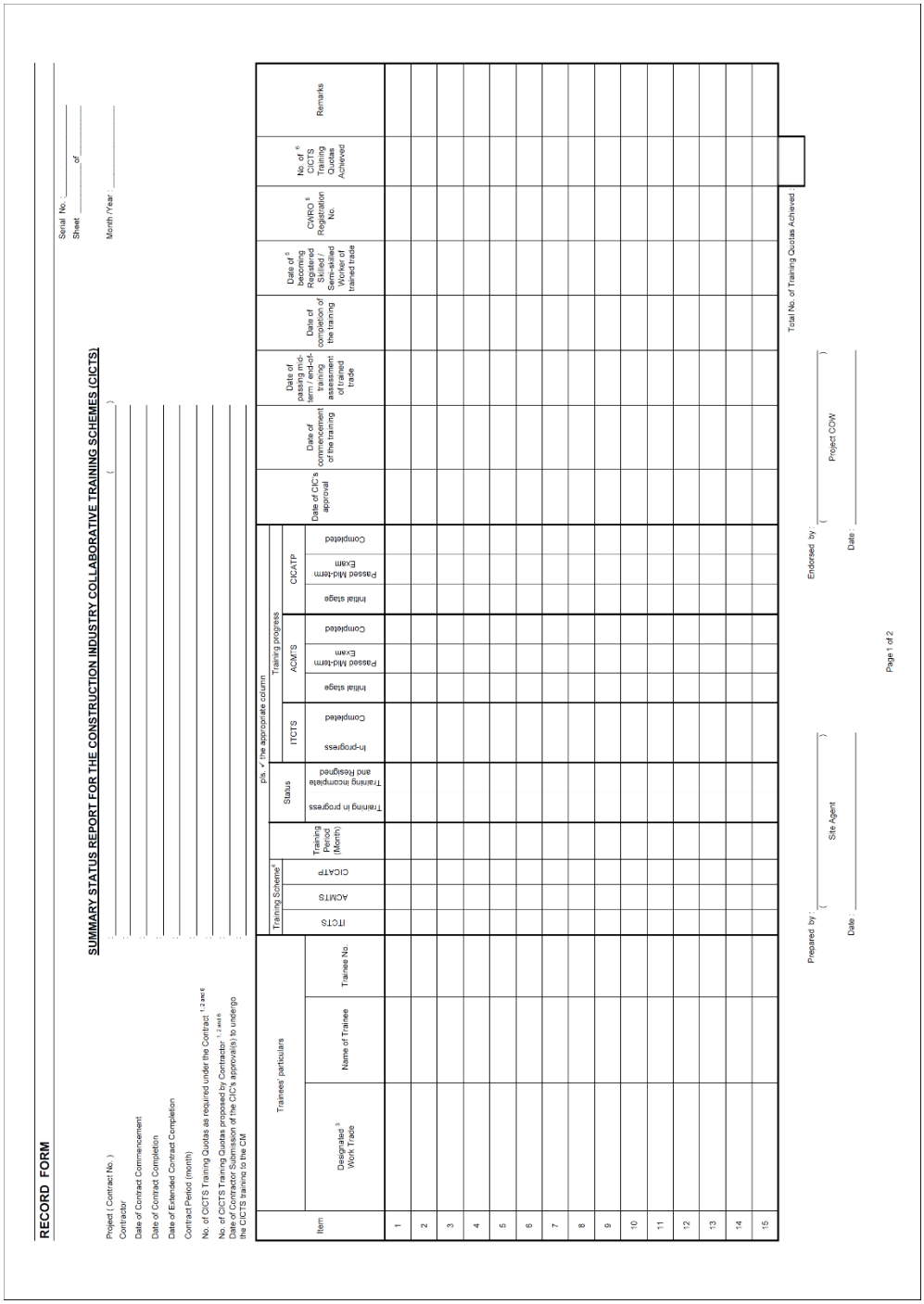
Contract Title:
Contract No.:

CVI Summary Table for Monthly Site Meetings
Civil Engineering

CVI Ref. No. (CVI-CE-xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

APPENDIX PRE.B8/XVI

PRE.B8.APPEND16.9 SUMMARY TRAINING STATUS REPORT FOR THE CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES (CICTS)



RECORD FORM

Serial No.: _____
Sheet _____ of _____

SUMMARY STATUS REPORT FOR THE CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES (CICTS)

Project (Contract No.) : _____ (_____)
Contractor : _____
Date of Contract Commencement : _____
Date of Contract Completion : _____
Date of Extended Contract Completion : _____
Contract Period (month) : _____
No. of CICTS Training Quotas as required under the Contract [1,2 and 4] : _____
No. of CICTS Training Quotas proposed by Contractor [1,2 and 4] : _____
Date of Contractor Submission of the CIC's approval(s) to undergo the CICTS training to the CM : _____

Month / Year : _____

Item	Trainees particulars			Training Scheme[4]			Training Period (Month)	Status		Training progress							Date of CIC's approval	Date of commencement of the training	Date of passing mid-term / end-of-training assessment of trained trade	Date of completion of the training	Date of [6] becoming Registered Skilled / Semi-skilled Worker of trained trade	CWRO [5] Registration No.	No. of [6] CICTS Training Quotas Achieved	Remarks
	Designated[3] Work Trade	Name of Trainee	Trainee No.	ITCTS	ACMTS	CICATP		Training in progress	Training incomplete and Resigned	ITCTS		ACMTS			CICATP									
										In-progress	Completed	Initial stage	Passed Mid-term Exam	Completed	Initial stage	Passed Mid-term Exam	Completed								
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								
15																								

pls. √ the appropriate column

Total No. of Training Quotas Achieved

Prepared by : (_____)
Site Agent
Date : _____

Endorsed by : (_____)
Project COW
Date : _____

Page 1 of 2

RECORD FORM

GUIDELINE

1. Refer PRE.B8.1500 for the implementation of "Construction Industry Collaborative Training Schemes (CICTS)".

2. The Contractor and/or his sub-contractor(s) shall join at least one of the training schemes of the CICTS for provision of the necessary training to the employed trainees under the Contract (hereinafter referred to as "CICTS Trainees"). Submit to the CM a copy of CIC's approval(s) to undergo the CICTS training within 12 months from the notified date for commencement of the Works.

3. Contractor shall record the CICTS Trainees with respect to the CIC designated trade division(s) shown in the Construction Industry Council (CIC) website.

4. This Summary Status Report shall exclude the trainee record under nominated sub-contractors. The CICTS comprises the following training schemes administered by CIC for on-the-job training of construction workers:

   ITCTS : Intermediate Tradesman Collaborative Training Scheme;
   ACMTS : Advanced Construction Manpower Training Scheme;
   CICATP : Construction Industry Council Approved Technical Talents Training Programme.

5. For the CICTS Trainee who has completed training and has not yet registered as a registered skilled / semi-skilled worker of the relevant trade division(s) under CWRO:

   a) If the CICTS Trainee received ITCTS training, "N/A" shall be filled in "Date of becoming registered skilled / semi-skilled worker of trained trade" and "CWRO Registration No." if there is no relevant trade division or the trade division does not have the level of registered semi-skilled worker for registration under CWRO;

   b) "--" shall be filled in "Date of becoming registered skilled / semi-skilled worker of trained trade" and "CWRO Registration No." if the trainee has passed the end-of-training assessment but not yet registered as skilled / semi-skilled worker of trained trade division(s).

6. A CICTS Trainee who is employed and trained by the Contractor and/or his sub-contractor(s) excepting Nominated Sub-contractor(s) shall be counted towards the number of CICTS training quota(s) as stipulated below:

   a) each CICTS Trainee shall only be counted under one contract at any one time;

   b) one CICTS training quota will be counted after a CICTS Trainee has completed the ITCTS training in accordance with sub-clause (11) of PRE.B8.1500;

   c) two CICTS training quotas will be counted after a CICTS Trainee has passed the mid-term assessment under the ACMTS or CICATP for the trained trade division(s);

   d) two CICTS training quotas will be counted after a CICTS Trainee has completed the ACMTS or CICATP training of the trade division(s) and has registered as a registered skilled worker for the same designated trade division(s) under CWRO; and

   e) ensure that at least 50% of such training quotas met by ITCTS before the certified date of completion of the Works.

7. Contractor shall complete this Summary Training Status Report with updated information, and submit to the CM on monthly basis on or before the Monthly Site Meeting with the following:

   a) Copy of the CIC's approval(s) to undergo the CICTS training; and

   b) Summary Status Report of the CICTS Trainees who joined the scheme in the contract period, no matter they are being trained / has resigned and not yet passed the trade test / has completed the training.

8. Contractor shall incorporate this Form in the Contractor's Report for Monthly Site Meeting.

APPENDIX PRE.B8/XVII

PRE.B8.APPEND17.9 TECHNICAL NOTES FOR GUIDANCE IN ASSESSING THE EFFECTS OF CIVIL ENGINEERING CONSTRUCTION / BUILDING DEVELOPMENT ON RAILWAY STRUCTURES AND OPERATIONS

Technical Notes for Guidance in Assessing the Effects of Civil Engineering Construction/Building Development on Railway Structures and Operations

A. General

All proposals for new building and engineering works including utilities works involving excavation within the limits of the Railway Protection Area shall be subject to special scrutiny by MTRCL prior to giving approval to any plans and consent for commencing construction works. Every proposal shall be assessed individually on its impact on existing railway and related structures/installations including all plant and fixtures necessary for the safe operation of the railway and subject to satisfactory compliance with the following technical requirements.

B. Underground Railway Structures

1. Site Formation/Foundation Works

Where site formation or foundation works or excavation works etc. are proposed above, beneath or adjacent to railway underground structures/installations including cooling water mains system, the effects of such works shall not exceed the following limits: -

(a) The vertical or horizontal pressure change on any underground structures/installations due to the works, including filling, ground improvement, dewatering etc. and due to addition or reduction of loads transmitted from foundations (including any loads arising during construction), shall not exceed 20 kPa.

(b) Differential movement resulting from the works shall not produce distortion in any railway structures/installations including the plinth or track in excess of 1 in 1 000 in any plane or a total movement in any railway structures/installations including the plinth or track exceeding 20 mm in any plane.

(c) The induced level difference between rails of a track in perpendicular plan resulting from the works shall not exceed 5 mm.

(d) The peak particle velocities induced to any railway structures resulting from blasting (where permitted) and from driving or withdrawing of piles or any similar operation which can induce prolonged vibration shall not exceed 25 mm/sec and 15 mm/sec respectively, when measured with a vibrograph.

(e) No pile, foundation, borehole/drillhole, well, soil nail, horizontal drain, rock bolt/dowel or other geotechnical installation shall be driven, constructed or installed within a distance of 3 m from any point of the underground railway structures.

(f) Any part of an anchor, if allowed, shall be more than 3 m away from any part of a railway structure/installation, and the centroid of the fixed length of the anchor shall be more than twice the fixed length away from any railway structure/installation.

2. Ground Investigation Works

Ground investigation proposals should include the following details and requirements: -

(a) Details of the exploration and locations of the proposed exploration holes, trial pits, trenches, field testing or instrumentations relative to any railway structures whether inside or outside the lot;

(b) Proposed depth of boreholes/drillholes, pits or trenches;

(c) A method statement for sinking boreholes/drillholes, excavating trial pits and trenches including back-filling, conducting field testing or installing instrumentation;

(d) A method statement for checking verticality of boreholes/drillholes located within a distance of 10 m on plan of any point of the underground railway structure, should boreholes/drillholes be sunk to a depth of 3 m from the highest point of the railway structures; and

(e) A method statement for controlling depth of boreholes/drillholes sinking within a distance of 3 m on plan of any point of the underground railway structures.

Each proposal will also be judged against the technical guidelines as specified in paragraph B.1 above.

3. Utility Works

Utility trenches/pits which require excavation within the Railway Protection Area shall not be carried out without the approval of MTRCL.

4. Marine Works

Any reclamation, dredging, laying of pipes, dropping of anchors, or other engineering works to be carried out within the Railway Protection Area shall be submitted to MTRCL for approval.

5. Sinking of Wells

Sinking of wells within Railway Protection Area shall not be carried out without the approval of MTRCL.

C. Overhead Railway Structures

1. Scaffolding, Advertising Signs, Projections

Erection of scaffolding, working platforms, advertising signs or any projections at a level above the railway tracks shall not be allowed within a distance of 6 m on plan of any point of the railway tracks, without the agreement from MTRCL. When such works are permitted to be carried out within the 6 m limit, effective measures to protect the railway structures shall be provided. According to individual circumstances it may be necessary for such works to be conducted outside the railway operation hours and all protective works shall be subject to the special approval of MTRCL.

2. Overhead Structures

The requirements of paragraph B.1(b) to B.1(f) shall also apply to overhead structures.

3. Utility Works

When cables, ducts and pipes, etc. are to cross above or below railway overhead structures, the Utility Undertaker shall submit to MTRCL details of the cables, ducts, pipes and the method of construction and seek approval before works can commence. When cables, ducts and pipes, etc. are to pass over the railway, the provisions of paragraphs B.1, C.1 and D shall apply.

D. At-grade Railway Structures

1. When utility works are to be carried out across the at-grade railway tracks, agreement from MTRCL has to be sought.

2. Unless prior special agreement has been obtained from MTRCL, piling works will not be permitted within 3 m on plan from the railway fence or wall along the Railway Protection Area, or 7 m on plan from the centreline of the nearest track when there is no railway fence or wall.

3. Vibration measured on the overhead power line mast or signalling and telecommunication furniture of the railway shall not exceed the peak particle velocity of 10 mm/sec and the vibration amplitudes shall not exceed 80 μm.

4. The requirements of paragraphs B.1, B.2, B.3 and C.1 shall also apply to the at-grade railway structures and tracks.

E. Operation of Stationary Lifting Appliance (tower crane, hoist, piling/drilling rigs)

1. When a stationary lifting appliance is erected adjacent to railway tracks and/or above ground structures/installations, effective measures to protect the railway structures shall be provided. According to individual circumstances it may be necessary for such works to be conducted outside the railway operation hours. All protective works shall be subject to MTRCL's approval. MTRCL may impose conditions on the operation and positioning of the appliance if in its opinion such operation and positioning may endanger the safe operation of the railway.

2. The swings of the lifting appliance shall not encroach within 6 m of the railway tracks and/or above ground structures/installations on plan except with special approval from MTRCL.

F. Mobile Lifting Appliance

Where a mobile lifting appliance (e.g. crane, excavator) operates within 6 m on plan of railway structures and any part of the appliance is higher than the railway track level, the provisions of paragraph E shall apply.

G. Maintenance of Road Lamp Standards

When road lighting tower maintenance vehicles are to be used to service road lamp standards adjacent to railway tracks, the working equipment shall not be positioned closer to the railway tracks than the nearest part of the road lamp standard where the height of the lamp standard is greater than the height of the tracks. If the working equipment is to be operated at a level higher than 1 m above railway tracks and closer than 6 m from the railway tracks, provisions of paragraphs C.1, E and F shall also apply.

H. Fire Services Department/Police Force Vehicles

The operation of Fire Services/Police vehicles adjacent to the railway tracks or vent shafts under emergency situations shall be in accordance with the emergency procedure(s) agreed between MTRCL and the respective organization.

I. Storage of Materials

1. No materials, containers, huts etc. shall be stored within 6 m on plan of the railway structures/tracks and vent shaft openings except with the special approval from MTRCL.

2. No dangerous goods or other inflammable materials shall be stored within 6 m on plan of railway structures/tracks except with the special approval from MTRCL.

J. Demolition Works

Where demolition and removal works for any structure which includes scaffolding, advertising signs, container offices and buildings are proposed above or adjacent to above ground railway structures, such as entrances, vent shafts, power distribution substations, traction substations, plant rooms, overhead railway structures and at-grade railway tracks, effective measures to protect the railway structures shall be provided. Demolition works proposal with the protective measures shall be submitted to MTRCL for approval and consent prior to commencing the works.

K. Exemption

Exemption is given to those works involving only ground breaking and excavations not exceeding 1 m deep, provided that MTRCL has been advised of the works in advance, and under the following condition:

(a) outside the areas measuring at 6 m from the at-grade railway tracks and station entrances; or
(b) outside the areas bounded by railway fence/wall.

APPENDIX PRE.B8/XVIII

PRE.B8.APPEND18.A KEY INDUSTRIAL SAFETY PRECAUTIONS FOR CONTRACTORS WORKING WITHIN RAILWAY PREMISES

Key industrial safety precautions for Contractors working within railway premises

1 General Requirements

The Contractor shall comply with all of MTRCL's Railway Safety Rules, Procedures and Code of Practice and the relevant Ordinances and statutory regulations, especially the Factories and Industrial Undertakings Ordinance, Dangerous Goods Ordinance and their subsidiary legislations.

2 Breach of Requirements

The Contractor shall be required to stop the works whenever any of the requirements mentioned in these precautions is found breached and shall not resume the works until the satisfactory rectification of the unsafe condition.

3 Site of Works and Routes of Access

Within MTRCL's railway premises, the Contractor shall not work in areas other than the works site defined and agreed by the MTRCL ("the MTRCL Site"). Suitable barriers and warning signs shall be erected where necessary to segregate the Site.

4 Person-in-Charge

The Contractor shall appoint a person-in-charge for the job to ensure that all works are done safely. He shall be present at the Site at all times of works. The person-in-charge shall ensure that all sources of ignition are removed, all power supplies are isolated, and the Site is in a safe condition before leaving the Site.

5 Portable Fire Extinguisher

At least one 4.5 kg dry chemical powder type portable fire extinguisher, or its equivalent, in efficient working state, shall be provided at each working location of the Site to guard against incipient fires. Additional fire extinguishers shall be required as necessary.

6 Flammable Substance

No flammable substance shall be kept at the Site unless prior approval has been obtained from MTRCL. However, if such material shall be used on the Site and permitted by MTRCL it shall be contained in suitable receptacles for the specific work requirement, the quantity shall be kept as low as possible in a closed metal cabinet provided by MTRCL, and the Contractor shall comply with the safety precautions as may be instructed by the Contract Manager.

7 Dangerous Substances

The Contractor shall label all dangerous substances, keep them in suitable containers and handle with extreme care as per statutory requirements.

8 Welding and Flame-cutting

No welding or flame-cutting is permitted without prior authorisation from MTRCL. Only one set of oxy-acetylene is allowed at the Site, and it shall be fitted with proper flashback arrestors. The oxygen and acetylene set shall be in good working conditions and free of cracks and leaks.

9 Painting

Painting and welding or flame-cutting shall not be done simultaneously at the Site.

10 Guarding of Machinery

All machinery in use shall be properly guarded against human bodies reaching its dangerous parts.

11 Electrical Tools, Equipment and Installation

The Contractor shall ensure that all electrical tools, equipment and installation in use shall be –

11.1 suitable for the supply voltage and loading current;
11.2 suitable for the type of environmental condition;
11.3 properly insulated; and
11.4 properly protected against electrocution by earth leakage circuit breakers or by earthing.

12 Temporary Electric Wiring

The Contractor shall ensure that all temporary wiring in use shall be –

12.1 free of frayed portions;
12.2 free of exposed live conductors;
12.3 free of sloppily-taped joints;
12.4 properly connected by plugs and sockets;
12.5 properly protected against mechanical damage;
12.6 properly secured and running at high levels; and
12.7 properly secured at suitable locations.

13 Conveyance of Bulky Items

No bulky items shall be conveyed onto MTRCL's railway premises without the prior permission from the MTRCL.

14 Dangerous Tools and Equipment

Dangerous tools and equipment shall not be brought onto MTRCL's railway premises including –

14.1 cartridge operated fixing tools;
14.2 open type welding transformers;
14.3 spray painting equipment; and
14.4 asbestos products.

15 Pressure Receivers

All air receivers in use on MTRCL Site shall be in good working condition and provided with a valid certificate to prove that they have been properly tested and examined in accordance with the provisions of the Boilers and Pressure Vessels Ordinance.

16 Lifting Appliance

All lifting appliances and gears in use within and in the vicinity of MTRCL's railway premises shall be in good working condition, and shall not be expired on their weekly inspections and 6/14 monthly examinations as per the requirements under the Construction Sites (Safety) Regulations. The Contractor shall obtain valid certificates of inspection and examination before use, and produce them for inspection on demand.

17 Scaffolding

All scaffolding, if permitted, including mobile scaffoldings in use shall be –

17.1 erected by competent persons;
17.2 guarded against overturning by the erection of outriggers or other suitable means;
17.3 displayed with warning signs on the danger of falling objects;
17.4 kept away from causing obstruction to any passageway;
17.5 locked at designated locations after each workshift;
17.6 maintained in good working condition;
17.7 provided with putlogs (metal ties) painted in bright red colour and warning signs to putlogs for alerting workers not to make any alteration to bamboo or metal scaffold and putlogs without CM's approval. The signs shall display the words "DANGER: DO NOT ALTER SCAFFOLD & PUTLOG 危險: 不可改動棚架及連牆器)" in red on a white background. The height of each letter / Chinese character on the signs shall not be less than 20mm; and ,
17.8 inspected periodically by a competent person as per statutory requirements.

18 High Level Working Platform

All high level working platforms shall be –

18.1 without access to MTRCL operating area; and
18.2 closely planked with minimum 2 m long solid planks.

Safety belts, safety nets or fall arrestors shall be used by all workers when working at height.

19 House-keeping

Good house-keeping shall be maintained at the Site at all times. All flammable waste and sources of ignition shall be removed, all power supplies isolated and the Site left in a safe condition after each workshift.

20 Electric Cables

The Contractor shall treat all electric cables and the like installed within MTRCL's railway premises as "LIVE" and no work shall be carried out on or cause any damage to them.

21 Personal Protective Equipment

All workmen on the Site shall wear the necessary personal protective equipment, i.e. safety helmets, eye goggles, ear protectors, respirators and safety belts, etc. as required by the nature of work.

22 Smoking

The Contractor shall ensure that there is no smoking when working within MTRCL's railway premises.

23 Working on MTRCL Equipment

The Contractor and its workers shall not work on any MTRCL equipment unless prior approval has been obtained from MTRCL.

24 Working on or near Railway Tracks

24.1 High-visibility clothing shall be worn when working on or near railway tracks; and
24.2 All persons, tools and materials shall be cleared of the track upon completion of each workshift.

25 Illumination

The Contractor shall provide adequate lighting to the Site within and in the vicinity of MTRCL's railway premises.

26 First Aid Facilities

Sufficient first aid facilities shall be provided in a first aid box at the Site as per statutory requirements.

27 Ladders

27.1 All ladders in use shall be of good construction and be made of good material. Each ladder shall bear an identification mark and be inspected six-monthly by a competent person. The next due date for examination shall be marked on the equipment; and
27.2 No metal ladder shall be permitted to be used on the Site.

28 Additional Safety Precautions

The aforementioned safety precautions are in no way exhaustive and additional ones will be imposed whenever necessary.

APPENDIX PRE.B8/XIX

PRE.B8.APPEND19.9 MTRCL'S INDEMNITY FORM

THE INDEMNITY

In consideration of your permission to allow me/ourselves to visit/work at_____ (site location) from _____ to _____ (duration of work), I, _____ (full name), the duly authorised representative of _____ (name of Company), hereby agree that I/we shall do so entirely at my/our own risk and that the MTR Corporation Limited, its servants and agents shall not be liable in any manner whatsoever to whomsoever in respect of all claims, costs, damages or expenses for any damage to or loss of property, personal injury or loss of life howsoever caused arising out of or in any way connected with my/our visit/work, and I/we for myself/ourselves and for and on behalf of _____ (name of aforesaid Company) hereby agree to indemnify and keep the MTR Corporation Limited indemnified from and against all claims, cost, damages and expenses in respect of any damage to or loss of property, personal injury or loss of life howsoever caused arising out of or in any way connected with my/our visit/work within/in the vicinity of MTR Corporation Limited premises.

Dated this day of 20

Witness: _____

Name (block letter): _____

_____

Address: _____

_____

Occupation or description:

_____

Signed: _____

Name (block letter): _____

_____

Occupation or description:

_____

Name of the Company:

_____

Company Chop:

_____

APPENDIX PRE.B8/XX

PRE.B8.APPEND20.9 LETTER OF UNDERTAKING

To: MTR Corporation Limited

LETTER OF UNDERTAKING

In consideration of your permission to allow me/ourselves to visit/work at _____ (site location) from _____ to _____ (duration of work), I, _____ (full name), the duly authorised representative of _____ (name of Company), hereby agree that I/we shall undertake to indemnify and keep the MTR Corporation Limited indemnified or to make good any damage to its services equipment or property to the satisfaction of MTR Corporation Limited due to my/our activities within/in the vicinity of MTR Corporation Limited premises.

Dated this day of 20

Witness: _____ Signed: _____

Name (block letter): _____ Name (block letter): _____

_____ _____

Address: _____ Occupation or description:

_____ _____

Occupation or description: Name of the Company:

_____ _____

Company Chop:

APPENDIX PRE.B8/XXI

PRE.B8.APPEND21.N RECORD OF CALIBRATION OF EQUIPMENT

Monthly Record of Calibration of Equipment

Contract No. : _____

Contract Title : _____

APPENDIX PRE.B8/XXII

PRE.B8.APPEND22.N QUARTERLY CARBON EMISSION PERFORMANCE REPORT

Quarterly Carbon Emission Performance Report
[Project Name]

Reporting Period: (01/11/2023 to 31/01/2024)

Prepared by: _____

Signature: _____
Post: CAT Operator / Supervisor[1]
Date: _____

Checked by: _____

Signature: _____
Post: Site Agent / Project Manager
Date: _____

[1] If the CAT Operator has enrolled but not yet started or completed the required CIC training course, before the completion of required training course, the report shall be endorsed by the Environmental Manager or Environmental Supervisor or Building Services Engineer or other personnel in Contractor's management team as the Supervisor.

1. PROJECT INFORMATION

Please provide brief project information based on instruction below.
Commencement date: __/__/____(DD/MM/YYYY)

Completion date: __/__/____(DD/MM/YYYY) *(Original / Extended / Anticipated / Actual)* *
**Delete as inappropriate*

Please include a brief description about each work stage. Format to be agreed with the CM.
Work Section 1
Description:

Work Section 2
Description:

…
…
…

Work Section X
Description:

2. SITE WORK PROGRESS

Please provide necessary inputs to complete the table below, the data below is for illustration only.

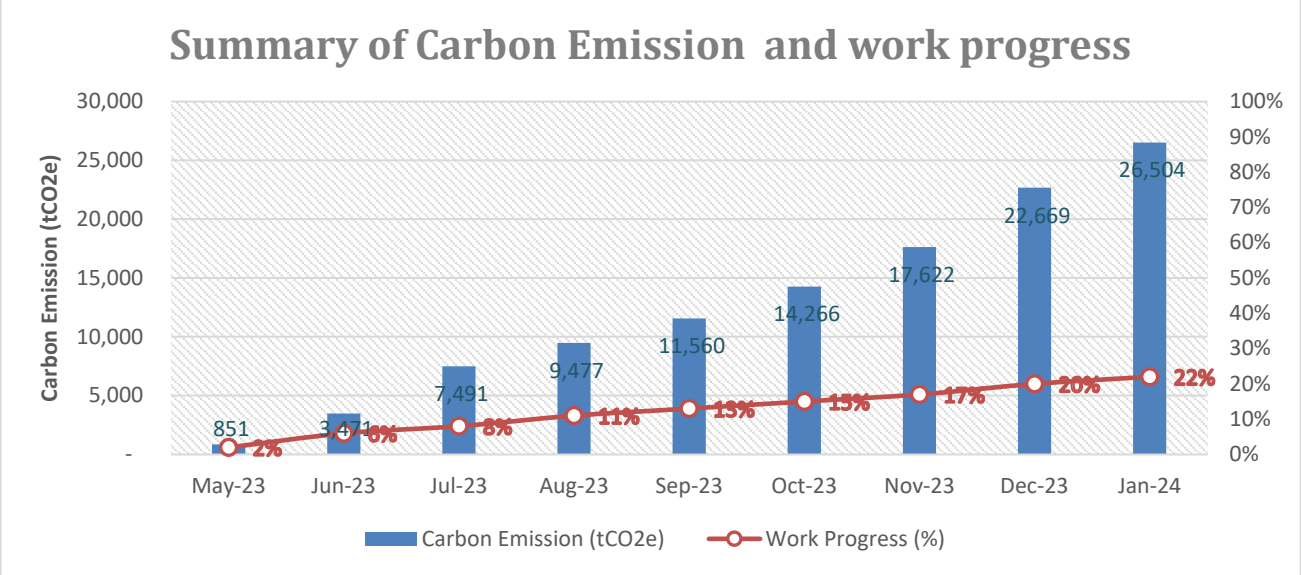
Work Section	**Starting Date** (DD/MM/YYYY)	**Completion Date** (DD/MM/YYYY) *(Contractual / Anticipated / Actual)*	**Progress by the end of last reporting period** (%)	**Progress by the end of this reporting period** (%)
Work Section x	01/05/2023	31/12/2024	20% Oct-2023	35% Jan-2024
…	…	…	…	…
OVERALL	01/05/2023	01/08/2025 *(Anticipate)*	15% by Oct-2023	22% by Jan-2024

3. OUTPUT DATA SUMMARY

*Provide a summary table showing **monthly carbon emission** by the end of this reporting period. Plot the data against the overall site work progress.*
Sample summary table:

Category	Total tCO2									
	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Accumulated
Substructure										3,619.54
Superstructure										21,691.92
Temporary Works										177.74
Site Impacts										1,014.91
Monthly Total	851	2,620	4,020	1,986	2,083	2,706	3,356	5,047	3,835	26,504.11
Accumulated	851	3,471	7,491	9,477	11,560	14,266	17,622	22,669	26,504	
Work Progress (%)										
Superstructure	2%	6%	8%	11%	13%	15%	17%	20%	22%	

Sample chart:



4. SUPPLEMENTARY INFORMATION

Please provide supplementary reports exported from CAT in digital format for the CM's record. Please provide the reports with data recorded from notified date for commencement of the Works up to the end of this reporting period.

4.1 Exported editable data input excel from CAT under the "Data Input" page.
4.2 "Report for BEAM Plus FA" exported from CAT under the "Results" page.
4.3 "Carbon Audit Report" exported from CAT under the "Results" page.
4.4 "ESG Report" exported from CAT under the "Results" page.

APPENDIX PRE.B8/XXIII

PRE.B8.APPEND23.N FORM OF DECLARATION AND CONSENT TO THE EMPLOYER

To : Hong Kong Housing Authority
Attention : Contract Manager

Contract No. : _____
Contract Title : _____

In accordance with Clause PRE.B8.005 of the Specification, I declare that the information attached to this form as to my qualifications, experience, employment status and other required information (**"submitted information"**) is true, accurate and complete.

I hereby give consent to you to obtain from and verify the authenticity of any of the submitted information with the relevant parties (including but not limited to my employers, the employers/clients/project managers/professionals of the projects/contracts listed in the submitted information, professional bodies/institutions, universities, any issuing bodies, or the like as to my professional and academic qualifications). I also give consent to you for collection, use and input of the submitted information into your database (if any) for the purposes of contract procurement and management of the Contract and any of your other contracts.

Name : _____
(Note: full name matched with HKID / passport)

Signature : _____

Position : _____

Company Name : _____

Date : _____

PRE.B9 QUALITY STANDARDS

MATERIALS AND WORKMANSHIP

PRE.B9.010.9 GOOD PRACTICE

Materials and workmanship generally to be consistent with good ..... practice in Hong Kong and to comply with this Specification and with the relevant BS or CP, except when specified otherwise, and/or Approved.

PRE.B9.020.A MATERIALS

1. Materials for inclusion in the permanent works to be new except when specified otherwise;
2. Appearance or packing of materials to be supplied or services to be provided in connection with the Works containing any messages (whether explicit or implicit) which are likely to constitute or cause the occurrence of any offences endangering national security or which would otherwise be contrary to the interest of national security shall strictly be prohibited.

PRE.B9.030.9 CONSISTENCY OF MATERIALS

1. When a choice of manufacturer is permitted for any material, obtain the entire quantity required to complete the work from one manufacturer. Unless otherwise Approved, also obtain such material from the same source of supply;
2. When a choice of type, colour or size of material is permitted (e.g. glazed wall tiles, mosaic tiles), use the same type, colour and size throughout for all work in like locations unless otherwise Approved.

PRE.B9.040.9 MIX PROPORTIONS

Unless otherwise specified, mix proportions to be by volume.

PRE.B9.050.9 MANUFACTURER'S RECOMMENDATIONS

Handle, store and fix each material in accordance with manufacturer's recommendations. Submit copies of these recommendations to the CM when requested before work is commenced.

PRE.B9.060.9 EQUIVALENT MATERIALS AND IMPERIAL SIZES

1. When materials or products to the appropriate standard are not available, materials or products conforming with equivalent standards will be acceptable subject to Approval;
2. When a material is available in Hong Kong in metric size, an imperial size equivalent will not be acceptable;
3. If a material is unobtainable in metric size, a material of an imperial size equivalent which will fully meet the specification may be substituted if prior Approval has been obtained, but the rates and prices will not be changed from those submitted for the materials specified.

PRE.B9.070.9 BRITISH STANDARDS

1. "British Standards" (BS) and "Codes of Practice" (CP) shall, except for head standards, be deemed to include for the latest revision and any amendments to that revision, that are listed in the BSI Standard Catalogue and its Supplements 42 days prior to the date for the return of tenders unless the year of revision is specified in this Specification;

2. "Head standards" to BS and CP shall be deemed to include for all dated revisions to their parts and amendments which are listed in the BSI Standards Catalogue and its Supplements 42 days prior to the date for the return of tenders unless otherwise specified;
3. "Head standards" are not dated because they do not contain any technical content. However reference to a head standard invokes all extant "parts" of that standard which are themselves dated. Reference to head standards is a practicable method of using a general BS reference in situations where detailed reference to each part would be cumbersome.

PRE.B9.080.9 OTHER NATIONAL AND INTERNATIONAL STANDARDS

Hong Kong Construction Standards (CS), International Standards Organisation (ISO) Standards and standards issued by the American Society for Testing and Materials (ASTM) and similar standards shall be deemed to include for the latest revision and any amendments to that revision, that are published 42 days prior to the date for the return of tenders unless the year of revision is specified in this Specification.

PRE.B9.090.9 EQUIVALENT STANDARDS

In the event of Approval being sought, pursuant to PRE.B9.010, for materials or workmanship, for which compliance is claimed to a standard, other than that specified, submit full details to the CM one month before such materials are required for manufacture or incorporation into the works.

PRE.B9.095.9 PNAP & PNRC

PNAP and PNRC issued by BD shall be deemed to include the issue of the Practice Note and any amendments to that issue published 42 days prior to the date for the return of tenders unless otherwise specified.

CONSTRUCTION INDUSTRY COUNCIL (CIC)

PRE.B9.100.9 CIC GUIDELINES

1. The Construction Industry Council (CIC) from time to time issues "Guidelines". Such "Guidelines" set out the recommendations on standards and procedures for all relevant industry participants to adopt and to adhere to all times. Industry participants have to prepare for justifying any course of action that deviates from these recommendations;
2. Comply with this specification and with the relevant guidelines promulgated by the CIC. This specification shall prevail if there is conflict between the specification and the CIC requirements.

PERFORMANCE ASSESSMENT SCORING SYSTEM (PASS)

PRE.B9.106.A PILINGPASS

Option 1

1. The performance of the Contractor and/or the Piling Subcontractor under this Contract is to be assessed by the Piling Contractor's Performance Assessment Scoring System, abbreviated as PilingPASS, which is a means of comparing the performance of individual Piling Contractors in the Housing Authority List of Piling Contractors. It will also be used to guide the Contractor and the Piling Subcontractor on aspects which require improvement and will be a practical and continuous assessment tool in persuading the Contractor and the Piling Subcontractor to improve their performance;

2. The assessment shall be carried out quarterly unless the performance of the Contractor and/or the Piling Subcontractor warrants a shorter assessment period as determined by the CM;
3. The Contractor and/or the Piling Subcontractor shall attend site meetings and site assessments as required and co-operate in the selection of samples of the works to be assessed;
4. The Contractor and/or the Piling Subcontractor shall acknowledge the PilingPASS Assessment and Score Sheets when required by CM.

Option 2

1. The performance of the Piling Subcontractor and/or the Piling Sub-subcontractor under this Contract is to be assessed by the Piling Contractor's Performance Assessment Scoring System, abbreviated as PilingPASS, which is a means of comparing the performance of individual Piling Contractors in the Housing Authority List of Piling Contractors. It will also be used to guide the Piling Subcontractor and the Piling Sub-subcontractor on aspects which require improvement and will be a practical and continuous assessment tool in persuading the Piling Subcontractor and the Piling Sub-subcontractor to improve their performance;
2. The assessment shall be carried out quarterly unless the performance of the Piling Subcontractor and/or the Piling Sub-subcontractor warrants a shorter assessment period as determined by the CM;
3. The Piling Subcontractor and/or the Piling Sub-subcontractor shall acknowledge the PilingPASS Assessment and Score Sheets when required by CM;
4. Attend site meetings and site assessments with the Piling Subcontractor and/or the Piling Sub-subcontractor to discuss the assessment as required;
5. The Piling Subcontractor and/or the Piling Sub-subcontractor shall attend site meetings and site assessments as required by the CM and co-operate in the selection of samples of the works to be assessed.

PRE.B9.107.9 DEMOLITIONPASS

Option 1

1. The performance of the Contractor under this Contract is to be assessed by the Demolition Contractor's Performance Assessment Scoring System, abbreviated as DemolitionPASS, which is a means of comparing the performance of individual Demolition Contractors in the HA List of Demolition Contractors. It will also be used to guide the Contractor on aspects which require improvement and will be a practical and continuous assessment tool in persuading the Contractor to improve his performance;
2. The assessment shall be carried out quarterly unless the performance of the Contractor warrants a shorter assessment period as determined by the CM;
3. Attend site meetings and site assessments as required and co-operate in the selection of samples of the works to be assessed;
4. Acknowledge the DemolitionPASS Assessment and Score Sheets when required by CM.

Option 2

1. The performance of the Demolition Subcontractor under this Contract is to be assessed by the Demolition Contractor's Performance Assessment Scoring System, abbreviated as DemolitionPASS, which is a means of comparing the performance of individual Demolition Contractors in the HA List of Demolition Contractors. It will also be used to guide the Contractor and the Demolition Subcontractor on aspects which require improvement and will be a practical and continuous assessment tool in persuading the Contractor and Demolition Subcontractor to improve their performance;

2. The assessment shall be carried out quarterly unless the performance of the Contractor and/or the Demolition Subcontractor warrants a shorter assessment period as determined by the CM;
3. The Demolition Subcontractor shall attend site meetings and site assessments as required by the CM and co-operate in the selection of samples of the works to be assessed;
4. The Demolition Subcontractor shall acknowledge the DemolitionPASS Assessment and Score Sheets when required by CM;
5. Attend site meetings and site assessments with the Demolition Subcontractor to discuss the assessment as required.

PRE.B9.110.9 PASS

Option 1

1. The performance of the Contractor under this Contract is to be assessed by the Performance Assessment Scoring System, abbreviated as PASS, which is a means of comparing the performance of individual Contractors in the Housing Authority List of Building Contractors. It will also be used to guide the Contractor on aspects which require improvement and will be a practical and continuous assessment tool in persuading the Contractor to improve his performance;
2. Attend site meetings and site assessments as required and co-operate in the selection of samples of the works to be assessed;
3. Provide the following facilities for enabling Housing Department to carry out PASS assessment on the production of the precast concrete components at the casting factory for every interval of three months when the precast concrete components are cast off-Site in mainland China:
   a. A vehicle with driver in mainland China for any purpose in connection with the carrying out of the PASS assessment. The vehicle shall comply with the following requirements:
      i. Specification for vehicle as described in PRE.B10.610 (2)(a), unless otherwise agreed;
      ii. The insurance policy for the vehicle shall provide insurance protection to passengers of the vehicles and any third parties and to any use of the vehicle pursuant to sub-clause (3)(a) above.
   b. Attendance at locations of production and storage areas for the precast concrete components, including but not limited to the following:
      i. Assistance in the selection and examination of samples;
      ii. Lifting and transportation of samples;
      iii. Provision of videotelephony system, calibrated measuring equipment and any other equipment as required.

Option 2

1. The performance of the Contractor under this Contract is to be assessed by the Performance Assessment Scoring System, abbreviated as PASS, which is a means of comparing the performance of individual Contractors in the Housing Authority List of Soft Landscape Contractors. It will also be used to guide the Contractor on aspects which require improvement and will be a practical and continuous assessment tool in persuading Contractors to improve their performance;
2. Attend site meetings and site assessments as required and co-operate in the selection of samples of the works to be assessed.

INDEPENDENT CHECKING UNIT (ICU)

PRE.B9.112.A GENERAL

Prepare and submit drawings, documents and ICU forms required under this Specification or as directed by the CM via the Public Housing Electronic Plan Submission System (Public Housing e-Plan) at time frame specified by the CM.

PRE.B9.113.A SERVICES AND FACILITIES REQUIRED BY ICU

1. In facilitating ICU's inspection and checking:
   a. Provide facilities and labour to carry out Schmidt Hammer Tests on completed structures;
   b. Provide attendance on loading tests on curtain walls and tests on proprietary items;
   c. Provide attendance to facilitate the checking of personnel and attendance records of supervisory staff against the SP;
   d. Provide attendance on any other site activities and tests for ICU's inspection as and when necessary;
   e. Provide videotelephony for ICU's inspection as and when necessary. The videotelephony shall be two-way simultaneous communication with both audio and video in real time through telephone or computer network connections;
   f. Provide any other information as required by the CM.
2. Inform the CM at least 7 working days prior to carrying out the following tests:
   a. Tests as described in sub-clause (1)(b) above;
   b. Any other tests to be specified by the CM for inspection by ICU.

PRE.B9.115.9 CHECKING BY ICU ON FOUNDATION WORK

1. Staff of ICU, in the presence of the CM, will carry out the following checking or inspection on Site:
   a. Witness pile installation and loading test, if any, of preliminary pile or first working pile;
   b. Check personnel and attendance records of supervisory staff against the SP;
   c. Check third party safety audit reports against the Safety Plan required under GCC Clause 5.11 and PRE.B8.210;
   d. Witness pre-drilling of Types 3, 5 & 6 piles;
   e. Inspect bearing strata of footings;
   f. Witness core drilling process for Type 3 pile;
   g. Witness post construction proof drilling for Types 5 & 6 piles;
   h. Witness loading test of the piles selected by ICU;
   i. Witness or inspect any other site activities as and when necessary.
2. The CM will select certain piles to undergo loading tests, core tests or any other tests as necessary for the ICU's inspection;
3. Inform the CM at least 7 working days before:
   a. The preliminary pile or first working pile is ready to be installed or load tested;
   b. The testing of the piles selected by the CM for the ICU's inspection is ready to be performed.
4. Attend inspection and checking with the ICU and provide information to the ICU to facilitate the inspection and checking;
5. Programme the Works by taking into account of the checking or inspection by ICU.

PRE.B9.116.A DOCUMENTATION

Unless otherwise specified hereinunder, submit all documentation in both hard and soft copies which include but not limited to the following certificates, material test reports, method statements, calculations, sketches and monitoring records for structural and geotechnical works; the soft copy shall be in suitable Portable Document Format (PDF) with search function if applicable, as agreed with the CM.

Item	Type of Document
1	Mill certificates for steel reinforcement
2	Monitoring records for foundation / ELS / retaining wall works
3	Test reports of stone cladding and cladding works
4	Mill certificates of structural steel for Classes 1, 2 or 1H steel
5	Safety test reports on a representative portion of curtain wall system
6	Heat soak test reports of tempered glass and impact resistance test reports of glass (e.g. glass used in curtain wall, window wall and glass balustrade) which performs the function of protective barrier
7	Compliance certificate (comprise of sealant compatibility report, sealant adhesion report and print review report) for structural sealant used in curtain wall, glass canopy and window wall
8	Quality Assurance Scheme issued by the manufacturer to ensure the quality of the produced tempered glass (e.g. glass used in curtain wall, window wall and glass balustrade)
9	Compliance report for the heat soak process issued by the glass manufacturer to ensure the heat soak process has been duly carried out to all tempered glass (e.g. glass used in curtain wall, window wall and glass balustrade)
10	Quality supervision report to confirm that adequate supervision has been provided in accordance with the quality supervision plans for the quality supervision of manufacturer's heat soak process
11	Mill certificate of structural aluminium
12	Strength test reports of drilled-in anchors used for steel cantilevered canopy works / curtain wall remedial works / signboard works
13	Method statement on the anchor pull out tests and / or shear load tests; method statement on the grouted bolts / dowels / reinforcing bars pull out tests and / or shear load tests
14	Mill certificate and tensile test reports of stainless steel
15	Mill certificate and proof tests of stainless steel spider components, including its associated "routel"
16	Quality assurance scheme of the manufacturer for the mechanical splices
17	Report upon completion of mechanical splicer works
18	Test report showing the ultimate tensile strength at break for both weft and warp directions before and after ageing achieve the design strength as specified for fabric the membrane material

19	Test report showing the ultimate tensile strength of any seam introduced for fabrication of the fabric membrane to be not less than the parent fabric
20	Acceptable quality assurance and control scheme adopted by the fabric supplier or manufacturer as well as the membrane fabricator
21	Fire test report or fire assessment report showing the fabric membrane material fulfill the fire performance requirement in compliance with the Building (Construction) Regulations or the Code of Practice for Fire Safety in Buildings 2011
22	Type testing report by the manufacturer or purchaser test report to justify the minimum breaking force of the wire rope for flexible edging using the wire ropes and terminations components for supporting the fabric membrane
23	Type testing report by the manufacturer or purchaser test report to confirm the structural integrity of the terminations for flexible edging using the wire ropes and terminations components for supporting the fabric membrane
24	Material certificate of the wire rope produced by the supplier for flexible edging using the wire ropes and terminations components for supporting the fabric membrane
25	Quality assurance and control plan from the fabricator of the terminations with sufficient information related to the entire fabrication process, such as manufacturer's details, fabrication method statement and procedures, adopted conforming standards, type testing and material used, etc. for flexible edging using the wire ropes and terminations components for supporting the fabric membrane
26	Performance test report or proof load test report shall be carried out to demonstrate the structural integrity of the connection for the stiff edging using keders fixing device (e.g., metal clamping or keders rail) for supporting the fabric membrane
27	A quality assurance and control plan from the manufacturer or fabricator of the fixing device for the stiff edging using keders fixing device (e.g., metal clamping or keders rail) for supporting the fabric membrane
28	Quality assurance scheme of the manufacturer for the bearing works
29	Report for completion of the bearing works
30	Method statement including the design, drawings and installation procedures for the temporary support works for erection of the precast concrete components
31	Quality assurance scheme of the manufacturer of the precast concrete works to confirm the quality of production
32	Registered Structural Engineer's audit reports of the precast concrete factory, or Chief Structural Engineer's on-site audit reports on the quality of the precast concrete components delivered to the building site, and the Authorized Signatory's audit reports of the precast concrete factory
33	Foundation Report
34	Core test of precast prestressed spun concrete piles report
35	Visual inspection report of pile delivered to Site

36	Report on stress wave dynamic tests
37	Mill certificate of prestressing bars, spiral wires and steel plates of precast prestressed spun concrete piles
38	Manufacturer's certificates of precast prestressed spun concrete piles
39	Trial / test pile testing reports
40	Report on Trial pile testing
41	Performance review report of the trial pile works
42	Predrilling report
43	Post-installation proof drilling report
44	Test boring proposal
45	Test installation report
46	Test on bearing strata report
47	Grouting records
48	Excavation (and boring) records
49	Compliance certificate issued by the polycarbonate sheeting manufacturer where polycarbonate sheeting display surface is used for signboard
50	Performance test reports of Glass Reinforced Polyester (GRP) water tank
51	Superstructure - Part I Calculations
	Superstructure - Part II Calculations
52	Foundation - Calculations
53	Demolition - Stability Report including Calculations
54	ELS works - Structural Calculations including supporting geotechnical documentations, if any
55	Temporary support works (e.g. temporary works for transfer structures and footbridge etc.) - Method Statement, Installation Procedures, Calculations including A4 / A3 Sketches
56	Construction reports for cantilevered slabs with span exceeding 750mm and exposed to weathering
57	Structural / Geotechnical Assessment Report
58	Public Relations Plan
59	Ground investigation fieldwork reports

60	Site formation construction records including soil compaction records and soil nailing records
61	TCP T5 and Directorate Site Supervisor (DSS) reports for foundation and excavation and lateral support (ELS) works
62	TCP T5 and DSS reports for site formation works
63	Supervision Plans
64	Video records of tests / inspections witnessed / conducted by using videotelephony. The video record shall be in colour with resolution of not less than 1080p in AVI or MP4 format (Submission of hard copy is not required)

PRE.B9.120.A REQUIREMENTS TO PREPARE ICU SUBMISSIONS AND APPLICATIONS THROUGH ELECTRONIC MEANS FOR ONWARD SUBMISSION TO ICU VIA PUBLIC HOUSING ELECTRONIC PLAN SUBMISSION SYSTEM (PUBLIC HOUSING E-PLAN)

1. Prepare ICU submissions to the CM for onward submission to the ICU of HD by electronic means via Public Housing e-Plan as required;
2. Authorized Signatory (AS) and their designated representatives shall access to the Public Housing e-Plan via the Internet at the URL address provided by the CM or HD;
3. AS and their designated representatives shall register as Public Housing e-Plan users and prepare submissions to the CM or his representatives for onward submission to ICU via Public Housing e-Plan. AP / RSE / RGE appointed by AS shall provide personal information as required in the user registration;
4. Prepare submissions and applications by electronic means including but not limited to:
   a. Complete ICU specified e-forms on-line;
   b. Prepare and upload submissions as follows:

Submissions	Format
Prescribed plans and calculations	Vector Portable Document Format (Vector PDF) with text content searchable according to the latest ICU Instructions (ICUIs) issued by ICU
Reports and other documents	Suitable Portable Document Format (PDF) with text content searchable as far as practicable according to the latest ICUIs issued by ICU
Supporting documents and drawings	Common and recognized file format such as AutoCAD (.dwg), Microstation (.dgn), Microsoft Word (.doc / .docx), Microsoft Excel (.xls / .xlsx), Revit (.dwf or .rvt), Portable Document Format (PDF) etc., as appropriate.

   c. Make reference to the Public Housing e-Plan Manual for Applicants, drawing and computer aided drafting guidelines and standards;
   d. AP or RSE or RGE shall digitally sign the prescribed plans, calculations, reports, e-forms and other necessary documents as appropriate with a Digital Certificate accepted by the Public Housing e-Plan. The digitally signed plans and documents shall be recognizable under the provisions of the Electronic Transaction Ordinance (Cap. 553);

e. Receive replies such as mark-up comments on submissions, digitally-signed reply letters / memos and drawings in PDF files, from ICU by electronic means via Public Housing e-Plan.

5. The minimum computer system requirements to access the Public Housing e-Plan of ICU, HD are as follows:
   a. Minimum requirements on PC:
      i. CPU: Pentium 3.4 GHz;
      ii. Memory: 4GB RAM;
      iii. Hard disk: 500 GB hard-disk;
      iv. Operating System: English / Chinese Microsoft Windows 7 Professional (64-bit or 32-bit);
      v. Other software: English / Chinese Microsoft Internet Explorer 8, PDF Viewer, Java Runtime Environment version 1.6 (for digital signing).
   b. Requirements on Digital Certificate:
      i. Organizational Digital Certificate issued by a Recognized Certification Authority such as Hongkong Post Certification Authority or Digi-Sign Certification Services Limited under the latest provisions of the Electronic Transaction Ordinance (Cap. 553);
      ii. Certificate Standard: X.509v3;
      iii. 2048-bit RSA key;
      iv. In *.p12 file format;
      v. Digital Certificate stored in a USB storage is recommended.
6. Contingency measures in case Public Housing e-Plan is out of service:
   a. Prepare ICU submissions and applications by conventional paper-based method. Make reference to the latest ICU Instructions issued by ICU for the detail procedures to prepare ICU submissions and applications by conventional paper-based method;
   b. Back-up all necessary data, including but not limited to the Approved Plans, Approval Letters / Memos, Consent Letters / Memos etc., to external storage outside Public Housing e-Plan for emergency use;
   c. Continue to prepare electronic submissions and application via Public Housing e-Plan as directed by the CM after the system resumed service;
   d. Assist ICU to reproduce the submission and application records in Public Housing e-Plan as directed by the CM or ICU, including but not limited to providing submitted plans, calculations and documents in appropriate electronic formats, and scanning the hard-copy of approved or acknowledged plans, calculations and documents to appropriate electronic formats.
7. The Contractor shall not be entitled to any compensation in time and cost whatsoever as a consequence of the Public Housing e-Plan system being out of service and as a result, any ICU submissions and application which had prepared by conventional paper-based method and any re-submissions via Public Housing e-Plan after the system resumed service.

PRE.B9.125.9 NEW BUILDING MATERIALS / BUILDING COMPONENTS/ CONSTRUCTION SYSTEMS

Upon completion of the Works, submit to the CM a list to confirm the new building materials, building components and construction systems, which have been used in this Contract including specify their type and model number. The new building materials, building components, and construction systems shall include concrete admixture/ fire protection materials/ fire-stop materials for curtain wall / mechanical couplers / structural fixing / structural sealant / stainless steel spider bracket / composite slab with profile sheeting.

PRE.B9.127.9 DOCUMENTATION FOR HIGH STRENGTH CONCRETE WORKS

Prior to CM's consent application of high strength concrete works (concrete of grade strength higher than 60 MPa), submit documentation on high strength concrete works which include but not limited to the following in both hard and soft copies.

Item	Type of Document
1	Quality assurance proposal for high strength concrete works, with sufficient preliminary test results to confirm that reliable and consistent concrete can be produced. This should include a detailed assessment of the concreting materials, the mix design and the quality control procedures of the batching plant. In this respect the designed mean resistance to crushing shall initially exceed the specified resistance to crushing by a margin of not less than 12 MPa.
2	Details of any subsequent revision of the mix design stipulated in item 1 above.
3	Proposals for the onsite facilities for sampling of fresh concrete and making, curing and storing the test cubes for high strength concrete works.
4	Proposal for insitu core testing of the finished concrete structure for high strength concrete works.

CHECKING AND SURVEYING ON FOUNDATION WORKS

PRE.B9.130.9 CHECKING AND SURVEYING ON FOUNDATION WORKS

1. The CM or his representatives will carry out the following checking or surveying works on Site:
   a. Check setting out of site boundaries;
   b. Check site formation levels and profiles at contract commencement and completion;
   c. Check survey control points for piles and structures;
   d. Check pile location markers before pile installation;
   e. Check locations and levels of selected piles after pile installation;
   f. Check founding level of bored piles before concreting;
   g. Check locations and levels of selected piles and/or bored holes in connection with the following works or tests, as appropriate:
      i. Predrilling and post-drilling;

ii. Confirmatory core tests;
iii. Concrete core tests;
iv. Loading tests;
v. Non-destructive tests on piles.

h. Check locations and levels of pile caps;
i. Carry out any other checking and surveying works as may be considered necessary.

2. Programme the Works by taking into account of the checking and surveying works carried out by the CM or his representatives.
3. At a time to be determined by the CM:
   a. Carry out a joint survey with the subsequent building contractor after completion of the Works and upon award of the subsequent building contract in the presence of the CM or his representatives to record the site topography and the setting out and levels of piling, pilecaps, etc. which are to be handed over to the subsequent building contractor;
   b. Allow access to and within the Site for the subsequent building contractor to carry out the joint survey;
   c. Check the draft survey drawings produced by the subsequent building contractor from the joint survey;
   d. Co-sign on the finalized survey drawings with the subsequent building contractor to signify mutual agreement to the survey records.

APPROVED CONTRACTORS AND SUPPLIERS

PRE.B9.210.B LISTS OF APPROVED CONTRACTORS FOR SPECIALIST WORKS

There are no specialist works forming part of this Contract to be carried out by firms included in the Lists of Approved Contractors.

Carry out the following specialist work forming part of the Contract by a contractor whose name is included on the appropriate list of Approved Contractors included or specified in the Contract:

1.	Ground investigation work and works required to be carried out by RSC(GIFW) under the Contract:	see	EAR1.D060 & PRE.B9.250;
2.	Removal of asbestos:	see	DEM2.W020;
3.	Play equipment:	see	EXT10.M010;
4.	Footbridge bearings :	see	.....;
5.	Roads run-in, footpath repair and drainage works outside the boundary of the Site:	see	DRA2.W1910, EXT1.W610, EXT2.W1310, EXT3.W810, EXT5.W310;
6.	Water supply connection works outside the boundary of the Site:	see	PLU1.G010;
7.	Site Formation Works:	see	PRE.B9.260;
8.	Structural steelworks for space frame:	see	STR1.D250;
9.	Fresh and flush water supply installations and above-ground drainage works excepting the works undertaken by Nominated Sub-contractors:	see	PLU1.G012 & DRA1.W002;
10.	Off-site prefabrication of steel reinforcing bars to be produced by Type 1 Yard:	see	CON9.G020;

11. Arboricultural work: see PRE.B8.1114.

PRE.B9.220.9 AVAILABILITY OF CONTRACTORS APPROVED FOR SPECIALIST WORKS

Accept responsibility for establishing the availability of contractors approved for specialist works forming part of the Contract. In the event that one or more of the named contractors is not available, employ one of the remaining contractors included in the appropriate approved list. Where the specialist works has been partially completed before a contractor becomes unavailable, seek Approval to any change of contractor before employing him. Bear any additional costs arising from the non-availability of any of the named contractors.

BUILDING WORKS

PRE.B9.240.N BUILDING WORKS

For all Building Works required under the Contract, the Contractor shall have been registered under the BD's List of General Building Contractors to carry out the works.

GROUND INVESTIGATION WORKS

PRE.B9.250.B GROUND INVESTIGATION WORKS

1. For all ground investigation works required under the Contract, employ a Ground Investigation Contractor, who shall have been registered under the Housing Authority List of Ground Investigation Contractors and the BD's List of RSC(GIFW), to carry out the works. Alternatively, the Ground Investigation Contractor may be employed by the Piling Subcontractor to carry out ground investigation works relating to foundation works;
2. Unless otherwise specified, the Ground Investigation Contractor shall carry out all ground investigation works in accordance with the following requirements:
   a. Carry out the works in accordance with the recommendations, methods and procedures described in latest edition of 'Guide to Site Investigation (Geoguide 2)' published by GEO, unless otherwise specified;
   b. In the logging and reporting of the works, adopt all material descriptions, classifications, symbols and definitions of terms in accordance with latest edition of 'Guide to Rock and Soil Descriptions (Geoguide 3)' published by GEO, unless otherwise specified;
   c. Provide Technically Competent Persons (TCPs) for ground investigation field works (GIFW), who shall comply with the minimum requirements on the qualifications and experience required for each grade of TCP for GIFW set out in the TMSP and the CoPSS, to carry out supervision of the GIFW in accordance with the supervision requirements stated in TMSP and the CoPSS regarding RSC (GIFW);
   d. Engage a Competent Person (Logging), who shall comply with the minimum requirements on the qualifications and experiences required for the Competent Person (Logging) set out in the CoPSS, to carry out logging of samples and preparation of borehole logs;
   e. Comply with the administration procedures for GIFW set out in the CoPSS, including completing and submitting prescribed plans and relevant ICU Forms to be specified by the CM;

f. The reports on the works shall contain a certificate signed by the Authorized Signatory of the Ground Investigation Contractor confirming the standards of works carried out. Detailed requirements for the certification shall comply with the CoPSS;

g. Store all drill hole cores and samples properly in core boxes / containers and protected them from the weather to the satisfaction of the CM and in such a manner that inspection of the cores can easily be made.

3. The number of Ground Investigation Contractor shall be limited to one unless otherwise approved by the CM;

4. Submit to the CM the name of the Ground Investigation Contractor and the names of the personnel provided in accordance with sub-clauses (2)(c) and (2)(d) above;

5. Incorporate the following conditions into the contract between the Contractor and the Ground Investigation Contractor or in the contract between the Piling Subcontractor and the Ground Investigation Contractor, as appropriate:

   a. Assignment of ground investigation works by the Ground Investigation Contractor is forbidden;

   b. A probity clause which shall be drafted for the respective contract in similar wording as given in the following sample clause:

      "If the Ground Investigation Contractor or any of his agents, employees or persons acting on his behalf are found:

      i. To have offered or given or agreed to give any advantage which include but not limited to gratuity, bonus, commission, discount, bribe, loan of any sort, consideration of any kind or office, employment, contract or any service (the "Advantage") to any agents, employees or persons acting on behalf of the Employer (i.e. the Contractor or Piling Sub-contractor, as appropriate), any agents or employees or members of the Hong Kong Housing Authority, or any employees of the Government of the Hong Kong Special Administrative Region working in the Housing Department (the "Relevant Persons"); or

      ii. To have solicited or received or agreed to receive any Advantage from any of the Relevant Persons.

      The Employer shall be at liberty forthwith terminate the employment of the Ground Investigation Contractor under the Contract and to hold the Ground Investigation Contractor liable for any loss or damage which the Employer may thereby sustain."

SITE FORMATION WORKS

PRE.B9.260.9 SITE FORMATION WORKS

1. For all Site Formation Works required under the Contract, employ a Site Formation Contractor, who shall have been registered under the BD's List of RSC(SF) and DEVB's List of LANP, to carry out the works;

2. The Site Formation Contractor shall:

   a. Complete and submit SP for Site Formation Works in accordance with PRE.B8.1405;

   b. Complete and submit Form ICU 10 in accordance with PRE.B4.065;

   c. Carry out supervision of the Site Formation Works in accordance with the submitted supervision plan, relevant PNAPs, PNRCs and etc.;

   d. Complete and submit Form ICU 14 together with all test / assessment reports, monitoring results and as-built record plans for the Site Formation Works as required under the Contract upon completion of the Site Formation Works.

3. The number of Site Formation Contractor employed shall be limited to one unless otherwise approved by the CM;
4. Submit to the CM the name of the Site Formation Contractor and the names of the personnel provided in accordance with the Contract for Site Formation Works;
5. Incorporate the following conditions into the contract between the Contractor and the Site Formation Contractor:
   a. Assignment of Site Formation Works by the Site Formation Contractor is forbidden;
   b. A probity clause which shall be drafted for the respective contract in similar wording as given in the following sample clause:

      "If the Site Formation Contractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Employer, agents or employees or members of Hong Kong Housing Authority, or employees of the Government of the Hong Kong Special Administrative Region working in the Housing Department, the Employer shall be at liberty forthwith terminate the employment of the Site Formation Contractor under the Contract and to hold the Site Formation Contractor liable for any loss or damage which the Employer may thereby sustain."

TOLERANCES

PRE.B9.310.9 TOLERANCES IN GENERAL CONSTRUCTION

Option 1

Unless otherwise specified, or indicated on the Drawings execute work within the tolerance limits defined in Appendix H to this Specification.

Option 2

Execute the work within the tolerance limits specified.

SAMPLES

PRE.B9.410.9 SAMPLES OF MATERIALS - GENERAL REQUIREMENTS

Submit samples of materials as requested by the CM and do not confirm orders until Approval has been obtained. Keep Approved samples at the place agreed by the CM for comparison with materials used in the Works, which must conform with the samples set aside. Where there is a choice of material, colour or texture, submit samples for Approval. When Instructed, submit technical literature for materials specified.

PRE.B9.415.9 SAMPLES OF MATERIALS - APPROVAL

CM shall have the discretion to make reference to and take account of the track records of materials or components as maintained by Housing Department within the three year period prior to the date of commencement of the Works in his decision for Approval or not of the Contractor's sample submissions for the following materials or components:

1. Aluminium windows;
2. uPVC windows;
3. Timber doorsets;
4. Anti-mould internal emulsion paint;
5. Anti-mould external emulsion paint;
6. Shower handsets;
7. Lever handle furniture and locks;

8. Multi-layer acrylic paint with texture coat and without texture coat;
9. Overhead door closers;
10. Panel wall partitions;
11. Precast concrete components and volumetric precast concrete components;
12. Bath/Shower mixers, basin mixers and kitchen sink mixers;
13. Synthetic paint;
14. Tile adhesive;
15. Tile grout;
16. uPVC pipes and fittings;
17. Galvanized mild steel gatesets;
18. Ready-mixed mortars and ready-to-use mortars;
19. WC suites;
20. Plastic folding doors;
21. Tactile homogeneous floor tiles;
22. Tactile interlocking concrete blocks;
23. Tactile precast concrete paving slabs.

PRE.B9.420.9 SAMPLES OF MATERIALS - PARTICULAR REQUIREMENTS

Option 1

Submit samples of materials as listed in Appendix ..... to this Specification.

Option 2

1. Particular attention is drawn to the following which applies to domestic blocks only:
   a. The requirements for provision of samples of the proposed filler, undercoat and finishing coats in two sets of the upper half of the finished doorsets for kitchens, bathrooms, flat entrances and exit staircases are described in FIN7.W2120;
2. Particular attention is drawn to the following which applies to commercial centres:
   a. ……...

Option 3

When instructed by CM, submit samples of materials for hoarding, covered walkway and gantry.

PRE.B9.430.9 SAMPLES OF FINISHED WORK - GENERAL REQUIREMENTS

Make samples of finished work as specified or as required by the CM and obtain Approval before proceeding with the work. Unless otherwise specified retain samples on the Site for comparison with the completed work.

PRE.B9.440.A SAMPLES AND CONSTRUCTION MOCK-UP OF FINISHED WORK - PARTICULAR REQUIREMENTS

Particular attention is drawn to the following requirements:

1. Provision of sample wing, sample flats (and sample classrooms) and a construction mock-up as described in PRE.B4.080;
2. Provision of samples and trial panels for finishes and for concrete as described in CON2.W710;
3. Provision of full scale mock-up for precast units as described in CON4.T010;
4. Provision of full scale mock-up for volumetric precast bathroom (VPB) and volumetric precast kitchen (VPK) components as described in CON8.T040, completed with fixtures, fittings and finishes;

5. Provision of construction mock-up demonstrating the workmanship of the wall, floor and ceiling construction in the living room, bathroom, kitchen, lift lobby and corridor as described in the relevant Worksections. Details of domestic flat and common area mock-ups are given in Appendix PRE 9/I;
6. Provision of construction mock-up for pipe sleeves for drainage pipe, water pipe and gas pipe at external wall of domestic flat which serve as benchmark standard of workmanship, demonstrating the proposed method of filling the annular space between the pipe sleeve and the pipe with proprietary waterproof filling mortar or polyurethane foam approved by the CM as described in PRE.B12.230;
7. ……..……..

PRE.B9.450.9 SAMPLES OF FINISHED WORK - PARTICULAR REQUIREMENTS

Particular attention is drawn to the following which applies to domestic blocks only:

1. Where precast facade / precast balcony units are required or proposed, provide a full size trial sample of the precast facade / precast balcony unit complete with joints, windows and glazing, the electrical conduit system installation and all finishings as described in CON7.W710.

PRE.B9.460.X DELETED

TESTING

PRE.B9.510.9 TESTING - COSTS BORNE BY THE CONTRACTOR

In addition to the requirements of GCC Clause 7.1, make tests on materials and workmanship to ensure conformity with the Specification or as Instructed as follows:

1. Propose testing laboratory that complies with PRE.B9.570 for carrying out the tests for the CM's approval and confirm no affiliation with the proposed testing laboratory using the standard template at Appendix PRE.B9.APPEND2. Ensure the sub-contractors responsible for the materials and workmanship have no affiliation with the proposed testing laboratory and confirm the same in the standard form;
2. Provide test samples under the supervision of the CM and where required submit samples to the Approved testing laboratory and unless otherwise specified, pay all fees and charges;
3. Mark test samples the location or delivery batch from which the test samples were taken and seek for countersigning of the CM or his representatives. Take photos showing the test samples and the marking for record purpose;
4. Test samples shall be delivered to the Approved testing laboratory on the same day of selection and taking of samples, or within a reasonable time frame as soon as the arrangement for delivery can be made. If delivery of test samples on the same day of selection and taking of samples cannot be arranged, agree with the CM or his representatives designated area(s) for secured storage of the sample(s). Maintain a record of all test samples covering details of samples selection, storage arrangement and delivery status etc. for inspection by the CM or his representatives at all times. Keep the CM informed about any changes of the record. Update the record upon delivery of test samples with photo record;
5. Test samples shall be properly protected from weather, vandalism and tampering to the satisfaction of the CM;
6. Request the Approved testing laboratory to submit the original of test certificates to the CM and the Contractor at the same time and keep a copy of all records on Site;
7. Submit samples of materials, carry out tests and obtain Approval, before the materials are used in the Works;

8. When requested by the CM provide test certificates or obtain guarantees from the manufacturers, that materials specified to a BS or other specified standard, conform to the relevant standard.

PRE.B9.520.9 PARTICULAR TESTING FOR DOMESTIC BLOCKS - COSTS BORNE BY THE CONTRACTOR

1. Where precast concrete components are required or proposed for domestic blocks, carry out tests on workability, and make and cure concrete cubes for the concrete used for casting the precast concrete components as described in CON7.T110;
2. Propose testing laboratory that complies with PRE.B9.570 for carrying out the tests for the CM's approval and confirm no affiliation with the proposed testing laboratory using the standard template at Appendix PRE.B9.APPEND2. Ensure the sub-contractors responsible for the materials and workmanship have no affiliation with the proposed testing laboratory and confirm the same in the standard form;
3. Carry out all tests for the above in the Approved testing laboratory to be provided as described using qualified technicians. The Approved testing laboratory shall certify and submit all test results to the CM and the Contractor at the same time for Approval;
4. The requirements of this sub-clause shall in no way relieve the Contractor of his obligations to carry out other tests under the Contract, including sampling and testing under CON1.T210 to CON1.T820 inclusive.

PRE.B9.530.B TESTING - COSTS BORNE BY THE AUTHORITY

Unless otherwise specified, the Contractor is responsible for the testing cost of temporary and permanent works. The cost of tests carried out by Direct Testing Contractor(s) in parallel to the Contractor's tests will be borne by the Authority. The following tests for permanent works will be carried out by Direct Testing Contractor(s) and/or by the Housing Department Material Testing Laboratory and their costs will be borne by the Authority:

1. Non-destructive tests on piles including Pile Driving Analyser Test, Pile Integrity Test and Sonic Logging Test;
2. Non-destructive test on welds;
3. Coring of concrete and testing of concrete cores;
4. Tests on concrete and its constituent materials excluding coring of concrete and testing of concrete cores;
5. Tests on reinforcement steel, structural steelwork and steel piles samples;
6. Repair mortar and its constituent materials;
7. Asbestos monitoring and testing;
8. Non-destructive test on waterproofing of roof;
9. Static pile loading tests on working piles;
10. Confirmatory core test of founding strata of Type 3 piles (this test is also required to be carried out by Approved Ground Investigation Contractor employed by the Contractor);
11. Proving bedrock after installation of Types 5 & 6 piles;
12. Ultrasonic Echo Sounder Test for Type 3 piles (this test is also required to be carried out by Approved Laboratory employed by the Contractor);
13. Verification test for slip resistance of floor surface materials.

PRE.B9.540.9 PARTICULAR TESTING FOR DOMESTIC BLOCKS - COSTS BORNE BY THE AUTHORITY

The following tests which apply to domestic blocks only will be carried out by the CM, Direct Testing Contractor and / or Housing Department Material Testing Laboratory:

1. Where precast concrete components (as defined in CON7.D010) are required or proposed:
   a. Schmidt hammer tests and covermeter tests on construction quality at casting yard as described in CON5.T030, CON7.T030 and CON8.T030;
   b. Tests on concrete constituent materials, tests on compressive strength of concrete cubes and concrete cores, tests on reinforcement bars and fabric reinforcement for the precast concrete components in domestic blocks as described in CON5.T030, CON7.T030 and CON8.T030.
2. Non-destructive test on water-proofing of roof as described in WAT1.T030 and WAT6.T125;
3. Material verification test on tile adhesive and latex delivered to Site as described in FIN5.T105 and FIN5.T106 respectively;
4. Material verification test on tile adhesive and latex delivered to manufacturer's factory of precast concrete components as described in FIN5.T108 and FIN5.T109 respectively;
5. Surveillance tests on the following:
   a. Aluminium windows as described in COM2.T405;
   b. uPVC windows as described in COM3.T050;
   c. Timber doorsets as described in COM5.T1605;
   d. Galvanized mild steel gatesets as described in COM7.T010;
   e. Ready-mixed mortars and ready-to-use mortars as described in FIN1.T010;
   f. Tile grout as described in FIN5.T110;
   g. Floor surface materials as described in FIN5.T130;
   h. Anti-mould internal emulsion paint, anti-mould external emulsion paint, synthetic paint, multi-layer acrylic paint with texture coat and multi-layer acrylic paint without texture coat as described in FIN7.T050;
   i. Overhead door closers as described in IRO1.T030;
   j. Lever handle furniture and locks as described in IRO1.T040;
   k. Panel wall partitions as described in MAS1.T105;
   l. Draw off taps as described in PLU1.T131;
   m. WC suites as described in PLU2.T110;
   n. Bath / shower mixer, basin mixer, kitchen sink mixer and shower handset as described in PLU2.T310;
   o. uPVC pipes and fittings as described in DRA1.T310;
   p. Epoxy coated cast iron pipes and fittings as described in DRA1.T410;
   q. Tactile interlocking concrete blocks as described in EXT3.T510;
   r. Tactile precast concrete paving slabs as described in EXT3.T520;
   s. On-site operation tests - movement of sash as described in COM2.T410;
   t. Plastic folding doors in COM12.T010.

PRE.B9.550.9 TEST RECORDS

1. Test reports and certificates issued either by the Direct Testing Contractor or the Housing Department Materials Testing Laboratory related to testing carried out by them as provided for in the Contract will be available to the Contractor as follows:
   a. A printed copy of all test reports and certificates will be kept on Site by the CM for the Contractor's inspection and photocopying;
   b. If an electronic copy of the test reports and certificates as referred to in sub-clause (a) above is available for advance information, the Contractor will be allowed to inspect them at CM's site office;

c. Where any ambiguity, discrepancy or conflict arises between the electronic copy and the printed copy, the latter shall take precedence.

2. When notified by CM, the SQCC shall within 7 days:
   a. Prepare a summary of test results in a prescribed format based on the test reports and certificates provided by the CM;
   b. Submit a material testing booklet comprising the summary of test results and the test reports and certificates stipulated in sub-clause (2)(a) above.

PRE.B9.560.9 WITNESSING TESTING

The Contractor or his authorised representative is at liberty to be present at all stages of the sampling, making and testing of materials and workmanship but failure to attend will not invalidate the test results.

PRE.B9.570.9 TESTING LABORATORIES

When submission of test reports or certificates are required to be made, the laboratories for carrying out the tests and issuing the test reports or certificates shall be one of the following:

1. Laboratories approved by Housing Authority; or
2. Laboratories accredited either by Hong Kong Laboratory Accreditation Scheme (HOKLAS) or an equivalent organization which has signed a mutual recognition agreement with HOKLAS; or
3. Laboratories that had issued test reports or certificates which were previously accepted by the Housing Authority.

QUALITY MANAGEMENT SYSTEM

PRE.B9.610.9 GENERAL

1. Demonstrate that the requirements of the approved Quality Control System as stipulated in PRE.B8.1425 have been incorporated into the Contractor's Quality Management System (QMS);
2. Subject the Quality Control System implemented in the Contract to annual audit as stipulated in PRE.B8.1425;
3. When the Contractor has not achieved ISO 9001 certification or whose ISO 9001 certification has been withdrawn by the certification body during the progress of the Works, establish and implement a quality management system, complying with PRE.B9.610 to PRE.B9.690 so as to ensure completion of the Works in accordance with the requirements of the Contract. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS;
4. Within 14 days of the date of the Letter of Acceptance, submit for Approval a quality assurance plan for the execution of all elements of the Works, including those carried out by Sub-contractors;
5. Upon obtaining Approval to the quality assurance plan, adhere to the principles and procedures contained therein and submit for further Approval any revisions subsequently made to this document;
6. Include in but do not restrict the quality assurance plan to the requirements specified in PRE.B9.620 to PRE.B9.690.

PRE.B9.620.9 ORGANISATION AND RESPONSIBILITY

1. Clearly define the quality assurance organisation for the Works under the Contract and the responsibilities of the main participants;

2. Produce an organisation chart to illustrate the sub-division of the work into elements for effective technical and management control, the reporting structure and the interface relationships between all parties involved;
3. List the names, addresses, telephone and fax numbers of all principal contacts.

PRE.B9.630.9 DESIGN CONTROL

Adopt the following procedures for the control and verification of the design to ensure they comply with the requirements of the Specification:

1. Employ qualified personnel to plan and carry out the design and verification activities employing qualified personnel with suitable resources;
2. Identify and document the design input requirements;
3. Ensure the design output satisfies the design input requirements;
4. Ensure any changes and modifications to the design are identified, actioned, documented, reviewed and approved by the appropriate personnel;
5. Properly control design documents such as calculations, drawings, reports, bar schedules, Buildings Department approved design software, etc..

PRE.B9.640.9 PURCHASING OF MATERIALS AND SERVICES

Adopt the following procedures for the procurement of materials and services to ensure that they comply with the requirements of the Specification:

1. Select sub-contractors and suppliers of materials and technical services on the basis of their ability to satisfy the requirements of the Specification;
2. Maintain records of suitable sub-contractors and suppliers;
3. Ensure purchasing documents clearly describe the material or service being ordered;
4. Retain purchasing documents as records.

PRE.B9.650.9 CONSTRUCTION PROCESS CONTROL

Adopt the following procedures for the control of the construction processes to ensure compliance with the requirements of the Specification:

1. Produce documented work instructions to cover the construction processes which directly affect the quality of work;
2. Monitor and control these processes to ensure that the Works are carried out in accordance with the requirements of the Specification and quality plans with the use of suitable equipment;
3. Contractor shall record the execution of those rectification works including the covered up works which may affect the permanent works.

PRE.B9.652.9 TEMPORARY WORKS PROCESS CONTROL

Adopt the following procedures for the control of the Temporary Works construction to ensure there would be no adverse impact to the execution of permanent works:

1. Produce documented work instructions to cover the design and execution of Temporary Works, including planning, coordination among different trades and sequencing of works during various stages and, where applicable, the checking or verification processes;
2. Monitor and control the Temporary Works processes to ensure that the Temporary Works are carried out in accordance with the requirements of the Specification and quality plans with the use of suitable equipment.

PRE.B9.653.9 MAINTENANCE WORKS PROCESS CONTROL

Adopt the following procedures for the control of the Maintenance Works during the Maintenance Period:

1. Produce documented work instructions to cover the execution of Maintenance Works during the Maintenance Period, including those involving NSC's works and drawing up method statements for the Maintenance Works to minimise nuisance to tenants;
2. Monitor and control the Maintenance Works processes to ensure that the Maintenance Works are carried out in accordance with the requirements of the Specification and approved method statements with the use of suitable equipment;
3. Record and monitor the execution of those Maintenance Works with concealed conduit which may affect the permanent works.

PRE.B9.660.9 INSPECTION, MEASURING AND TESTING EQUIPMENT

Adopt the following procedures for the control, calibration and maintaining the inspection, measuring and testing equipment:

1. Use inspection, measuring and testing equipment in such a way that the accuracy is known and within the required limit;
2. Maintain and calibrate inspection, measuring and testing equipment against certified equipment having a known relationship to nationally recognized standards. Where no such standards exist, the basis used for calibration must be acceptable to the CM;
3. Keep calibration and maintenance records for inspection, measuring and testing equipment.

PRE.B9.670.9 CONTROL OF NON-CONFORMING MATERIALS AND WORKS

Adopt the following procedures for the identification and control of non-conforming materials and work:

1. Positively identify and segregate non-conforming materials and works;
2. Keep records of all non-conforming materials and works and of the subsequent corrective actions taken;
3. Notify all personnel concerned that a non-conformance exists;
4. Inspect reworked/rectified items in accordance with documented procedures.

PRE.B9.680.9 TRAINING

The procedures for identifying training requirements and for the provision of training to all personnel performing activities which affect the quality of work must ensure:

1. Personnel carrying out specific assigned tasks are suitably qualified (i.e. with formal qualifications, training or suitable experience);
2. Records of staff training and qualifications are maintained.

PRE.B9.690.9 QUALITY ASSURANCE PLAN REVIEW

Institute procedures for the regular evaluation and updating of the quality assurance plan to safeguard the continuing effectiveness of the quality management system.

PROJECT SPECIFIC PARTNERING

PRE.B9.810.B START-UP PARTNERING SESSION */ WORKSHOP* *(*TO DELETE THE INAPPLICABLE WORD)*

Option A

1. Held a simplified start-up partnering session in one of the Monthly Site Progress Meetings within 12 weeks from the notified date for commencement of the Works to promote free communication, and a culture of co-operation and team work for the management of the Contract. The CM shall decide the mode of the partnering session to be adopted (e.g. conducted by the CM or his representatives or by an independent professional facilitator) to suit the need of the Contract;

2. Agree among participants "the discussion in the partnering session" which to be documented by the CM or his representatives or independent professional facilitator (discussion items and sample refer to the Annex to DCMP-F710 for reference) and submit within one month from the date of the partnering session for the CM's record.

Option B

1. The Director's representative shall convene a start-up workshop preferably:

Option 1

   a. Within 60 days after the notified date for commencement of the Works.

Option 2

   a. Within 90 days after the notified date for commencement of the Works.

Option 3

   a. Within 60 days each after the notified date for commencement of the piling work and after the CM's written permission to commence the building work.

2. To be facilitated by an independent professional facilitator so as to promote free communication, and a culture of co-operation and teamwork for the management of the Contract.

PRE.B9.820.A REGULAR PARTNERING MEETING

1. The parties must meet regularly to evaluate and monitor performance of the Contract and identify priority for improvement;
2. Arrange regular meetings between the CM in-person and senior management from the Contractor at either quarterly or 6-monthly intervals to reinforce the partnering platform, if necessary.

PRE.B9.830.A ADDITIONAL SESSION* / WORKSHOP*

1. Where in his opinion the working relationship of the parties concerned is not developed in a healthy manner and is likely to affect the timing, cost and quality of the Works, the party holding this opinion may request the agreement of the other parties to conduct an additional partnering session* / workshop* to reinstate the performance of the process, identify opportunities for improvement and to resolve problems;
2. To be facilitated by an independent professional facilitator.

PRE.B9.840.A CLOSE-OUT MEETING

Option 1

The Director's representative shall, with the engagement of an independent professional facilitator, convene a close-out meeting to review the performance of the partnering arrangement within 3 months after the completion of the whole of the Works.

Option 2

The Director's representative shall, with the engagement of an independent professional facilitator, convene a close-out meeting to review the performance of the partnering arrangement within 21 days after the completion of the whole of the Works.

PRE.B9.850.A FACILITATOR FOR THE SESSIONS* / WORKSHOPS*

1. The facilitator shall be:
   a. An independent professional;
   b. Knowledgeable of the partnering process, value management and preferably experienced in construction industry.
2. The selection and appointment of the facilitator shall be initiated by Director's representative and agreed by the major external stakeholders (Consultant, where appropriate, and Contractor).

PRE.B9.860.A PARTIES FOR THE PARTNERING SESSION* / WORKSHOP* / MEETING

1. The Contractor, Director's representative and Contract Manager must attend the workshops / meetings. The partnering session* / workshop* / meeting shall be attended by representatives of the Employer and Contractor, together with others concerned with the Works. This may include the ultimate users of the Works (if appropriate, persons such as local community representatives), Consultants, Sub-contractors, Suppliers and any other persons that the Contractor and the Director's representative deemed necessary. Participation in sessions* / workshops* / meetings does not give the participants any additional rights or responsibilities;
2. Each party must meet its own costs for attendance at the start-up session* / workshop*, any subsequent session* / workshops* / meetings, and close-out meeting and share equally all other costs such as direct expenses for the venue and procurement services of the facilitator.

PRE.B9.870.9 HONORARY PLAQUE

Provide and install honorary plaques as shown on Drawings with one plaque for each individual building in recognition of the partnering spirit and concerted effort of all stakeholders of the Works.

PRE.B9.890.A COMMUNITY ENGAGEMENT - ACTION SEEDLING ACTIVITIES AND PUBLIC ENGAGEMENT ACTIVITIES*

1. The Contractor shall engage an ……. (eg. Event Manager / Facilitator), who must be a public relation (PR) veteran with experience on conducting PR event for at least 100 persons, to arrange and coordinate Action Seedling Activities as described in sub-clauses (2) to (5) below with the participation of all stakeholders including but not limited to the Contractor, ….....…..... (eg. adjacent neighbourhoods, residents, schools students, community organizations, District Council members) and HA's representatives.
2. The Action Seedling Activities comprising not more than two Stages as detailed below and will be conducted as directed by the CM:
    a. Stage 1: Distribute the seedling by the Contractor at around 6 months before the date for completion of the Works to the participants to nurture these plants at their places, or if there is any Section of the Works, before the latest date for completion among the Sections;
    b. Stage 2: Arrange collection of the distributed plants and the participant's planting of them within or outside the Site as directed by the CM after completion of the project at any date within the Maintenance Period, or if there is more than one such Period, at any date within the Period having the latest expiry date.

Option A

3. The seedlings / pot plants shall be supplied by the Contractor unless otherwise approved by the CM. For the Stage 2 of the Action Seedling Activities, the Contractor shall facilitate the planting works and activities by the participants. Establishment works of the seedlings / pot plants transplanted to the planting area in the Stage 2 shall be carried out by the Direct Contractor(s) of the Employer;

Option B

3. The seedlings / pot plants shall be supplied by the Direct Contractor(s) of the Employer. For the Stage 2 of the Action Seedling Activities, the Direct Contractor(s) of the Employer shall facilitate the planting works by the participants. The Contractor shall facilitate and provide attendance for the two Stages of the activities;
4. Submit proposal and plan of the coordination and arrangement of the Action Seedling Activities for the CM's prior approval at least nine months before the date for completion of the Works (or if there is any Section of the Works, before the latest date for completion among the Sections);

5. The Contractor shall provide public relation services for the events, including planning, coordination, implementation and overall management of Action Seedling Activities in accordance with the proposal as approved by the CM and the instructions of the CM;
6. Allow the times for submission / resubmission, planning, coordination and the execution of the Action Seedling Activities in the time for completion of the Works or any Section thereof. Bear all associated costs and the extra time required for any delay caused by the Contractor's failure to comply with the requirements described in this clause and the direction as may be given by the CM in connection with the Action Seedling Activities;
7. The Contractor and Employer must meet its own costs for attendance of the events for Action Seedling Activities and share equally the direct expenses for the engagement of the event facilitator, provision of seedlings / pot plants, the holding of events of distribution of seedling / pot plants and the subsequent collection and the planting activities.

1. The Contractor shall engage an ……..……. (e.g. Event Manager / Facilitator) for Action Seedling Activities, who must be a public relation (PR) veteran with experience on conducting PR event for at least 100 persons, and an Art Curator referred in PRE.B6.060 for Public Engagement Activities, to organise, coordinate and hold Action Seedling Activities and Public Engagement Activities as described in sub-clauses (2) to (8) below with the participation of all stakeholders including but not limited to the Contractor, ……..…….....…… (e.g. adjacent neighbourhoods, residents, schools students, community organizations, District Council members) and HA's representatives.
2. The Community Engagement Activities comprising events as detailed below and will be conducted as directed by the CM:
    a. Action Seedling Activities
        i. Stage 1: Distribute the seedling by the Contractor at around 6 months before the date for completion of the Works to the participants to nurture these plants at their places, or if there is any Section of the Works, before the latest date for completion among the Sections;
        ii. Stage 2: Arrange collection of the distributed plants and the participant's planting of them within or outside the Site as directed by the CM after completion of the project at any date within the Maintenance Period, or if there is more than one such Period, at any date within the Period having the latest expiry date.
    b. Public Engagement Activities
        i. Stage 1: Organize, coordinate and hold of at least two (2) Public Engagement Activities with the adjacent neighbourhood by the Art Curator to create and complete two (2) pieces of artwork before the certified completion of the Works through public engagement art co-creation within or outside the Site or as directed by the CM;
        ii. Stage 2: Organize, coordinate and hold of at least two (2) Public Engagement Activities with the residents by the Art Curator to create and complete two (2) pieces of artwork after the completion of mass intake of flats and at any date within the Maintenance Period through public engagement art co-creation within or outside the Site or as directed by the CM;
        iii. Stage 3: Organize, coordinate and hold of Public Engagement Activities with the adjacent neighbourhood and / or residents by the Art Curator to rearrange and relocate minimum 20% of the movable seating as stated in EXT15.M070 when requested by the CM for at least one (1) time during the Maintenance Period.

Option A

3. The seedlings / pot plants / art co-creation materials and etc. shall be supplied by the Contractor unless otherwise approved by the CM. For the Stage 2 of the Action Seedling Activities, the Contractor shall facilitate the planting works and activities by the participants. Establishment works of the seedlings / pot plants transplanted to the planting area in the Stage 2 shall be carried out by the Direct Contractor(s) of the Employer;

Option B

3. The seedlings / pot plants shall be supplied by the Direct Contractor(s) of the Employer. The art co-creation materials and etc. shall be supplied by the Contractor unless otherwise decided / approved by the CM. For the Stage 2 of the Action Seedling Activities, the Direct Contractor(s) of the Employer shall facilitate the planting works by the participants and the establishment works of the seedlings / pot plants. The Contractor shall facilitate and provide attendance for the two Stages of the activities;
4. Submit proposal and plan of the coordination and arrangement of the Community Engagement Activities for the CM's prior approval at least twenty-four (24) months before the date for completion of the Works (or if there is any Section of the Works, before the earliest date for completion among the Sections). The proposal and plan shall include the design, supply, fabrications and innovations of the artworks. The design concept, size of the artworks and the specific locations for display shall be proposed by the Contractor for the acceptance of CM. The proposed locations of artwork refer to Drawing No……. in Appendix B to this Specification;
5. The Contractor shall provide public relation services for the events, including planning, coordination, implementation and overall management of Community Engagement Activities in accordance with the proposal as approved by the CM and the instructions of the CM;
6. Allow the times for submission / resubmission, planning, coordination and the execution of the Community Engagement Activities in the time for completion of the Works or any Section thereof. Bear all associated costs and the extra time required for any delay caused by the Contractor's failure to comply with the requirements described in this clause and the direction as may be given by the CM in connection with the Community Engagement Activities;
7. The Contractor and Employer must meet its own costs for attendance of the events for Action Seedling Activities and share equally the direct expenses for the engagement of the event facilitator, provision of seedlings / pot plants, the holding of events of distribution of seedling / pot plants and the subsequent collection and the planting activities;
8. The Contractor must meet its own costs for attendance of the events for Public Engagement Activities, provision of art co-creation materials and etc., the holding of events of distribution of art co-creation materials and etc. and the subsequent collection art co-creation activities.

1. The Contractor shall engage an Art Curator referred in PRE.B6.060 for Public Engagement Activities, to organise, coordinate and hold Public Engagement Activities as described in sub-clauses (2) to (7) below with the participation of all stakeholders including but not limited to the Contractor, ….....….....…… (e.g. adjacent neighbourhoods, residents, schools students, community organizations, District Council members) and HA's representatives.
2. The Public Engagement Activities comprising events as detailed below and will be conducted as directed by the CM:

a. Stage 1: Organize, coordinate and hold of at least two (2) Public Engagement Activities with the adjacent neighbourhood by the Art Curator to create and complete two (2) pieces of artwork before the certified completion of the Works through public engagement art co-creation within or outside the Site or as directed by the CM;

b. Stage 2: Organize, coordinate and hold of at least two (2) Public Engagement Activities with the residents by the Art Curator to create and complete two (2) pieces of artwork after the completion of mass intake of flats and at any date within the Maintenance Period through public engagement art co-creation within or outside the Site or as directed by the CM;

c. Stage 3: Organize, coordinate and hold of Public Engagement Activities with the adjacent neighbourhood and / or residents by the Art Curator to rearrange and relocate minimum 20% of the movable seating as stated in EXT15.M070 when requested by the CM for at least one (1) time during the Maintenance Period.

3. The art co-creation materials and etc. shall be supplied by the Contractor unless otherwise decided / approved by the CM;

4. Submit proposal and plan of the coordination and arrangement of the Public Engagement Activities for the CM's prior approval at least twenty-four (24) months before the date for completion of the Works (or if there is any Section of the Works, before the earliest date for completion among the Sections). The proposal and plan shall include the design, supply, fabrications and innovations of the artworks. The design concept, size of the artworks and the specific locations for display shall be proposed by the Contractor for the acceptance of CM. The proposed locations of artwork refer to Drawing No……. in Appendix B to this Specification;

5. The Contractor shall provide public relation services for the events, including planning, coordination, implementation and overall management of Public Engagement Activities in accordance with the proposal as approved by the CM and the instructions of the CM;

6. Allow the times for submission / resubmission, planning, coordination and the execution of the Public Engagement Activities in the time for completion of the Works or any Section thereof. Bear all associated costs and the extra time required for any delay caused by the Contractor's failure to comply with the requirements described in this clause and the direction as may be given by the CM in connection with the Community Engagement Activities;

7. The Contractor must meet its own costs for attendance of the events for Public Engagement Activities, provision of art co-creation materials and etc., the holding of events of distribution of art co-creation materials and etc. and the subsequent collection art co-creation activities.

QUALITY CONTROL MEASURES FOR WELDING CONSUMABLES FOR STRUCTURAL STEELWORKS

PRE.B9.1000.9 WELDING CONSUMABLES FOR STRUCTURAL STEELWORKS

1. The Contractor is to follow the following quality control measures on Site for the welding consumables to be used for temporary or permanent structural steelworks on Site of steel grade as stated in STR1.M060 and shown in the structural working drawings:

Option 1

a. Centrally procure all welding consumables by the Contractor or the Piling Sub-contractor;

b. In the event that all the welding consumables are procured by the Piling Sub-contractor, the Contractor shall monitor closely the procurement and control of the welding consumables.

Option 2

a. Centrally procure all welding consumables by the Contractor;
b. Submit materials sample board for all types of welding consumables to be used on Site and at off-site fabrication yard if applicable;
c. Submit the manufacturer's test certificates for each batch of welding consumables in accordance with STR1.M490;
d. Complete and submit report of the chemical analysis for the welding consumables in accordance with STR1.T093 to STR1.T097;
e. Store the welding consumables in lockable storage. Welding consumables of different testing status shall be kept separately;
f. Control the distributions of all welding consumables and record the distributions in a distribution record form;
g. Prepare a daily consumption record on the welding consumables, which shall include, but not be limited to, information such as:
    i. The quantities delivered to Site;
    ii. The approximate quantities used and wasted;
    iii. The quantities left;
    iv. The approximate total quantities to be used based on the construction drawings or testing sample.
h. Keep on Site all distribution record form and daily consumption record for checking by the CM or his representatives;
i. Submit the distribution record form and the daily consumption record for discussion in monthly site meeting;
j. Conduct daily check to ensure the welding consumables are properly used by welders;
k. Stock a minimum quantity of tested welding consumables on Site which should be adequate for the anticipated consumption of next three weeks, or a longer period as is considered necessary for the Works by the CM;
l. Submit a Quality Control System for ensuring the compliance of materials and tests for the use of welding consumables on Site in accordance with PRE.B8.1425;
m. Submit for Approval a colour code system under the Quality Control System as stipulated in PRE.B8.1425 for identification of welding consumables on Site:
    i. For different batches, as defined in STR1.T093, before any testing:
        - Keep the welding consumables under wrapping during quarantine and label with adhesive tape of white, yellow, blue, grey colour or other specific colour, except green or red colour, by applying the adhesive tape to the package;
        - Do not use the same colour code for different batches of welding consumables.
    ii. For each batch of welding consumables with all test results (including the re-test results as required under the Specification) available, apply:
        - Green colour to the packaging material and the tips of the welding consumables when the packaging material is removed where the welding consumables comply with the Specification;
        - Red colour to the packaging material where the welding consumables do not comply with the Specification.

2. For off-site fabrication, follow the following quality control measures at the off-site fabrication yard for the welding consumables to be used for temporary or permanent structural steelworks on Site of steel grade as stated in STR1.M060 and shown in the structural working drawings:
   a. Submit the procurement record for all welding consumables to be used;
   b. Submit materials sample board for all types of welding consumables to be used at the fabrication yard;
   c. Submit the manufacturer's test certificates for each batch of welding consumables in accordance with STR1.M490;
   d. Complete and submit report of the chemical analysis for the welding consumables in accordance with STR1.T093 to STR1.T097;
   e. Control the distributions of all welding consumables and record the distributions in a distribution record form;
   f. Prepare a daily consumption record on the welding consumables, which shall include, but not be limited to, information such as:
      i. The quantities delivered to Site;
      ii. The approximate quantities used and wasted;
      iii. The quantities left;
      iv. The approximate total quantities to be used based on the construction drawings or testing sample.
   g. Keep at the off-site fabrication yard all distribution record form and daily consumption record, for checking by the CM or his representatives;
   h. Submit a quality assurance (QA) scheme for ensuring the compliance of materials and tests for the use of welding consumables at the off-site fabrication yard in accordance with STR1.W1420.

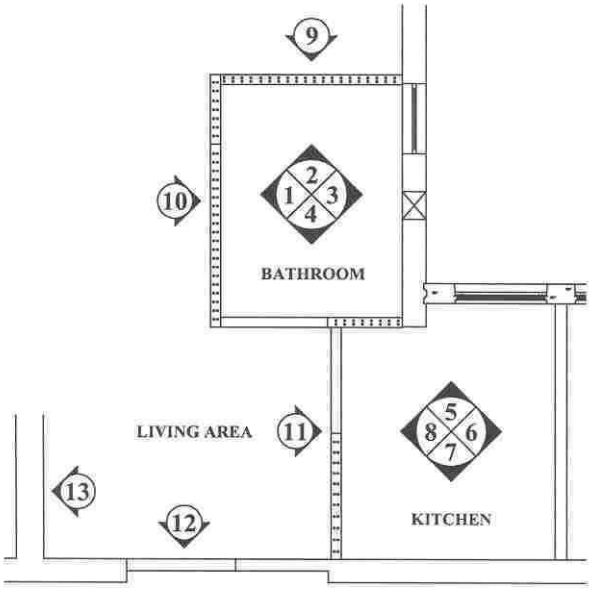
APPENDIX PRE.B9/I

PRE.B9.APPEND1.9 CONSTRUCTION MOCK-UP

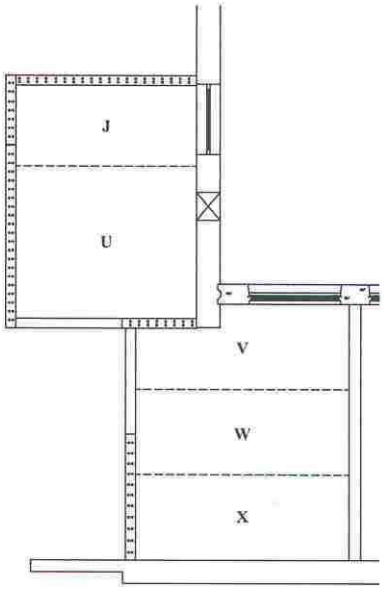
(1) Construction Mock-up for Domestic Flat:

A	PANEL WALL
B	PANEL WALL FIXING DEVICES
C	DOOR FRAME WITH FIXING BOLTS
D	NON-SHRINK CEMENT MORTAR
E	ANGLE FILLET
F	MOISTURE SEALER
G	SEALANT
H	FIBRE TAPE
J	WATERPROOFING
K	CEMENT-BASED ADHESIVE BEDDING
L	SPATTERDASH
M	RENDERING
N	CEMENT/SAND MORTAR BEDDING
P	WALL TILES
Q	TILE GROUT
R	SKIM COAT
S	PAINT BASE COAT
T	PAINT FINISHED COAT
U	CONCRETE FLOOR
V	CEMENT/SAND SCREED
W	CEMENT/SAND BEDDING AND SLURRY COAT
X	FLOOR TILES
Y	LINTEL FIXING
Z	NO FINISH

MATERIALS FOR MOCK UP



KEY PLAN

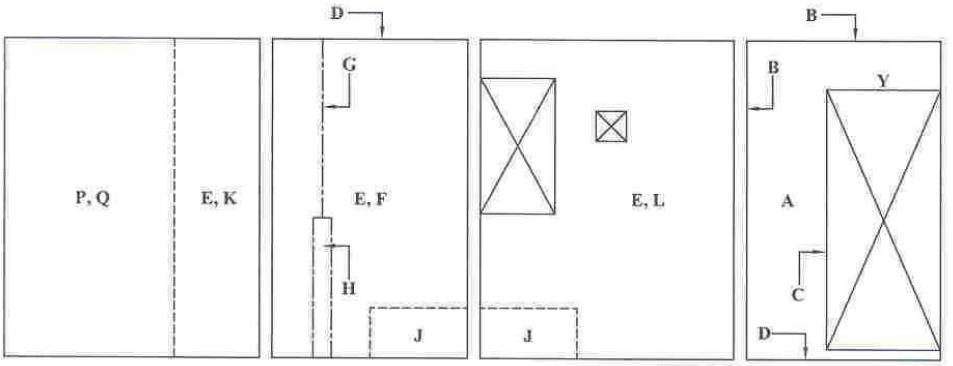


CONSTRUCTION LAYERS FOR BATHROOM & KITCHEN FLOOR

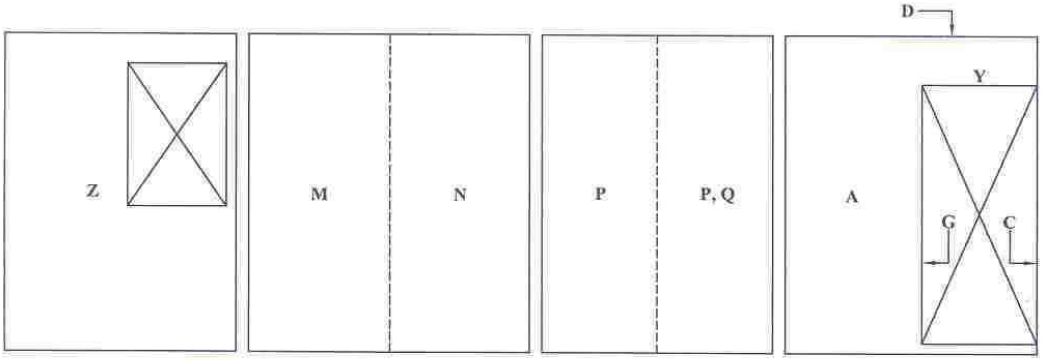
NOTE:

1. MATERIAL NOTATIONS STATED IN THE PLAN AND ELEVATIONS SHOW THE TOPMOST CONSTRUCTION LAYER ONLY, ALL WORKS BUILDING UP TO THE STATED LAYER ARE ALSO REQUIRED TO BE INSTALLED.
2. REFER TO THE RELEVANT WORKSECTIONS FOR DETAILS OF THE WORKS INVOLVED.
3. CEILING TO BATHROOM TO HAVE NO FINISH, APPLY SKIM COAT TO KITCHEN ONLY.

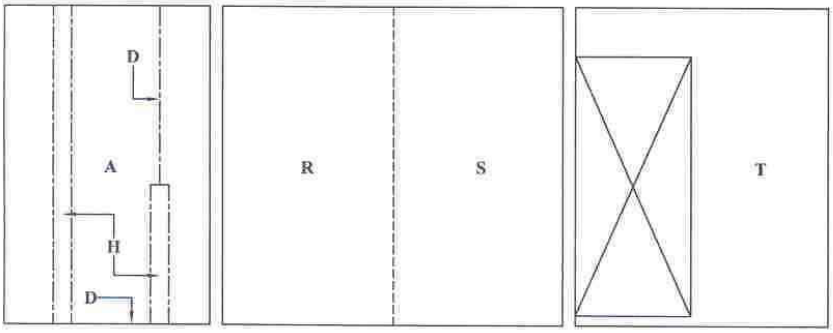
(1) Construction Mock-up for Domestic Flat: (Cont'd)



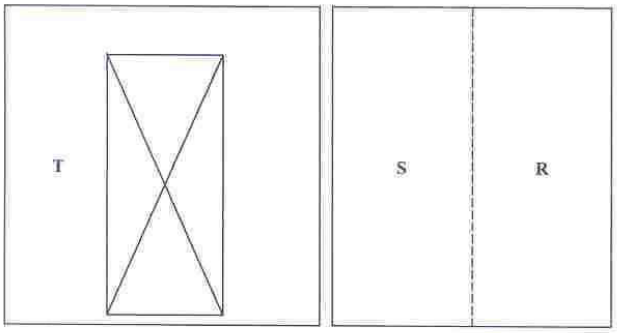
ELEVATION 1 ELEVATION 2 ELEVATION 3 ELEVATION 4



ELEVATION 5 ELEVATION 6 ELEVATION 7 ELEVATION 8



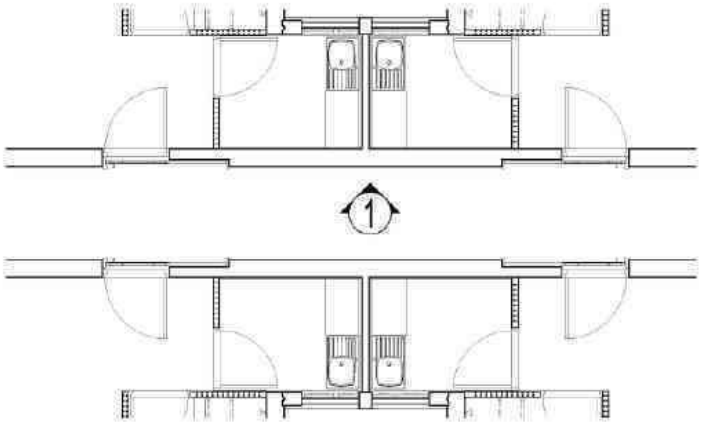
ELEVATION 9 ELEVATION 10 ELEVATION 11



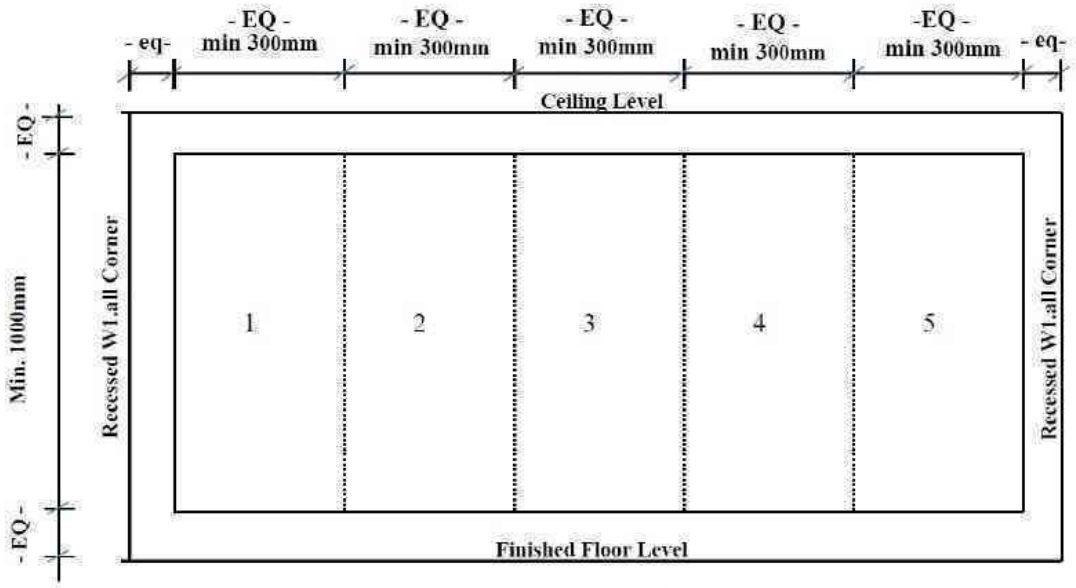
ELEVATION 12 ELEVATION 13

CONSTRUCTION LAYERS FOR WALLS OF BATHROOM, KITCHEN & LIVING AREA

(2) Construction Mock-up for Common Areas:



KEY PLAN OF COMMON AREAS



ELEVATION 1

AREA	MATERIAL
1	SKIM COAT APPLY ON STRUCTURAL WALL
2	SEALER
3	TEXTURE COAT
4	BASE COAT
5	FINISHING COAT

NOTES:

1. THIS SKETCH DRAWING IS FOR REFERENCE ONLY. PROJECT TEAM SHOULD CONSIDER AND DECIDE THE LOCATION AND EXTENT OF CONSTRUCTION MOCK-UP NEEDED FOR THE WORKS, AND PREPARE SKETCH DRAWING(S) TO SUIT IF NEEDED.
2. MATERIAL NOTATIONS STATED IN THE PLAN AND ELEVATIONS SHOW THE TOPMOST CONSTRUCTION LAYER ONLY. ALL WORKS BUILDING UP TO THE STATED LAYER ARE ALSO REQUIRED TO BE INSTALLED.
3. REFER TO THE RELEVANT WORKSECTIONS FOR DETAILS OF THE WORKS INVOLVED.
4. CEILING AND/OR FLOOR TO CORRIDOR AND LIFT LOBBY ARE OPTIONAL.

APPENDIX PRE.B9/II

PRE.B9.APPEND2.A APPLICATION FORM FOR APPROVAL OF TESTING LABORATORY

Application for Approval of Testing Laboratory (Original) *Note 1

Contract No. : _____

Contract Title : _____

To Contract Manager,

(Attn:)

I apply for your approval of the commissioning of _____ (Name of testing laboratory) that complies with PRE.B9.570 to carry out the following test(s):

Description of the test(s)	Relevant specification clauses
_____	_____
_____	_____
_____	_____
_____	_____

I confirm that our company and our sub-contractors have no affiliation with the proposed testing laboratory; and the test reports will be sent directly to the Contract Manager and to our company and/or sub-contractors at the same time.

Signature : _____

Name: _____

(BLOCK LETTER)
Post/Name of Company : _____

(with company chop)
Date : _____

Note 1 This form consists of an original and a duplicate copy.
The original copy shall be submitted to the CM.
The Duplicate copy shall be forwarded to CSE/DC for record.

Application for Approval of Testing Laboratory (Duplicate) *Note 1

Contract No. : _____

Contract Title : _____

To Contract Manager,

(Attn:)

I apply for your approval of the commissioning of _____
(Name of testing laboratory)
that complies with PRE.B9.570 to carry out the following test(s):

Description of the test(s)	Relevant specification clauses

I confirm that our company and our sub-contractors have no affiliation with the proposed testing laboratory; and the test reports will be sent directly to the Contract Manager and to our company and/or sub-contractors at the same time.

Signature : _____

Name: _____

(BLOCK LETTER)
Post/Name of Company : _____

(with company chop)
Date : _____

Note 1 This form consists of an original and a duplicate copy.
The original copy shall be submitted to the CM.
The Duplicate copy shall be forwarded to CSE/DC for record.

APPENDIX PRE.B9/III

PRE.B9.APPEND3.X DELETED

PRE.B10 TEMPORARY WORKS AND FACILITIES

TEMPORARY WORKS

PRE.B10.010.A TEMPORARY WORKS

Option 1

1. At commencement of Contract, take over, maintain / obtain approval prior to modification of the temporary works and allow for the following restrictions in the works sequence:
   a. Temporary earth retaining structure located at ..... is as shown in Drawing No. .....;
   b. Limitation of works area / no-dig zone are as shown in Drawing No. .....;
   c. Drainage reserve area is as shown in Drawing No. .....;
   d. Other works .....
2. Obtain the CM's approval for the location of spoil heaps, temporary roads, services, hoists, temporary passenger lifts, temporary buildings, toilet accommodation and the like;
3. Take over the full responsibility for the design and safety of the existing temporary works left on Site. Unless otherwise specified, QE shall submit the safety certificate for the existing Case 2 and Case 3 Temporary Works in sub-clauses (6) and (7) of PRE.B10.010 and RSE shall submit the safety certificate for the existing Case 1, Case 2 and Case 3 Temporary Works in sub-clauses (5), (8) and (9) of PRE.B10.010 within 14 days of the notified date for commencement of the Works using the form provided at APPENDIX.PRE.B10/XI. For the existing temporary works that may affect or be affected by slopes / retaining walls or with significant geotechnical content, RGE shall submit the safety certificate within 14 days of the notified date for commencement of the Works using the form provided at APPENDIX.PRE.B10/XI. Where necessary, dismantle, modify and / or provide additional support measures on these temporary works to ensure the safety of these existing temporary works. Comply with the requirements stipulated under this clause for dismantling, modification and addition and bear all associated costs and the extra time required for maintaining, modifying and dismantling of the existing temporary works handed over from the previous contractor;
4. Take up the duties and responsibilities of the Registered Contractor for all Case 1, Case 2 and Case 3 Temporary Works as defined in the CoPSS clause 4.9. For the avoidance of doubt, compliance with the requirements for temporary works specified under sub-clauses (5) to (9) below and elsewhere in the Contract shall not relieve the Contractor from any liability or obligation as the Registered Contractor for temporary works as defined in the CoPSS or any duty or responsibility under the Contract. In case of discrepancies on the requirements for temporary works specified under this clause and elsewhere in the Contract, the clause with the more stringent requirements shall prevail;

5. All temporary works classified as Case 1 under the CoPSS clause 4.9 including the design, method statement and completion should be certified by RSE. Unless otherwise specified, submit the design and method statement certified by RSE and allow at least 45 days for obtaining the CM's approval before construction. Allow further 30 days for granting of approval by the CM for each re-submission. The supervision of Case 1 Temporary Works shall be in accordance with the approved / prescribed plans and the Buildings Ordinance / Regulations. Unless otherwise specified, submit the completion certificate of Case 1 Temporary Works certified by RSE prior to the request for the CM's inspection and allow at least 14 days for the CM to grant the permission to use. For Case 1 Temporary Works erected and remained on Site for over a year, RSE shall submit the annual safety certificate provided at APPENDIX.PRE.B10/XI not less than 7 days before each anniversary of the date of the completion certification. For any modification of Case 1 Temporary Works, re-certification by RSE on the design, method statement and completion is required. Before dismantling / removal of Case 1 Temporary Works, submit the method statement including precautionary and protection measures certified by RSE and allow at least 14 days for the CM to grant the permission to commence. Take video throughout the dismantling / removal process at location(s) to be agreed with the CM and keep video records for at least 14 days or as agreed with the CM;
6. Submit the design of Case 2 Temporary Works including plans and construction drawings with design justifications certified by QE (or equivalent as approved by the CM) and allow at least 14 days for the CM to grant the permission to commence as listed below:
    a. Details of the designated storage yard and storage device of accessories for large panel formwork as specified in sub-clause (1) of PRE.B8.262;
    b. Supporting frames for site video recording system as specified in PRE.B8.1835 and mounting posts for CMDTS as specified in PRE.B10.1510;
    c. Weighbridge as specified in PRE.B8.1836;
    d. Temporary refuse chutes as specified in PRE.B10.060;
    e. Falsework and scaffolding as specified in PRE.B10.065, PRE.B10.820 and STR1.W790 that do not have effect on the permanent structure;
    f. Temporary supporting device for strut removal as specified in sub-clause (9) of PRE.B10.065;
    g. Accommodation as specified in PRE.B10.110, PRE.B10.140, PRE.B10.160, PRE.B10.210, PRE.B10.280 and PRE.B10.300;
    h. Mounting posts for RSMS as specified in PRE.B10.1410;
    i. Large panel formwork and small panel metal formwork for domestic block as specified in CON2.D240;
    j. Temporary support for façade and precast units as specified in CON5.W660, CON7.W940 and CON7.W1330. For temporary support requiring ICU submission and the design, drawing and installation procedures for the erection method of precast concrete components as specified in CON5.W650, CON7.W650 and CON8.W530, RSE's certification shall be required;
    k. Any other temporary works of which the design should be certified by QE (or equivalent as approved by the CM) as required under the Drawings, the Specification and / or directed by the CM.
7. Submit the design including plans and construction drawings with design justifications, method statement including precautionary and protection measures, and completion certificate of Case 2 and Case 3 Temporary Works all certified by QE (or equivalent as approved by the CM) prior to the request for the CM's inspection and allow at least 14 days for the CM to grant the permission to use the temporary works as listed below:
    a. Anchorage in lift wells as specified in sub-clause (9)(c) of PRE.B8.210;

b. Rebar lifting frames as specified in sub-clause (4) of PRE.B8.265;

c. Movable noise barrier as specified in PRE.B8.856;

d. Lifting appliances as specified in PRE.B10.040;

e. Falsework and scaffolding as specified in PRE.B10.065, PRE.B10.820 and STR1.W790 that may have effect on the permanent structure;

f. Temporary protection net and associated structures above steel bending yard as specified in PRE.B10.1021;

g. Steel lifting frames as specified in CON4.D030, CON5.W510, CON7.W510 and CON8.D820. For steel lifting frame design requiring ICU submission, RSE's certification on the design shall be required in accordance with PRE.B6.060;

h. Falsework / formwork for vehicular ramp, cantilevers exceeding 1.5m, beam with span exceeding 12m, deep beams with depth exceeding 3m, elevated water tank, space frame, prestressed structure, columns and walls with height exceeding 6m, and retaining wall higher than 4m as specified in CoPSS;

i. Method statement of lifting operation of plant and machinery as specified in CoPSS;

j. Temporary working platform for the operation of plant and machinery as specified in CoPSS other than that specified in sub-clause (9) below;

k. All Case 3 Temporary Works as defined in CoPSS other than that specified in sub-clauses (8) and (9) below;

l. Any other temporary works of which the design, method statement and completion certificate should be certified by QE (or equivalent as approved by the CM) as required under the Drawings, the Specification and / or directed by the CM.

8. Submit the design including plans and construction drawings with design justifications, method statement including precautionary and protection measures certified by RSE and allow at least 14 days for the CM to grant the permission to commence the construction of Case 2 and Case 3 Temporary Works listed below. Submit the completion certificate of Case 2 and Case 3 Temporary Works certified by RSE prior to the request for the CM's inspection and allow at least 14 days for the CM to grant the permission to use the temporary works as listed below:

a. Derrick crane as specified in PRE.B8.242 including the siting of the crane, the assessment of maximum loads, the foundations, supporting structures, all connections between the derrick crane and permanent structure;

b. Protective canopy as specified in PRE.B10.860;

c. Temporary works for bridge and transfer structure construction as specified in CON2.D050, CON2.D250 and STR1.D760;

d. Patent wallform systems as specified in CON2.D440;

e. Metal scaffolding in lift well for lift installation and lift shaft platforms as specified in PNAP ADV-10 and the latest edition of the Guidelines on Safety of Lift Shaft Works issued by CIC;

f. Temporary works that may affect or be affected by slopes or retaining walls except for temporary slopes formed by the Contractor which should be certified together with the associated temporary works;

g. Any other temporary works of which the design, method statement and completion certificate should be certified by RSE as required under the Drawings, the Specification and / or directed by the CM.

Before dismantling / removal, submit the method statement including precautionary and protection measures certified by RSE and allow at least 14 days for the CM to grant the permission to commence. Take video throughout the dismantling / removal process at location(s) to be agreed with the CM and keep video records for at least 14 days or as agreed with the CM.

9.

a. For the following Case 2 and Case 3 Temporary Works:

i. Tower crane as specified in PRE.B8.242 including the siting of the crane, the assessment of, the foundations, supporting structures, all connections between the tower crane and permanent structure, and associated test of materials and workmanship, shall be certified by RSE and independently inspected and certified by ICC. The load test or examination of tower cranes under the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations should not be conducted prior to acknowledgement of Form ESP-F5 by the CM;

ii. Temporary passenger lift as specified in PRE.B10.030 including the siting of the temporary passenger lift, the assessment of maximum loads, the foundations, supporting structures, all connections between the temporary passenger lift and permanent structure;

iii. Falsework spanning public highways as specified in CON2.D110;

iv. Temporary steel working platform for the operation of plant and machinery as specified in CoPSS with the required design loading greater than 20kPa;

v. Any other temporary works of which the design, method statement and completion certificate should be certified by RSE and of which the design and completion should be independently certified by ICC as required under the Drawings, the Specification and / or directed by the CM.

b. Submit the design, including plans and construction drawings with design justifications, certified by RSE and independently certified by ICC, and submit the method statement including precautionary and protection measures certified by RSE and allow at least 14 days for the CM to grant the permission to commence. The completion of these Case 2 and Case 3 Temporary Works shall be certified by RSE (or equivalent as approved by the CM) and independently inspected and certified by ICC. Submit the request for the CM's inspection and allow at least 14 days for the CM to grant the permission to use;

c. For any modification, re-certification by RSE on the design, method statement and completion and re-certification by ICC on the design and completion are required. For temporary works erected and retained on Site for over a year, RSE shall submit the annual safety certificate provided at APPENDIX.PRE.B10/XI not less than 7 days before each anniversary of the date of the completion certification;

d. Before dismantling / removal, submit the method statement including precautionary and protection measures certified by RSE and allow at least 14 days for the CM to grant the permission to commence. Take video throughout the dismantling/removal process at location(s) to be agreed with the CM and keep video records for at least 14 days or as agreed with the CM.

10. Mill certificates certified by QCM for Case 1, Case 2 and Case 3 Temporary Works in sub-clauses (5), (7), (8) and (9) above shall be submitted to the CM for record before the request for the CM's inspection;

11. Refer to PRE.B6.060 for the certification requirements of temporary works by RGE;

12. Refer to PRE.B6.060 for the certification requirements of hand-dug tunnelling works by Competent Engineer and ICE;

13. Handover the temporary works as agreed with the CM at the certified completion of the Works. Submit as built records and calculations of the temporary works to the CM before handover of the Works;

14. Dismantle and remove temporary works after completion of the permanent works unless otherwise agreed by the CM;

15. Maintain a set of plans, method statement including precautionary and protective measures, completion certificates, and safety certificates on Site for the reference of TCPs and the inspection of the ICU. Submit the register of certification status of the design, method statement, completion, safety certificate and dismantling method statement for temporary works as defined in clause 4.9 of the CoPSS and in sub-clauses (5) to (9) above in the monthly site meeting for monitoring.

Option 2

1. Obtain the CM's approval for the location of spoil heaps, temporary roads, services, hoists, temporary lifts, temporary buildings and the like;
2. Dismantle and remove temporary works after completion of the permanent works unless otherwise Approved.

PRE.B10.015.N TESTING FOR TEMPORARY WORKS

1. Propose tests required for temporary works supplied as proprietary products based on the recommendations of the suppliers for the CM's approval and carry out the tests as approved by the CM;
2. Propose tests required for Case 2 and Case 3 Temporary Works in sub-clauses (7), (8) and (9) of PRE.B10.010 that are not supplied as proprietary products for the CM's approval and carry out the tests as approved by the CM. Unless otherwise specified in the Specifications, Drawings, imposed by ICU or as agreed by the CM, the minimum tests required shall be:
   i) Tests of bolts, nuts and washers shall be referred to STR1.T030;
   ii) Tests of steel sections shall be referred to STR1.T050;
   iii) Weld tests shall be referred to STR1.T120;
   iv) Pull-out tests and / or shear load tests as appropriate in accordance with BS 5080 for fixings and anchors shall have the following sampling rates:

Item	Temporary fixings and anchors	Sampling rate
A	Drilled-in anchors used for cantilevered structure and hanger	5% or 5 numbers, whichever is more
B	Fixings and anchors other than Item A	1% or 5 numbers, whichever is more

3. Carry out tests required for Case 1 Temporary Works in sub-clause (5) of PRE.B10.010 in accordance with the Drawings and the Specificaiton, prevailing Code of Practice and / or approval conditions imposed by ICU;
4. All test results for temporary works shall be issued by testing laboratories in accordance with PRE.B9.570 and certified by QCM for submission to the CM before the request for the CM's inspection. Propose any remedial measures for any failed test results to the CM for agreement. Bear all associated costs and the extra time required for testing and re-testing of temporary works.

PRE.B10.020.A ACCESS AND ROADS

1. Provide and maintain temporary access to the Site and working areas and provide and maintain temporary roads, tracks, crossings and hardstandings, with adequate drainage, required for use by those engaged upon or in connection with the Works. Divert and subsequently reinstate permanent drainage systems as necessary;
2. Pave the main haul road with concrete, hardcores or rugged metal plates with adequate skid resistance for trafficking. Keep clear of dusty materials and maintain the entire road surface wet by either spraying with water or a dust suppression chemical;
3. Obtain Approval of the CM for the proposed alignment and levels of temporary roads;

4. In addition to the requirements of GCC Clause 5.11(6), comply with all regulations and all requirements of Government departments concerning the use and crossing of public roads. Obtain authorisation to cross pavements and similar areas;
5. When using estate and/or public roads for access purposes, co-operate with the Authority, Government departments, Utility Undertakings and others using such roads to ensure that they are kept free from obstruction at all times and comply with any requirements for restriction on access.

PRE.B10.030.A TEMPORARY PASSENGER LIFTS

1. Provide temporary passenger lifts to the following blocks:

   Blocks ..... - ..... No

   Blocks ..... - ..... No

   Blocks ..... - ..... No

2. Comply with all current regulations for use of persons engaged in the execution of the Works and for all Specialist Works and for the use of the CM:
3. Install the lifts in agreed and unobstructed locations, not in any permanent lift well and ready for use in all respects;
4.
   a. Provide access starting at first floor level and then at the 6th floor level immediately when the structural slab is cast at the 12th floor level;
   b. Provide access landing, at every six floors thereafter as construction work progresses, with the top access landing to the floor not exceeding more than three floors below roof level;
   c. Once the temporary security metal gate and fence are installed as PRE.B8.160, prohibit access at ground level and allow access to temporary passenger lift at the 1st floor level.
5. Provide for each lift:
   a. All power and maintenance;
   b. A competent full time operator;
   c. Test and examination certificate required under current legislation for the CM's inspection.
6. Do not dismantle any lift earlier than six months from the anticipated completion of each block;
7. Do not use passenger lifts for the movement of materials;
8. Refer to PRE.B10.010 sub-clause (9) for the certification requirement of RSE and ICC.

PRE.B10.040.A OTHER LIFTING APPLIANCES

1. Provide, maintain and operate lifting appliances properly;
2. Enclose hoist shafts with nylon mesh;
3. Operate all gondola by 4 wire system with arrestors. The condition of wire ropes shall be checked:
   a. The suspension and safety rope are at all times kept vertical during the raising, lowering or suspension of the working platform;
   b. The condition of suspension ropes and safety ropes are checked and free from kink, broken wires, flatten surface or any other patent defect before commencement of daily work and recorded in contractor’s daily checklist.
4. Display current valid test and examination certificates duly signed by a Registered Professional Engineer (Mechanical or Marine Discipline) for each hoist:

a. Material or skip hoists: Forms 1, 2 and 3 of Construction Sites (Safety) Regulations (CSSR) where appropriate;
b. Others: (e.g. Gondola) Forms 1, 3, 4 or 5 of Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations where appropriate.

5. Provide all hoist openings with complete nylon mesh and timber boarding to prevent falling objects;
6. Install lockable metal gates at all hoist openings;
7. Keep hoist gates closed at all times except where hoist is at rest at the landing place and material is to be loaded or unloaded from the hoist;
8. Enclose skip hoist for material transport shafts with impervious sheeting;
9. Provide safety measure(s) including a movable slanting aluminium plate to collect loose objects from the external wall and reduce the risk of falling objects during chipping, grinding or similar operations on the external wall. Submit detail drawings of the safety measure(s) for the CM's approval. Refer to drawing no. REF/SS/GO/SK-01 in Appendix U to this Specification for reference only;
10. Provide and install a CCTV system composing of a camera and associated equipment fixed at each material hoist and a video recording system in compliance with the following:
    a. The system shall be automatically started as the material hoist is in operation;
    b. The power, control and video cables connecting the camera shall be of the plug and socket type. 75 ohms BNC type video connectors shall be provided for all cable connections of the video system equipment;
    c. The camera shall be:
        i. Fixed onto the material hoist cabin allowing capture of best view;
        ii. Powered by rechargeable battery that can be charged during the normal operation of the material hoist without any disruption to the material hoist operation;
        iii. Designed at a minimum 2X optical zoom with resolution 752(H) x 582(V);
        iv. Able to function at 1 lux with automatic iris and focus control which can be manually overridden;
        v. Provided with camera housing with proper shading against direct sunlight;
        vi. Capable of being controlled on its zooming function by the contractor by joystick or foot pedals through a computerized system in the work station of the responsible site supervisory staff of Contractor or Contractor's site office.
    d. The monitor / display unit shall be:
        i. A colour LCD screen at least 7 inches wide diagonally;
        ii. Of industrial type with a resolution not lower than 752(H) x 582(V);
        iii. Equipped with control buttons / knobs to adjust the basic setting, including brightness and contrast.
    e. Provide earth connection to all connection panels, equipment mounting brackets, camera housing that are constructed in metal to prevent electric shock;
    f. Video recording system and associated equipment in Contractor's site office:
        i. Provide, operate and maintain, including all necessary cables, wirings, lightings and other accessories, a video recording system connected to the CCTV system:
            - Power backup shall be provided to cater for accidental breakdown of the power supply to the system;
            - Videos captured by the CCTV system shall be recorded continuously without break unless agreed by the CM;

- Videos shall be captured in a format acceptable to the CM.

ii. Provide the software and hardware for capturing the time and date and the operation conditions for the CM's viewing and taking photographs immediately or when required. Keep the videos record for at least 60 days and the photographs until such time as required by the CM;

iii. Post sufficient notices at conspicuous positions on Site to notify the workers and staff about the purpose of the video recording system (i.e. all collected personal information / data will be used by the CM to monitor the operation conditions only and will not be released/issued to irrelevant persons / parties without the permission of the persons / parties being monitored) in accordance with data protection principles set out in the Personal Data (Privacy) Ordinance.

g. Maintenance and Repair:

i. Check the CCTV system and video recording system daily for its normal functioning;

ii. Carry out weekly inspection and monthly checking of the CCTV system and video recording system;

iii. Check the focus of the CCTV camera on a regular basis;

iv. Clean the camera lens, camera housing and the screen of the LCD display unit on regular basis;

v. If the CCTV system or video recording system is not functioning, attend to the problem within 24 hours of its failure;

vi. In case of malfunctioning of the CCTV system or video recording system, immediate action shall be taken to rectify the malfunction and the material hoist operation shall be monitored by the assigned responsible person at all times until completion of the rectification work.

11. Refer to PRE.B10.010 sub-clause (7) for the certification requirement of QE.

PRE.B10.050.9 USE OF LIFTS

Access to podia and/or upper floors of domestic blocks by way of passenger lifts is restricted to materials which are carried by hand. All other goods and materials must be carried up the stairs or by a specially erected hoist.

PRE.B10.060.B TEMPORARY REFUSE CHUTES

1. Provide and maintain temporary refuse chutes for buildings over 3 storeys extended below 1/F canopy;
2. Install at 5 floors below working floor or up to roof level when structural work is completed;
3. Construct temporary refuse chutes properly braced and secured, fully enclosed without hole or gap;
4. Use materials of good quality, adequate strength and stability;
5. Provide hoppers at each entry point to refuse chute with adequate falls and with secured closing device to cover entire opening;
6. Provide secure screens and barriers of minimum height 600 mm on the sides to prevent waste material falling outside the chute and to protect operatives using the chute;
7. Ensure that discharge point is not higher than the barrier;
8. Post warning notices in Chinese and English characters;
9. Do not use lift well as refuse chute.

10. Provide a visual signal system to alert users that the refuse chute is in use;
11. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE.

PRE.B10.065.B FALSEWORK

1. Design, construct, use, alter and dismantle falsework in accordance with the practical guidance and good practices stipulated in the prevailing edition of the Code of Practice for Metal Scaffolding Safety and the Guidance Notes: Safety at Work (Falsework-Prevention of Collapse) both issued by the LD;
2. The design, construction, use, alteration and dismantling of falsework shall comply with BS 5975 or other equivalent national / international standards or provisions. The falsework shall be designed by a professional engineer. If the falsework may cause any effect on the permanent structure or as instructed by the CM, a Qualified Engineer, as per PRE.B10.010 sub-clause (7) shall certify the design, method statement and completion of such works;
3. The professional engineer referred to in sub-clause (2) above shall be a corporate member of the Hong Kong Institute of Engineers in the civil or structural discipline, and should have adequate training and experience, and be able to justify how and why the designed scaffold can safely resist the imposed loads in accordance with recognized engineering principles;
4. Comply with the legal requirements set out in Sections 6A & 6B of the Factories and Industrial Undertakings Ordinance and the requirements of the Construction Sites (Safety) Regulations regarding the safety in metal scaffolding;
5. Potentially hazardous site features and other aspects likely to impair the safety of falsework shall be identified and the risk arising from each hazard shall be evaluated;
6. Carry out risk assessment to identify hazards in associated with the works and develop a safe system of works under the Safety Plan for the safety and health of workers at work. The Contractor shall also ensure that the workers at work use suitable personal protective equipment;
7. The Contractor shall maintain and list out in a register on Site a set of plans showing the method statement and precautionary / protective measures for reference of TCPs and inspection of the CM;
8. The Contractor shall continuously monitor / inspect the falsework throughout its use to ensure that the falsework is maintained in good conditions. The Contractor shall also ensure that all the necessary safeguards are used and maintained. Records of the monitoring / inspection shall be certified by a Contractor's superintendent holding qualification equivalent to TCP Grade T4 in civil or structural engineering discipline and such record shall be kept on Site;
9. During strut removal, provide safety measure(s) by mechanical means, certified by the Qualified Engineer as stipulated in PRE.B10.010 sub-clause (6) as necessary, to prevent free-swinging of the section being cut and eliminate the risk of striking any persons. Submit details of the safety measure(s) to for the CM's approval. Refer to drawing no. REF/SS/TS/SK-01 in Appendix U to this Specification for reference only.

PRE.B10.070.9 MAINTENANCE OF TEMPORARY WORKS

Maintain, alter, adapt and move temporary works as necessary. Clear away when no longer required and make good.

PRE.B10.080.9 TEMPORARY STAIRCASES

When permanent staircases are unavailable and the level difference is not less than 600mm, provide a secure temporary staircase or other safe means of access. The temporary staircase provided shall have top railings at a height of 900 mm to 1100 mm and middle railings at a height of 450 mm to 500 mm. The riser and the tread shall not be more than 175mm and less than 250mm respectively whereas the sum of two times the riser plus the tread shall not be less than 600mm.

PRE.B10.090.A BUILDING SETTLEMENT AND VERTICALITY MONITORING

Supply and install stainless steel settlement markers, paint verticality markers and install linear scale at locations as directed by the CM in accordance with Drawing No. ..... and the following:

1. Provide markers of a coupling type comprised of a portion to be fixed rigidly, truly horizontally and entirely in the structural walls and another portion to be screwed in or inserted into left-in portion each time a levelling exercise is being carried out. Provide a sample for Approval prior to installation;
2. Install the markers horizontally at locations indicated in sketch No. ..... and at positions about 500 mm from the ground such that the markers are at least 2200 mm clear from any obstruction vertically above;
3. Paint verticality markers and install linear scale at locations indicated in sketch No. ..... at positions specified by the CM. Ensure that the markers are clear from obstructions for survey purposes;
4. Affix the markers to the structural walls or columns of each individual block including the commercial centre / carpark as soon as these structural members are built;
5. Attend upon a Chartered Land Surveyor appointed by the Authority to carry out levelling at times and in phases decided by the Authority;
6. Retain these markers throughout the Contract; accept responsibility for the maintenance of the markers including providing covering caps and preventing the holes being blocked by any construction materials or debris, and keeping all monitoring markers fully greased and free from rust and damage;
7. Provide clear and unobstructed access to the markers and to the 2.20 metres space above each marker, at the time of each survey;
8. At end of Maintenance Period or when being Instructed, take out the settlement markers, verticality markers and the linear scale and make good work disturbed to the satisfaction of the CM, unless otherwise instructed by the CM.

PRE.B10.091.N HARD PAVED CONSTRUCTION

1. Unless otherwise approved by the CM, pave the following areas with the following hard paving if there is no existing hard standing ground:
   a. Precast concrete panels:
      i. Main haul roads and the branch haul roads leading from the main entrance(s) of the Site to the footprint of the building blocks;
      ii. All storage areas, fabrication yard and site office.
   b. Crushed rock / rockfill (Grade 200) or other material approved by the CM:
      i. The footprint of the building blocks.
2. Subject to the approval of the CM, provide minor patching up with in-situ concrete to suit site conditions;
3. Comply with the following requirements for supply, installation and design of the hard paving and in carrying out works in connection with the hard paving:
   a. Supply and install the precast concrete panels on compacted sub-base with reference to the following requirements:
      i. The precast concrete panels shall not exceed 2m x 4m on plan and shall be of minimum thickness of 175mm, unless otherwise approved by the CM;
      ii. Drawing nos. ……. showing the construction details of the precast concrete panels are given in Appendix C to this Specification.

b. The Contractor shall ascertain that the hard paving including the precast concrete panels with details specified in sub-clause (a) above are suitable and structurally adequate to withstand the loadings of the site activities. Once the details of the hard paving are adopted, the Contractor is deemed to satisfy with and accept full responsibility for the suitability and structural adequacy of the hard paving;

c. In the event that alternative design of precast concrete panels is adopted, submit the design calculations and drawings, certified by QCM, to the CM for information. The precast concrete panels and sub-base shall be of adequate strength and durability to withstand the loadings of site activities including site traffic;

d. The hard paving and sub-base shall be constructed to provide sufficient skid resistance to allow all the machinery to operate in a proper and safe manner;

e. Used precast concrete panels may be installed provided they are certified by the QCM in good conditions to the satisfaction of the CM. Submit design calculations and drawings showing the construction details of used precast concrete panels for the CM's information;

f. Prior to the installation of the hard paving, submit the following, certified by QCM, to the CM for information:

i. Drawings showing relevant information including but not limited to the location, number, size, etc. of the precast concrete panels;

ii. Drawings showing the hard paving and sub-base;

iii. Drawings showing the layout and method of installation;

iv. Revised design calculations and drawings for any subsequent modifications.

g. Design, install and maintain proper drainage at the areas covered with the hard paving throughout the Contract and make good the ground after the hard paving is removed;

h. Construct firm and level supporting sub-base and keep it free from ridges, cracks, loose materials, pot-holes, ruts or other unsuitable materials.

4. Comply with the following requirements for adopting the existing concrete slab as an alternative to the hard paving and in carrying out works in connection with the existing concrete slab:

a. Ascertain the existing concrete slab is suitable and structurally adequate to withstand the loadings of the site activities. Once the existing concrete slab is adopted, the Contractor is deemed to satisfy with and accept full responsibility for the suitability and structural adequacy of the existing concrete slab;

b. Ascertain the existing concrete slab and sub-base shall be of adequate strength and durability to withstand the loadings of site activities including site traffic;

c. Ascertain the existing concrete slab and sub-base shall provide sufficient skid resistance to allow all the machinery to operate in a proper and safe manner;

d. Design, install and maintain proper drainage at the areas covered with the existing concrete slab throughout the Contract and make good the ground after the existing concrete slab is removed;

e. Keep the existing concrete slab free from ridges, cracks, loose materials, pot-holes, ruts or other unsuitable materials.

5. Clear away frequently any excavated materials or construction waste from the hard paving;

6. Carry out regular inspection to the hard paving and sub-base to ensure no unevenness in alignments, ground subsidence and damages of the hard paving that will affect the performance of the hard paving and site activities at the paved areas. Maintain the hard paving and sub-base in good conditions. Repair or replace any damaged hard paving and sub-base to the satisfaction of the CM;

7. Unless otherwise instructed by the CM, remove hard paving off Site upon completion of the Works.

GREENING ON SITE

PRE.B10.100.9 TEMPORARY GREENING ON SITE

1. Provide temporary greening on Site such as planting at-grade with vegetation and pre-grown trees and / or features such as potted plants, hoarding with decorative plants, vertical green panels, roof greening on site office buildings etc. with the CM's consent. The total greening area shall not be less than the roof area of all external site office buildings;
2. Submit temporary site greening proposal at the commencement of the Contract to the CM for approval. The proposal shall take into account the extent, timing and location for temporary soft landscaping provisions on Site with due consideration of the site activities throughout the duration of the Contract;
3. Maintain and replace when perished the temporary greening on Site according to the Contractor's submitted proposal.

SITE ACCOMMODATION FOR THE CONTRACTOR

PRE.B10.110.A ACCOMMODATION GENERALLY

In addition to the requirements of GCC Clause 5.31, provide all necessary offices, mess rooms, toilet accommodation, washing facilities and the like for all workers engaged in the execution of the Works. Provide lighting, power, telephones, cleaning etc and maintain toilet accommodation and washing facilities in a sanitary condition at all times. Temporary site accommodation shall be constructed from prefabricated, demountable, reusable components unless otherwise approved by the CM. The use of tropical hardwoods in the construction of temporary site accommodation is expressly prohibited. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE.

PRE.B10.120.A MINIMUM TOILET ACCOMMODATION AND WASHING FACILITIES

Option 1

1. Provide at the minimum toilet accommodation and washing facilities on Site for the period from the date of possession of the Site to the date of certified completion of the Works as follows:

	Contract Sum ($m)			
	Under 100	100-200	200-300	Over 300
1. Toilets etc for Male Workers:				
WC with flushing water	3	3	4	6
Urinal with flushing water	6	8	10	14
Washhand basin with fresh water	3	4	5	7
Shower with hot water supply	4	6	6	10
Changing room including showers (Size in m²)	20	30	30	58

2. Toilets etc for Female Workers				
WC with flushing water	1	1	2	2
Washhand basin with fresh water	1	1	2	2
Shower with hot water supply	1	1	2	2
Changing Room including showers (Size in m^2)	5	5	8	8

2. Provide hot water to the shower facilities for workers on Site as required in PRE.B10.125;
3. Provide lighting and exhaust fans to the toilet accommodation and washing facilities;
4. Provide shoe cleaning trays with water supply and brushes at each Site exit;
5. Provide drainage system for WC, urinal, basin, shower facilities and shoe cleaning trays by installing drainage pipes connection, sewerage/ septic tank or other chemical treatment;
6. Provide cleaning services daily to keep the toilet accommodation and washing facilities in a sanitary condition at all times.

Option 2

1. Provide at the minimum toilet accommodation and washing facilities on Site for the period from the date of possession of the Site to the date of certified completion of the Works as follows:

	Contract Sum ($m)	
	Under 500	Over 500
1. Toilets etc for Male Workers:		
WC with flushing water	3	6
Urinal with flushing water	3	6
Washhand basin with fresh water supply	3	6
Shower with hot water supply	2	4
Changing room including showers (Size in m^2)	13	26
2. Toilets etc for Female Workers		
WC with flushing water	2	4
Washhand basin with fresh water supply	2	4
Shower with hot water supply	1	2

Changing Room including showers (Size in m^2)	6	13

2. Provide hot water to the shower facilities for workers on Site as required in PRE.B10.125;
3. Provide lighting and exhaust fans to the toilet accommodation and washing facilities;
4. Provide shoe cleaning trays with water supply and brushes at each Site exit;
5. Provide drainage system for WC, urinal, basin, shower facilities and shoe cleaning trays by installing drainage pipes connection, sewerage/ septic tank or other chemical treatment;
6. Provide cleaning services daily to keep the toilet accommodation and washing facilities in a sanitary condition at all times.

PRE.B10.125.9 ELECTRICAL/SOLAR WATER HEATER SYSTEM

1. Provide hot water to the shower facilities by electrical/solar water heater system for workers on Site within 3 months from the notified date for commencement of the Works until the Contractor's site office is moved to the permanent structure;
2. Design and construct all necessary temporary works, including any supporting frames for the electrical/solar water heater system and the accessories;
3. Design, supply, install and maintain the electrical/solar water heater system including solar thermal collection system, water pipework system, automatic controls, thermal insulation, electric water heater with hot water storage calorifier, electrical supply system, water circulation pumps, valves and accessories where necessary;
4. The solar thermal collection system shall comprise with solar thermal collector panel(s) of approximate 2 m^2 face area of solar reception for every 150 litre hot water storage and installed on appropriate supporting framework;
5. Electric water heater with thermal insulated hot water storage calorifier shall be able to withstand the designed temperature and pressure with the support of a valid working and test pressure certificate. The system shall comprise of:
   a. Heating back-up for hot water from the solar thermal collection system;
   b. A minimum of 20 litres hot water storage per shower;
   c. Timer control for daily operation;
   d. Thermostatic control system to maintain water temperature inside the calorifier and able to heat up the water inside the calorifier from 20°C to 60°C within two hours;
   e. Safety temperature and pressure relief valves.

PRE.B10.130.A ADDITIONAL TOILET ACCOMMODATION FOR MULTI-STOREY BUILDING

1. In addition to the minimum toilet accommodation set out in PRE.B10.120 provide, in Approved locations, one male and one female temporary latrine accommodation including hand washing facilities on or adjacent to the ground floor and on every third floor of all multi-storey buildings and maintain in a sanitary condition at all times;
2. Provide lighting and exhaust fans to the toilet accommodation and washing facilities;
3. Provide chemical treatment, toilet with water tank for flush water supply, wash hand basin with water tank for fresh water supply, foot pumps to flush toilet and wash hands, vent pipe, coat hook, paper roller, toilet paper, mirror, gender sign and in-use indicator for latrine accommodation;
4. Provide cleaning services daily to keep the toilet accommodation and washing facilities in a sanitary condition at all times.

PRE.B10.135.9 FOOD WASTE COMPOSTER

1. Submit food waste composting proposal at the notified date for commencement of the Works to the CM for approval. The proposal shall take into account the food waste generated on Site, the potential amount of compost to be produced and the recommended use of the compost;
2. Provide the Approved food waste composter to transform food waste on Site into compost for use in on-site planters or other environmentally friendly applications as recommended by the Contractor within 3 months after the notified date for commencement of the Works until three months prior to the last certified date for completion of the Works.

PRE.B10.140.A STORAGE SHEDS

1. Provide, for the Contractor's own use, temporary sheds of weatherproof construction with raised floors, and with racks, for storage of materials. Where areas in partially completed buildings are allocated for storage, make these areas weatherproof and provide racks;
2. Attention is drawn to PRE.B12.840 regarding erection of sheds by Nominated Sub-contractors, Direct Contractors, etc.;
3. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE

PRE.B10.150.9 SECURE STOREROOMS

1. The Employer will endeavour to provide for the Contractor's own use, a secure storeroom with a minimum floor area of 10 m² for storing, tools and materials;
2. Take possession of all keys, keep the storeroom clean, neat and tidy and return it to the Housing Manager at the completion of the works in the same condition as received at the outset;
3. Pay all rents and hire charges to the Housing Manager for the use of the storeroom.

SITE ACCOMMODATION FOR BUILDING SERVICES NOMINATED SUB-CONTRACTORS

PRE.B10.160.A ACCOMMODATION GENERALLY

Provide on-site lockable weatherproof office accommodation of sufficient strength, adequately braced and anchored to resist typhoon conditions for each building services Nominated Sub-contractor during construction period. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE.

PRE.B10.170.9 ACCOMMODATION SIZES

Provide the accommodation with sufficient area for office work for each building services Nominated Sub-contractor.

PRE.B10.180.9 ACCOMMODATION FACILITIES

The accommodation for each building services Nominated Sub-contractor shall be fitted with the following facilities:

1. Two office desks;
2. Four chairs;
3. One file cabinet.

PRE.B10.190.9 ACCOMMODATION SERVICES

The accommodation for each building services Nominated Sub-contractor shall be fitted with the following accommodation services. Such services shall be provided at the same time as the Contractor provides the accommodation services stipulated in PRE.B10.250.

1. Lighting and power;
2. Full air conditioning;
3. One broadband line with unlimited 24 hours internet services access through Internet Service Provider (ISP).

SITE ACCOMMODATION FOR THE CM AND THE CM'S REPRESENTATIVES

PRE.B10.210.A ACCOMMODATION GENERALLY

1. Provide weatherproof office accommodation of sufficient strength, adequately braced and anchored to resist typhoon conditions. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE;
2. A site office is not required for this Contract. Provide suitable accommodation on the ground floor of ..... Provide attendance.

PRE.B10.215.9 SUSTAINABLE PROVISIONS OF SITE ACCOMMODATION

1. Orientate and design site accommodation to maximise natural ventilation and daylighting to reduce energy consumption where applicable;
2. Design, install and maintain building services installations in accordance with the latest edition of the Code of Practice for Energy Efficiency of Building Services Installation issued by EMSD where applicable;
3. Submit design drawings for the CM's agreement before actual construction commences;
4. Make sustainable provisions as follows:
   a. Use demountable office furniture / equipment in modular design layout where applicable to facilitate future re-use and to minimize wastage during transit from one site to another;
   b. Use energy efficient products with energy labels of:
      i. "Grade 1" or "Grade 2" for products fall within the category of "Mandatory Energy Efficiency Labelling Scheme" (MEELS) of EMSD;
      ii. "Recognition Type" for products fall within the category of "Voluntary Energy Efficiency Labelling Scheme" (VEELS) of EMSD.
   c. Use water-consuming appliances registered under the "Water Efficiency Labelling Scheme" (WELS) of WSD;
   d. Use recycled paper with Forest Stewardship Council (FSC) certificate(s) or Programme for the Endorsement of Forest Certification (PEFC) certificate(s) for printing and photocopying.
5. Allow used materials and products which are in reasonable and serviceable conditions;
6. Maintain the site accommodation together with the sustainable provisions in serviceable conditions;
7. Display notices prominently to remind staff to switch off computers and other electrical appliances when they are not in use or after business hours.

PRE.B10.220.9 ACCOMMODATION SIZES

Option 1

Provide the following accommodation of the areas shown:

1. Office for 3 persons	-	24 m²	……. No.
2. Office for 2 persons	-	16 m²	……. No.
3. Office for 1 person	-	8 m²	……. No.

4. Sample room with lock - 12 m² ……. No.
5. Conference room - 24 m² ……. No.
6. Computer room with security lock - 8 m² ……. No.

Option 2

Provide the following accommodation of the areas shown:

1. Office for 3 persons - 24 m² ……. No.
2. Office for 2 persons - 16 m² ……. No.
3. Office for 1 person - 8 m² ……. No.
4. Sample room with lock - 20 m² ……. No.
5. Conference room - 45 m² ……. No.
6. Computer room with security lock - 8 m² ……. No.

PRE.B10.230.9 ACCOMMODATION FACILITIES

Provide the accommodation with the following facilities:

1. Separate lock-up male and female toilet accommodation each complete with wash-hand basin, shower and flushing facilities;
2. A hot and cold water dispenser with a continuous supply of drinking water.

PRE.B10.240.9 ACCOMMODATION FURNITURE AND FITTINGS

Fit accommodation with the following:

Accommodation	Furniture and Fittings
1. Office for the CM or his representatives	One desk per person with lock-up drawers, plan chests, plan benches, filing cabinets, cupboards, pinboards, chairs, stools, whiteboard and full air conditioning.
2. Conference room	Projector and screen, laser pointers, microphones, speakers, conference table and chairs and full air conditioning.
3. Lock up sample room	Shelves.

PRE.B10.250.9 ACCOMMODATION SERVICES

Provide the following services to accommodation:

1. Lighting and power;
2. Separate telephone line for fax machine;
3. One telephone line for every one or two person office;
4. Two telephone lines for every office intended for three or more persons;
5. Make available telephone connections on commencement. If connections are not available, provide one mobile telephone and related consumables for the use of the CM until lined telephone is installed;
6. Burglar alarm system.

PRE.B10.255.9 BURGLAR ALARM SYSTEM FOR SITE ACCOMMODATION

The Contractor shall provide and maintain the following burglar alarm system for each site office accommodation till the completion of the Works and for other longer period as instructed by CM for the necessary completion of additional works within the Maintenance Period. The Contractor shall engage a licensed security company with employee who possesses valid security personnel permit for the provision and maintenance of the system fulfilling statutory regulations.

1. The burglar alarm system shall be an integrated system providing reliable security detection to prevent illegal intrusion into the site accommodation. The system shall be designed to allow easy operation by the security staff;
2. The burglar alarm system shall consist of the following main components:
   a. Volumetric motion detector;
   b. Magnetic door contacts;
   c. Burglar alarm panel and repeater panel;
   d. Alarm annunciator.
3. System Requirement
   a. The burglar alarm panel shall be installed near the main entrance inside the protected area of the site accommodation connecting to peripheral equipment including the volumetric motion detectors, magnetic door contacts;
   b. The burglar alarm panel shall also be connected to the repeater alarm panel located inside a 24 hours manned site security office;
   c. The burglar alarm system shall be activated or deactivated at the burglar alarm panel by using a designated smart card and keying in secret code via the panel keypad on the burglar alarm panel;
   d. The Contractor shall assign dedicated security staff for the activating and deactivating the burglar alarm system in the presence of site staff when being notified by the last leaving and first arriving site staff of the site accommodation respectively;
   e. Upon detection of intrusion after activation of the system, audio and visual alarm shall be displayed at both the burglar alarm panel and the repeater security control panel with additional alarm signal automatically sending to a designated mobile phone of the security staff assigned by the Contractor.
4. Volumetric motion detector
   a. Volumetric detectors used shall make use of dual technology, including passive infra red and microwave / ultrasonic wave, such that the possibility of false alarm will be reduced to the minimum;
   b. The detectors shall be provided to cover the entire site accommodation including windows and exit doors. There shall be at least one detector installed covering each separate room.
5. Magnetic door contact

   Surface-mounted magnetic door contacts shall be installed on the inner door frame of all exit doors. It will be used to detect door open.
6. Burglar alarm panel and repeater alarm panel
   a. The burglar alarm panel shall have real time clock display and alarm latching display and shall be used to activate or deactivate the burglar alarm system by using a designated smart card and keying in secret code via the panel keypad. The card reader and smart card should utilise proven technology of industrial standard. The panel shall also be built-in with entry and exit delay timer, such that the timer will be triggered by the entry, exit route sensors;

b. The burglar alarm panel shall be able to store all alarm logs including system arming / disarming time, alarm triggering time and devices, alarm resetting time, etc. at a minimum period of 30 days. The log shall be viewed from display on the alarm panel;

c. The burglar alarm panel shall be powered by AC mains from continuous power supply source within site accommodation and backed up by stand-by battery sufficient for minimum 8 hours operation. The burglar alarm panel shall raise an indication alarm and repeated to repeater alarm panel upon the absence of AC main power supply or the stand-by battery voltage goes below the threshold limit;

d. The repeater alarm panel shall be installed inside the site security office to repeat the status of the burglar alarm panel including the on / off of the burglar alarm system and alarms, etc..

7. Alarm annunciator

a. Self-activated alarm bells shall be installed at prominent location on the outer wall of the protected site accommodation and the site security office. The bell shall be housed in strong steel housing with anti-corrosion finishing and are tamper protect against removal of the lid, the bolt or attempted removal of the housing from the wall. The bell shall be self-powered by rechargeable battery. If input circuit is cut off, it shall give out annunciation. Upon activation it shall give out alarm sound level not less than 100 dBA at 1 metre distance. There shall also be a strobe light on the bell to provide visual warning;

b. A cut off timer adjustable from 1 minute to 15 minutes shall be provided. Should the bell ring for the pre-set period, it shall be cut off by the timer. However, the strobe light shall remain flashing. Should the built-in battery voltage goes below the threshold limit, the bell shall give intermittent audio and visual warning to signify the need for battery replacement.

8. Cables

All cables shall be properly installed to avoid damage and alarm shall be activated on the alarm panel when the cable is under open / short circuit conditions.

9. Submission and testing

a. The Contractor shall submit the system design, drawings and materials together with the submission of layout of site accommodation for approval by Contract Manager prior to commencement of the installation;

b. The Contractor shall complete the installation of the system within 3 months after the approval of system design and materials by CM;

c. The Contractor shall carry out performance tests on each month and submit reports to ensure the system be capable to cover the entire site accommodation to the satisfaction of the Contract Manager.

10. Operating cost

All operating and maintenance costs for the burglar alarm system, including the rental charges for the lease-line, mobile phone charges, etc. shall be borne by the Contractor.

PRE.B10.260.9 ACCOMMODATION CLERICAL SERVICES

Option 1

1. Provide two clerical assistants, with experience in using PC such as word and data processing etc., for the exclusive use of the CM and his representatives from the notified date for commencement of the Works to four months after the date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the whole, including such additional periods as may be necessary for the completion of any outstanding work within the Maintenance Period;

2. Arrange for the clerical assistant to work full time on Site in CM's accommodation or upon completion of the Works, in such Estate Management Office as directed by the CM and to be available to provide clerical services and computer data input during normal working hours. Provide the replacement if, in the opinion of the CM, the standard of work is unsatisfactory.

Option 2

1. Provide a clerical assistant for the exclusive use of the CM and his representatives from the notified date for commencement of the Works to the date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the whole, including such additional periods as may be necessary for the completion of any outstanding work within the Maintenance Period;
2. Arrange for the clerical assistant to be based on Site in CM's accommodation and to be available to provide clerical services during normal working hours;
3. Provide a replacement if, in the opinion of the CM, the standard of work is unsatisfactory.

PRE.B10.270.9 ACCOMMODATION MAINTENANCE

Provide attendance to clean accommodation daily and maintain in good working order.

PRE.B10.280.A VEHICLE ACCOMMODATION

Provide sufficient hardstanding and covered vehicle spaces as required by the CM. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE.

PRE.B10.290.9 TEMPORARY ACCOMMODATION FOR THE CM AND HIS REPRESENTATIVES DURING MAINTENANCE PERIOD

Option 1

1. Provide a temporary accommodation comprising building works (BW) workstations, building services (BS) workstations and separate lock up material stores by fitting out the minimum 2 nos. of Mutual Aid Committee (MAC) Office in Blocks …. & …. as the BW workstations and BS workstations and by setting up separate lock up material store(s) of approximate floor area of 18 m² at location as shown on the drawing no. ……. listed in Appendix C to this Specification. Partition off each MAC Office with light-weighted partitions to provide a reduced floor area of approximate 15 m² for use as BW and BS workstations when instructed by the CM;
2. Provide the temporary accommodation with the following:
   a. Lighting and power;
   b. Two telephone lines (one for each BW workstation and BS workstation);
   c. One separate telephone line for facsimile in each BW workstation and BS workstation;
   d. Broadband line service for totally 2 nos. of personal computers in each BW workstation and BS workstation.
3. Provide furniture and fittings to the temporary accommodation as follows:
   a. A hot and cold water dispenser with a continuous supply of drinking water;
   b. Plan chests, plan benches, filing cabinets cupboards, pin boards, chairs, stools, whiteboard and 4 nos. of desks with lock up drawers for each BW workstation and BS workstation;
   c. Only shelves, lighting and power for lock up material stores;
   d. Full air conditioning for BW and BS workstations.
4. Bear all charges including deposits etc., in connection with the use of electricity;
5. Provide attendance and clean the temporary accommodation daily to maintain it in good condition for working;

6. Dismantle the BW workstation, BS workstation and material store(s), and restore the space disturbed to their original condition as far as reasonable and acceptable when instructed by the CM.

Option 2

1. Provide a temporary accommodation comprising a combined building works (BW) and building services (BS) workstation and a lock up material store by partitioning off with light-weighted partitions and by fitting out the Maintenance Service / Store Room to make a combined BW and BS workstation with floor area of approximate 30 m² and to set up a lock up material store floor area of approximate 18 m² as shown on the drawing no. …… listed in Appendix C to this Specification;
2. Provide the temporary accommodation with the following:
   a. Lighting and power;
   b. Two telephone lines;
   c. One separate telephone line for facsimile;
   d. Broadband line service for 4 nos. of personal computers.
3. Provide furniture and fittings to the temporary accommodation as follows:
   a. A hot and cold water dispenser with a continuous supply of drinking water;
   b. Plan chests, plan benches, filing cabinets cupboards, pin boards, chairs, stools, whiteboard and 8 nos. of desks with lock up drawers for the combined BW and BS workstation;
   c. Only shelves, lighting and power for lock up material store;
   d. Full air conditioning for the combined BW and BS workstation.
4. Bear all charges including deposits etc., in connection with the use of electricity;
5. Provide attendance and clean the temporary accommodation daily to maintain it in good condition for working;
6. Dismantle the combined BW and BS workstation and material store, and restore the space disturbed to their original condition as far as reasonable and acceptable when instructed by the CM.

Option 3

1. Provide a temporary accommodation comprising a combined building works (BW) and building services (BS) workstation or separate BW and BS workstations, with a separate lock up material store. Set up the following in the space allocated at the location as shown on the drawing no. …… listed in Appendix C to this Specification:
   a. A combined BW and BS workstation with floor area of approximate 30 m² or separate BW and BS workstations with floor area of approximate 15 m² for each workstation;
   b. A lock up material store with floor area of approximate 18 m².
2. Provide the temporary accommodation with the following:
   a. Lighting and power;
   b. Two telephone lines for combined BW and BS workstation, or one telephone line for each BW and BS workstation;
   c. Two telephone lines for facsimile for combined BW and BS workstation, or one telephone line for facsimile for each BW and BS workstation;
   d. Broadband line service for 4 nos. of personal computers for combined BW and BS workstation, or broadband line service for 2 nos. of personal computers in each BW and BS workstation.
3. Provide furniture and fittings to the temporary accommodation as follows:
   a. A hot and cold water dispenser with a continuous supply of drinking water;

b. Plan chests, plan benches, filing cabinets cupboards, pin boards, chairs, stools and whiteboard;

c. 8 nos. of desks with lock up drawers for combined BW and BS workstation, or 4 nos. of desks with lock up drawers for each BW and BS workstation;

d. Only shelves, lighting and power for lock up material store;

e. Full air conditioning for combined BW and BS workstation or separate BW and BS workstations.

4. Bear all charges including deposits etc., in connection with the use of electricity;

5. Provide attendance and clean the temporary accommodation daily to maintain it in good condition for working;

6. Dismantle the combined BW and BS or separate BW and BS workstations and separated material store(s), and restore the space disturbed to their original condition as far as reasonable and acceptable when instructed by the CM.

Option 4

1. Provide off-site temporary accommodation comprising a building works (BW) workstation and a building services (BS) workstation, each with separate lock up material store and set up as follows:

   a. A BW workstation with floor area of approximate ……. m² with a lock up material store with floor area of approximate 18 m²;

   b. A BS workstation with floor area of approximate ……. m² with a lock up material store with floor area of approximate 18 m².

2. Provide combined BW and BS workstations at the same premises as far as practicable; failing which seek approval of the CM for separated BW and BS workstations in different premises with due justification;

3. Contractor shall propose location for the off-site temporary accommodation under this clause for the CM's prior approval at least …..… months before the date or extended date for completion of Section ……. / the Works;

4. Provide the temporary accommodation with the following:

   a. Lighting and power;

   b. Two telephone lines for combined BW and BS workstation, or one telephone line for each of the BW and BS workstations;

   c. Two telephone lines for facsimile for combined BW and BS workstation, or one telephone line for facsimile for each of the BW and BS workstations;

   d. Broadband line service for 4 nos. of personal computers for combined BW and BS workstation, or broadband line service for 2 nos. of personal computers in each of the BW and BS workstations.

5. Provide furniture and fittings to the temporary accommodation as follows:

   a. A hot and cold water dispenser with a continuous supply of drinking water;

   b. Plan chests, plan benches, filing cabinets cupboards, pin boards, chairs, stools and whiteboard;

   c. ……. nos. of desks with lock up drawers for BW workstation and ……. nos. of desks with lock up drawers for BS workstation;

   d. Only shelves, lighting and power for lock up material store;

   e. Full air conditioning for the combined BW and BS workstation or the separated BW and BS workstations.

6. Bear all charges including deposits etc., in connection with the use of electricity and the temporary accommodation;

7. Provide attendance and clean the temporary accommodation daily to maintain it in good condition for working;

8. Dismantle the combined BW and BS or the separated BW and BS workstations and the associated material store(s), and restore the space disturbed to their original condition as far as reasonable and acceptable when instructed by the CM.

SITE ACCOMMODATION FOR THE CM'S LAND SURVEY TEAM

PRE.B10.300.A ACCOMMODATION GENERALLY FOR THE CM'S LAND SURVEY TEAM

Provide an 8m^2 on-site lockable weatherproof office accommodation of sufficient strength, adequately braced and anchored to resist typhoon conditions for the CM's Land Survey Team during the period of piling works. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE.

PRE.B10.303.9 ACCOMMODATION FURNITURE AND FITTINGS FOR THE CM'S LAND SURVEY TEAM

Fit accommodation with the following:

Accommodation	Furniture and Fittings
Office for CM's Land Survey Team	1. One notice board (size : 600mm x 450mm); 2. One edged cork display board (size : 2000mm x 1200mm); 3. One lockable desk (size : 1500mm x 800mm x 760mm); 4. One office desk (size : 1300mm x 800mm x 760mm); 5. Four chairs; 6. One cabinet with door lock facility (min. size : 1780(H) x 890(W) x 460(D) mm.

PRE.B10.306.9 ACCOMMODATION SERVICES FOR THE CM'S LAND SURVEY TEAM

Provide the following services to the accommodation for the CM's Land Survey Team at the same time as the Contractor provides the accommodation services stipulated in PRE.B10.250:

1. Lighting and power;
2. Full air conditioning;
3. One telephone line.

SITE ACCOMMODATION ASSOCIATED WITH IN-SITU CONCRETING WORK

PRE.B10.310.9 SITE TESTING LABORATORY

1. Where the Contractor has proposed other minimum periods before striking formwork or has proposed any modification to the Drawings and/or Specification to suit his method of construction, erect and equip a testing laboratory on Site of adequate size with facilities for carrying out the following tests:

a. Cube tests to confirm that the concrete has obtained the minimum crushing strengths where minimum periods other than those specified in CON2.W630 have been proposed by the Contractor and Approved. The equipment to include a concrete crushing machine of adequate strength;

b. All other in-situ tests as required by this Specification and as required by the CM in connection with the Contractor's proposed method of construction.

2. Provisions for testing are included in Worksection PRE.B9.

PRE.B10.320.9 CONTAINER OFFICE

Where in-situ concreting work is to be carried out on Site and which forms part of the permanent Works, provide a standard steel container office of nominal size 6000 x 2500 x 2350 mm (as and when required by the CM) for exclusive use of the CM or his appointed Direct Contractor. Equip the container with the following:

1. A security door lock;
2. Windows with security metal grilles;
3. Fluorescent lighting;
4. Reversible air conditioner;
5. Work bench 2500 x 900 x 850 mm high;
6. Direct line telephone;
7. Desk with lock-up drawers;
8. Pin board;
9. Chair and stool.

PRE.B10.322.B CONTAINER STOREROOMS

1. Take over, transport all core samples and core boxes obtained from ground investigation works executed under previous separate contracts from HA core stores located within the territory of HKSAR to the Site. All core samples and core boxes shall be transported in appropriate steel containers in such a manner as to prevent disturbance of the core samples by sudden movement, continuous or intermittent vibration to the satisfaction of the CM;
2. Relocate, protect, repair and maintain existing core boxes. Do not use the core boxes for storage of any items other than the existing core samples without the CM's approval;
3. Provide sufficient numbers of steel container storerooms, to the satisfaction of the CM, for storing the following core samples:
   a. Samples obtained from sampling and testing founding levels for Type 3 Piles as described in PIL1.T210 & PIL1.T220;
   b. Samples obtained from core testing of Type 3 Piles as described in PIL1.T1220;
   c. Samples obtained from confirmatory core tests of founding strata of Types 3 piles as described in PIL1.T1710;
   d. Samples obtained from ground investigation works executed under previous separate contracts (about ….. nos. of core boxes).
4. The core samples and core boxes shall be accessible and stored in a logical sequence. When instructed by the CM, transport the core samples and core boxes within the Site for storage;
5. Hand over the steel container rooms and the core samples contained therein to the CM upon completion of the Contract;
6. When Instructed, dispose of the core samples and core boxes upon completion of the Contract.

PRE.B10.324.9 TAKING OVER OF CONTAINER STOREROOMS

1. Take over …… No. existing steel container storerooms and the core samples contained therein;
2. As directed by the CM, dispose of the core samples and core boxes prior to completion of the Contract.

PRE.B10.330.9 CONTAINER CURING ROOMS AND TANKS

Where in-situ concreting works is to be carried out on Site and forms part of the permanent Works, provide sufficient numbers of steel container rooms and steel curing tanks for storing and curing test cubes to the satisfaction of the CM. Take note that:

1. A standard curing tank of nominal size 1650 x 860 x 510 mm will be deemed to have a capacity to accommodate one hundred eighty 100 mm concrete cubes;
2. For curing tanks with different nominal sizes, the number of required curing tanks may be estimated on the basis of the capacity for a standard curing tank of equivalent volume at the discretion of the CM, who will require appropriate adjustments in the pump and heater capacities;
3. A standard steel container room of nominal size 6000 x 2500 x 2350 mm may accommodate up to a maximum of five standard curing tanks;
4. Each curing tank must be accessible, and at least one spare curing tank must be provided at all times for cleaning purpose;
5. Concreting work will not be allowed to commence until curing tanks and steel container rooms have been completed and accepted by the CM;
6. A wall mounted switch panel on the external face of each curing room, with indication light and due protection against inclement weather and accidental damage, must be provided for ensuring the proper functioning of all electrical curing facilities at all times.

PRE.B10.335.9 STEEL CONTAINERS FOR TEST SAMPLES OF BAR REINFORCEMENT/FABRIC REINFORCEMENT

As directed by the CM, provide …… lockable steel containers, …… of nominal size 1500 x 600 x 600 mm high and …… of nominal size 1500 x 150 x 1500 mm high, securely adhered to the curing room, for the exclusive use of the CM or his appointed Direct Testing Contractor.

PRE.B10.340.9 STEEL CONTAINER ROOM SPECIFICATION

Equip each steel container room with the following:

1. A security door lock;
2. Windows with security metal grilles;
3. Fluorescent lighting;
4. Reversible air conditioner. Keep the air temperature kept at 27°C ± 5°C for curing test cubes in moulds.

PRE.B10.350.9 STEEL CURING TANK

1. Construct each curing tank of galvanized sheet steel to BS EN ISO 1461:2009 for hot-dip galvanized coating, fully welded on all seams and equip with the following accessories:
   a. A lockable insulated lid or cover properly numbered;
   b. A recirculating water pump and a standby pump both of waterproof types and with capacities not less than 1000 litres per hour, earthed and fitted internally at one end of the tank drawing the water through a pipe from the bottom to the diagonally opposite top of the tank at least 25 mm above the water level to stimulate efficient mixing of the water by free falling;

c. A thermostatically controlled electric immersion heater and a standby heater both with wattage of not less than 3 kW and connected with a temperature sensor for continual monitoring of the water temperature at 27°C ± 3°C;

d. A set of three removable lower racks;

e. Two layers of removable racks (ten removable racks per layer) suspending from the sides of the tank;

f. A drainage valve and an overflow system;

g. A steel stand supporting the water tank;

h. Minimum/maximum thermometers for both air and water temperatures;

i. A thermograph for continual recording of the water temperature;

j. Comply with all other requirements for a curing tank as stated in Appendix A of CS1:2010 (Construction Standard for Testing Concrete).

2. Notwithstanding sub-clause (1)(i) above, if a thermograph is proposed for two or more curing tanks, submit for Approval:

a. Details of the water circulating system including the provision of a central water closet to the curing tanks;

b. Measurement records by an Approved laboratory showing efficient mixing of the water to attain a temperature of 27°C ± 3°C in the circulating system under working environment.

PRE.B10.360.9 CURING TANK MAINTENANCE

Clean each tank at regular intervals and change the water in each tank at least once a month in accordance with CS1:2010 and as directed by the CM. In order to provide adequate circulation of water and to facilitate the removal of test cubes from the curing tank, provide at least 15 mm of water horizontally between test cubes and the sides of the tank.

PRE.B10.370.9 CURING RECORDS

Record the daily maximum and minimum moist air and water curing temperatures and keep the records on site at all times for the inspection of the CM.

PRE.B10.380.9 ACCESS BY DIRECT TESTING CONTRACTOR

Where directed by the CM, allow Direct Testing Contractor's sole access and use of the curing room and curing tanks together with all the equipment provided under the Contract.

PRE.B10.390.9 ACCOMMODATION MAINTENANCE

Provide attendance including regular cleaning, lighting and power and maintenance to container rooms and curing tanks.

SITE EQUIPMENT FOR THE CM AND CM'S REPRESENTATIVES

PRE.B10.410.9 EQUIPMENT GENERALLY

1. Take note that, unless otherwise specified, the equipment described in this sub-section must be new and is required from the notified date for commencement of the Works to the date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the whole, including such additional periods as may be necessary for completion of any work within the Maintenance Period, after which the equipment shall revert to the Contractor;

2. Provide maintenance by the original supplier and equivalent substitute equipment during any period when the equipment so provided is taken out of service for calibration, maintenance, repair or similar servicing;
3. Provide all consumables necessary to the function and operation of each item of equipment during the period specified in sub-clause (1) above.

PRE.B10.420.A BASIC OFFICE EQUIPMENT

1. Provide all necessary office equipment, including but not limited to the following:

    a. ..... colour copier-printer-scanner-facsimile equipment with adequate supply of paper and other consumables like printer ink cartridges.
    b. One projector for conference room:
        i. Native Resolution: 1280 x 800;
        ii. Color reproduction: Full color, 16.77 million colors;
        ii. Brightness: 4200 lumens (Color and Whtie Brightness);
        iii. Interfaces: Video, computer and HDMI connections.
    c. One projector screen for conference room:
        i. View Area: 120-inch (Diagonal);
        ii. Screen Fabric: Matte white;
        iii. Height adjustable.
2. The colour copier-printer-scanner equipment shall be networked with driver installed in networked PCs to provide functions of printer and scanner in addition to photocopying function. The specification for the colour copier-printer-scanner equipment is as follows:
    a. Copier:
        i. Copy speed: not less than 20 copies per minute;
        ii. Resolution: up to 600 dpi;
        iii. Multiple copies: up to 999;
        iv. Zoom: 25 - 400%;
        v. Paper input capacity: 2 x 500-sheet paper trays, 1 x 100-sheet bypass trays;
        vi. Paper output capacity: not less than 1,500 sheets;
        vii. Paper size: A3 to A5.
    b. Printer:
        i. Print speed: not less than 20 prints per minute;
        ii. Resolution: 600 dpi minimum.
    c. Scanner:
        i. Scan speed: not less than 40 originals per minute;
        ii. Resolution: up to 1,200 dpi;
        iii. Original size: A3 to A5;
        iv. Output format: PDF, JPEG, TIFF & high compression PDF.
    d. Fax:
        i. Original size: Original size: A3 to A5;
        ii. Coding method: MMR, MR, MH, JBIG;
        iii. Transmission speed: 33.6 kbps;
        iv. Memory: 12MB;
        v. Dual fax / Network fax: Yes;

vi. Transmission log or report.

PRE.B10.430.X DELETED

PRE.B10.450.9 PASS EQUIPMENT

1. Within 6 weeks from the notified date for commencement of the Works, provide for the use of the CM and his representatives a set of new equipment as scheduled below for the duration of the Contract plus six months commencing from the date of the certificate of completion of the Works (or where phased completion of Sections is specified, the last date of completion stated amongst the different certificates of completion for the Sections of the Works) or the date of completion of all the outstanding works including variations thereon as ordered by the CM, whichever is the later;
2. Attach to the equipment an Identification Label and a Calibration Status Label;
3. Provide Calibration Certificates as listed below so as to satisfy the equipment calibration requirements of the ISO 9001;
4. Maintain and calibrate the equipment against the appropriate national and international standards at the interval as specified below;
5. Schedule of equipment:

	Description	Calibration Certificate	Calibration Interval
a.	1 No. Portable Dial Thermometer, model ELE EL45-5342, stem length 300 mm, measuring range 0 to 250 degrees Celsius, graduate in 5 degrees division.	Required	1 year
b.	1 No. Anodising Meter, model ELCOMETER 300SP (Stats/Printer) A300FNP23 for ferrous and non-ferrous bases with Standard Probe, T30076531 9 volt rechargeable Battery and charger, 240V 13 Amp BS Plug, model T96086030 Elcometer Data Collection Software 3.5 inch English, model T3007892 300 to IBM interface lead.	Required	1 year
c.	1 No. Digital Caliper, equivalent to model MITUTOYO 500 series, range 0 – 150 mm.	Required	1 year
d.	1 No. Digital Measurement Probe, type DKS-35, 3 m * 5 section, measurable range 845-3000 mm, 1 mm graduation.	Required	1 year
e.	1 No. Steel Plumb Bob, weight 650 gram, with string.	Not required	-------
f.	1 No. Steel Measuring Tape, 30 m long.	Required	1 year
g.	10 No. Steel Measuring Tape, pocket size, 3.5 mm long	Required	1 year
h.	1 No. Steel Carpenters Level 300 mm long, KOD brand, model L-160Q-300.	Not required	Reversible test before use

i. 1 No. Steel Carpenters Level 600 mm long, KOD brand, model L-160Q-600.	Not required	Reversible test before use
j. 1 No. Steel Carpenters Level 1200 mm long, KOD brand, model L-160Q-1200.	Not required	Reversible test before use
k. 1 No. Wire Brush.	Not required	-------
l. 1 No. Feeler Gauge complete set.	Required	1 year
m. 1 No. 300 mm Engineers' Try Square, Model No 12EM, Stanley	Required	1 year
n. 1 No. Binoculars	Not required	-------
o. 1 No. Test Sieves, full height, stainless frame with stainless steel plain wire mesh to BS410, Diameter 300mm, aperture 300 microns, depth 75mm complete with certificate of conformity.	Required	1 year
p. 1 No. Micrometer, equivalent to model MITUTOYO 293 series, range 0 – 25.4 mm.	Required	1 year
q. 1 No. Moisture Meter (pinless type), equivalent to model WAGNER MMC220, measure wood moisture content from 4% to 32% to a depth of 3/4".	Required	1 year
r. 1 No. Moisture Meter (pin type), equivalent to model BES Bollmann Easy, measure wood moisture content from 6% to 44%".	Required	1 year

PRE.B10.465.D EQUIPMENT FOR DEVELOPMENT AND CONSTRUCTION SITE MOBILE SYSTEM (DCSMS) AND HOUSING SMART INTAKE (HOST) SYSTEM

Option 1:

1. Provide all necessary equipment and sufficient stable wireless network (4G) and mobile broadband internet access including service plan charges to fulfil the function requirements for the Development and Construction Site Mobile System (DCSMS) maintained by the Employer for inspection of building works, building services works, foundation works, structural works, and inspection of works at off-site casting yard, structural materials testing request, accident / incident reporting, submission and agreement of site operation documents, status update of defects rectification works after intake and for the Housing Smart Intake (HOST) system for follow up action of defects reporting after intake as follows:
   a. …… smartphone sets within one month after the notified date for commencement of the Works;
   b. …… additional smartphone sets for final flat-to-flat inspection at the time instructed by the CM. The required service duration for these additional smartphone sets shall be …… months. Re-deploy the smartphone sets to Intake Ambassadors after intake to carry out duties via HOST system.
   c. …… additional smartphone sets for inspection of works at off-site casting yard for precast concrete components at the time instructed by the CM. The required service duration for these additional smartphone sets shall be throughout the production period of the precast concrete components.

2. Each smartphone set shall comprise a smartphone installed with a 4G SIM card and networked with wireless connection to the server for DCSMS at the Hong Kong Housing Authority Headquarters. The specification for the smartphone is tabled as follows:

a. Operating System	Android 11.0 or above Non-rooted
b. Screen Size	6.0 inches or above
c. Display	Resolution (pixel): 2220 x 1080 – 2340 x 1080 Capacitive and Multi-touch
d. Dimension	Height <= 6.4 inches Width <= 3.1 inches Thickness <= 0.4 inches
e. Weight	190 g or below
f. CPU	CPU core: –8 or above Frequency: 1.8 GHz or above
g. Memory (RAM)	4 – 6 GB
h. Memory (Storage: ROM)	64 – 128 GB
i. Primary Camera	Image Resolution: 12M pixel or above Features: Autofocus, Flash
j. Network	Cellular Network: 4G LTE 1800 / 2300 / 2600 UMTS 850 / 900 / 2100 GSM 900 / 1800 Wi-Fi: 802.11 b/g/n/ac or more Bluetooth: 4.0 or above
k. Tracking / Positioning	A-GPS
l. Battery	Can serve > 10 hours (3G Talk time) Spare battery for battery detachable smartphone or External battery pack as required
m. Accessories	With protection case With Anti-glare Screen Protector

3. Unless otherwise stated, the required service duration for the smartphone sets in sub-clause (1)(a) shall be up to the date of six months after the date of certified completion of the Works and the required service duration for the smartphone sets in sub-clause (1)(b) shall be up to the end of Intake Ambassador's engagement period, which is of approximately nine months after the date of certified completion of the Works. Nevertheless, no claim for extra costs shall be entertained even if the ultimate engagement period shall exceed the aforesaid period.

Option 2:

1. Provide all necessary equipment and sufficient stable wireless network (4G) and mobile broadband internet access including service plan charges to fulfil the function requirements for the Development and Construction Site Mobile System (DCSMS) maintained by the Employer for inspection of foundation works and structural works, structural materials testing request, accident / incident reporting, and submission and agreement of site operation documents as follows:

a. …… smartphone sets within one month after the notified date for commencement of the Works.

2. Each smartphone set shall comprise a smartphone installed with a 4G SIM card and networked with wireless connection to the server for DCSMS at the Hong Kong Housing Authority Headquarters. The specification for the smartphone is tabled as follows:

a. Operating System	Android 11.0 or above Non-rooted
b. Screen Size	6.0 inches or above
c. Display	Resolution (pixel): 2220 x 1080 – 2340 x 1080 Capacitive and Multi-touch
d. Dimension	Height <= 6.4 inches Width <= 3.1 inches Thickness <= 0.4 inches
e. Weight	190 g or below
f. CPU	CPU core: 8 or above Frequency: 1.8 GHz or above
g. Memory (RAM)	4 – 6 GB
h. Memory (Storage: ROM)	64 – 128 GB
i. Primary Camera	Image Resolution: 12M pixel or above Features: Autofocus, Flash
j. Network	Cellular Network: 4G LTE 1800 / 2300 / 2600 UMTS 850 / 900 / 2100 GSM 900 / 1800 Wi-Fi: 802.11 b/g/n/ac or more Bluetooth: 4.0 or above
k. Tracking / Positioning	A-GPS
l. Battery	Can serve > 10 hour (3G Talk time) Spare battery for battery detachable smartphone or External battery pack as required
m. Accessories	With protection case With Anti-glare Screen Protector

3. Unless otherwise stated, the required service duration for the smartphone sets shall be up to the date of six months after the date of certified completion of the Works.

PRE.B10.470.9 UNINTERRUPTIBLE POWER SUPPLY

1. Provide ……. No. Uninterruptible Power Supply (UPS) for the CM or his representatives to protect the computer equipment installed in the site office for the duration of the Contract plus six months commencing from the date of the certificate of completion, and for other longer period as instructed by the CM for the necessary completion of the Works and /or additional works within the Maintenance Period;
2. The UPS shall comply with the following minimum requirements:
   a. Output Power Capacity: 700 Watts/1000VA;
   b. Nominal Input/Output Voltage: 230V;
   c. Backup Time: able to support 15 minutes or more at half load.

PRE.B10.480.9 CAMERAS

1. Provide …… No. of new digital camera for the use of the CM and his representatives for the duration from the date of commencement of the Works up to six months after the date of certified completion of the Works;
2. The new digital camera shall comply with the following:
   a. Be equipped with memory card of not less than 2G and flashes together with batteries and any other consumables required for the cameras and flashes;
   b. Size of the camera: small;
   c. Optical resolution of the camera: 5M pixels or above.

PRE.B10.485.9 BROADBAND LINE AND NETWORKING

1. Provide …..No. of broadband line for the use of the CM and his representatives for the duration from the date of commencement of the Works up to six months after the date of certified completion of the Works;
2. The broadband line shall comply with the following:
   a. Unlimited 24 hours internet service access through Internet Service Provider (ISP) via broadband line with minimum 3M connected individually to each of the computer systems provided by the CM, equipped with security hardware / software systems to protect the computer systems from hackers / unauthorized intruders. The internet service shall be solely used by the computer systems provided by the CM only;
   b. Networking to connect each of the computer equipment provided by the CM. The broadband router or switch used to connect the network to the ISP must support Virtual Private Network (VPN) using IPSec technology;
   c. Maintenance and support under an agreement between the Contractor and the original supplier for all equipment so provided for the internet service;
   d. All necessary training, manuals and instructions for operating the internet service as directed by the CM or his representatives.

PRE.B10.490.9 COVER METER

Provide one cover meter of Approved make for the exclusive use of the CM and his representatives

PRE.B10.500.9 REBOUND HAMMER AND ACCESSORIES

1. Provide and maintain ……..... set of rebound hammer and accessories, all complying with BS EN 12504-2:2001 or ASTM C805-02 and comprise the following:
   a. Rebound hammer:
      i. Be spring driven steel hammer manufactured by PROCEQ SA or equivalent Approved;
      ii. Of a type suitable for testing normal concrete of strength up to 70N/mm² unless otherwise instructed by the CM.
   b. Abrasive stone;
   c. Steel reference anvil:
      i. Be hardened steel material weighing at least 16kg;
      ii. To have a guide tube which is compatible with the rebound hammer in hardness and dimension provided in sub-clause (a).
2. Carry out calibration and submit the calibration certificate in accordance with PRE.B8.1480 and PRE.B8.1490.

PRE.B10.520.9 EQUIPMENT MAINTENANCE

Provide attendance, consumables and bear all running costs, maintenance and repair charges and all other expenses in connection with the use of equipment provided for the CM and his representatives.

SITE EQUIPMENT FOR THE CM'S LAND SURVEY TEAM

PRE.B10.530.A PROVISION OF SURVEY EQUIPMENT

1. Within 6 weeks from the notified date for commencement of the Works, provide and maintain instruments and equipment for the CM's Land Survey Team as follows:
   a. Survey Equipment

Equipment	Quantity	Unit
i. Total Station and Total Station Accessories		
a. The Total Station shall have a valid calibration certificate and shall be under valid maintenance services for the duration of the Contract or the duration of the piling works as appropriate. The specifications of the Total Station are:	1	Set
a. Distance accuracy (prism mode): equal to or better than (1 mm + 1.5 ppm);		
b. Distance accuracy (reflectorless mode): equal to or better than (3 mm + 2 ppm);		
c. Angular accuracy: equal to or better than 3";		
d. Keyboard with touch screen and colour display;		
e. With Total Station container and user manual;		
f. With data conversion software to generate GSI format data for the CAD application software (i.e. Microstation MX V8i; AutoCAD 2011 or the latest version to be approved by the CM).		
b. Total Station Accessories:		
g. Tribrach for the Total Station;	1	No.
h. Battery for the Total Station;	2	Nos.
i. Battery Charger;	1	No.
j. External Flash memory card;	2	Sets
k. Circular Prism, in container with holder and target plate;	2	Sets
l. Tribrach with optical plummet and carrier set for the Circular Prism;	2	Sets
m. Reflector pole, telescopic with circular bubble, cm graduation, extends 2 sets to 2.15 m and the 1 m extension pole;	2	Sets

n. Mini Prism and mini reflector pole with circular bubble;	2	Nos.
o. Wooden Tripod.	3	Nos.
ii. Digital Level and Accessories a. Digital Level shall have a valid calibration certificate and shall be under valid maintenance services for the duration of the Contract or the duration of the piling works as appropriate. The specifications of the Digital Level are: p. Standard deviation with invar staff equal to or better than 0.3 mm/km; and with aluminium staff equal to or better than 1.0 mm/km; q. Measurement programs: aBFFB, BFFB, BF and aBF; r. Electronic measurement range: equal to or better than1.8-100 m.	1	Set
b. Accessories of the Digital Level		
s. Container and User Manual;	1	Set
t. Battery for the Digital Level;	2	Nos.
u. Battery Charger;	1	Set
v. Memory Card;	2	Nos.
w. Ground Plate;	2	Nos.
x. Aluminium Staff, Dual faces, 4.0 m;	2	Nos.
y. Aluminium tripod.	1	No.
iii. 10 mm wide Nylon Coated Steel Tape (30 m) with accuracy equal to or better than ± 3.2 mm in 30 m.	1	No.

b. Consumables

i. Plumb bobs, red clothes, pegs, stakes, strings, paints, chart paper, etc. as necessary for field surveying work.
ii. Stationery items and computer consumable items, e.g. CD-ROM and DVD ROM, printer toner cartridges and printer papers etc. as necessary for data processing and storage.

c. One new digital camera as per PRE.B10.480.

2. The survey equipment listed in sub-clause (1)(a) shall be:
   a. not necessarily new so long as a valid calibration certificate of the instrument issued by an approved laboratory is provided;
   b. of specified source or equivalent;
   c. compatible with each other;
   d. covered by valid calibration certificate issued by approved laboratory;
   e. maintained by the service agent and calibrated by an approved laboratory annually;

   The Contractor shall be responsible for payment of all costs for maintenance of equipment and instruments listed in this clause.
3. Provide equivalent replacements when the equipment listed in sub-clause (1)(a) is out of services;

4. The survey equipment shall be reverted to the Contractor at the completion of the Contract or the completion of the piling works as appropriate.

PRE.B10.540.9 COMMUNICATION SYSTEM

1. Provide 4 sets of portable transceivers and accessories, including batteries and chargers, and hand free speaker microphone with spring belt clip for transmission and reception of clear messages between the transmitter/receiver in the CM's principal office and all parts of the Site;
2. The portable transceivers shall have a range suitable for use on Site and be subject to CM's approval;
3. Maintain all licences and permissions for the portable transceivers necessary for use with the radio communication system.

SERVICES FOR THE CM AND CM'S REPRESENTATIVES

PRE.B10.580.A CONTRACT TECHNICAL ASSISTANTS

1. When Instructed, employ the following Contract Technical Assistant(s) (hereinafter referred to as CTA) for the exclusive use of the CM or his representatives:
   a. __ (__No.) full time Contract Technical Assistant(s) (Structural) (hereinafter referred to as CTA(S));
   b. __ (__No.) full time Contract Technical Assistant(s) (Architectural) (hereinafter referred to as CTA(A));
   c. __ (__No.) full time Contract Technical Assistant(s) (Building Services) (hereinafter referred to as CTA(BS));
   d. __ (__No.) full time Contract Technical Assistant(s) (Building Works) (hereinafter referred to as CTA(BW));
   e. __ (__No.) full time Contract Technical Assistant(s) (Building Services Site) (hereinafter referred to as CTA(BSS));
   f. __ (__No.) full time Contract Technical Assistant(s) (Works Supervisor) (hereinafter referred to as CTA(WS)).
2. CTA should not be considered as an employee or agent of the Government of the Hong Kong Special Administrative Region or the Hong Kong Housing Authority. The deployment of any CTA by the Contractor with the Hong Kong Housing Authority shall in no way relieve the Contractor from any liability as the employer of the CTA, either under this Contract or at law;
3. When Instructed, submit the recruitment advertisement for Approval, place the recruitment advertisement, check qualifications of the candidate(s), obtain previous employers' references and provide all related administrative support and submit to the CM within 21 days from date of Instruction a shortlist of suitable candidate(s) with all associated information. The number of candidate(s) to be shortlisted shall be decided by the CM. The shortlisted candidate(s) shall be considered by representatives of the CM. The candidate(s) to be employed shall be those as instructed by the CM;
4. Qualification and Experience:
   a. The CTA(S) shall possess at least a Diploma or Higher Certificate in either Civil or Structural Engineering from the Hong Kong Polytechnic University or an institute of vocational education which acceptability is subject to CM's confirmation, or equivalent as accepted by the CM, and with experience in drafting and preparation of structural drawings together with good knowledge of Building Regulations and Code of Practices. Possession of proficient skill in AutoCAD and EXCEL applications is preferred;

b. The CTA(A) shall possess at least a Diploma or Higher Certificate in either Building Studies or Architectural Studies from the Hong Kong Polytechnic University or an institute of vocational education which acceptability is subject to CM's confirmation, or equivalent as accepted by the CM, and with good skill and experience in AutoCAD drafting and preparation of architectural drawings together with good knowledge of Building Regulations and Code of Practices. Possession of proficient skills in Photoshop, 3D and PowerPoint applications are preferred;

c. The CTA(BS) shall possess at least a Diploma or Higher Certificate in either Building Services, Electrical or Mechanical Engineering from the Hong Kong Polytechnic / Polytechnic University or an institute of vocational education which acceptability is subject to CM's confirmation, or equivalent as accepted by the CM, and with good skill and experience in AutoCAD drafting, preparation of building services drawings, carrying out design calculations together with good knowledge of statutory Regulations and Code of Practices relating to building services trades;

d. The CTA(BW) shall possess at least a Diploma or Higher Certificate in either Building Studies, Civil or Structural Engineering from the Hong Kong Polytechnic University or an institute of vocational education which acceptability is subject to CM's confirmation, or equivalent as accepted by the CM, and with experience in construction field. Possession of proficient skill in WORD, EXCEL applications are preferred;

e. The CTA(BSS) shall possess at least a Diploma or Higher Certificate in either Building Services, Electrical or Mechanical Engineering from the Hong Kong Polytechnic / Polytechnic University or an institute of vocational education which acceptability is subject to CM's confirmation, or equivalent as accepted by the CM, and with experience in inspection of building services works. Possession of good knowledge in personal computer applications is preferred;

f. The CTA(WS) shall:

i. Possess at least a Certificate in Construction or Building Studies from the Hong Kong Polytechnic University / Polytechnic, the Hong Kong Institute of Vocational Education or technical institute / technical college, or equivalent which acceptability is subject to CM's confirmation, or equivalent as accepted by the CM;

ii. Meet the language proficiency requirements of Level 2 or above in Chinese Language and English Language in the Hong Kong Diploma of Secondary Education Examination (HKDSEE) or Hong Kong Certificate of Education Examination (HKCEE), or equivalent. 'Grade E' in Chinese Language and English Language (Syllabus B) in previous HKCEE is accepted administratively as comparable to 'Level 2' in Chinese Language and English Language in the 2007 HKCEE and henceforth. Possession of proficient skill in WORD, EXCEL applications is preferred.

5. Conditions of Employment:

a. Duration - The period of employment of the CTA and the probationary period of employment shall be determined by the CM. The period of employment shall be normally within the period between the notified date for commencement of the Works to the expiry of the Maintenance Period unless otherwise Instructed;

b. Place of duty - The CTA shall work in the Housing Authority Headquarters or in any other office of the Housing Department / Hong Kong Housing Authority or in any site office or other locations at the discretion of the CM;

c. Duties:

i. The duties of the CTA(S) shall be in accordance with Clause PRE.B10.581 of the Specification;

ii. The duties of the CTA(A) shall be in accordance with Clause PRE.B10.582 of the Specification;

iii. The duties of the CTA(BS) shall be in accordance with Clause PRE.B10.583 of the Specification;

iv. The duties of the CTA(BW) shall be in accordance with Clause PRE.B10.584 of the Specification;

v. The duties of the CTA(BSS) shall be in accordance with Clause PRE.B10.585 of the Specification;

vi. The duties of the CTA(WS) shall be in accordance with Clause PRE.B10.586 of the Specification.

d. Office Hours - The normal office hours of the CTA(S), CTA(A) and CTA(BS) are either (i) from 08:30 to 17:18 or (ii) from 08:57 to 17:45, Monday to Friday as determined by the CM. The normal office hours of the CTA(BW), CTA(BSS) and CTA(WS) are from 08:00 to 18:00 Monday to Friday. The office hours may be subject to changes to follow the general office hours of the Housing Department upon CM's written instruction;

e. Annual Leave with Pay - The CTA shall be entitled to annual leave of a total of 14 working days with pay for every 12 months period of continuous employment or part thereof on a pro rata basis. Where the period of employment is less than 12 months, the CTA shall be entitled to the same benefit of annual leave on a pro-rata basis to the period of employment except that if the CTA is being dismissed within the probationary period, the CTA shall not be entitled to any annual leave with pay;

f. Leave - For any anticipated leave of a CTA longer than 14 consecutive working days, whether annual leave, sick leave, maternity leave or study leave, etc., provide a temporary CTA to take up the role of CTA during the leave period if it is required by the CM. The temporary CTA shall be subject to Approval;

g. Performance - The Housing Department / Housing Authority officers supervising the works of the CTA may provide feedback / comments on the performance of the CTA to the Contractor. Such officer may give suitable counselling and advice if the performance of a CTA is considered unsatisfactory. The CTA will be warned of the consequence of failing to improve within a specified period. The CM shall inform the Contractor of any persistent unsatisfactory performance of the CTA for remedial action or replacement if the situation so warrants. For a CTA who has neglected or wilfully refused to perform his duties, the CM may instruct the Contractor to replace the CTA in accordance with sub-clause (5)(n) below. Do not replace any CTA without the prior consent of the CM;

h. Insurance, MPF & Others for CTA of disciplines described in PRE.B10.580 (1)(a) or (1)(b) or (1)(c) - Comply with the statutory requirements such as those stipulated in the Employment Ordinance and Employee's Compensation Ordinance and bear all costs and expenses in connection with the employment of the CTA including but not limited to administration charges, financial charges, arrangement of and paying premium for employees' compensation insurance policy, the monthly contribution for the employee's selected scheme registered under the Mandatory Provident Fund (MPF) Schemes Ordinance, arrangement of and paying premium for medical insurance scheme, etc.. Detailed insurance requirements are set out at APPENDIX.PRE.B10/VI;

i. Insurance, MPF & Others for CTA of disciplines described in PRE.B10.580 (1)(d) or (1)(e) or (1)(f) - Comply with the statutory requirements such as those stipulated in the Employment Ordinance and Employee's Compensation Ordinance and bear all costs and expenses in connection with the employment of the CTA including but not limited to administration charges, financial charges, arrangement of and paying premium for employees' compensation insurance policy and public liability insurance policy, the monthly contribution for the employee's selected scheme registered under the Mandatory Provident Fund (MPF) Schemes Ordinance, arrangement of and paying premium for medical insurance scheme, etc.. Detailed insurance requirements are set out at APPENDIX.PRE.B10/VI;

j. Remuneration - A fixed monthly salary, which shall not be changed, unless otherwise Instructed, within the employment period of a CTA, shall be designated and instructed by the CM at the time of employment of the CTA. The CTA shall also be entitled to payment for the designated extra hours of overtime working, which fall outside the normal office hours in sub-clause (d), pursuant to sub-clause (k) below. The fixed monthly salary shall be exclusive of bonuses, gratuities, payment for the designated extra hours of overtime working pursuant to sub-clause (k) below and other fringed benefits such as medical attention, dental treatment, housing and education allowances, etc.. For the avoidance of doubt, the fixed monthly salary and the payment for the designated extra hours of overtime working pursuant to sub-clause (k) below shall be subject to local taxation and is inclusive of the employee's monthly contribution but exclusive of the employer's monthly contribution to the employee's selected scheme registered under the Mandatory Provident Fund (MPF) Schemes Ordinance;

k. Working Outside Stipulated Working Hours – For CTA(S), CTA(A), CTA(BS), CTA(BW) and CTA(BSS), the number of extra hours of working, if any, required from the CTA shall be notified by the CM from time to time in consideration of the workload requirements. Such designated extra hours of overtime working as notified by the CM shall be either for a total of 20, 30 or 40 hours and be paid for at rates designated and instructed by the CM at the time of employment of the CTA. There shall be no extra payment to the CTA for any work rendered outside the office hours as stipulated in sub-clause (d) and the designated extra hours of overtime working as notified by the CM. When further extra hours of overtime working of the CTA are required by the CM to meet project requirements and programme, such further extra hours of overtime working worked by the CTA may be compensated by time off in lieu subject to Approval. For CTA(WS), the number of extra hours of working, if any, required to be rendered by the CTA(WS) shall be notified by the CM from time to time in consideration of the workload requirements. Each extra hour of overtime working as notified by the CM shall be entitled to hourly payments but subject to maximum limit of 20 hours per month. Any further hours of overtime working in excess of 20 hours per month shall be compensated by time off in lieu. The rate of hourly payments shall be designated by the CM at the time of employment of the CTA(WS);

l. Work other than the employment under this Contract - The CTA must not engage in any work or employment other than in performance in connection with this Contract, with or without remuneration, which could create or potentially give rise to a conflict or a perceived conflict between their personal / financial interests with the interest of the Housing Department / Hong Kong Housing Authority. Any infringement of this sub-clause shall be a valid ground for replacement of the CTA;

m. Code of Conduct - As a particular application of the principles set out in GCC Clauses 4.4 and 5.30 in respect of a CTA's services, the CTA must comply with the Code of Conduct and the Confidentiality Undertaking set out at Appendices APPENDIX.PRE.B10/I and APPENDIX.PRE.B10/V respectively and sign the appropriate declarations and forms at Appendices PRE.B10.APPEND2, PRE.B10.APPEND4 and PRE.B10.APPEND5 as Instructed. The Contractor shall make sure that, as his employee, the CTA must not disclose any such information related to his work with the Housing Department / Hong Kong Housing Authority to any person including but not limited to the Contractor. Information in this context refers to, but is not limited to, public housing development programmes, project / construction programmes, design, drawing information, etc.. This provision shall survive the termination of CTA's employment. Any infringement of this sub-clause shall be a valid ground for replacement of the CTA;

n. Replacement of CTA - Do not replace any CTA without the prior consent of the CM. Replace the CTA when Instructed. The Contractor shall arrange for the recruitment and employment of a replacement CTA in accordance with sub-clauses (1) to (5) immediately after the Instruction for replacement of the CTA, unless otherwise Instructed. Inform the CM immediately when the employment is terminated by the CTA. Any payment in lieu of notice shall be deducted from or added to, as the case may be, the Contract Sum;

o.

i. The Contractor shall, before entering into an employment contract with the prospective Resident Site Staff, require the prospective Resident Site Staff to submit a declaration (sample attached at Appendix PRE.B10.APPEND10) to declare whether or not the prospective Resident Site Staff has been convicted of offences under the Prevention of Bribery Ordinance, Cap 201 and the Theft Ordinance, Cap 210, the offence of conspiracy to defraud, and the offence of misconduct in public office, and whether or not he / she has been terminated for employment as a Resident Site Staff. Such submission by the prospective Resident Site Staff shall be a condition precedent for employment;

ii. The Contractor shall make clear to the prospective Resident Site Staff that the information contained in the declaration shall be disclosed to the Hong Kong Housing Authority, Government policy bureaux and departments and obtain the consent of the prospective Resident Site Staff;

iii. The Contractor shall submit the declaration made by the prospective Resident Site Staff to the CM at least one week prior to offering employment to the prospective Resident Site Staff. The information in the declaration shall be taken into account in considering whether the Contractor's proposal for the Resident Site Staff employment should be approved;

iv. The Contractor shall terminate the employment of the Resident Site Staff who has given false information in the declaration or is convicted of offences under the Prevention of Bribery Ordinance, Cap 201 and the Theft Ordinance, Cap 210, the offence of conspiracy to defraud, and the offence of misconduct in public office, during employment. Such provision for termination should be included in the employment contract of the Resident Site Staff.

6. After the employment of the CTA, deliver to the CM a copy of his employment contract, certified true by a director of the Contractor, to substantiate that the employment conditions in sub-clause (5) above, including in particular the fixed monthly remuneration and the rates for the designated extra hours of overtime working receivable by the CTA, are fully complied with;

7. At the end of each period of interim certificates stated in the Appendix to the Form of Tender, deliver to the CM:
   a. a "Monthly Statement for Payment of CTA" for endorsement by the CM based on the sample at Appendix PRE.B10.APPEND9 showing all CTA employed under the Contract, with details of each CTA's working period, extra hours of overtime working required by the CM and information of leaves taken by the CTA;
   b. other information as required by the CM for the relevant items in the Bills of Quantities for CTA.
8. Interim payments for the relevant items in the Bills of Quantities for CTA shall be valued and certified by the Surveyor only upon written confirmation and / or endorsement by the CM of the statement as referred to in sub-clause (7)(a).

PRE.B10.581.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (STRUCTURAL)

1. Duties and Responsibilities - The CTA(S) is responsible to the CM or other personnel as appointed by the CM for the following duties:
   a. To prepare, check and update structural drawings, sketches and details;
   b. To undertake the design of minor structural elements manually or by means of computer under the direction of the CM;
   c. To prepare site sketches for construction and amend structural drawings under the direction of the CM;
   d. To assist the CM or his representatives in carrying out tests and inspection of structural works on Site;
   e. To coordinate structural, civil, geotechnical, architectural and building services drawings;
   f. To liaise with professionals, technical officers and site staff of the Housing Department, consultants and contractors where appropriate, on matters related to the design and construction of the project;
   g. To prepare estimates, site instructions for construction for the CM;
   h. To assist with the research of building materials for use in the Contract and where applicable, their costs and sources of supply;
   i. To arrange for printing and distribution of drawings among Housing Authority Headquarters, ICU, other offices outside Headquarters and site offices to ensure smooth transmission of drawings;
   j. To assist in updating as-built record drawings;
   k. To assist in processing application for Excavation Permit;
   l. To perform other duties as directed by the CM.
2. Problem-solving and Decision-making - The CTA(S) must be capable of handling technical problems arising from site difficulties and / or discrepancies in drawings and where appropriate referring such matters to the CM for direction. He shall also be capable of making decisions to resolve simple technical matters that do not require professional expertise;
3. The CTA(S) shall be for exclusive and sole use of the CM and his representatives for any project at the discretion of the CM.

PRE.B10.582.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (ARCHITECTURAL)

1. Duties and Responsibilities - The CTA(A) is responsible to the CM or other personnel as appointed by the CM for the following duties:
   a. To prepare, check and update working drawings, submission drawings, presentation drawings, survey plans and schedules;

b. To update drainage disposal plans;
c. To check shop drawings and as-fitted drawings submitted by contractor, suppliers and utility companies;
d. To coordinate architectural, building services, structural, site formation, drainage, geotechnical and other drawings as necessary;
e. To liaise with professionals, technical officers and site staff of the Housing Department and contractor's representatives where appropriate, on matters related to the project;
f. To assist in the research of architectural/ building materials for use in the contract and where applicable, their costs and sources of supply;
g. To prepare, update record drawings and programme charts;
h. To compute site areas, plot ratio, etc.;
i. To take on-site measurement and prepare survey drawings;
j. To be responsible for the issue and receipt of drawings and to maintain a proper record of such;
k. To construct study models;
l. To arrange printing of drawings;
m. To perform other duties as directed by the CM.

2. Problem Solving and Decision Making - The CTA(A) must be able to handle technical problems arising from drawing preparation and site construction, and to refer such matters to the CM for direction. The CTA(A) must be able to make decisions on resolving simple technical matters which do not require professional expertise;
3. Coordination and Contact - The CTA(A) must be able to handle frequent contact with professional and technical staff of his team, staff of allied professions in the Housing Department, consultants and contractors;
4. The CTA(A) shall be for exclusive and sole use of the CM and his representatives for any project at the discretion of the CM.

PRE.B10.583.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (BUILDING SERVICES)

1. Duties and Responsibilities - The CTA(BS) is responsible to the CM or other personnel as appointed by the CM for the following duties:
   a. To prepare and update drawings for site variations;
   b. To undertake minor design work and to prepare sketches / drawings under the direction of the CM;
   c. To check shop drawings and as-fitted drawings submitted by contractors, suppliers and utility companies;
   d. To coordinate architectural, building services, structural and utility drawings;
   e. To liaise with professionals, technical officers and site staff of the Housing Department and contractor's representatives where appropriate, on matters related to the design and construction of the project;
   f. To assist with the research of building services materials for use in the contract and where applicable, their costs and sources of supply;
   g. To update record drawings and prepare management and programme charts;
   h. To be responsible for the issue and receipt of drawings and to maintain a proper record of such;
   i. To arrange printing and transfer of drawings;

j. To direct, supervise and control other junior CTA(BS)s, if any, under his charge and to responsible for the checking of drawings prepared by them to ensure compliance with instructions;

k. To handle technical problems arising from site difficulties and / or discrepancies in drawings and to refer such matters to the CM or his representatives for direction;

l. To resolve simple technical matters which do not require professional expertise;

m. To perform other duties as directed by the CM.

2. Problem Solving and Decision Making - The CTA(BS) must be able to handle technical problems arising from site difficulties and / or discrepancies in drawing and to refer such matters to the CM for direction. The CTA(BS) must be able to make decisions on resolving simple technical matters which do not require professional expertise;

3. Coordination and Contact - The CTA(BS) must be able to handle frequent contact with professional / technical / site staff of his team, staff of allied professions in the Housing Department, consultants and contractors;

4. The CTA(BS) shall be for exclusive and sole use of the CM and his representatives for any project at the discretion of the CM.

PRE.B10.584.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (BUILDING WORKS)

1. Duties and Responsibilities - The CTA(BW) is responsible to the CM or other personnel as appointed by the CM for the following duties:

a. To assist in the survey and inspection duties to identify defects & compile survey/ inspection reports/ records;

b. To assist the CM or his representatives in carrying out tests and inspection of structural works on Site;

c. To check site safety, security and environmental protection measures performed by contractors and report non-conformities;

d. To check drawing and other documents required for the execution of construction works;

e. To assist in coordination with Contractor for the arrangement of repairs of defects;

f. To assist in the reporting of progress and inspecting of defects rectification;

g. To assist in updating and keeping of site inspection records;

h. To assist in coordination with contractor and Estate Management Division etc. for defect rectification after intake of building/ flats;

i. To perform other duties as directed by the CM.

2. Problem-solving and Decision-making - The CTA(BW) must be capable of handling technical problems arising from site difficulties and/ or discrepancies in drawings and where appropriate referring such matters to the CM for direction. He shall also be capable of making decisions to resolve simple technical matters that do not require professional expertise;

3. The CTA(BW) shall be for exclusive and sole use of the CM and his representatives for any project at the discretion of the CM.

PRE.B10.585.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (BUILDING SERVICES SITE)

1. Duties and Responsibilities - The CTA(BSS) is responsible to the CM or other personnel as appointed by the CM for the following duties:

a. To carry out site supervision and inspection of all building services installations under construction and / or maintenance stages;

b. To liaise with other parties including Utility Undertakings and the public for the necessary execution and completion of the building services installations;
c. To perform routine and ad hoc inspection of all building services installations including trouble shooting and site matter recording;
d. To supervise and monitor site progress, quality and quantity of work and to feedback the performance of contractors to the CM or his representatives;
e. To check sample boards and materials for compliance with specifications and monitor the correct use of materials on Site;
f. To check drawings, programme against site condition and contract specifications;
g. To keep site drawings and documents updated;
h. To take measurement on Site and prepare survey drawings as necessary;
i. To perform other duties as directed by the CM.

2. Problem Solving and Decision Making - The CTA(BSS) must be able to handle technical problems arising from site difficulties and / or discrepancies in drawing and to refer such matters to the CM for direction. The CTA(BSS) must be able to make decisions on resolving simple technical matters which do not require professional expertise;
3. Coordination and Contact - The CTA(BSS) must be able to handle frequent contact with professional / technical / site staff of his team, staff of allied professions in the Housing Department, consultants and contractors;
4. The CTA(BSS) shall be for exclusive and sole use of the CM and his representatives for any project at the discretion of the CM.

PRE.B10.586.9 JOB SPECIFICATION FOR CONTRACT TECHNICAL ASSISTANT (WORKS SUPERVISOR)

1. Duties and Responsibilities - The CTA(WS) is responsible to the CM or other personnel as appointed by the CM for the following duties:
   a. To assist in the survey and inspection duties to identify defects & compile survey / inspection reports / records;
   b. To assist the CM or his representatives in carrying out tests and inspection of structural works, building works and plumbing works on Site;
   c. To check site safety, security and environmental protection measures performed by contractors and report non-conformities;
   d. To check drawing and other documents required for the execution of construction works;
   e. To assist in co-ordination with Contractor for the arrangement of repairs of defects;
   f. To assist in the reporting of progress and inspecting of defects rectification;
   g. To assist in updating and keeping of site inspection records;
   h. To assist in co-ordination with contractor and Estate Management Division etc. for defect rectification after intake of building / flats;
   i. To assist in the verification checking and testing of building / plumbing materials delivered to Site;
   j. To perform other duties as directed by the CM.
2. Problem-solving and Decision-making – The CTA(WS) must be capable of handling technical problems arising from site difficulties and / or discrepancies in drawings and where appropriate referring such matters to the CM for direction. He shall also be capable of making decisions to resolve simple technical matters that do not require professional expertise;
3. The CTA(WS) shall be for exclusive and sole use of the CM and his representatives for any project at the discretion of the CM.

SERVICES FOR THE CM AND CM'S LAND SURVEY TEAM

PRE.B10.590.9 SURVEY SUPPORT

1. Provide attendance including all labour, part-time experienced survey assistants, staging, ladders, wire ropes and the survey equipment, information and assistance required by the CM's representatives for checking or surveying works when required by CM under PRE.B9.130. When CM or his representatives are carrying out checking or surveying works, there should be at least 3 part-time and having at least 2 years construction site engineering survey experienced survey assistants supporting their works;
2. Programme the Works by taking into account the checking and surveying on foundation works carried out by the CM or his representatives.

TRANSPORT FACILITIES FOR THE CM, THE CM'S REPRESENTATIVES AND SITE STAFF

PRE.B10.610.B VEHICLE AND DRIVER

Option 1

A vehicle for the use of the CM and his representatives is not required for this Contract. The CM may direct vehicles provided under other Housing Authority contracts to visit this Site. Allow the entrance of such vehicles into the Site and provide suitable parking spaces within the Site for these vehicles.

Option 2

1. Provide ..... (no.) petrol vehicle(s) and ..... (no.) electric vehicle with driver(s) for the use of the CM and his representatives, any officials, employees, consultants or agents of the Housing Authority or the Housing Department or any persons authorized or permitted by the CM. The vehicle(s) will be used for any purposes in connection with this Contract or otherwise. The vehicle(s) shall revert to the Contractor upon the expiration of the period defined in sub-clause (2)(c) below;
2. Comply with the following requirements:
   a. Specification for petrol vehicle:
      i Vehicle design standard: meet the standards for private cars registered on or after 1 July 2017 of the Air Pollution Control (Vehicle Design Standards) (Emission) Regulations (Cap.311J) and shall not be diesel private cars;
      ii. Air conditioning: fitted;
      iii. Body type: saloon / estate;
      iv. Drive: two wheel / four wheel as directed by the CM;
      v. Seating capacity: not less than 5 (including driver);
      vi. Engine capacity: not less than 1600 c.c.;
      vii. Age of vehicle: not more than 30 months with certificate of good condition issued by an approved Car Examination Centre at the time of provision of the vehicle;
      viii. Mobile phone: to be issued to and carried by the driver.
   b. Specification for electric vehicle:
      i. Air conditioning: fitted;
      ii. Body type: saloon / estate / hatchback;
      iii. Seating capacity: not less than 5 (including driver);

iv. Power: a battery powered automobile which is solely propelled by electric motor(s) and has zero tailpipe emission;

v. Maximum Power: not less than 45kW;

vi. Maximum Torque: not less than 180 N-m;

vii. Driving range (in a single charge without operating the air-conditioning system): not less than 280 km tested under the New European Driving Cycle or relevant international / national driving test requirement;

viii. Charging method: equipped with on-board charger with rated capacity not less than 6kW. All necessary cables / accessories / couplers shall be capable of charging the vehicle battery pack with a medium charging via 220V single phase electric vehicle charger with output power of not less than 7kW, and shall comply with IEC 62196 (or SAE J1772);

ix. Battery performance: able to deliver the specified electric range in a single charge during the whole period of use;

x. Age of vehicle: not more than 30 months with certificate of good condition issued by an approved Car Examination Centre at the time of provision of the vehicle;

xi. Mobile phone: to be issued to and carried by the driver.

c. Period of provision:

From the notified date for commencement of the Works to the date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the Works, but in the event that there are works remaining uncompleted after such date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the Works, the said period of provision shall be extended until all of the said outstanding works have been completed in accordance with this Contract within the Maintenance Period;

d. Availability:

Make the vehicle(s) available for use during the following periods:

i. Normal working hours and such other times when the Contractor is working;

ii. Outside the times stated in sub-clause (2)(d)(i) above when requested by the CM for emergency situations, for the discharge of his or her duties, or for other purposes as may be authorized or permitted by the CM.

e. Licence and insurance:

i. The vehicle(s) shall be properly licensed;

ii. Provide a fully comprehensive insurance policy for the vehicle(s) as private car(s) under the ownership of the Contractor. The insurance policy shall provide insurance protection to passengers of the vehicle(s) and any third parties and to any use of the vehicle(s) pursuant to sub-clause (1) and sub-clause (2)(d) above;

iii. Present the insurance policy and submit a written confirmation of compliance of the insurance policy of the vehicle(s) with this Specification clause from the insurer or the insurance broker / agent, to the Surveyor, as soon as practicable but in any event no later than the notified date for commencement of the Works.

f. Records of vehicle journeys:

i. Ensure that the driver for each vehicle institutes and maintains a record of the use of the vehicle. Such a record, in the form of a log book, shall include, inter alia, details, times and purpose of journeys together with appropriate meter readings and distances travelled. The driver is required to ensure that the person using the vehicle or authorising the journey signs his name and title against the entries;

ii. Obtain log books from the CM. Ensure the driver presents current log books for inspection when so required by the CM and hand over all completed log books to the CM for safe keeping.

g. Vehicle maintenance:

i. Maintain vehicle(s) in clean and roadworthy condition and bear costs of fuel, electricity, running cost, maintenance and repair charges and other incidental items;

ii. Provide an equivalent substitute or form of transport during any period when the vehicle(s) above is / are not available, or out of service for maintenance or repair.

Option 3

1. Provide a vehicle with driver for the use of the CM and his representatives, any officials, employees, consultants or agents of the Housing Authority or the Housing Department or any persons authorized or permitted by the CM. The vehicle will be used for any purposes in connection with this Contract or otherwise. The vehicle shall revert to the Contractor upon the expiration of the period defined in sub-clause (2)(b) below;
2. Comply with the following requirements:
   a. Specification:
      i. Vehicle design standard: meet the standards for private cars registered on or after 1 July 2017 of the Air Pollution Control (Vehicle Design Standards) (Emission) Regulations (Cap.311J) and shall not be diesel private cars;
      ii. Air conditioning: fitted;
      iii. Body type: saloon / estate;
      iv. Drive: two wheel / four wheel as directed by the CM;
      v. Seating capacity: not less than 5 (including driver);
      vi. Engine capacity: not less than 1600 c.c.;
      vii. Mobile phone: optional;
      viii. Age of vehicle: not more than 30 months with certificate of good condition issued by an approved Car Examination Centre at the time of provision of the vehicle.
   b. Period of provision:

      From the notified date for commencement of the Works to the date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the Works, but in the event that there are works remaining uncompleted after such date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the Works, the said period of provision shall be extended until all of the said outstanding works have been completed in accordance with this Contract within the Maintenance Period;
   c. Availability:

      Make the vehicle available for use during the following periods:

i. Normal working hours and such other times when the Contractor is working;

ii. Outside the times stated in sub-clause (2)(c)(i) above when requested by the CM for emergency situations, for the discharge of his or her duties, or for other purposes as may be authorized or permitted by the CM.

d. Licence and insurance:

i. The vehicle shall be properly licensed;

ii. Provide a fully comprehensive insurance policy for the vehicle as private car under the ownership of the Contractor. The insurance policy shall provide insurance protection to passengers of the vehicle and any third parties and to any use of the vehicle pursuant to sub-clause (1) and sub-clause (2)(c) above;

iii. Present the insurance policy and submit a written confirmation of compliance of the insurance policy of the vehicle with this Specification clause from the insurer or the insurance broker / agent, to the Surveyor, as soon as practicable but in any event no later than the notified date for commencement of the Works.

e. Records of vehicle journeys:

Obtain log sheets, DLAP-F046, from the CM at the commencement of the Contract, keep a record of the use of the transport and return the completed log sheets at completion of each Section of the Works;

f. Vehicle maintenance:

i. Maintain the vehicle in clean and roadworthy condition and bear costs of fuel, running cost, maintenance and repair charges and other incidental items;

ii. Provide an equivalent substitute or form of transport during any period when the vehicle above is not available, or out of service for maintenance or repair.

PRE.B10.620.9 BOAT AND BOATMAN

1. Provide boat and boatman for the exclusive use of the CM and his representatives to revert to the Contractor upon expiration of the period defined in sub-clause (2)(b) below;
2. Comply with the following requirements:

a. Specification:

i. Seating capacity .....;

ii. Engine capacity .....;

iii. Mobile phone: fitted;

iv. Canopy to provide weather protection;

v. Pager: to be issued to and carried by boatman.

b. Period of provision:

From the notified date for Commencement of the Works to the date stated in the Certificate of Completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the whole, including such additional periods as may be necessary for the completion of any outstanding work within the Maintenance Period;

c. Availability:

Make the boat available for use at reasonable times during the following periods:

i. Normal working hours and such other times when the Contractor is working;

ii. When requested by the CM for emergency situations, or for the discharge of his or her duties outside the times stated in sub-clause (2)(c)(i) above.

d. Licence and insurance: comply with maritime regulations properly licence and cover the boat by a fully comprehensive insurance policy with an endorsement in the policy expanding the definition of the passengers to include the CM and his representatives and all personnel from the Housing Department or from Consultants engaged by the Authority in connection with official visits to the Authority's sites. Present this policy to the Surveyor, when requested, for verification;

e. Records of boat journeys:

i. Ensure that the boatman institutes and maintains a record of the use of the boat. Such a record, in the form of a log book, shall include, inter alia, details, times and purpose of journeys together with appropriate meter readings and distances travelled. The boatman is required to ensure that the person using the boat, or authorising the journey, signs his name and title against the entries;

ii. Obtain log sheets AL-F046 from the CM. Ensure the boatman presents current log sheets for inspection when so required by the CM and hand over all completed log books to the CM for safe keeping.

f. Boat maintenance:

i. Maintain boat in clean and seaworthy condition and comply with any relevant maritime regulation;

ii. Bear costs of fuel and other incidental items;

iii. Provide an equivalent substitute form of transport during any period when the boat above is not available, or taken out of service for maintenance or repair.

PRE.B10.630.9 SHUTTLE BUS AND DRIVER

1. Provide …… (no.) vehicle(s) with driver(s) for the CM and his representatives, Labour Relations Officer (LRO), Site Staff, and other person as authorized by the CM commuting between Site.....and the designated point(s) ……..The location of the designated point(s) may be subject to change as directed by the CM to suit the actual usage and any site constraints. The Contractor is to make due allowance for such change;
2. Comply with the following requirements:
   a. Specification:
      i. Must be environment-friendly commercial vehicles which are type-approved by Environmental Protection Department (EPD) or for which EPD has issued "Environment-friendly Commercial Vehicle Certificates", or other commercial vehicle subject to approval by the CM if the environment-friendly commercial vehicle is not readily available in the market;
      ii. Air conditioning:fitted;
      iii. Seating capacity: …….. seaters (not including driver);
      iv. Age of vehicle: not more than 30 months with a certificate of good condition issued by an approved Vehicle Examination Centre acceptable to the Transport Department.
   b. Period of provision:

From the date which shall be a day within the period of two months from the notified date for commencement of the Works to the date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the Works, but in the event that there are works remaining uncompleted after such date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the Works, the said period of provision shall be extended until all of the said outstanding works have been completed in accordance with this Contract;

c. Availability:

Make the vehicle(s) available for use during the following periods excluding travelling time:

i. 7:30am to 8:30am; (Monday to Saturday);

ii. 12:00 noon to 1:30pm; (Monday to Saturday);

iii. 5:00pm to 7:00pm; (Monday to Saturday).

d. Licence and insurance:

i The vehicle(s) shall be registered under the Transport Department with a 'passenger service licence – public bus service (employees' service)' with respect to the seating capacity stipulated in sub-clause (2)(a)(iii) above. Submit a copy of the receipt/acknowledge slip for the licence application issued by the Transport Department to the CM within two weeks from the notified date for commencement of the Works;

ii. The vehicle(s) shall possess the valid passenger service licence certificate(s) and the employees' service (A04) endorsement(s);

iii. The driver(s) shall be holder(s) of a valid passenger service licence with minimum 2 years passenger driving experience, no major misconduct in driving in the past 2 years and not more than 5 points deduction in driving-offence point at the time of enrolment. A replacement driver with equivalent licence and experience shall be made available when necessary;

iv. Provide a fully comprehensive insurance policy for the vehicle(s), which shall provide insurance protection to passengers of the vehicle(s) and any third parties and to any use of the vehicle(s) pursuant to clause (1) and sub-clause (2)(c) above. Present this policy to the Surveyor, when requested, for verification.

e. Record of vehicle journeys:

Ensure that the driver for each vehicle institutes and maintains a record of the use of the vehicle. Obtain log books, from the CM on the date of commencement of the Works and present for inspection when so required by the CM;

f. Vehicle maintenance:

i. Maintain vehicle(s) in clean and roadworthy condition and bear costs of fuel, running cost, maintenance and repair charges and other incidental items;

ii. Provide an equivalent substitution or form of transport during any period when the vehicle(s) above is/are not available, or out of service for maintenance or repair.

HOARDINGS AND GANTRIES

PRE.B10.710.B HOARDINGS AND GANTRIES GENERALLY

Option 1

In addition to the requirements of GCC Clause 5.11(3):

1. Provide temporary fencing, barriers, guard rails, gangways, walkways, fans, lighting, and the like for protecting the public and others during the proper execution of the Works including warning notices in English and Chinese characters;
2. Where excavation works are undertaken in occupied estates, protect the public by Approved interlocking steel barriers and signs reading "Danger - Keep away" in English and Chinese characters.

Option 2

For the purpose of clauses PRE.B10.710 to *PRE.B10.720 / PRE.B10.730, the term "hoardings" shall be deemed to include footings, catch platforms, gantries, covered walkways, all necessary lighting and elements associated with hoardings where appropriate.

In addition to the requirements of GCC Clause 5.11(3):

1. Prepare trial trenches where appropriate or as directed by the CM to ensure that the existing underground utilities and fence wall footings are not in conflict with the hoarding erection;
2. Provide temporary fencing, barriers, guard rails, gangways, walkways, fans, lighting, and the like for protecting the public and others during the proper execution of the Works including warning notices in English and Chinese characters. Contractor's emergency contact persons with telephone numbers shall be posted up at site hoarding prominent location(s);
3. Employ a RSE and, where applicable, a RGE to:
    a. Certify the safety or stability of the existing hoardings taken over from previous contractor for submission to the CM in accordance with PRE.B10.720; and / or
    b. Prepare the design calculations, construction details and drawings and method statements where appropriate for the hoardings for submission to the CM for approval in accordance with PRE.B10.730.
4. Ensure that:
    a. There are no gaps or holes in hoardings, etc. which would allow illegal entry;
    b. The number of entrances and exits to the Site are kept to a minimum or as indicated on the Drawings;
    c. Gates are provided to all entrances and exits and ensure that all gates are locked outside working hours;
    d. No parts of the fencings, hoardings, covered walkways and gantries, including their footing, should affect the existing preserved trees within the Site or adjoining the Site. The Contractor shall provide all means of protective and remedial measure to the affected trees.
5. Completely erect all hoardings, etc. prior to the commencement of any demolition work. Do not commence any asbestos removal work until approved by the CM and the relevant portion(s) of the Site is / are fully enclosed by fencing, hoardings, etc. from unauthorized entry;
6. Upon the commencement of the Works, provide and maintain temporary external lighting including electricity supply along the hoardings and fencing to the periphery of the Site;
7. Where excavation works are undertaken in occupied estates, protect the public by Approved interlocking steel barriers and signs reading "Danger - Keep away" in English and Chinese characters;
8. When any Section of the Works is nearing completion or a certificate of completion has been given for any Section of the Works, provide all necessary additional hoardings, temporary fencing, barriers, guard rails, gangways, walkways, fans, lighting, and the like including warning notices and direction signs in English and Chinese characters;

9. Paint all new and existing perimeter hoardings and fencing and provide sign writing and graphics in gloss finish all as directed by the CM;
10. In the event that the hoardings have to be modified to suit the works progress, site condition or any work to be executed by other Government departments or Utility Undertakings, or in the event of any amendment to the design submission for hoardings as described in PRE.B10.720 and / or PRE.B10.730, which includes but not limited to the alignment or the structural details of the existing and / or new hoarding is required:
    a. Submit three sets of revised details and drawings, and design calculations where necessary, which shall be certified by the RSE and, where applicable, the RGE, showing the modification and / or details of amendment, which may due to change in member size, span length, imposed loadings, or capacity of members, etc. for the CM's approval. If the position of the gantry or run-in / run-out is changed, a copy of the memorandums of no objection or no comment obtained from each of TD, HyD and other Government departments shall be provided, unless otherwise agreed by the CM;
    b. Provide continuous temporary hoarding or chain-link fence of sufficient strength and of height not less than 2 m high at the outer periphery of the Site or at suitable locations to prohibit unauthorised entry;
    c. Where there is the need for the hoardings, etc. to be temporarily dismantled or opened up to allow works to proceed:
        i. Re-erect the hoardings etc. to close all gaps or openings, so as to reinstate the continuity and integrity of the same; or
        ii. If re-erection of the hoardings as described in sub-clause (10)(c)(i) above is not possible and / or where gap(s) in hoardings or fencing must exist, the gap(s) shall not be wider than 4m. Post security guard to station at all the gap(s) to keep close surveillance of the entire area at all times, and provide adequate flood lights to light up the aforesaid areas at night time; or
        iii. Propose any other measures for approval by the CM.
    d. Obtain approval of the CM to commence modification works at least ..... days before commencement of the modification works. The CM's permission will not be granted before the design submission for hoardings mentioned in sub-clause (10)(a) above, if applicable, have been Approved;
    e. Bear all associated costs and the extra time required for such modification.
11. Submit safety certificate to the CM as stipulated in PNAP APP-23 for existing hoardings erected by previous contractor on the date of possession of the Site or relevant Portion(s) of the Site, regardless of whether such existing hoardings will be modified afterwards. Submit subsequent annual safety certificates not less than 7 days before each anniversary of the date of issue of the hoarding permit for the subsequent year(s) for the newly erected hoardings / existing hoardings modified by previous contractor with or without modification. The annual safety certificates shall be signed by the RSE to certify the safety and the stability of the hoardings and, where applicable, signed by the RGE to certify that the stability of any nearby slopes or retaining wall is not adversely affected (supporting documentation may be required if significant signs of distress or failure of the slope / wall in question have been noted);

12. Further to sub-clause (11) above, submit within 7 days upon completion of the newly erected hoardings / modification of the existing hoardings erected by previous contractor, a safety certificate to the CM. The safety certificate shall be signed by the RSE to certify the safety of the hoardings and, where applicable, signed by the RGE to certify that the stability of any nearby slopes or retaining wall is not adversely affected (supporting documentation may be required if significant signs of distress or failure of the slope / wall in question have been noted). For the existing hoarding with modification carried out, an assessment report signed by the RSE shall be submitted with the safety certificate and, where applicable, shall also be signed by the RGE. The assessment report shall include strengthening / modification works as considered necessary to ensure structural and geotechnical, if applicable, adequacy and stability of the hoardings. Bear all associated costs and the extra time required for complying with these requirements;
13. Renewal and reuse of components of hoardings dismantled from other HA's contract(s), excluding bolts and nuts, such as concrete footings with / without cast-in bolts, structural steel posts, beam sections, channel sections, angle bracings, saddle rings, railings, corrugated metal sheets, etc. are permitted subject to the CM's approval and compliance with the following conditions:
    a. Corrugated metal sheets to be reused shall be free from excessive burrs and dents, and qualified by the squareness and rigidity of the sheets ready to be affixed to the structural frames;
    b. Structural steel members to be reused shall be free from distortion. Assembled components shall be true and square for the plumbing, levelling and alignment of the hoarding system;
    c. Metal parts to be reused shall be adequately protected from excessive rusting, cleaned and repainted for the provision of new sign writing where necessary;
    d. Cut away and make good cracked or defective concrete footing with new concrete properly bonded to the old at the Contractor's own cost.
14. Hoardings shall be properly and adequately lit at night in accordance with PNAP APP-23;
15. Hoardings shall not obscure sightline of the road users, traffic signs and signals, CCTV and shall not obstruct access to any manholes, inspection chamber, draw-pit and Means of Escape, Means of Access and Emergency Vehicular Access.

PRE.B10.720.9 TAKING OVER EXISTING HOARDINGS

1. Take over existing hoardings erected by previous contractor around the area as indicated on the layout drawing no. ..... Preparation of the design submission for hoardings shall be carried out as described in sub-clauses (2) and (3) below;
2. Employ a RSE and, where applicable, a RGE to certify safety and stability of the existing hoardings for submission to the CM. The RSE shall ensure that the hoarding works are structurally safe and are in compliance with the provisions of the Buildings Ordinance during progress of the Works. The RSE and RGE shall assume full responsibility in connection with the hoarding works under the Buildings Ordinance;
3. Submit the annual safety certificate / safety certificate in accordance with sub-clauses (11) and (12) of PRE.B10.710;
4. The Contractor shall:
    a. Alter where necessary, repair and maintain all the hoardings in good condition during progress of the Works;
    b. Leave the hoardings on Site for use by subsequent contractors or remove them as directed by the CM at the Contractor's own cost and time.

PRE.B10.730.A NEWLY ERECTED HOARDINGS

1. Provide hoardings around the Site as indicated on the layout drawing no .....;

2. Drawings nos. ..... show the minimum member sizes and dimensions of the hoardings and are for reference only. The Contractor shall be responsible for the design of the hoardings to suit the site conditions as revealed by trial trenches and site inspection. Preparation of the design submission for hoardings shall be carried out as described in sub-clause (3) below;
3. Employ a RSE and, where applicable, a RGE to prepare the design calculations, construction details and drawings and method statements for the hoardings for submission to the CM for approval. The RSE shall ensure that the hoarding works are structurally safe and are in compliance with the provisions of the Buildings Ordinance during progress of the Works. The RSE and RGE shall assume full responsibility in connection with the hoarding works under the Buildings Ordinance;
4. The Contractor shall:
   a. Alter where necessary, repair and maintain all the hoardings in good condition during progress of the Works;
   b. Leave the hoardings on Site for use by subsequent contractors or remove them as directed by the CM at the Contractor's own cost and time.
5. Allow at least 30 days to obtain approval and consent of the CM for the design submission for hoardings before the commencement of hoarding works;
6. In the event that the Contractor decides to erect the hoardings according to the hoarding details shown in drawing nos. ..... provided in Appendix U to this Specification before obtaining the CM's approval on the design submission for hoardings, apply for the CM's consent at least 7 days before the commencement of the hoarding works. The CM's consent will not be given unless the Contractor undertakes the following:
   a. A RSE and, where applicable, a RGE have been employed by the Contractor to prepare the design calculations and construction details and method statements for the hoardings for submission to the CM for approval in accordance with sub-clause (3) above;
   b. Approval by the CM on the design submission for hoardings as required in sub-clause (3) above must be obtained before completion of the hoarding works;
   c. Bear all associated costs and the extra time required arising from any disapproval of the design submission for hoardings by the CM, and any modifications of the hoarding works as may be required by the CM after completion of the hoarding works;
   d. Bear all associated costs and the extra time required for complying with this sub-clause (6).

PRE.B10.740.9 GATES AT VEHICULAR INGRESS / EGRESS FOR TRAFFIC CONTROL

1. Provide an electrically-operated gate system at vehicular ingress / egress points of the hoardings and covered walkways fronting public footpaths, including gantries to control vehicular and pedestrian flow across footpath. Operate the gate system (including vehicular gates and pedestrian gates) by a single action. The pedestrian gates shall be closed before the vehicular gates are opened for ingress / egress of vehicles; and the vehicular gates shall be closed before the pedestrian gates are opened for pedestrian passage at the site vehicular entrance. Refer to drawing no. REF/SS/GA/SK-01 in Appendix U to this Specification for reference only. Submit detail drawings of the electrically-operated gate system for the CM's approval;
2. The Registered Professional Engineer registered under the Engineers Registration Ordinance within the discipline of mechanical engineering shall certify the design and installation of the gate system and proper functioning of the safety devices such that no person or objects shall be trapped during operation of the gates;
3. Station security guards as required under PRE.B12.880 at the vehicular ingress / egress point to operate the gate system, direct the crossing pedestrians, and control the vehicles entering or leaving the Site;
4. Install the gate system with the following warning / safety devices and ensure their function and safe operation:

a. Flashing amber lights and audible alarms activated automatically when the gate is in operation under the control of the security guards posted at the vehicular ingress / egress point;

b. The warning devices shall be visible and audible to the pedestrian crossing the vehicular ingress / egress points;

c. The movement of the gate shall be controlled by continuous pressure type push buttons or switches, i.e. the motion would persist only if the button or switch is being continuously pressed or held on manually. Each button or switch shall be suitably coloured and indicated corresponding to its function;

d. At least one emergency stop push button shall be provided adjacent to the gate in a conspicuous position to immediately stop the movement of the gate. Emergency stop buttons shall each have a large red mushroom head and be suitably labelled in both English and Chinese;

e. The terminal stopping of the gate shall normally be effected by limit switches. The limit switches shall be robust in construction and suitable for outdoor operation;

f. At both ends of the travel, mechanical end stoppers shall be provided to prevent the gate from over-travel;

g. Safety devices shall be provided for protection against accidental damage to passing objects or injury to persons such that the movement of the gate system could be stopped immediately and the gate system shall immediately be capable of manually operated to relieve the grip on the passing object or person when an obstruction is detected;

h. A simple manual release device shall be incorporated in the driving unit to release the gate from its locked position under power failure or emergency conditions. When the gate system is released from its locked position, it shall be capable of being moved manually by an adult. An instruction for use of the manual release device shall be posted in a conspicuous position adjacent to the drive unit. The instruction shall be properly protected for durable use and frequent reference. The security guard responsible for operation of the gate system shall be trained on the use of the manual release device. Instructions shall be provided in English and Chinese;

i. All associated electrical equipment shall comply with the relevant safety standard. The electrical wiring work shall comply with the requirements of the Electricity Ordinance (Cap. 406) and its associated Regulations. In particular, all metal work of the installation shall be properly earthed.

5. Paint the gates in contrasting colours for clear identification;
6. Provide sign(s) at prominent locations in Chinese and English to alert the existence of the gate system, describe how it works, and inform the steps for the pedestrians to follow when the gate system is in operation;
7. Provide a floor mark / line preferably with simple wordings in both Chinese and English on both sides of the ingress / egress point to alert the pedestrians to keep clear of the closing gates when the gate system is in operation;
8. Repair and maintain the gate system and associated warning / safety devices in good working condition till the date of certified completion of the Works as far as practicable, and in any case the gate system and associated warning / safety devices could be dismantled within 3 - 6 months prior to the date of certified completion of the Works and as approved by the CM, unless otherwise proposed by the Contractor and agreed by the CM;
9. Ensure that the gate system and the warning / safety devices are re-installed and in operation in the event of any location change of the gantries or openings at hoardings or covered walkways;
10. Leave the gate system and associated warning / safety devices on the Site for use by subsequent contractors, or remove them as directed by the CM at the Contractor's own cost and time.

PRE.B10.750.9 TAKING OVER EXISTING GATES AT VEHICULAR INGRESS / EGRESS FOR TRAFFIC CONTROL

1. Take over existing gate system and associated warning / safety devices and signs;
2. Station security guards as required under PRE.B12.880 at the vehicular ingress / egress point to operate the horizontal gate system, direct the crossing pedestrians, and control the vehicles entering or leaving the Site;
3. Repair and maintain the gate system and associated warning / safety devices in good working condition till the date of certified completion of the Works as far as practicable, and in any case the gates and associated warning / safety devices could be dismantled within 3 - 6 months prior to the date of certified completion of the Works and as approved by the CM, unless otherwise proposed by the Contractor and agreed by the CM;
4. Ensure that the gate system and the warning / safety devices are properly re-installed and in operation in the event of any location change of the gantries or openings at hoardings or covered walkways;
5. Leave the gate system and associated warning / safety devices on the Site for use by subsequent contractors, or remove them as directed by the CM at the Contractor's own cost and time.

SCAFFOLDING (BAMBOO AND METAL) AND SCREENS

PRE.B10.810.A SAFETY REGULATIONS AND REQUIREMENTS FOR SCAFFOLDING ETC

In addition to complying with the requirements of GCC Clause 5.11 and the statutory regulations, comply with the following:

1. CoP for Bamboo Scaffolding Safety issued by LD;
2. Guidelines on the Design and Construction of Bamboo Scaffolds issued by BD;
3. Guidelines on Planking Arrangement for Providing Working Platforms on Bamboo Scaffolds issued by CIC;
4. Guide on Construction and Work Safety of Truss-out Bamboo Scaffolds issued by LD;
5. Specification clauses in connection with the provision of bamboo scaffolds and its associated walkways, gangways, sloping catch fans, safety nets, protective canopies and the like;
6. CoP for Metal Scaffolding Safety issued by LD;
7. Specification clauses in connection with the provision of metal scaffold and its associated working platforms, gangways, runs, ladders together with guard-rails, toe-boards and the like in lift well.

PRE.B10.820.A DESIGN OF SCAFFOLDING SYSTEM

1. Accept responsibility for the design of the scaffolding system. The submission to the CM of such design or amendment shall not relieve the Contractor of any duty or responsibility under the Contract. Refer to PRE.B10.010 sub-clauses (6) and (7) for the certification requirement of QE;
2. Refer to the CoPs and Guidelines mentioned in PRE.B10.810 and the Drawings provided under the Contract in connection with the provisions of the scaffolding system for the design, installation, management, inspection, maintenance and dismantling requirements for safety. The supporting system, structural layout, connections, and the like, as shown therein, are indicative only and only serve as guidelines in the design of such works;

3. When the recommendations for typical scaffolding system in the CoPs and Guidelines mentioned in PRE.B10.810 cannot be followed, the design of the scaffolding system shall be on a performance-based approach carried out by a professional engineer to the satisfaction of the CM;
4. Provide effective bonding system to earth, and suitable protective equipment such as insulation mats to the metal scaffold;
5. Comply with all design requirements stipulated in this Clause and PRE.B10.830 to PRE.B10.980;
6. Professional Engineer

   The professional engineer referred to in sub-clause (3) above shall be a corporate member of the Hong Kong Institute of Engineers in the civil or structural discipline, and should have adequate training and experience, and be able to justify how and why the designed scaffold can safely resist the imposed loads in accordance with recognized engineering principles;
7. Use Suitable Materials as Gangway of Bamboo Scaffold

   Use either metal or wooden planks as gangway for bamboo scaffold. The Contractor shall consider the use of metal planks to promote lower risk of manual handling. In case metal planks are used, in order to prevent the hazard of electrical shock, install equipotential bonding if the metal plank fails to present an electrical conductivity resistance of 45000 ohms. The installation of equipotential bonding shall comply with all design requirements of the CoPs and Guidelines mentioned in PRE.B10.810 and Code of Practice for the Electricity (Wiring) Regulations regarding requirement of equipotential bonding and supplementary bonding to all extraneous conductive parts and other metal parts. Other materials are also accepted subject to the CM's prior approval.

PRE.B10.830.A ERECTION / ADDITION / ALTERATION / DISMANTLING OF BAMBOO SCAFFOLDING

1. Plan and implement the scaffolding works safely in compliance with the safety legislations;
2. If the erection, addition, alteration or dismantling of bamboo scaffolds is carried out by scaffolding companies with employees less than 50 persons, the companies shall be certified under OSH Star Enterprise - RMAA Safety Accreditation Scheme;
3. Carry out the erection, addition, alteration or dismantling of scaffolds by trained workmen under the immediate supervision of a competent person;
4. The following measures, which are not exhaustive, shall be taken when carrying out erection, addition, alteration or dismantling of bamboo scaffolds:
   a. Preparation and Planning Stage:
      i. Submit design calculation and detailed drawings to justify the safe working load, the anticipated wind loads, the arrangement of supporting brackets, steel ties and main members of the scaffolding;
      ii. Submit method statement, phasing of work particularly with different trades of workers and all essential information for the scaffolding work;

iii. Conduct a risk assessment, develop and implement safe working procedures, and provide full and proper fall protective equipment with fall arrestors and suitable anchorage points or independent lifelines. Each lifeline shall be used by one person only at any particular time and the anchorage point shall be as nearly to vertical as possible directly above the place of work to reduce the liability to swing. Use a second line to limit the swing where the possibility of swing in the event of fall is unavoidable. The extent of possible swing shall be as small as possible. In the event of fall, the person using the lifeline shall not hit any obstacle in the swing path. The suitable anchorage points and independent lifelines shall comply with relevant international safety standards;

iv. Appoint competent person and trained workmen;

v. For a scaffold equal to or greater than 15m in height, arrange a professional engineer as defined in the CoP for Bamboo Scaffolding Safety to design before erection;

vi. For a scaffold less than 15m in height, if more than 2 consecutive layers of working platforms are used at the same time at any bay for light duty purpose or more than 1 working platform for heavy duty purpose, arrange a professional engineer as defined in the CoP for Bamboo Scaffolding Safety to verify the stability of the scaffold before erection;

vii. Designate the location for temporary storage of bamboo members;

viii. Formulate the method of temporary storage and fastening of bamboo members to prevent dislocation or falling down of members.

b. Erection Stage:

i. Comply with method statement and safety precautionary measures derived from risk assessment;

ii. Enclose the works area with display of warning notice;

iii. Provide safety equipment for bamboo scaffolders, e.g. safety helmet, safety harness and anchor point. Ensure proper use of such equipment by bamboo scaffolders;

iv. Paint putlogs (metal ties) of a scaffold in bright red colour and affix warning signs to putlogs for alerting workers not to make any alteration to scaffold and putlogs without the CM's approval. The signs shall display the words "DANGER: DO NOT ALTER SCAFFOLD & PUTLOG) 危險: 不可改動棚架及連牆器)" in red on a white background. The height of each letter / Chinese character on the signs shall not be less than 20mm;

c. Arrange a competent person to inspect scaffold within 14 days immediately preceding each use of scaffold, to inspect scaffold after exposure of scaffold to such weather conditions as heavy rain, storm, etc. which are likely to have affected its strength or stability and to complete Form 5 (Appendix I of the CoP for Bamboo Scaffolding Safety);

d. Addition / Alteration / Dismantling Stage:

i. Comply with method statement and safety precautionary measures derived from risk assessment for addition / alteration / dismantling of scaffold;

ii. Remove materials or debris from scaffold;

iii. Make good all damaged scaffold components before dismantling commences;

iv. Provide adequate members to support and stabilize the scaffold before removal of ties;

v. Arrange a competent person to check stability and strength of a scaffold at intervals in accordance with the CoP for Bamboo Scaffolding Safety;

vi. Ensure proper use of safety equipment by bamboo scaffolder, e.g. safety helmet, safety harness and anchor point;

vii. Enclose the works area with display of warning notice;

viii. Lower dismantled bamboo members, where practicable, with a lifting appliance or lifting gear that has been examined;

ix. Lower all dismantled bamboo members immediately without leaving them on scaffold;

x. Arrange a competent person to inspect and sign Form 5 (Appendix I of the CoP for Bamboo Scaffolding Safety) after extension, partial dismantling or alteration of scaffold;

xi. Start dismantling from upper level to lower level, from exterior to interior and from non load-bearing parts to load-bearing parts;

xii. Allow sufficient time for the dismantling work to be conducted safely;

xiii. The scaffold to be dismantled shall be fenced off at ground level / public area to prevent persons from entering the work area and warning notices shall be posted up in the vicinity;

ix. Paint putlogs (metal ties) of a scaffold in bright red colour and affix warning signs to putlogs for alerting workers not to make any alteration to scaffold and putlogs without the CM's approval. The signs shall display the words "DANGER: DO NOT ALTER SCAFFOLD & PUTLOG 危險: 不可改動棚架及連牆器)" in red on a white background. The height of each letter / Chinese character on the signs shall not be less than 20mm.

e. Truss-out Bamboo Scaffold:

i. For scaffolds erected above building entrance or exit, provide protective canopy such as rakers or frame supports for protection from falling objects;

ii. Maintain the width of working platform at not less than 400mm;

iii. Maintain the width of working platform for moving materials at not less than 650mm;

iv. Metal brackets shall not be installed horizontally;

v. Scaffold shall not be tied to pipes of gas supply or other building services.

5. Provide the trained workmen with sufficient information, instruction, training and supervision regarding safety of work at heights;

6. Scaffolds shall not obstruct the removal of table-forms, large panel formwork components or small panel metal formwork components;

7. At locations where the facade walls are pre-fabricated and cladded with finishing, scaffold may not be required, but maintain provisions of protective canopy (PRE.B10.860) and overhead protection (PRE.B10.870);

8. Competent Person

The competent person referred to in sub-clause (3) & (4) above shall have acquired substantial training and possess practical experience as specified in the CoP for Bamboo Scaffolding Safety and Guidelines mentioned in PRE.B10.810. The competent person who immediately supervises scaffolding works shall not actively engage in carrying out such work;

9. Trained Workmen

The trained workmen referred to in sub-clauses (3), (4) & (5) above shall have acquired the requisite training and possess practical experience as specified in the CoP for Bamboo Scaffolding Safety mentioned in PRE.B10.810. When a trained workman is newly employed, the Contractor shall verify the adequacy of the training and practical experience of such trained workman.

PRE.B10.835.B ERECTION / ADDITION / ALTERATION / DISMANTLING OF METAL SCAFFOLDING

1. The use of metal scaffolding is mandatory in case scaffolding is required for the construction of any part or parts of the Works. In the event that special circumstance arises which renders the Contractor unable to use the metal scaffolding, the Contractor may propose to use other types of scaffolding with justifications to the CM for approval;
2. Design, erect, maintain, add, alter and dismantle the metal scaffolding. Plan and implement the scaffolding works safely in compliance with the safety legislations;
3. The following measures, which are not exhaustive, shall be taken when carrying out erection, addition, alteration or dismantling of metal scaffolds:
   a. Preparation and Planning Stage:
      i. Submit design calculation and detailed drawings to justify the safe working load, the anticipated wind loads, the arrangement of supporting members, steel ties and main members of the scaffolding;
      ii. Submit method statement, phasing of work particularly with different trades of workers and all essential information for the scaffolding work;
      iii. Conduct a risk assessment, develop and implement safe working procedures, and provide full and proper fall protective equipment with fall arrestors and suitable anchorage points or independent lifelines. Each lifeline shall be used by one person only at any time and the anchorage point shall be as near to vertical as possible directly above the place of work to reduce the liability to swing. Use a second line to limit the swing where the possibility of swing in the event of fall is unavoidable. The extent of possible swing shall be as small as possible. In the event of fall, the person using the lifeline shall not hit any obstacle in the swing path. The suitable anchorage points and independent lifelines shall comply with relevant international safety standards;
      iv. Appoint competent person and trained workmen;
      v. Arrange a professional engineer as defined in the CoP for Metal Scaffolding Safety to design the scaffold before erection;
      vi. Designate the location for temporary storage of scaffold members;
      vii. Formulate the method of temporary storage and fastening of members to prevent dislocation or falling down of members.
   b. Erection Stage:
      i. Comply with method statement and safety precautionary measures derived from risk assessment;
      ii. Enclose the works area with display of warning notice;
      iii. Provide safety equipment for metal scaffolders, e.g. safety helmet, safety harness and anchor point. Ensure proper use of such equipment by metal scaffolders;

iv. Paint putlogs (metal ties) of a scaffold in bright red colour and affix warning signs to putlogs for alerting workers not to make any alteration to scaffold and putlogs without the CM's approval. The signs shall display the words "DANGER: DO NOT ALTER SCAFFOLD & PUTLOG) 危險: 不可改動棚架及連牆器)" in red on a white background. The height of each letter / Chinese character on the signs shall not be less than 20mm.

c. Arrange a competent person to inspect scaffold within 14 days immediately preceding each use of scaffold, to inspect scaffold after exposure of scaffold to such weather conditions as heavy rain, storm, etc. which are likely to have affected its strength or stability and to complete Form 5 (Appendix I of the CoP for Metal Scaffolding Safety);

d. Addition / Alteration / Dismantling Stage:

i. Comply with method statement and safety precautionary measures derived from risk assessment for addition / alteration / dismantling of scaffold;

ii. Remove materials or debris from scaffold;

iii. Make good all damaged scaffold components before dismantling commences;

iv. Provide adequate members to support and stabilize the scaffold before removal of ties;

v. Arrange a competent person to check stability and strength of a scaffold at intervals in accordance with the CoP for Metal Scaffolding Safety;

vi. Ensure proper use of safety equipment by metal scaffolders, e.g. safety helmet, safety harness and anchor point;

vii. Enclose the works area with display of warning notice;

viii. Lower dismantled scaffold members that have been examined, where practicable, with a lifting appliance or lifting gear that has been examined;

ix. Lower all dismantled members immediately without leaving them on scaffold;

x. Arrange a competent person to inspect and sign Form 5 (Appendix I of the CoP for Metal Scaffolding Safety) after extension, partial dismantling or alteration of scaffold;

xi. Start dismantling from upper level to lower level, from exterior to interior and from non load-bearing parts to load-bearing parts;

xii. Allow sufficient time for the dismantling work to be conducted safely;

xiii. The scaffold to be dismantled shall be fenced off at ground level / public area to prevent persons from entering the work area and warning notices shall be posted up in the vicinity;

ix. Paint putlogs (metal ties) of a scaffold in bright red colour and affix warning signs to putlogs for alerting workers not to make any alteration to scaffold and putlogs without the CM's approval. The signs shall have the words "DANGER: DO NOT ALTER SCAFFOLD & PUTLOG) 危險: 不可改動棚架及連牆器)" in red on a white background. The height of each letter / Chinese character on the signs shall not be less than 20mm.

4. Carry out the erection, addition, alteration or dismantling of scaffolds by trained workmen under the immediate supervision of a competent person;

5. Provide the trained workmen with sufficient information, instruction, training and supervision regarding safety of work at heights;

6. Scaffolds shall not obstruct the removal of table-forms, large panel formwork components or small panel metal formwork components;

7. At locations where the facade walls are pre-fabricated and cladded with finishing, scaffold may not be required, but maintain provisions of protective canopy (PRE.B10.860) and overhead protection (PRE.B10.870);
8. Competent Person

   The competent person referred to in sub-clauses (3) & (4) above shall have acquired substantial training and possess practical experience as specified in the CoP for Metal Scaffolding Safety mentioned in PRE.B10.810. The competent person who immediately supervises scaffolding works shall not actively engage in carrying out such work;
9. Trained Workmen

   The trained workmen referred to in sub-clauses (4) & (5) above shall have acquired the requisite training and possess practical experience as specified in the CoP for Metal Scaffolding Safety mentioned in PRE.B10.810. When a trained workman is newly employed, the Contractor shall verify the adequacy of the training and practical experience of such trained workman.

PRE.B10.840.9 SUPPORTS TO SCAFFOLDING

1. Provide firm and adequate supports to the scaffold at appropriate locations. If steel brackets are used as scaffolding supports, the vertical spacing between two layers of brackets should not exceed 6 floors. Alternatively the brackets spacing shall not exceed 8 floors if not more than 5 tiers of walkways/overhead covers are installed at any time between two layers of brackets;
2. Use T-shaped angle brackets as support for a truss-out scaffold. The horizontal spacing between the brackets shall not be larger than 1.3m. Support truss-out bamboo scaffolds by the structural elements of a building. The concrete strength of the structural element shall not be less than 25N/mm^2;
3. Fix the brackets with anchor bolts selected to fit for the base material of the wall and the drill holes shall be of suitable size. Install anchor bolts at a suitable spacing and at an appropriate distance from the edge of the wall, properly and securely in accordance with the manufacturer's instructions;
4. Do not use scaffolding members as supports for lifting appliances unless the scaffold has been designed for such purpose.

PRE.B10.850.9 ACCESS TO/EGRESS FROM SCAFFOLDING

1. Provide safe access/egress to and from the walkway to each wing at every floor of the building at locations to be agreed with the CM;
2. Fit the access/egress with middle and top railings at heights of 450 mm to 600 mm and 900 mm to 1150 mm respectively;
3. Provide steps or ramp where the level difference between top of access/egress and walkway is more than 300 mm, and provide railings if the level difference is more than 600 mm.

PRE.B10.860.B PROTECTIVE CANOPY

1. Design, build, maintain and remove after use temporary protective canopy of horizontal projected width 3600 mm (minimum) at the first floor level around the edges of the building except in locations where the concrete canopy is of width 3000 mm or more for the following buildings:
   a. Block ……;
   b. Block ……;
   c. Carport …….

2. Refer to Sketch no. STD/TPC/S/SK-001 for the indicative design of the temporary protective canopy. Such Sketch shows a plan of the canopy and typical sections consisting of timber boardings 20 mm (minimum) thick covered by a layer of galvanized metal sheeting 0.8 mm (minimum) thick as minimum requirements for the canopy;
3. Design the protective canopy in accordance with the Building (Construction) Regulations in Hong Kong and design codes satisfying such regulations, which shall be capable of sustaining the loadings as specified in sub-clauses (a) to (c) below. Submit the calculations and construction method statements, certified by the Qualified Engineer as stipulated in PRE.B6.060, to the CM:
   a. Live load of 1.5 kPa (minimum);
   b. Wind load calculated in accordance with the "CoP on Wind Effects in Hong Kong 2019" published by BD;
   c. Any other loads as appropriate.
4. Accept responsibility for the design of the protective canopy. The submission to the CM of such design or amendment shall not relieve the Contractor of any duty or responsibility under the Contract;
5. Complete the erection of the protective canopy no later than the seventh floor slabs have been cast;
6. Keep the temporary protective canopy clear of debris and do not overload it;
7. If scaffold is used, do not remove the temporary protective canopy before the removal of the scaffold;
8. Refer to PRE.B10.010 sub-clause (8) for the certification requirement of RSE.

PRE.B10.870.9 OVERHEAD PROTECTION

Provide overhead protection 500 mm wide at edges of slab immediately after removal of slab table-forms or slab formworks where overhead covers associated with the bamboo scaffold have not yet been erected.

PRE.B10.880.9 WALKWAY/WORKING PLATFORM AND COVER FOR FINISHING WORKS

1. Comply with the Guidelines on Planking Arrangement for Providing Working Platforms on Bamboo Scaffolds issued by CIC;
2. Where finishing or fitting work along sections of the external building facade is in progress, provide:
   a. 450 mm (minimum) wide walkway/working platform and overhead cover, continuous along the area being worked on, formed by 225 mm wide x 25 mm thick closed timber boardings;
   b. Toe-boards 200 mm (minimum) high at the side of the walkway/working platform from which a person or any object is liable to fall for more than 2 metres;
   c. 25 mm thick timber boardings for closing gaps of more than 25 mm width between edges of walkway / working platform and walls/slabs;
   d. Ensure that each board has a minimum of three supports and is adequately restrained at both ends. Additional supports are required depending on the distance between the supports so as to prevent sagging.
3. Provide a full overhead cover at the floor immediate above the walkway / working platform on which work or inspection is being carried out. The overhead cover may be temporarily removed to facilitate the ease of work execution, provided that a fully installed overhead cover is maintained immediate above the overhead cover that is wholly or partly removed.

PRE.B10.890.9 ACCESS/PROTECTION FOR THE CM AND HIS REPRESENTATIVES

Notwithstanding PRE.B10.880, provide and install walkway/overhead cover, at levels as directed by the CM for occasional inspection by the CM and his representatives.

PRE.B10.900.9 GUARD RAILS

Provide 2 No. bamboo / metal guardrails at every side of the walkway/working platform from which a person is liable to fall for more than 2 metres. The top guard rail shall be between 900 mm and 1150 mm above the walkway/working platform. The height of the intermediate guard rail shall be between 450 mm and 600 mm above the walkway/working platform. This shall not apply to a bamboo scaffold if the walkway/working platform is protected by not less than 2 horizontal members spaced at intervals between 750 mm to 900 mm.

PRE.B10.910.B PROTECTIVE MATERIALS INSTALLED ON THE SCAFFOLDING

1. Provide protective nets, screens, tarpaulin and plastic sheeting (collectively referred to as protective materials) installed at the facade of buildings under construction, demolition, alteration and addition, repair or minor works in compliance with PNAP APP-23, PNRC 85 and relevant prevailing documents, including but not limited to:
   a. Code of Practice for Fire Safety in Buildings 2011;
   b. Guidelines on the Design and Construction of Bamboo Scaffolds;
   c. PNAP APP-70;
   d. PNRC 26;
   e. BD's Circular Letters on Use of Fire Retardant Protective Net / Screen / Tarpaulin / Plastic Sheeting on Façade of Buildings under Construction, Demolition, Repair or Minor Works;
   f. Code of Practice for Bamboo Scaffolding Safety;
   g. Code of Practice for Metal Scaffolding Safety;
   h. Construction Industry Council Safety Message No. 24/25.
2. The protective materials installed at the facade of buildings under construction, demolition, alteration and addition, repair or minor works shall have fire retardant performance in compliance with recognised standards specified in the PNRC 85;
3. Sampling, testing, installation and maintenance of protective materials shall comply with PNRC 85.

PRE.B10.920.9 OBSTRUCTION OF WALKWAY/WORKING PLATFORM AND GANGWAY

Do not stack any materials or debris on the working platform, walkway and gangway etc. at any time.

PRE.B10.930.9 CLEARANCE OF DEBRIS

1. Keep the bamboo scaffold and its associated working platforms, walkways, sloping catch fans, safety nets, protective canopies and the like clear of debris and do not overload them;
2. Keep the metal scaffold and its associated working platforms, gangways, runs, ladders and the like clear of debris and do not overload them.

PRE.B10.940.9 SLOPING CATCH FAN

1. Provide sloping catch fan to give a minimum horizontal coverage of 1500 mm wide and at not more than 15m vertical intervals for all buildings under construction;
2. When protective canopy stipulated in PRE.B10.860 with horizontal coverage not less than 1500mm wide is provided, it is equivalent to a catch fan required under this clause;

3. The sloping catch fan shall consist of 3 mm (minimum) thick timber boardings covered by layer of galvanized metal sheeting 0.2 mm (minimum) thick;
4. Fit 400 mm wide x 200 mm (minimum) deep receptacle at the bottom of catch fan.

PRE.B10.945.9 INSPECTION AND MAINTENANCE

1. The competent person mentioned in PRE.B10.830 shall inspect, check the strength and stability of the scaffolds, record the findings in the inspection record form at certain stages and intervals including before and after adverse weather conditions, as stipulated in the Guidelines on the Design and Construction of Bamboo Scaffolds issued by BD, the CoP for Bamboo Scaffolding Safety and the CoP for Metal Scaffolding Safety issued by LD;
2. Rectify defects found during the inspection immediately;
3. Display conspicuously warning notices on defective scaffolds to alert workers to the prohibition of their use.

PRE.B10.950.9 RETENTION OF PROTECTIVE MEASURES

Retain the sloping catch fans, safety nets and protective canopy in place until all works to the external building facades are completed.

PRE.B10.980.9 DISMANTLING

1. Programme the time of dismantling at the design stage. Dismantle scaffolds as soon as they are not used any more;
2. Plan and implement the dismantling work safely in compliance with the safety legislations;
3. Prior to commencing dismantling work:
   a. Conduct a risk assessment, develop and implement safe working procedures and provide full and proper fall protective equipment with fall arrestors and suitable anchorage points or independent lifelines;
   b. Submit method statement to justify the strength and stability of the scaffolding system at different stages of dismantling;
   c. Check the strength and stability of the scaffold;
   d. Make good all the defective parts of the scaffold;
   e. Clear all debris in the safety nets and catch fans before dismantling;
   f. Fence off the ground below the scaffold;
   g. Post warning notices at appropriate locations.
4. Dismantling shall follow strictly the designed working procedures mentioned in sub-clause (3)(a);
5. Carry out dismantling work by the trained workmen mentioned in PRE.B10.830 under the immediate supervision of a competent person mentioned in PRE.B10.830;
6. Provide the trained workmen with sufficient information, instructions, training and supervision regarding the safety of work at heights;
7. Dismantle scaffolding, safety nets, fans and platforms carefully and lower the dismantled parts in a safe, controlled method without throwing, tipping, shooting or dropping any item from a height.

TEMPORARY SAFETY FENCES, RAILS AND BARRIERS

PRE.B10.1010.9 EXTERNAL OPENINGS AND FLOOR OPENINGS

1. Appoint competent persons to conduct risk assessments, and after considering the nature of the work and the impact of the surrounding environment, identify the potential hazards of all processes, especially the risks of fall from height. Develop safe construction methods and procedures for related processes;
2. Cover all floor openings or provide railings around floor openings and voids to prevent people falling from height as follows:
    a. Cover all floor openings with solid and sound material constructed and securely fixed in position to prevent the fall of persons, materials and article. These covers shall be clearly and boldly marked to show its purpose; or
    b. Provide rigid guard-rails and toe boards around floor openings with, including but not limited to, the following:
        i. Secure top railings at a height of 900 mm to 1150 mm;
        ii. Secure middle railings at a height of 450 mm to 600 mm;
        iii. Secure toe boards of 200 mm high above the surface of the slab where no permanent upstand exists;
        iv. Brightly coloured safety nets onto the railings and toe boards; and
        v. At floor opening with considerable risk or safety concerns, provide safety nets of sufficient size and strength covering the floor openings to catch falling persons and objects. The safety nets shall be clear of any debris.
3. Provide rigid guard-rails and toe boards for openings on building envelope or slab edges along building periphery to prevent people falling from height with, including but not limited to, the following:
    a. Secure top railings at a height of 900 mm to 1150 mm;
    b. Secure middle railings at a height of 450 mm to 600 mm;
    c. Secure toe boards 200 mm high above the surface of the slab where no permanent upstand exists; and
    d. Brightly coloured safety nets onto the railings and toe boards.
4. Where the provision of guard-rails or coverings to prevent fall from openings is impracticable, provide fall arrest system comprising appropriate safety harness, independent lifelines and adequate, stable and sufficient anchor points so as to facilitate continuous anchorage of safety harness;
5. Regularly remove debris from the safety nets provided in the sub-clause 2(b)(v) above;
6. Develop and implement an effective monitoring system to ensure that the above safety measures are provided and properly maintained.

PRE.B10.1015.9 OPEN EXCAVATIONS

Protect the public from all excavations by providing:

1. Secure bamboo fencing as SLW1.M420 but 1100 mm high; or
2. Secure close boarding over entire excavation.

PRE.B10.1020.9 TEMPORARY PROTECTION TO LIFT WELL OPENINGS

1. Provide temporary steel barrier to all lift well openings. The temporary steel barrier shall comply with all statutory requirements and the following performance requirements:
    a. Function as protection against fall of persons and falling objects through lift well openings from the respective floor levels;

b. Be closed at all time and be lockable from outside, and be readily openable from the inside of lift wells at any time without the need of separate key operations;
c. Steel barrier shall consist of four-leaf doors with an upper pair and a lower pair of doors;
d. Height of steel barrier: full height to cover the lift well opening;
e. Mesh size for steel barrier: maximum 50 mm x 50 mm.

2. Refer to drawing no. STD/HC/A/662/AS001 in Appendix U to this Specification for reference only. Submit detail drawings of the temporary steel barrier for the CM's approval;
3. Maintain the temporary steel barrier to operate in a proper, efficient and safe manner;
4. Dismantle and clear away the temporary steel barrier properly and safely when they are not required anymore;
5. Ensure that no part of the temporary steel barrier shall obstruct the installation of the permanent lift doors and architraves.

PRE.B10.1021.B TEMPORARY PROTECTION ABOVE STEEL BENDING YARD

1. Design, construct, operate, maintain, and remove after use, electrically-operated retractable protection net for protecting workers at steel bending yard;
2. The electrically-operated retractable protection net shall consist of the following components:
   a. Supporting frame with vertical and horizontal H-steel members;
   b. Steel U-channel as guiding track shall be welded onto the supporting frame;
   c. Steel wires of diameter of at least 10 mm;
   d. Double layer of fire retardant strong nylon safety net with lapping of not less than 300 mm;
   e. Electric motor (380V) provided with switch box and hand remote control shall be installed on two sides of the guiding track and provided with machine guards complying with the Factories and Industrial Undertakings (Guarding and Operation of Machinery) Regulations.
3. Design the protection net and associated structures in accordance with the Building (Construction) Regulations in Hong Kong and design codes satisfying such regulations, which shall be capable of sustaining the loadings as specified in sub-clauses (a) to (c) below. Refer to drawing no. REF/SS/PN/SK-01 in Appendix U to this Specification for reference only. Submit the detail drawings, calculations and construction method statements of the electrically-operated retractable protection net, and completion certified by the Qualified Engineer as stipulated in PRE.B10.010 sub-clause (7), to the CM for approval:
   a. Live load of 1.5kPa (minimum);
   b. Wind load calculated in accordance with the "CoP on Wind Effects in Hong Kong 2019" published by BD;
   c. Any other loads as appropriate.
4. Accept responsibility for the design of the protection net. The submission to the CM and the CM's approval of such design or amendment shall not relieve the Contractor of any duty or responsibility under the Contract;
5. Keep the protection net clear of debris and do not overload it.

PRE.B10.1030.9 PERMANENT STAIRCASES

When secure permanent railings are not available:

1. Provide secure top railings at a height of 900 mm to 1100 mm;
2. Provide secure middle railings at a height of 450 mm to 500 mm.

PRE.B10.1040.9 OPENINGS AT TOWER CRANES

1. Provide secure top railings at a height of 1100 mm;
2. Provide secure middle railings at a height of 600 mm;
3. Provide secure toeboards of 200 mm high.

SIGNBOARDS

PRE.B10.1110.9 SIGNBOARDS

1. Provide as detailed on Drawing(s) Nos. …….., maintain and update the information of the following publicity board(s) as necessary or as required by the CM for the duration of the Contract and leave in position in good condition for use by subsequent contractors:
   a. ……. No. publicity board(s);
   b. ……. No. accident statistic board(s) at the Site;
   c. ……. No. publicity board(s) for motorists and……. No. publicity board(s) for pedestrians at prominent locations as agreed by the CM, where works are carried out on carriageway or footway.
2. Take over the following existing publicity board(s) from previous contractor, provide as detailed on Drawing(s) Nos. ……., maintain and update the information of the publicity board(s) as necessary or as required by the CM for the duration of the contract and clear away on completion:
   a. ……... No. publicity board(s);
   b. …….. No. accident statistic board(s) at the Site;
   c. ……. No. publicity board(s) for motorists and……. No. publicity board(s) for pedestrians at prominent locations as agreed by the CM, where works are carried out on carriageway or footway.

PRE.B10.1130.9 PAINTING AND SIGNWRITING

1. Paint signboards at commencement of Contract;
2. Provide sign writing in multi-coloured gloss finish over the completed board or print signage on recyclable plastic banner, including English letters and Chinese characters, artist's impressions or diagrammatic plans and logos;
3. Submit draft drawings for Approval before painting;
4. Re-paint, provide new sign writing or print signage on new recyclable plastic banner when necessary as directed by the CM;
5. Provide new sign writing to update the accident statistics at monthly intervals.

PRE.B10.1140.9 DISPLAY SIGNS FOR SLOPE/RETAINING WALL REGISTRATION NUMBERS

Provide, fabricate and install display signs for slope/retaining wall registration numbers at the locations and to the details and requirements specified on the Drawings. Maintain for the duration of the Contract and handover in good condition for subsequent use by the Hong Kong Housing Authority.

SERVICES FOR THE EXECUTION OF THE WORKS

PRE.B10.1210.9 WATER SUPPLY

Option 1

Provide an adequate temporary water supply for the Works and all Direct Contractor's Works, obtain water by metered supply from Government mains where possible.

Option 2

Water will be supplied free of charge for the work provided there are not imposed restrictions by the Water Supplies Department.

PRE.B10.1220.9 WATER SUPPLY RESTRICTIONS

1. In the event of water restrictions, ensure there is sufficient water storage capacity on Site, to supply water in accordance with the detailed requirements of the specification, to maintain the general good health of the plants, and to ensure the progress of the work is not adversely affected;
2. In the event of the water restrictions imposing a total ban on the use of the Water Supplies Department's mains supply for watering of plants, make arrangements for the supply of non-toxic water in sufficient quantities to comply with the requirements in the immediately preceding paragraph. Take samples from every 1,000 cu.m delivered to Site and produce Certificates of Analysis of the water, from the Approved Laboratory within seven (7) calendar days of taking the sample. Each Certificate to state pH and salinity.

PRE.B10.1230.A TESTING WATER SUPPLY

If water is taken from a source other than Government mains supply, test it at an Approved laboratory in accordance with BS EN 1008:2002 when required by the CM.

PRE.B10.1240.9 WATER DISTRIBUTION

Provide temporary pipe lines and make arrangements for storage, pumping and distributing the water about the Site.

PRE.B10.1250.9 PROVISION OF WATER DISTRIBUTION DETAILS

Submit installation details and routing of the water supply for the information of the CM prior to commencement of the installation.

PRE.B10.1260.9 TESTING WATER DISTRIBUTION

Provide for testing of the water distribution installation when Instructed.

PRE.B10.1270.A ELECTRICITY SUPPLY

Provide an adequate temporary electricity supply and equipment for lighting and power for the Works and all Direct Contractor's Works where and when specified. Comply with the following:

1. The Contractor shall liaise with the power supply company for the temporary electricity supply connection as early as practicable. Before the temporary electricity supply from the power supply company is available, the Contractor shall arrange his own power supply for the Works and all Direct Contractor’s works. Whenever the temporary electricity supply available from the power supply company can fully satisfy the power demand of the Works and all Direct Contractor’s works, any alternative form of power supply shall not be permitted unless it utilizes renewable energy source(s) or is solely for back up purpose;
2. If the temporary electricity supply available from the power supply company cannot meet the power demand profile of the Works and all Direct Contractor’s works, the Contractor shall adopt a battery energy storage system (BESS) before any consideration of employment of diesel generator(s) for the provision of temporary power supply in order to minimize carbon emissions and adverse impacts generated from diesel generator(s) to the environment and the workers, unless otherwise agreed by the CM.

Number of Domestic Block in the Contract	Minimum no. of BESS adopted
1	1
2	1
3	2
4	2
> 4	Round up of half of domestic block number

3. Diesel generators (using B5 diesel or Euro V diesel / Ultra-low-sulphur diesel) shall only be adopted for the following purposes, and subject to the approval from the CM is obtained:
   a. The temporary electricity supply from the power supply company is not yet available or sufficient to charge all the BESS units required to meet the power supply for the Works and all Direct Contractor's work; or
   b. The installation of BESS is not feasible; or
   c. As an emergency back up to BESS during the down time of BESS, if deemed necessary by the Contractor; or
   d. Within the first 4 months after the notified date for commencement of the Works when temporary power demand is relatively low and adoption of diesel generator may allow more flexibility for site mobilisation than using BESS; or
   e. Within the last 6 months before the date of certified completion of the Works when disposition of BESS may obstruct external works.
4. The installed BESS with its component(s) shall deliver high level of reliability and operate safely in tough construction environment.
   a. The location and erection of the BESS shall be selected and conducted according to supplier's recommendations and also to prevent causing an additional fire hazard to the Site.
5. The Contractor shall ensure that the installed BESS or diesel generators together with the associated electrical installations shall comply with the requirements as stipulated in the prevalent Electricity (Wiring) Regulations, Supply Rules of Power Supply Company and all applicable regulations / ordinances and codes of practices issued by FSD and EMSD;
6. In case diesel generators are installed, PRE.B8.475 and PRE.B8.870 shall be complied with. Besides, the Contractor shall reduce carbon emissions during the operation of diesel generators, which include but are not limited to the following:
   a. Detailed estimate of power consumption of machinery and tools, and selection of suitably sized generator which can optimize the oil consumption during daily operations;
   b. Advanced plan of Site layout so that generators are located near load centres to reduce cabling work and power loss during transmission;
   c. Study the feasibility and implement, where appropriate, parallel operations of smaller generators with an aim of operating the generators at an optimal efficiency continuously by matching the running capacity closely with the load profile.

PRE.B10.1280.9 PROVISION OF ELECTRICITY SUPPLY INFORMATION

Submit installation details and routing of the electricity supply for the information of the CM prior to the commencement of the installation.

PRE.B10.1290.A USE OF TEMPORARY ELECTRICITY SUPPLY FACILITIES

Option 1

1. The following temporary electricity supply facilities have been provided on Site:
   a. Power supply company has installed temporary power supply cable to Site boundary and ready for subsequent connection by the Contractor;
   b. ….. Nos. of …...kVA temporary transformer compound / temporary transformer and switch room compounds are installed on Site;
   c. …. Nos. of …..kVA temporary power supply pillar box are installed on Site.
2. Do not use the ..... for any purpose other than the provision of a temporary electricity supply;
3. When using the ..... liaise and coordinate with and comply with all requirements of the public utility Company;
4. The provision of the ..... shall in no way relieve the Contractor of his obligations, responsibilities and liabilities under the Contract.

Option 2

Not provided.

PRE.B10.1300.9 TELEPHONE

Option 1

Provide a separate direct-line telephone for own use.

Option 2

Provide a mobile telephone for own use and the use of the CM and his representatives when they are on Site.

PRE.B10.1310.9 TEMPORARY ELECTRICAL INSTALLATION

1. Fixing and precautions:
   a. Properly fix all wiring, switchgears and distribution boards above ground and inaccessible to general public;
   b. Provide minimum protection of cables in PVC/PVC sheath; ensure that all electrical joints are properly made. Where likely to be subject to damage, use conduits, armour or trunking systems;
   c. Support overhead cables by earthed steel catenary wires not lower than 5.8 m across public road and 5.2 m at other locations. Ensure that poles are of adequate strength and properly earthed (for metal poles and stay wires);
   d. Position installations away from wet areas and do not expose to weather unless they are of water-proof type;
   e. Display a circuit diagram at the main incomer;
   f. Provide circuit labels at all submains and distribution boards.
2. Protection against electrical shock and danger:
   a. Properly insulate or protect installations against direct contact to IP3X and in accordance with COP for the Electricity (Wiring) Regulations for other applications;
   b. Properly earth all circuits and exposed conductive parts;
   c. Provide main switch (or sub-main switches if adjacent) with RCCB. Protect socket outlets by a RCCB operating at 30mA. Connect portable equipment by socket and plug.
3. Circuit isolation and protection:
   a. Provide an isolation switch for each circuit in an accessible location;
   b. Provide proper circuit protective device against excess current and earth faults;
   c. Provide switches or emergency stop devices adjacent to operator of motor driven machines. Machines not to re-start automatically when supply resumes after power failures.

4. Temporary lighting:
   a. Provide all hoardings, covered walkways etc. with temporary lighting;
   b. Provide adequate level of illumination during all hours of site operation to all circulation areas, dangerous openings, places with lifting and lowering operation and areas where work is being carried out;
   c.
      i. In normal circumstances, provide all staircases with temporary lighting;
      ii. Where only one staircase is lit, provide illuminated directional signs on every floor to indicate access to this staircase;
      iii. Where structural works are still in progress, provide temporary lighting up to at least three floors below working floor (WF-3).
   d. Securely fix all wiring and non-portable lights above floor. (Generally mounted at a height not less than 2 m above floor level except under special circumstance);
   e. Provide lamp holders of all insulated type capable of withstanding rough usage;
   f. Provide hand lamps made of insulated material with lamp bulb guarded against breakage;
   g. Do not use incandescent light bulbs (GLS) or tungsten lamps. Use other lamp types with higher luminous efficacy. Provide only electronic ballast for all types of fluorescent fittings.
5. Power supply:
   a. Provide a power supply at a voltage of 110V or less from a step-down transformer with its output winding centre-tapped to earth including supply to the following:
      i. Portable and hand-held tools;
      ii. Temporary lighting.
   b. Provide a power supply at a voltage in excess of 110V only for the following:
      i. Heavy equipment such as hoists, tower cranes, etc. with an earth leakage circuit breaker installed and in proper function;
      ii. Site office and workshop.

REMOTE SITE MONITORING SYSTEM (RSMS)

PRE.B10.1410.A MOUNTING POST FOR RSMS

Option 1

1. Provide …… sets of mounting posts and necessary footings or supporting structures for RSMS control units and cameras at locations as shown on the layout Drawing No. ……;
2. Construct the mounting posts and necessary footings or supporting structures with reference to Drawing Nos. RSMS/SITE/S/SK-01 and RSMS/SITE/S/SK-03. Liaise and coordinate with the RSMS Direct Contractor on the provision of builder's works. Submit design proposals certified by QE as stipulated in PRE.B10.010 sub-clause (6) and method statements for the following to the CM for approval to ensure that the mounting posts and necessary footings or supporting structures are safe and stable for supporting the RSMS control units and cameras on the posts and also for proper maintenance:
   a. Details of the mounting posts including footings or supporting structures;
   b. Fixing details of the mounting posts;
   c. Painting for the posts.
3. Repair, maintain and alter if necessary the mounting posts and necessary footings or supporting structures for the duration of the Contract;

4. Ensure that the installed cameras are clear from obstructions;
5. Leave the mounting posts and footings or supporting structures on the Site in good conditions for use by subsequent contractors or dismantle and remove them from Site when instructed by the CM;
6. When instructed, relocate the mounting posts and necessary footings or supporting structures to new locations;
7. Make good and reinstate the affected areas to their original conditions after the relocation or removal of the mounting posts and footings or supporting structures, or when instructed by the CM;
8. Provide notice in English and Chinese characters as shown in Drawing No. RSMS/SITE/S/SK-04. Exact location shall be directed by the CM.

Option 2

1. Take over existing mounting posts and necessary footings or supporting structures for RSMS control units and cameras erected by previous contractor at locations as shown on the layout Drawing No. ……;
2. Relocate existing mounting posts to new locations or provide new mounting posts and necessary footings or supporting structures at locations as shown on the layout Drawing No. ……;
3. When new mounting posts are to be erected, construct the mounting posts and necessary footings or supporting structures with reference to Drawing Nos. RSMS/SITE/S/SK-01 and RSMS/SITE/S/SK-03. Liaise and coordinate with the RSMS Direct Contractor on the provision of builder's works. Submit design proposals certified by QE as stipulated in PRE.B10.010 sub-clause (6) and method statements for the following to the CM for approval to ensure that the mounting posts and necessary footings or supporting structures are safe and stable for supporting the RSMS control units and cameras on the posts and also for proper maintenance:
   a. Details of the mounting posts including footings or supporting structures;
   b. Fixing details of the mounting posts;
   c. Painting for the posts.
4. Submit method statements of relocation for the CM's approval prior to relocating the existing mounting posts;
5. Repair, maintain and alter if necessary the mounting posts and necessary footings or supporting structures for the duration of the Contract;
6. Ensure that the installed cameras are clear from obstructions;
7. Dismantle and remove the mounting posts and necessary footings or supporting structure from the Site upon completion of the Works or when instructed by the CM;
8. Make good and reinstate the affected areas to their original conditions after the relocation or removal of the mounting posts and footings or supporting structures, or when instructed by the CM;
9. Provide notice in English and Chinese characters as shown in Drawing No. RSMS/SITE/S/SK-04. Exact location shall be directed by the CM.

PRE.B10.1430.9 RSMS TO BE MOUNTED ON WALLS OR OTHER SUPPORTING STRUCTURES

1. For the RSMS to be mounted on walls or other supporting structures, provide fixing holes for the installation as shown on Drawing no. RSMS/SITE/S/SK-02. Liaise and coordinate with the RSMS Direct Contractor on the number, position and depth of the holes;
2. Make good and reinstate the affected areas to their original conditions after the relocation or removal of the RSMS or any parts of the RSMS;
3. Provide notice in English and Chinese characters as shown in Drawing no. RSMS/SITE/S/SK-04. Exact location shall be directed by the CM.

CONSTRUCTION & DEMOLITION MATERIALS DISPOSAL TRACKING SYSTEM (CMDTS)

PRE.B10.1510.A MOUNTING POST FOR CMDTS

1. Provide the mounting posts and necessary footings or supporting structures for cameras, RFID readers & other accessories for CMDTS adjacent to the weighbridge. The exact location shall be confirmed with the Direct Contractor of CMDTS on Site;
2. Construct the mounting posts and necessary footings or supporting structures with reference to Drawing No. CMDTS/SITE/S/SK-01. Liaise and coordinate with the Direct Contractor of CMDTS on the provision of builder's works. Submit design proposals certified by QE as stipulated in PRE.B10.010 sub-clause (6) and method statements for the following to the CM for approval to ensure that the mounting posts and necessary footings or supporting structures are safe and stable for supporting the CMDTS control units and cameras on the posts and also for proper maintenance:
   a. Details of the mounting posts including footings or supporting structures;
   b. Fixing details of the mounting posts;
   c. Painting for the posts (if any).
3. Repair, maintain and alter if necessary the mounting posts and necessary footings or supporting structures for the duration of the Contract;
4. Ensure that the installed cameras are clear from obstructions;
5. Leave the mounting posts and footings or supporting structures on the Site in good conditions for use by subsequent contractors or dismantle and remove them from Site when instructed by the CM;
6. When instructed by the CM, relocate the mounting posts and necessary footings or supporting structures to new locations;
7. Make good and reinstate the affected areas to their original conditions after the relocation or removal of the mounting posts and footings or supporting structures;
8. Provide notice in English and Chinese as shown in Drawing No. CMDTS/SITE/S/SK-02. Exact location shall be directed by the CM.

PRE.B10.1520.9 TAKING OVER EXISTING MOUNTING POST FOR CMDTS

1. Take over existing mounting posts and necessary footings or supporting structures for cameras, RFID readers & other accessories for CMDTS erected by previous contractor;
2. Relocate existing mounting posts to new locations if necessary;
3. When instructed, dismantle and remove the existing mounting posts and footings and replace with new mounting posts and necessary footings or supporting structures in locations if necessary;
4. When new mounting posts are to be erected, construct the mounting posts and necessary footings or supporting structures with reference to Drawing No. CMDTS/SITE/S/SK-01. Liaise and coordinate with the Direct Contractor of CMDTS on the provision of builder's works. Submit design proposals and method statements for the following to the CM for approval to ensure that the mounting posts and necessary footings or supporting structures are safe and stable for supporting the RFID readers, cameras and other accessories of CMDTS on the posts and also for proper maintenance:
   a. Details of the mounting posts including footings or supporting structures;
   b. Fixing details of the mounting posts;
   c. Painting for the posts (if any).
5. Submit method statements of relocation for the CM's approval prior to relocating the existing mounting posts;

6. Repair, maintain and alter if necessary the mounting posts and necessary footings or supporting structures for the duration of the Contract;
7. Ensure that the installed cameras are clear from obstructions;
8. Dismantle and remove the mounting posts and necessary footings or supporting structure from the Site upon completion of the Works;
9. Make good and reinstate the affected areas to their original conditions after the relocation or removal of the mounting posts and footings or supporting structures;
10. Provide notice in English and Chinese as shown in Drawing No. CMDTS/SITE/S/SK-02. Exact location shall be directed by the CM.

APPENDIX PRE.B10/I

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND1.9 CODE OF CONDUCT FOR CONTRACT TECHNICAL ASSISTANTS WORKING FOR HOUSING AUTHORITY / HOUSING DEPARTMENT

Code of Conduct for
Contract Technical Assistants working for
Housing Authority / Housing Department

This Code is to provide guidelines on the standard of conduct expected of Contract Technical Assistants (CTA) employed by the Contractor to work for HA / HD. It is by no means exhaustive and comprehensive. In case of doubt over any part of this Code, CTA should seek advice from their direct supervisors in Housing Authority (HA)/Housing Department (HD).

2. The CTA employed by the Contractor shall be well aware of and comply with the statutory obligations under the Official Secrets Ordinance (Cap. 521) (http://www.legislation.gov.hk/index.htm), the Prevention of Bribery Ordinance (POBO) (Cap. 201) (http://www.legislation.gov.hk/index.htm) and the relevant guidelines on acceptance of advantages and entertainment, offering of advantages, conflict of interests and confidentiality of information (paragraphs 3 to 16 below). The CTA shall sign a declaration form at PRE.B10.APPEND2 and a confidentiality undertaking at PRE.B10.APPEND5 upon request by the Contractor before their deployment to the HA / HD and submit it to the CM.

General Principle

3. CTA shall uphold the highest standard of integrity and probity by helping ensure that HA / HD's reputation is not placed in question by any misconduct or corrupt activities they commit or are implicated in. They shall refrain from engaging in conduct or behaviour that may bring disrepute and embarrassment to HA / HD. They shall avoid or declare at all times, by conscious effort as appropriate, any real, apparent or potential conflict of interest and circumstances of perceived conflict that may arise or has arisen. Failure to avoid or declare a conflict of interest may result in the termination of his employment and, in certain circumstances, even his prosecution under the related common law offence.

Solicitation and Acceptance of Advantages

4. CTA shall not solicit or accept, without lawful authority or reasonable excuse, any advantage in Hong Kong or elsewhere as an inducement to or reward for or otherwise on account of his performing or abstaining from performing his duties in HA / HD. "Advantage" as defined in Section 2 of the POBO refers to anything of value other than entertainment. Common examples are gifts of all forms (both of money and in kind), loan, employment, contract, service, favour etc.

5. CTA shall not solicit or accept any advantage from subordinates and any persons or companies having official dealings with HA / HD (e.g. service recipients, suppliers, contractors), and shall decline to accept any advantages or gifts offered / presented to him by virtue of his duties in HA / HD.

Acceptance of Entertainment

6. As defined in Section 2 of the POBO, “entertainment” means the provision of food or drink, for consumption on the occasion when it is provided, and of any other entertainment connected with or provided at the same time as the provision of food or drink. Although entertainment when offered by way of a favour is not an advantage per se and its acceptance is generally not subject to the POBO, a free entertainment may, in certain circumstances, amount to “a discharge of an obligation to pay” which is an advantage under Section 2 of the POBO.

7. CTA should not accept lavish, or unreasonably generous or frequent entertainment, or indeed any entertainment which is likely to give rise to any potential or real conflict of interest, put the CTA in an obligatory position in the discharge of their duties, compromise their impartiality or judgment, or bring them or HA / HD into disrepute bearing in mind public perception. When offered entertainment, a CTA should consider whether the entertainment offered could be regarded as:

(a) Excessive – taking into account its value, substance, frequency and nature;

(b) Inappropriate – taking into account the relationship between the staff member and the offer (e.g. whether they have any direct official dealings); or

(c) Undesirable – taking into account the character or reputation of the host or known attendees.

Offering of Advantages

8. CTA shall not offer advantages to any director or staff of any organization, for the purpose of influencing such person or organization in any dealings, or any public official, whether directly or indirectly through a third party, when performing his duties in HA / HD.

9. CTA shall as far as possible refrain from bestowing gifts / souvenirs to others during the conduct of official activities. Where it is necessary or unavoidable due to operational, protocol or other reasons, the number of gifts / souvenirs to be bestowed should be kept to a minimum; exchange of gifts / souvenirs should be made from organization to organization.

Conflict of Interest

10. A conflict of interest situation [Note] arises where the "private interests" of a CTA compete or conflict with the interests of HA / HD or his duties in HA / HD. "Private interests" include the financial and other interests of the CTA himself with those of the following relations –

(a) The Contractor and other contractors or sub-contractors;

(b) His family and other relations;

(c) His personal friends;

(d) The clubs and association to which he belongs;

(e) Any other groups of people with whom he has personal or social ties; or

(f) Any persons to whom he owes a favour or is obligated in any way.

11. CTA shall be honest, impartial and objective in carrying out their duties and in their official dealings with members of the public, staff of HA / HD, and contractors of HA / HD alike. They shall not promote their private interests or those of family, friends, associates or put themselves in a position giving rise to suspicion or perception of having done so, in the course of delivering their duties in HA / HD. In particular, CTA shall observe the following principles -

(a) Refrain from taking part in the deliberation, decision-making, investigation or enforcement process in connection with any matter in which he has a private interest;

Note **Common examples of conflict of interest for CTAs are described below but they are by no means exhaustive:**

(a) A CTA accepts frequent or lavish entertainment from any persons or companies having official dealings with HA / HD (e.g. Service recipients, suppliers, contractors).

(b) A CTA undertaking part-time work with a contractor whom he is responsible for monitoring.

(b) Avoid putting himself in a position of obligation to any person who has or may have official dealings with HA / HD;

(c) Decline to provide assistance, advice or information to any person including but not limited to the Contractor relating to his work whereby giving the recipient an unfair advantage over other persons. Legitimate requests for assistance, advice and information shall be referred to the proper subject officer of HA / HD for handling in the normal way according to established procedures;

(d) Decline to accept lavish or unreasonably generous or frequent entertainment or any entertainment that is likely to lead to embarrassment in the discharge of his duties or to bring him or HA / HD into disrepute; and

(e) Report to his direct supervisor in HA / HD on the proforma at PRE.B10.APPEND4 any private interests that might be seen or perceived to compromise personal judgment in the discharge of his duties.

12. CTA shall seek advice from his direct supervisor in HA / HD if he is doubtful whether a situation will give rise to potential or real conflict of interest.

Confidentiality of Information

13. CTA should not disclose any classified or proprietary information of HA / HD without authorization or misuse any HA / HD's information (e.g. using the information for personal gain or the benefit of others).

14. CTA who have access to or in control of such information should at all times ensure its security and prevent any abuse, unauthorized disclosure or misuse of the information.

15. Special care should be taken when handling any personal data of both the employees and customers to ensure compliance with the Personal Data (Privacy) Ordinance (Cap. 486) and the HA / HD's data privacy policy.

16. CTA should continue to observe their duty of confidentiality after they have left HA / HD. They should not use, or take advantage of any classified or proprietary information obtained in the course of their official duties.

APPENDIX PRE.B10/II

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND2.9 DECLARATION FORMS

Declaration Form

Contract Technical Assistant working for
Housing Authority / Housing Department
(To be completed in duplicate; a copy each to be kept by the CM and the Contractor)

I have read and understood the provisions of the Official Secrets Ordinance (Cap. 521) and the Prevention of Bribery Ordinance (Cap. 201), and the relevant guidelines on acceptance of advantages and entertainment, offering of advantages, conflict of interests and confidentiality of information including the Code of Conduct (PRE.B10.APPEND1 of the Specification) circulated to me by the Contractor. I confirm that I will comply with the relevant provisions and guidelines in the discharge of my duties as a result of my working for the Housing Authority / Housing Department, and will not disclose any classified or proprietary information of the contractor / Housing Authority / Housing Department without authorization.

Signature : _____

Name : _____

(BLOCK LETTER)

Section : _____

Date : _____

Signature : _____

Name of Witness : _____

(BLOCK LETTER)

Post / Name of Company : _____

(with company chop)

Date : _____

APPENDIX PRE.B10/IV

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND4.9 REPORT ON CONFLICT OF INTEREST

Report on Conflict of Interest
Contract Technical Assistant working for
Housing Authority/Housing Department
(To be kept by the CM for record)

To : _____
(Name and Post of Direct Supervisor in HA/HD)

Section A (to be completed by the CTA)

1. Name : _____
2. Section : _____
3. Office Tel. No. : _____
4. Description of present duties :

_____

_____

_____

5. Description of conflict of interest (real/apparent/potential):

_____

_____

_____

6. Declaration of any personal interest that might influence, or appear to influence your judgment in the performance of your duties :

_____

_____

7. Declaration of their relationship with the contractors to whom they are assigned to:

_____

_____

_____

Signature : _____ Date : _____

Section B (to be completed by the direct supervisor in HA/HD of the CTA)

My comments and proposed course of action are as follows :

☐ No follow-up action.

☐ Follow-up action taken. Swap of duties with another CTA/Replacement of the CTA by the Contractor*.

Signature : _____ Post : _____

Name : _____ Date : _____

* please delete where appropriate.

APPENDIX PRE.B10/V

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND5.9 CONFIDENTIALITY UNDERTAKING

Confidentiality Undertaking

Contract Technical Assistant working for Housing Authority/Housing Department

(To be completed in duplicate; a copy each to be kept by the CM and the Contractor)

I understand and agree that any information and documents, including but not limited to personal data, which have or may come into my possession in the course of or as a result of my secondment to the Housing Authority (HA)/Housing Department (HD) must be held in confidence. I will not, without written permission from my supervisor in HA/HD, disclose or make use of such information or documents or produce or retain photocopies and softcopies of such information or documents for any purpose other than purpose which is pursuant to the performance of my service in the HA/HD.

Further, I understand that, where such information or documents, including but not limited to personal data, are protected against disclosure under the Official Secrets Ordinance or the Personal Data (Privacy) Ordinance, I may be prosecuted for an offence under the Official Secrets Ordinance or may have contravened the provisions of the Personal Data (Privacy) Ordinance should I disclose, without lawful authority, or fail to take care to prevent the unauthorised disclosure of, any or any part of such information or documents.

Signature : _____

Name : _____

(BLOCK LETTER)

Section : _____

Date : _____

Signature : _____

Name of Witness : _____

(BLOCK LETTER)

Post/Name of Company : _____

(with company chop) _____

Date : _____

Disclaimer:

(a) The personal data provided in this form will only be used for purpose relating to the engagement of CTA service and for directly related purpose. It may be transferred to other departments/ agencies for the same purpose.

(b) For access to or correction of personal data provided in this form, please contact our Departmental Data Controlling Officer at Hong Kong Housing Authority Headquarters, 33 Fat Kwong Street, Kowloon.

APPENDIX PRE.B10/VI

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND6.9 INSURANCE REQUIREMENT

INSURANCE REQUIREMENT

1.1 Without limiting the Contractor's obligations and responsibilities of indemnifying Housing Authority (HA)/Housing Department (HD) under any indemnification clauses of the Conditions of Contract, the Contractor shall, at his own costs and expenses, effect and maintain throughout the period of employment of a Contract Technical Assistant (CTA) –

(a) an Employees' Compensation Insurance to cover all the liabilities in respect of all CTA who are employed by the Contractor in connection with the Contract in accordance with the latest statutory requirements, ordinance and at common law. This Policy shall be extended to include –

(i) HA/HD as the Insured Principal;

(ii) an "Indemnity to Principal Clause" and an "Indemnity to Principal Contractor Clause", where applicable, wordings as per the sample provided in the PRE.B10.APPEND7;

(iii) an endorsement to cover the employees being deployed to HA/HD and engaged in HA/HD's business/activities anywhere in Hong Kong [including but not limited to construction sites] ; and

(b) a Public Liability Insurance to cover the liability in respect of personal injury or death to any person and loss or damage to any property real or personal (including the property owned by HA/HD or for which they are responsible for) arising out of or in the course of or by reason of the carrying out of the CTA's services with –

(i) HA/HD jointly named as Insured;

(ii) a "Cross Liability Clause";

(iii) the Situation of Premises & Geographical Area being stated as "Anywhere in Hong Kong" without any exclusion of working at construction site.

1.2 Notwithstanding that the liability to indemnify HA/HD is absolute, the limit of the Public Liability Policy shall not be less than [HK$ _____] any one accident and unlimited in the aggregate any one period of insurance.

1.3 If the Contractor considers the limit of indemnity mentioned in Clause 1.2 above for any one accident is inadequate to cover these contractual obligations, he is at liberty to take out a policy with an increased limit of indemnity.

1.4 The Contractor shall continue such insurance during the whole period in which the CTA shall remain employed for this Contract. If the Contractor shall fail to effect and keep in force the insurance aforementioned or any other insurance which the Contractor may be required to effect pursuant to this Contract for the CTA, then the HA may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the HA as aforesaid from any monies due or which may become due to the Contractor or recover the same as a debt due from the Contractor.

1.5 The Contractor shall bear the cost of all excesses (deductibles), exclusions or limitations applying under all the insurance policies (in so far as they concern risks for which they are responsible under the terms of the Contract) whether in respect of claims made against the Contractor and/or HA/HD.

1.6 The Contractor shall when required deposit with the CM for safe keeping the policy of insurance as mentioned in Clause 1.1 (a) and (b) together with the receipt of payment of the current premium within 7 days from the first date of employment of a CTA and thereafter, in case where the insurance policy effected pursuant to this Clause does not cover his entire period of employment or period of insurance requirement, within 7 days of the insurance being effected upon the expiry of the current policy. The Contractor shall also submit "Confirmation on Compliance" from their insurers/brokers within the same timeframe. Sample confirmation letters are at PRE.B10.APPEND8.

1.7 The Contractor shall not take or omit to take any step the taking or omission of which may result in any insurance policy or the cover under such policy becoming void or voidable.

APPENDIX PRE.B10/VII

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND7.9 INDEMNITY TO PRINCIPAL CLAUSE AND INDEMNITY TO PRINCIPAL CONTRACTOR CLAUSE UNDER EMPLOYEES' COMPENSATION INSURANCE

Indemnity to Principal Clause and Indemnity to Principal Contractor Clause under Employees' Compensation Insurance

Indemnity to Principal Clause

It is hereby understood and agreed that this Policy is extended to indemnify the Housing Authority/Housing Department (hereinafter called the Principal) against liability at law (including liability under the Legislation set out in the Schedule) in like manner to the Insured but only so far as concerns the liability of the Principal to employees of the Insured engaged in connection with a contract undertaken by the Insured for the Principal.

Provided always that –

(a) The Principal shall as though he were the Insured observe fulfill and be subject to the Terms of this Policy insofar as they can apply;

(b) The Company shall have full conduct and control of all claims in respect which indemnity is granted by this Endorsement.

Subject otherwise to the Terms of this Policy.

Indemnity to Principal Contractor Clause

It is hereby understood and agreed that this Policy is extended to indemnify [please insert Name of the Contractor] (hereinafter called the Principal Contractor) against liability at law (including liability under the Legislation set out in the Schedule) in like manner to the Insured but only so far as concerns the liability of the Principal Contractor to employees of the Insured engaged in connection with a contract undertaken by the Insured for the Principal Contractor.

Provided always that

(a) The Principal Contractor shall as though he were the Insured observe fulfill and be subject to the Terms of this Policy insofar as they can apply;

(b) The Company shall have full conduct and control of all claims in respect which indemnity is granted by this Endorsement.

Subject otherwise to the Terms of this Policy.

APPENDIX PRE.B10/VIII

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND8.9 SAMPLE CONFIRMATION LETTER

Sample Confirmation Letter

(i) To be issued by Insurance Company

Date :
Contact Numbers :
Hong Kong Housing Authority or Housing Department (as appropriate)
Attn :

Dear Sir,

Re: Confirmation on compliance of Employees' Compensation / Public Liability Insurance Requirements for CTA employed under Contract No. …….

We write to confirm that the Employees' Compensation / Public Liability Insurance (delete if not applicable) Policy(ies) No(s). ……. placed with us by …… meet(s) the minimum insurance requirements as defined in the ……. included / attached in the captioned Contract, and that we are an authorized insurer to carry on the captioned insurance business(es) in Hong Kong by the Insurance Authority.

We also confirm that premium (*as per copy of invoice / receipt attached*) under the above mentioned policy(ies) (*copy as attached also*) has been paid and settled in accordance to the terms and conditions of the policy(ies). Therefore, the above mentioned policy(ies) is / are valid until ……. .

We shall notify you if any one of the above-mentioned policy(ies) is / are cancelled or altered during the interim of policy(ies) period.

Best regards,

Sample Confirmation Letter

(ii) To be issued by Insurance Broker / Agent

Date :

Contact Numbers :

Hong Kong Housing Authority or Housing Department (as appropriate)

Attn :

Dear Sir,

Re: Confirmation on compliance of Employees' Compensation / Public Liability (delete if not applicable) Insurance Requirements for CTA employed under Contract No. ……..

We write to confirm that the Employees' Compensation / Public Liability Insurance (delete if not applicable) Policy(ies) No(s). ……. arranged by us for …….. meet(s) the minimum insurance requirements as defined in the included / attached in the captioned Contract.

The above mentioned Employees' Compensation / Public Liability Insurance is(are) placed with ……. which is an authorized insurer to carry on the captioned insurance business(es) in Hong Kong by the Insurance Authority.

We also confirm that premium (as per copy of invoice / receipt attached) under the above mentioned policy(ies) (copy as attached also) has been paid and settled in accordance to the terms and conditions of the policy(ies). Therefore, the above mentioned policy(ies) is / are valid until ……. .

We shall notify you if the captioned policy(ies) is / are to be cancelled during the interim of policy(ies) period.

Best regards,

[Insert name and position of the person who sign the letter]

APPENDIX PRE.B10/IX

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND9.A SAMPLE MONTHLY STATEMENT

Monthly Statement for Payment of Contract Technical Assistants (CTA)

From : _____(Contractor)
To : _____(Contract Manager)
Contract : _____(Contract No:_____)
Month : e.g. June 2023

Name of CTA Employed under the Contract (1)	CTA Post (2)	Working Period (3)	Approved Overtime Working with Extra Payment (20/30/40 Hours) (4)	Total No. of Days of Leaves Taken on Working Days (5)	Remarks (6)
e.g. CHAN Ngai-ngai	CTA(A) /7XX	1.6.2023 to 30.6.2023	20	8	-
LI Fong	CTA(A) /5XX	1.6.2023 to 30.6.2023	N/A	6	Maternity leave from 3.3.2023 to 8.6.2023
HO Tai-man	CTA(A) /6XX	1.6.2023 to 30.6.2023	30	5	Paternity leave from 12.6.2023 to 16.6.2023

Submitted by _____

Contractor:_____

Date:_____

Endorsed by

_____(_____)

Contract Manager / Contract Manager's Representatives

Date:_____

Notes:

1. The Statement shall be submitted to the Contract Manager (CM) for endorsement on a monthly basis.

2. Separate page(s) shall be used for each discipline of CTA to include all CTA of the same discipline employed under the Contract.

3. Upon endorsement by the CM / CMR, a copy of the Statement shall be provided by the CM / CMR to the PQS for payment assessment.

4. The entry in the column "Approved Overtime Working with Extra Payment" shall be either a total of 20, 30 or 40 hours as designated and required by the CM for the CTA. Put in 'N/A' if there is no such designation by the CM for the month. When the designated extra hours of overtime working required by the CM for a total of 20, 30, or 40 hours in a month cannot be fully completed by the CTA, the extra hours of overtime working completed by the CTA in that month will be compensated by time off in lieu and shall not be included in the column "Approved Overtime Working with Extra Payment".

5. Total No. of days of leaves taken on working days (including but not limited to annual leave, sick leave, maternity leave, paternity leave, training, medical appointment and absence from works) of the CTA shall be stated in Column 5. This total number of leave days shall not take into account any approved time off granted under Clause PRE.B10.580 (5)(k) in lieu of extra payment of overtime working or any leave in which a temporary CTA has been provided according to Clause PRE.B10.580 (5)(f) to take up the role of a CTA during the CTA's leave period.

6. Any maternity leave or paternity leave taken by a CTA shall be stated as such in Column 6 with the leave period indicated.

APPENDIX PRE.B10/X

CONTRACT TECHNICAL ASSISTANTS (CTA)

PRE.B10.APPEND10.9 SAMPLE DECLARATION FORM

Sample Declaration of Convictions for Offences and Information on Termination of Resident Site Staff Employment Contract

To: (the Contractor) ("the Company")

In consideration of your processing my application for the post of Resident Site Staff:

I hereby declare that I have not been convicted of any offence(s)@ for the period _____ to _____* / I have been convicted of an offence(s)@ for the period _____ to _____*#, details are as follows:

Offence@	Date of Conviction	Details

I hereby further declare that I have not been terminated for employment as a Resident Site Staff for the period _____ to _____* by any company, corporation or partnership / I have been terminated for employment as a Resident Site Staff for the period _____to _____*# by a company, corporation or partnership, details are as follows:

Reason(s) for Termination	Date of Termination	Name/Address of Employer	Details

I hereby declare that the information contained in this declaration is true, accurate and complete to the best of my knowledge. I understand that if any information is untrue, inaccurate or incomplete, I may be subject to criminal investigation and prosecution, and the Company may terminate my employment as Resident Site Staff.

I understand that for the purpose of ensuring the quality of site supervision of public works projects, the above information will be disclosed by the Company to the Housing Authority, Government policy bureaux and departments.

I hereby consent to the Company's disclosure of my personal data including my name, date of birth, identity card (or passport) number, and all of the above information to the Housing Authority, Government policy bureaux and departments to enable them to assess my eligibility for the post of Resident Site Staff.

Name (of Resident Site Staff) : _____
Identity Card/Passport Number : _____
Signature : _____
Date : _____

Notes

@ *The declaration of conviction records covers conviction for offences under the Prevention of Bribery Ordinance (Cap 201) and the Theft Ordinance (Cap 210), the offence of conspiracy to defraud, and the offence of misconduct in public office.*

\# *Delete whichever is inappropriate.*

***** *The period shall cover a minimum of 36 months immediately before the Date of Declaration.*

APPENDIX PRE.B10/XI

PRE.B10.APPEND11.N (ANNUAL*) SAFETY CERTIFICATE FOR TEMPORARY WORKS

To Director of Housing,

Part A (to be certified by Qualified Engineer (QE) or Registered Structural Engineer (RSE) in accordance with PRE.B10.010)

I (name in full) _____ (Chinese) _____, *QE / Registered Structural Engineer, hereby certify that I have inspected (description of temporary works) _____ erected at (address of the Site)_____ for (*PHCP/ISHM/Lot Number) _____, (Phase Code)_____, (Project Title) _____ and (Contract Number) _____ and in my opinion they are structurally safe and capable of lasting another _____ months. I also certify that the stability of any nearby buildings, streets, utilities, natural or man-made land, slopes or retaining walls will not be adversely affected.

Date_____ _____
Signature

Name of *QE / Registered Structural Engineer : _____

Certificate of BD Registered No. (for RSE only) : _____

Date of Expiry of BD Registration (for RSE only) : _____

Part B (to be certified by Registered Geotechnical Engineer (RGE) if applicable in accordance with PRE.B6.060)

I (name in full) _____ (Chinese)_____, Registered Geotechnical Engineer, hereby certify that I have inspected (description of temporary works) _____ erected at (address of the Site)_____ for (*PHCP/ISHM/Lot Number) _____, (Phase Code)_____, (Project Title) _____ and (Contract Number)_____ and in my opinion they are geotechnically safe and capable of lasting another _____ months. I also certify that the geotechnical stability of any nearby buildings, streets, utilities, natural or man-made land, slopes or retaining walls will not be adversely affected.

Date_____ _____
Signature

Name of Registered Geotechnical Engineer : _____

Certificate of BD Registered No. : _____

Date of Expiry of BD Registration : _____

* Delete where inapplicable

PRE.B11 WORK, MATERIALS AND SERVICES BY OTHERS

PRE.B11.010.C WORKS BY GOVERNMENT DEPARTMENTS, UTILITY UNDERTAKINGS, DIRECT CONTRACTORS AND / OR DIRECT TESTING CONTRACTORS

Option 1

Works by Government departments, Utility Undertakings, Direct Contractors and / or Direct Testing Contractors will be carried out as follows (attendance in connection with such works is described in Worksection PRE.B12):

1. Works by Government departments and Utility Undertakings:	Estimated Value (HK $)
a. Fitting out work to Police Posts	.....
b. Roadwork connection to Highway	.....
c. Soil and surface water drainage connections including terminal manholes	.....
d. Water connections	.....
e. Electricity supply connections	.....
f. Street lighting installation	.....
g. Town gas installation	.....
h. Fixed telecommunications network services installation	.....
i. Transformer compound / transformer and switch room compound inspection by Utility Undertakings	.....
j. Connection to street watermain	.....
2. Works by Direct Contractors:	Estimated Value (HK $)
a. Deep bore wells	.....
b. Specialist settlement monitoring survey	.....
c. LPG installation (separate bulk supply Contract)	.....
d. Turfing and planting	.....
e. Gas water heater installation / fitting-out gas pipework installation	.....
f. Room cooler installation	.....
g. Security alarm installation	.....
h. Remote Site Monitoring System (RSMS)	.....
i. Construction and Demolition Materials Disposal Tracking System (CMDTS)	.....
j Wi-Fi installation	.....
3. Works by Direct Testing Contractor(s):	Estimated Value (HK $)

a. Non-destructive tests on piles including Pile Driving Analyser Test, Pile Integrity Test and Sonic Logging Test	.....
b. Non-destructive test on welds	.....
c. Coring of concrete and testing of concrete cores	.....
d. Tests on concrete and constituent materials excluding coring of concrete and testing of concrete cores	.....
e. Tests on reinforcement steel and structural steelwork and steel piles samples	.....
f. Infra-red scanning test against roof waterproofing watertightness	.....
g. Compression tests on concrete cores for precast concrete components	.....
h. Testing drilled-in anchors and grouted bolts/dowels/ reinforcing bars	.....
i. Static pile loading tests on working piles	.....
j. Confirmatory core test of founding strata of Type 3 piles (this test is also required to be carried out by Approved Ground Investigation Contractor employed by the Contractor)	.....
k. Proving bedrock after installation of Types 5 & 6 piles	.....
l. Ultrasonic Echo Sounder Test for Type 3 piles (this test is also required to be carried out by Approved Laboratory employed by the Contractor)	.....
m. Tests carried out by Direct Testing Contractor(s) in parallel with the Contractor's test of temporary works under PRE.B10.015	

Option 2

Works by Government departments, Utility Undertakings, Direct Contractors and / or Direct Testing Contractors will be carried as follows (attendance in connection with such work is described in Worksection PRE.B12):

	Estimated Value (HK$)
1. Works by Government departments and Utility Undertakings:	
a.	.....
2. Works by Direct Contractors:	
a. Transplanting	.....
b. Site investigation	.....
c. Construction and Demolition Materials Disposal Tracking System (CMDTS)	.....
3. Works by Direct Testing Contractor:	
a. Air monitoring tests	.....
b. Asbestos monitoring and testing	.....

PRE.B11.030.9 WORKS BY NOMINATED SUB-CONTRACTORS

1. The following parts of the Works will be carried out by Nominated Sub-contractors:
   a. Supply and installation of irrigation system;
   b. Supply and place artificial plants;
   c. Lift installation/lift and escalator installation;
   d. Electrical installation including CCTV and door phone installation;
   e. Fire services installation/water pump installation and water feature installation;
   f. Air conditioning and mechanical ventilation installation;
   g. Kitchen and catering equipment installation;
2. In accordance with GCC Clause 5.15, the design requirements for each of the above Nominated Sub-contract works for which the Contractor will be responsible, are referred to in PRE.B6 of this Specification.

PRE.B11.040.9 SUPPLY ONLY OF MATERIALS BY NOMINATED SUB-CONTRACTORS

Supply only of the following materials for incorporation in the Works by Nominated Sub-contractors:

Kitchen fitments.

PRE.B11.050.9 SUB-CONTRACTING

In accordance with GCC Clause 3.2(1) the Contractor is expressly prohibited from sub-contracting more than twenty-five percent (25%) of the Works.

PRE.B11.070.9 CONCURRENT ADJOINING WORKS

Other contracts that are being carried out concurrently on adjoining sites are described in Worksection PRE.B2 of this Specification.

PRE.B12 ATTENDANCE

GENERAL ATTENDANCE ON ALL TRADES

PRE.B12.010.9 GENERAL ATTENDANCE ON ALL TRADES

Provide general attendance on all trades of workers and sub-contractors working on the Site.

GENERAL ATTENDANCE ON TENDERING CONTRACTORS

PRE.B12.110.A FACILITIES FOR TENDERING CONTRACTORS

Provide attendance on contractors tendering for Direct Contracts/Nominated Sub-contract Work/building contract work/piling contract work including every facility to inspect the Site and the Works in the legitimate pursuit of their submission of a tender.

PRE.B12.120.9 INFORMATION FOR TENDERING CONTRACTORS

Provide such information as can reasonably be requested as to method of construction, programme of Works, and the like.

PRE.B12.130.9 REMEDIAL WORKS OR EXPENSES

Carry out all work necessitated by any failure in the arrangements specified in PRE.B12.110 and PRE.B12.120 or pay to the Authority all expenses properly incurred as a result of such failure.

GENERAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS, DIRECT CONTRACTORS, GOVERNMENT DEPARTMENTS AND UTILITY UNDERTAKING

PRE.B12.210.9 PROVISION FOR ATTENDANCE

1. Provide for attendance to all Nominated Sub-contractors, Direct Contractors, Government Departments and Utility Undertaking and coordinate and sequence work programmes as specified in the following clauses in this Section;
2. Carry out all work necessitated by any failure in the above arrangements or pay to the Authority all expenses properly incurred as a result of such failure.

PRE.B12.220.9 PLANNING AND PROGRAMMING

Option 1

Plan the time and manner of the execution of the work, delivery of materials and the time and manner of the submission of drawings or schedules of builder's work requirements. In compliance with GCC Clause 5.7, submit to the CM additional programmes in respect of each Nominated Sub-contractor within 14 days of the acceptance of each Nominated Sub-contract.

Option 2

Plan the time and manner of the execution of the work, delivery of materials and the time and manner of the submission of drawings or schedules of builder's work requirements.

PRE.B12.230.A BUILDER'S WORK

1. Submit for the agreement of full particulars of all necessary builder's work, including but not be limited to forming or cutting openings, holes, grooves, chases, rebates, mortices, recesses and the like and all associated temporary works, trimming bars, sleeves, surrounds, fire-rated caulking, waterproofing and the like, to enable Nominated Sub-contractors, Direct Contractors and Utility Undertaking to execute their work;
2. On receipt of the CM's agreement, execute all such builder's work;
3. For openings through structural elements:
   a. Grout all voids between sleeves / cable ducts / pipeworks / equipment and openings / sleeves where required in reinforced concrete members and grout up with concrete of the same crushing strength and structural performance as the members (unless otherwise specified) after the sleeves / cable ducts / pipeworks / equipment are properly fixed in position;
   b. Fill up and seal with waterproof non-shrinking cement sand mortar approved by the CM unless otherwise specified. Make good gaps between wall openings and all equipment and pipework passing through structural members.
4. For pipes passing through external walls:
   a. Diameter of pipe sleeves as shown on the Drawings, otherwise at least one size larger than the pipe that passes through with minimum 8.5mm annular space between the pipe sleeve and the pipe;
   b. Fill the annular space between the sleeves and the pipes with proprietary waterproof filling mortar to MAS3.M360 or polyurethane foam to CON2.M260(1). Cut back all excess filling material for caulking both ends of pipe sleeves with mastic sealant which flushed with the adjoining finished surfaces. The proprietary waterproof filling mortar or polyurethane foam and mastic sealant shall be approved by the CM;
   c, Filling works for the annular space between the pipe sleeves and the gas pipes shall be carried out by skillful worker;
   d. Provide a construction mock-up for pipe sleeve as per PRE.B9.440;
   e. Carry out watertightness test to pipe sleeves as per WAT6.T020 at sample flats;
   f. Carry out open-up inspection of completed pipe sleeves as per MAS3.T100 and MAS3.T110;
   g. Cover the drilled hole for pipe bracket with stainless steel nut and washer as shown on the Drawings;
   h. Carry out watertightness-test to pipe sleeves as per WAT6.T020.
5. Provide all necessary materials and equipment for grouting, brackets and bolts;
6. Provide full ducting system with either unplasticized polyvinyl chloride (uPVC) or galvanized iron (GI) pipes and draw pits for the street lighting installation in accordance with the latest edition of Highways Department's Technical Circulars and other requirements;
7. For all underground and lead-in cable ducts entering the building, seal up cable ducts with Approved materials to form a gas, water and fire barrier and grout voids between cable ducts and openings as follows unless otherwise specified:
   a. Within 14 days after the cable ducts have been installed, seal up ends of cable ducts with the Approved materials and grout all voids between cable ducts and openings in reinforced concrete members with concrete of the same crushing strength and structural performance as the members;
   b. On completion of the cabling works by Utility Undertaking, seal up ends of cable ducts with the Approved materials;
   c. Ensure that all ends of spare installed cable ducts are sealed with either the Approved materials or duct plug as specified in ELE9.1.150.

8. Produce a set of Coordinated Builder's Works Drawings as follows:
    a. For the following section(s) of the Works containing building / structure other than standard domestic blocks, produce a set of Coordinated Builder's Works Drawings for the CM's approval prior to commencement of such work:
        i. Section of the Works: …..
    b. This set of drawings shall indicate all the necessary provisions to satisfy the builder's works requirements of Nominated Sub-contractors, Direct Contractors and Utility Undertaking to enable them to carry out their works. The Building Services Engineer shall be responsible for the preparation of the Coordinated Builder's Works Drawings and gather the necessary information from Nominated Sub-contractors, Direct Contractors and Utility Undertaking and resolve any conflicts and incompatibilities that may arise during the consolidation process. This set of Coordinated Builder's Works Drawings shall contain but not be limited to:
        i. The size, type and location (setting out and level) of permanent openings, penetrations, recesses and chases etc. in the structure, blockwork wall and cladding;
        ii. The size, type and location (setting out and level) of equipment foundations, supporting plinths etc., including details of fixing for equipment;
        iii. Details of the items (puddle flanges, sleeves, fixings etc.) to be cast into the structure;
        iv. Details of the temporary openings to be left in the structure to facilitate the delivery and installation of equipment;
        v. Details of the permanent lifting facilities required for the maintenance of the equipment;
        vi. Details of the temporary lifting facilities required for the delivery and installation of the equipment;
        vii. Details of any other items of a similar nature which may have an effect on the structure;
        viii. All the above items to be labelled to indicate the requesting party of each item;
        ix. The drawing reference with the exact revision number of the architectural / structural drawing on which the Coordinated Builder's Works Drawings are based.
    c. The scale of the Coordinated Builder's Works Drawings shall be not less than 1:100 for layout plans while the scale of the sectional and elevation plans shall not be less than 1:50. Other drawing scales may be required as and when considered necessary for the purpose of clarity by the CM.

PRE.B12.235.9 GENERAL ATTENDANCE FOR BUILDING SERVICES INSTALLATIONS

Provide all General Attendance to the requirements of the Nominated Sub-contractors and Direct Contractors of building services installations to execute their work in accordance with the Contract. This includes but is not limited to:

1. Provide access, including temporary openings, for transportation of equipment to the location of installation in plant rooms and plant areas;
2. Provide access to the location as required during testing and commissioning;
3. Provide adequate propping to roof and floor slabs required for transportation of heavy equipment to plant rooms and plant areas;
4. Provide attendance for delivery of equipment and materials.

PRE.B12.240.9 RESOLUTION OF CONFLICTING BUILDER'S WORK REQUIREMENTS

Check submitted builder's work requirements for conflict between all services. Submit full particulars of builder's work requirements to the CM for Approval, together with a report detailing any ambiguity, discrepancy or conflict between all services.

PRE.B12.250.9 ROUTING OF SERVICES

Take note that the location, size and routing of pipes and conduits shown on the Drawings are for indication only and must be followed as far as practicable. Notwithstanding that, obtain full particulars of any additional builder's work requirements and report any discrepancy or conflict to the CM as described in PRE.B12.240.

PRE.B12.260.9 PROVISION OF DETAILS OF METHOD OF CONSTRUCTION

Supply details of the method of construction including all dimensions and other information necessary to ensure that work by others is correctly executed or correct goods or materials are supplied.

PRE.B12.270.9 INSPECTION AND CERTIFICATION

Inspect building services Nominated Sub-contractors work and certify in writing that it is in accordance with the Specification and Drawings before seeking approval to covering up under GCC Clause 7.3(2).

PRE.B12.280.9 ENDORSEMENT OF CONFORMITY

1. Endorse all delivery vouchers and testing procedures from building services Nominated Sub-contractors; state with the endorsement that the materials and equipment delivered and incorporated in the Works and/or testing conform with the Specification and Drawings for building services Nominated Sub-contracts;
2. Endorse all delivery vouchers from Direct Contractors for building services works.

PRE.B12.290.9 REVIEW OF SITE SECURITY PLAN

Hold regular meetings to review adequacy of the Site Security Plan from time to time, and specifically in advance of each programmed work stage, to ensure compliance with specified requirements and continued adequacy of the Site Security Plan.

GENERAL ATTENDANCE ON MATERIALS SUPPLIED BY THE AUTHORITY

PRE.B12.310.9 GENERAL ATTENDANCE ON MATERIALS SUPPLIED BY THE AUTHORITY

Option 1

Where items are to be obtained from the Authority accept responsibility for any loss or damage and:

1. Take delivery at Housing Department Store or Government Store, as directed;
2. Load, transport to the Site, unload, check, examine, take to store and protect;
3. Take from store, distribute, hoist and fix in position;
4. Return surplus items to Housing Department Store and/or Government Stores;
5. Return all crates and other packing as required to Housing Department Store and/or Government Stores.

Option 2

Where trees, plants and other materials are to be obtained from the Authority, accept responsibility for any loss, damage or replacement and:

1. Take delivery at Housing Department Estates, other designated nurseries, or locations as Instructed;
2. Load, transport to the Site, unload, check, examine and protect;
3. Transplant and secure trees and plants in position as Worksections SLW2 and SLW3;
4. Accept responsibilities as Worksection EXT11.

SPECIAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS

PRE.B12.410.9 ELECTRICAL INSTALLATION

Provide the following Special Attendance:

1. Draw wires to all underground ducts;
2. Lubrication of all inaccessible ducts with graphite powder;
3. Street lighting;
4. Bus terminus lighting.

PRE.B12.430.A LIFT AND ESCALATOR INSTALLATION

Provide the following Special Attendance:

1. Preparation of entrances in lift wells suitable to accommodate requirements for landing doors or gates and filling the gaps between structure and door lining, indicator and control station with fire resisting material in accordance with the requirements in the Code of Practice for Fire Safety in Buildings. Complete the filling of fire resisting material within 3 days after the respective lift well is handed over by the Nominated Sub-contractor to the Contractor to carry out such work;
2. Provision of the following in lift well for lift installation:
    a. For lift installation with travel greater than 15m except lifts with side counterweight configuration, provision of Guided Suspended Working Platform (GSWP) for each lift well will be carried out by the Lift Nominated Sub-contractor;
    b. For lift installation with travel not exceeding 15m or lifts with side counterweight configuration, provision of suitable metal scaffolding to Nominated Sub-contractor's requirements and protection to work in progress, shall be carried out by the Contractor. Dismantle metal scaffolding and remove in around 5 days after the lift well is handed over back to the Contractor to carry out such work;
    c. The GSWP shall be operated by the Contractor for carrying out the builder’s work inside lift well if necessary. Training to the representatives of the Contractor to operate the GSWP for carrying out the builder’s work inside the lift well, will be provided by the Lift Nominated Sub-contractor;
    d. Provision of scaffolding at lift pit for each lift well for installation of GSWP;
    e. Provision of 380V 3-phase 50Hz temporary electricity supply terminating at an isolator located on lowest landing for each lift for operation of GSWP and lift material winch. The power ratings shall be determined by the Lift Nominated Sub-contractor.
3. Provision and maintenance of protective linings to the frames and architraves of lift openings on each and every floor, and to the internal walls, floors and ceilings of lift cars as indicated in the Drawings at Appendix C to this Specification, from completion of lift installation to the certified completion of the Works in accordance with the General Conditions of Contract;
4. Provision of temporary protection for lift well openings;
5. Provision of storage areas for lift and escalator equipment at least 12 months before the due date for completion of each block or Section;

6. Provision of two extra reinforcement bars for connection to each lift architrave to fulfil Nominated Sub-contractor's requirement on equipotential bonding. Tie the extra reinforcement bars securely to the nearby reinforcement bars to maintain electrical continuity;
7. Provision of temporary electricity at voltage 110V with circuits equipped with waterproof sockets for use by the Nominated Sub-contractor;
8. Installation of at least 3 sets of independent lifelines anchored to eyebolts inside a lift well before handing over to the Nominated Sub-contractor;
9. Provision of anchorage near lift well openings at the lowest landing floor for use by worker to lock fall arrestor and safety harness when required to access lift pit and provision of anchorage at other landing floors if necessary for use by worker to lock fall arrestor and safety harness when working near or in the lift well;
10. Provision of permanent anchorage adjacent to lift landing door (at the side of the cat ladder) at the lowest landing floor of every lift, for use by worker to lock fall arrestor and safety harness when required to access lift pit, in accordance with the approved drawing. On completion of the Works, provide Inspection Certificate issued by a Registered Professional Engineer in building, civil or structural discipline certifying that satisfactory visual inspection and check has been carried out by the Registered Professional Engineer on the permanent anchorage(s).

PRE.B12.431.N PROTECTION OF LIFT ARCHITRAVE

Provide the following works after coordination with the Lift Nominated Sub-contractor:

a. Submit the method statement for the installation procedure (including builder's work and appropriate protection after installation) of lift architrave to the CM for approval before carrying out the installation of lift architrave on Site.

b. Upon receiving the approval from the CM on the method statement, install the lift architrave as follows:
   (i) Construction of the Sample lift architrave
   - Provision and fixing of the lift architrave shall be by Lift Nominated Sub-contractor;
   - Provide all necessary builder's work for the lift architrave with associated temporary work;
   - Review with the CM or his representatives the procedure and workmanship for grouting, installation and finished surface condition of lift architrave;
   - Removal of the protection sheet on the lift architrave shall be by Lift Nominated Sub-contractor for the CM or his representatives' inspection of any apparent damage or scratch found on the surface finish of the lift architrave;
   - Provide appropriate protection to the lift architrave after removal of the protection sheet;
   - Upon receiving approval from the CM on the lift architrave installed on Site, submit all necessary document including site photos of the Approved Sample lift architrave to the CM for record.
   (ii) Lift architrave
   - Provision and fixing of the lift architrave shall be by Lift Nominated Sub-contractor;
   - Provide all necessary builder's work for the lift architrave with associated temporary work.

SPECIAL ATTENDANCE

PRE.B12.510.9 TESTING CONCRETE AND CONSTITUENT MATERIALS

Provide the following Special Attendance:

1. Provision of all facilities for the Direct Testing Contractor in the taking of samples;

2. Provision of a labourer for full attendance during the sampling and in-situ testing of fresh concrete on Site;
3. Submission of all samples and materials as the Direct Testing Contractor may demand to enable the required tests to be made;
4. Provision of sufficient curing tanks and rooms for the exclusive use of the CM, in accordance with PRE.B10.330 to PRE.B10.390 inclusive to be made available before any concreting works are carried out on Site;
5. Provision of transportation of test samples and materials within the Site area, including loading and unloading of test samples;
6. Provision of office accommodation for one technician of the Direct Testing Contractor in accordance with PRE.B10.320 to be made available before any concreting works are carried out on Site;
7. Provision of access to the location of sampling or Site testing, including access to supply sources of concrete, including ready-mixed concrete, and its constituent materials;
8. Provision of water and electricity as required 24 hours a day for the sampling and Site testing;
9. Provision of spoil areas for disposal of surplus concrete and samples and arrange to cart away;
10. Provision of hardstanding and covered car space for the exclusive use of the Direct Testing Contractor;
11. Provision of all facilities and attendance for carrying out coring and testing of concrete cores for the early core tests of precast concrete components by Direct Testing Contractor.

PRE.B12.511.9 TESTING DRILLED-IN ANCHORS AND GROUTED BOLTS/ DOWELS/ REINFORCING BARS

Provide the following Special Attendance:

1. Provision of all facilities for the Direct Testing Contractor in carrying out the required test as instructed by the CM;
2. Provision of additional materials for testing and making good after testing.

PRE.B12.515.9 ATTENDANCE ON DIRECT TESTING CONTRACTORS OF PILING WORKS

1. Provide information for the preparation of the report, all as required by the Direct Testing Contractors and / or Housing Department Materials Testing Laboratory;
2. Be responsible for the coordination of testing and for ensuring that the appropriate piles and materials are made available for such testing and commence early enough in the foundation contract and avoid subsequent delays in performing the pile load test.

PRE.B12.516.9 ATTENDANCE ON DIRECT TESTING CONTRACTOR FOR AIR MONITORING TESTS

1. Allow for coordination of the air monitoring tests in the programme;
2. Provision of all facilities for the Direct Testing Contractor in the taking of samples;
3. Provision of water and electricity as required 24 hours a day for the sampling and site testing.

PRE.B12.520.9 NON-DESTRUCTIVE TESTS ON PILES & ULTRASONIC ECHO SOUNDER TEST FOR TYPE 3 PILE

1. Provide the following Special Attendance:
   a. Compliance with all the requirements of PIL1 - Testing;

b. Provision of all necessary power including electricity, labour, materials, plant and equipment including welding facilities as required;

c. Provision of access to the test pile including access to pile when pitched;

d. Provision of all necessary water at the locations as required by the Direct Testing Contractor and/or Housing Department Materials Testing Laboratory, and a labourer for full attendance during the testing period, and ladder(s) as required in carrying out the test;

e. Expose and prepare pile heads for non-destructive tests such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads;

f. Provision of preliminary Pile Testing information to Direct Testing Contractor and/or Housing Department Materials Testing Laboratory;

g. Provision and installation of sonic access tubes in the Type 3 piles for sonic logging tests; details of the sonic access tubes shall be in accordance with PIL1.T1610 and Drawing No. .....;

h. Provision of driving equipment for piles selected for pile driving analyser test;

i. Extend the test pile to a level as and when required so that pile driving analyser tests can be carried out;

j. Fill sonic tubes solid with non-shrinkage grout of at least the same crushing strength as the pile tested.

2. Non-destructive tests on piles shall include Pile Driving Analyser Test, Pile Integrity Test and Sonic Logging Test.

PRE.B12.530.9 CONCRETE CORING AND TESTING EXCLUDING CORE TESTING OF TYPE 1(C) & TYPE 3 PILES

Provide the following Special Attendance:

1. Additional materials for coring and testing and making good after coring.

PRE.B12.532.9 CORE TESTING OF TYPE 1(C) & TYPE 3 PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of access to the test pile;
3. Expose and prepare pile heads for the tests such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads;
4. Provision of suitable working platforms for supporting the coring equipment in the execution of coring;
5. Provision of water and electricity as required 24 hours a day for the coring and site testing;
6. Fill cored holes solid with non-shrinkage grout of at least the same crushing strength as the pile cored.

PRE.B12.534.9 CONFIRMATORY CORE TESTING OF FOUNDING STRATA OF TYPE 3 PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of access to the test pile;
3. Expose and prepare pile heads for the tests such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads;

4. Provision of suitable working platforms for supporting the coring equipment in the execution of coring;
5. Provision of water and electricity as required 24 hours a day for the coring and site testing;
6. Fill cored holes and sonic tubes solid with non-shrinkage grout of at least the same crushing strength as the pile cored.

PRE.B12.536.9 NON-DESTRUCTIVE TESTS ON WELDS OF PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of access to the test pile including access to pile when pitched;
3. Provision of electricity as required for the weld tests;
4. Provision of welders and welding facilities when required.

PRE.B12.537.9 LOADING TESTS OF WORKING PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of electricity as required 24 hours a day for the loading tests;
3. Provision of access to the test piles;
4. Provision of reactions by means of kentledge, anchor piles or other anchorage with adequate stability and safety and approved by the CM;
5. As and when required by the CM, carry out the following:
    a. Extend the test pile to a suitable level for the carrying out of the test; and/or
    b. Design and construct a suitable pile cap and/or adequate lateral supports to the test pile;
    c. Construct a suitable pile cap and/or adequate lateral supports to the test pile as specified or instructed by the CM;
    d. Demolish the pile cap or lateral supports, as necessary, when they are no longer required for the loading test.
6. Expose and prepare pile heads such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads;
7. Provision of transportation of the testing equipment within the Site. Place the testing equipment at the location as required by the CM or the Direct Testing Contractor;
8. Throughout the period of the test, make observations of the settlement of the pile being tested by a suitable surveyor's level;
9. On completion of the test, remove the kentledge, anchor piles or other anchorage, demolish the test pile cap, make good the test pile and the Site back to their original condition and remove all debris arising from the test from the Site.

PRE.B12.538.9 PROVING BEDROCK AFTER INSTALLATION - TYPES 5 & 6 PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of access to the test pile;
3. Provision of suitable working platforms for supporting the coring equipment in the execution of coring;
4. Provision of water and electricity as required 24 hours a day for the coring and site testing;
5. Backfill the drillholes with clean sand.

PRE.B12.540.9 GAS WATER HEATER INSTALLATION / FITTING OUT GAS PIPEWORK

Provide the following Special Attendance:

1. Provide new scaffolding as appropriate or retain scaffolding in place and maintain protection whilst work is in progress;
2. Storage areas for water heater equipment and material at least 6 months before the due date for completion of each building.

PRE.B12.560.9 TURFING AND PLANTING WORKS

Provide the following Special Attendance:

1. Attendance on this Work during the Maintenance Period including provision of water for daily watering required to be carried out during this period.

   Note: The turfing and planting contract includes a twenty four month maintenance period for daily watering, care of the work etc. This maintenance period may extend into the Maintenance Period of the Main Contract.

PRE.B12.565.9 ATTENDANCE ON THE ENVIRONMENTAL PROTECTION DEPARTMENT'S DIRECT CONTRACTOR

1. The scope of work of EPD's direct contractor is limited to the supply and delivery of soil conditioning products based on animal manure as shown on Drawings and Schedules, or as Instructed;
2. The EPD's direct contractor shall undertake the supply, and delivery to site, of these materials in bulk and / or packaged form;
3. Liaise with the EPD's direct contractor and arrange for these materials to be delivered to Site at appropriate intervals to suit own operatives;
4. Coordinate timing of own soiling and backfilling operations to allow incorporation of the materials supplied by the EPD's direct contractor;
5. Permit vehicular access to the location where the delivery is to be made. Clear away obstructions or otherwise make allowance for vehicular access;
6. Take delivery and arrange temporary storage of the supplied materials as necessary before incorporation with own soiling works.

PRE.B12.570.9 ATTENDANCE ON THE EMPLOYER'S DIRECT CONTRACTOR

1. The scope of work of this contractor is limited to horticultural and arboricultural operations in relation to the vegetation designated to be protected or transplanted as shown in the Contract Drawings, or as Instructed;
2. Coordinate timing of own operations with those of the Employer's Direct Contractor as required;
3. Permit vehicular access to the location where the Employer's Direct Contractor works are to be undertaken. Clear away obstructions or otherwise make allowance for access;
4. Allow for temporary removal or relocation of plant materials as needed in planting areas where access is required by the Employer's Direct Contractor as necessary for the execution of his work;
5. The Employer's Direct Contractor shall carry out:
   a. Tree surgery, rootball preparation, and other arboricultural works, related to the removal of trees or palms required to be retained or transplanted;
   b. The transplanting of trees, palms or shrubs from or within the Site in accordance with Contract Drawings or as Instructed, including all excavation and backfilling operations;
   c. The supply and installation, of all Approved materials required during the transplanting operations and for backfilling, staking and guying.

PRE.B12.580.9 REMOTE SITE MONITORING SYSTEM (RSMS)

Provide the following Special Attendance:

1. Provision of all necessary facilities for the Direct Contractor for RSMS to carry out the installation, relocation, maintenance and dismantling of the RSMS;
2. Provision of power supply and power points for the RSMS;
3. Provision of security and regular cleaning for the RSMS control unit and camera;
4. Take due care to protect the RSMS control unit and camera from damage. In the event of failure to perform such due care resulting in damaging the RSMS control unit and camera, pay to the Authority all expenses incurred by the Authority for rectifying the damage.

PRE.B12.590.9 CONSTRUCTION & DEMOLITION MATERIALS DISPOSAL TRACKING SYSTEM (CMDTS)

Provide the following Special Attendance:

1. Provision of all necessary facilities for the Direct Contractor of CMDTS to carry out the installation, relocation, maintenance and dismantling of the CMDTS;
2. Provision of power supply and power points for the CMDTS;
3. Provision of security and regular cleaning for the RFID readers, cameras and other accessories for CMDTS;
4. Provision of shelter for housing of the notebook, router, 2D bar code reader, other IT equipment and accessories for CMDTS (The shelter shall be in weatherproof construction with sufficient strength, adequately braced and anchored to resist typhoon conditions. The shelter shall be lockable, and be equipped with adequate lighting, power supply and windows overseeing the weighbridge operations. Minimum area of the shelter shall be 1.5 m^2 for the Direct Contractor of CMDTS to carry out the monitoring works.);
5. Take due care to protect the RFID readers, cameras and other accessories for CMDTS from damage. In the event of failure to perform such due care resulting in damaging the RFID readers, cameras and other accessories for CMDTS, pay to the Authority all expenses incurred by the Authority for rectifying the damage.

SPECIAL ATTENDANCE ON UTILITY UNDERTAKING

PRE.B12.620.9 FIXED TELECOMMUNICATION NETWORK SERVICES INSTALLATION

Provide the following Special Attendance:

1. Draw wires to all telecommunication underground and lead-in ducts;
2. Attendance at "pass-thro" test including any remedial work.

PRE.B12.630.9 ELECTRICITY SUPPLY COMPANY

Provide the following Special Attendance:

1. Take delivery of emergency exit deadlock set with panic bar at store of electricity supply company and fix in position as directed and to the satisfaction of the electricity supply company. Return surplus items to the store of electricity supply company.

PRE.B12.640.X DELETED

SPECIAL REQUIREMENTS FOR PHASING THE WORKS

PRE.B12.710.A NOMINATED SUB-CONTRACTORS

Coordinate with Nominated Sub-contractors, to enable the proper and timely execution of their installation works in accordance with the Contract. Particular attention is drawn to the following requirements:

Nominated Sub-contract	Requirement
Electrical installation	Make available to Nominated Sub-contractor the transformer room at least 4 months prior to completion of each block. Make available to Nominated Sub-contractor the generator room at least 3 months prior to completion of each block. Make available to Nominated Sub-contractor the meter rooms at ground floor and lower zone of the block at least 6 months prior to completion of each block. Complete the whole of the main switch room in each building and make available to Nominated Sub-contractor 6 months after the completion of the structural frame and the ceiling slab of the respective main switch room or 4 months prior to the completion of each building, whichever is the earlier, together with wall and floor finishing, door and other internal finishing works as specified. Make available to Nominated Sub-contractor the meter room at upper zone of the block at least 4 months prior to completion of each block. Make available to Nominated Sub-contractor the automatic meter reading equipment room / cabinet for water supplies at least 6 months prior to completion of each block. Make available to Nominated Sub-contractor the underground cable ducts and draw pits at least 4 months prior to completion of each block. Vehicular access for transportation of equipment to the main switch room and generator room during the last 5 months prior to completion of each block.
Fire services and water pump installation / water pumps and water features installation	Make available to Nominated Sub-contractor the fire tank and fire pump room at ground floor and intermediate floor at least 5 months prior to completion of each block. Make available to Nominated Sub-contractor the fire tank and fire pump room at roof at least 4 months prior to completion of each block. Make available to Nominated Sub-contractor the pump room, sump and tank at least 6 months prior to completion of each block. Make available to Nominated Sub-contractor the pump room and ancillary builder's works provisions at least 4 months prior to completion of water feature.

Air conditioning / mechanical ventilation Installation	Make available to Nominated Sub-contractor the central plant room, pump room and space for outdoor equipment at least 6 months prior to completion of each block. Make available to Nominated Sub-contractor the Air-Handling Unit (AHU) rooms and fan rooms at least 5 months prior to completion of each block.
Kitchen and catering equipment installation	Make available to Nominated Sub-contractor the kitchen area with all finishing works completed and ready for the installation of the equipment at least 3 months prior to completion of the building containing the kitchen.
Lift installation	Complete the corresponding lift wells with metal scaffolding, builder's work and machine rooms ready for handover to the Nominated Sub-contractor on or before a date which is 110 calendar days prior to the respective date(s) for completion of the Nominated Sub-contract Works as specified in the written acceptance of the Nominated Sub-contractor's tender, or any re-scheduled date(s) in accordance with Clause 6.1(4) of the General Conditions of Nominated Sub-contract. N.B.: Provided that if the hand-over of the lift well and machine room has been or is likely to be delayed by the matters referred to in Clauses 6.1(3)(a) and 6.1(3)(b) of the General Conditions of Nominated Sub-contract beyond such date or dates of hand-over as specified, the Contractor shall determine a fair and reasonable re-scheduling of the respective date(s) for completion of the Nominated Sub-contract Works, and shall notify the same to the Nominated Sub-contractor in writing as soon as reasonable. Give the Nominated Sub-contractor not less than 21 day's advance notice in writing of the actual date(s) on which the lift well and machine room for the Nominated Sub-contract Works shall be handed over by the Contractor to the Nominated Sub-contractor.
Escalator installation	Complete the corresponding ..... ready for handover to the Nominated Sub-contractor on or before a date which is 110 calendar days prior to the respective date(s) for completion of the Nominated Sub-contract Works as specified in the written acceptance of the Nominated Sub-contractor's tender, or any re-scheduled date(s) in accordance with Clause 6.1(4) of the General Conditions of Nominated Sub-contract. N.B.: Provided that if the hand-over of the ..... has been or is likely to be delayed by the matters referred to in Clauses 6.1(3)(a) and 6.1(3)(b) of the General Conditions of Nominated Sub-contract beyond such date or dates of hand-over as specified, the Contractor shall determine a fair and reasonable re-scheduling of the respective date(s) for completion of the Nominated Sub-contract Works, and shall notify the same to the Nominated Sub-contractor in writing as soon as reasonable. Give the Nominated Sub-contractor not less than 21 day's advance notice in writing of the actual date(s) on which the ..... for the Nominated Sub-contract Works shall be handed over by the Contractor to the Nominated Sub-contractor.

PRE.B12.720.9 DIRECT CONTRACTORS

Option 1

Coordinate with Direct Contractors to enable the proper and timely execution of their installation works in accordance with the Contract. Particular attention is drawn to the following requirements:

Direct Contracts	Requirements
Gas water heater installation / fitting out gas pipework	Make available to Direct Contractor all associated builder's work and completion of finishing works ready for the installation of gas water heaters / fitting out gas pipework at least 3 months prior to completion of each block.
LPG installation (separate bulk supply contract)	Clearance and handover of site for central LPG compound within 1 month of notification by the CM. Make available to the Direct Contractor at least 3 months prior to completion of each block and within 2 weeks of notification by the CM or the Direct Contractor, all necessary underground and above ground service routes and openings as required by the Direct Contractor to properly execute their installations. Coordinate with Direct Contractor for installation of surface mounted gas pipes before subsequent finishing work such as painting, plastering and tiling. Coordinate with Direct Contractor for installation of cast-in gas pipes and conducting pressure and soundness tests for all concealed gas pipes before concreting, and testing and commissioning of all installed gas pipes after concreting.
Turfing and planting	Completion of formation of planting areas at least 2 months prior to completion of each Section of the Works.
Refuse Handling System Installation	Make available to Direct Contractor the refuse collection point and refuse storage & material recovery chamber in each building 3 months prior to completion of the refuse collection point and the building, together with wall and floor finishes, doors, louvres and other internal provisions and finishing works as specified. Complete the whole of the upper floor refuse rooms of the buildings and make available to the Direct Contractor at least 2 months prior to completion of each building together with wall and floor finishes, door, louvre and other internal provisions and finishing works as specified. Make available to Direct Contractor vehicular access for transportation of equipment to the refuse collection point and individual refuse storage & material recovery chamber 3 months prior to completion of the corresponding Sections or buildings.
Remote Site Monitoring System (RSMS)	Make available to Direct Contractor all associated builder's work ready for the installation and relocation of Remote Site Monitoring System (RSMS) within 2 weeks of notification by the CM.
Construction & Demolition Materials Disposal Tracking System (CMDTS)	Make available to Direct Contractor all associated builder's work ready for the installation and relocation of Construction & Demolition Materials Disposal Tracking System (CMDTS) within 2 weeks of notification in writing by the CM.

Option 2

Coordinate with Direct Contractor(s) to enable the proper and timely execution of their installation works in accordance with the Contract. Particular attention is drawn to the following requirements:

Direct Contracts	Requirements
Remote Site Monitoring System (RSMS)	Make available to Direct Contractor all associated builder's work ready for the installation and relocation of Remote Site Monitoring System (RSMS) within 2 weeks of notification by the CM.
Construction & Demolition Materials Disposal Tracking System (CMDTS)	Make available to Direct Contractor all associated builder's work ready for the installation and relocation of Construction & Demolition Materials Disposal Tracking System (CMDTS) within 2 weeks of notification in writing by the CM.

PRE.B12.730.A UTILITY UNDERTAKING

Coordinate with Utility Undertaking to enable the proper and timely execution of their installation works. Particular attention is drawn to the following requirements:

Utility Undertaking	Requirement
Electricity supply connection	Handover of transformer rooms to the electricity supply company at least three and a half months prior to completion of each block. Make available to the electricity supply company within the period commencing from the date 4 months prior to the programmed completion date of the earliest block to the programmed completion date of the last block in the project, and with 2 weeks of notification by the CM or the Power Company an area 1.5 m wide along the electricity supply company's external underground cable route for the power supply. Vehicular access for transportation of transformer and switchgear to the transformer rooms during the last 4 months prior to completion of each block.
Town gas installation	Make available to the Town Gas Company at least 3 months prior to completion of each block and within 2 weeks of notification by the CM or the Town Gas Company, all necessary underground and above ground service routes and openings as required by the Town Gas Company to execute their installation. Coordinate with Town Gas Company for installation of surface mounted gas pipes before finishing works such as painting, plastering and tiling. Coordinate with Town Gas Company for installation of cast-in gas pipes and conducting soundness tests for all concealed gas pipes before concreting, and testing and commissioning all installed gas pipes after concreting.
Street lighting installation	Make available to the Utility Undertaking within the period commencing from the date 5 months prior to the programmed completion date of the earliest block to the programmed completion date of the last block in the project, and within 2 weeks of notification by the CM or the Utility Undertaking an area 1.5 m wide along the Utility Undertaking's external underground cable route for the street lighting.

Fixed telecommunication network services (FTNS) installation	Make available to FTNS Operators the Telecommunication and Broadcasting Equipment (TBE) room and meter / communication rooms and other facilities at least 5 months prior to completion of each block. Arrange the provision of permanent electricity power supply installation within two weeks after energisation of the main switchboard and make available to FTNS Operators the permanent electricity power supply inside TBE rooms at least 1 month prior to completion of each block. Make available to FTNS Operators at least 5 months prior to completion of each block and within 2 weeks of notification by the CM or the FTNS Operator, the lead-in ducts and the area along the external cable route for FTNS installation.

PRE.B12.740.9 GOVERNMENT DEPARTMENTS

Coordinate the programme to enable phasing of the Works to suit the following requirements of Government Departments:

Government Department	Requirement
Hong Kong Police Force	Fitting out work to Police Posts Provide completion of Police Reporting Centre / Police Neighbourhood Unit for complete handover to Government for fitting out work at least three months before the completion date for Block No. .....

FACILITIES FOR NOMINATED SUB-CONTRACTORS, DIRECT CONTRACTORS AND UTILITY UNDERTAKING

PRE.B12.810.9 FREEDOM OF MOVEMENT

Provide every facility to move about the Site in the legitimate pursuit of their work.

PRE.B12.820.9 ACCESS ROAD FOR ELECTRICITY SUPPLY INSTALLATION

Pursuant to PRE.B10.020, keep a free access road of 4.0 m wide from the Site entrance to the Transformer Compound/Transformer and Switch Room Compound for installation works by other contractors or the Hong Kong Electric Company Limited / CLP Power Hong Kong Limited as directed by the CM.

PRE.B12.830.9 USE OF AVAILABLE PLANT

Allow the use of such plant, ladders, hoisting facilities, scaffolding or staging as may have been provided or erected by the Contractor, provided that there is no obligation to retain any such plant, ladders, hoisting facilities, scaffolding or staging longer than is necessary for the Contractor's own use.

PRE.B12.840.9 WORK AND STORAGE AREAS

1. Provide sufficient space within the Site or within the Works under construction for work areas and storage sheds for the storage of materials and plant brought onto the Site having regard to the nature of the Site and the Works;

2. Complete the main switch room in each building in whole and make available to the Nominated Sub-contractor for the electrical installation six months after the completion of the structural frame and the ceiling slab of the respective main switch room or four months prior to the completion of each building, whichever is the earlier, together with wall and floor finishing, door and other internal finishing works as specified;
3. Provide a minimum floor area of 48 m² for each block for the erection of special secure store rooms by Nominated Sub-contractors, Direct Contractors etc.;
4. Such sheds are to be provided, erected and cleared away by the Nominated Sub-contractors, Direct Contractors, Government Departments and Utility Undertaking;
5. Provide security to all storage areas and illuminate all surrounding areas to any storage sheds erected.

PRE.B12.850.9 TEMPORARY SERVICES

1. Provide adequate temporary water and electrical supplies at convenient positions throughout the Works under construction and to work and storage areas within the Site for lighting, operation of power tools and testing and commissioning up to and including final acceptance of the installation by the CM;

Option 1

2. In compliance with GCC Clause 5.11(4), ensure that all Nominated Sub-contractors, Direct Contractors, Government Departments and Utility Undertakings are provided with sufficient lighting where any of their work is carried out in darkness;

    Note 1: Special requirement for the provision of temporary electrical supply for testing installations are set out in PRE.B12.920.

    Note 2: The temporary electrical supply and a permanent water supply for testing to be made available for each installation at least 1 month before the completion date of each building.

Option 2

2. In compliance with GCC Clause 5.11(4), ensure that all Direct Contractors, Government Departments and Utility Undertakings are provided with sufficient lighting where any of their work is carried out in darkness.

PRE.B12.860.9 SITE CONVENIENCES

Provide the use of the telephone, drinking water, mess rooms, latrines and the usual conveniences of a building site.

PRE.B12.870.9 UNLOADING ETC

Provide such assistance as is necessary in the unloading of plant, goods and materials brought onto the Site.

Take delivery at the Site, unload, check, examine, store and protect, remove from store, distribute and hoist and deliver to position. Return all crates and other packing as required.

PRE.B12.880.9 WATCHMAN/SECURITY GUARDS

Provide such watchmen or security guards as are reasonably necessary to safeguard the Site. In this connection, Direct Contractors will be required to provide reasonable access to or knowledge of their materials stored on the Site in order that an adequate service can be provided for the safe custody of such materials.

PRE.B12.890.9 CLEARING AWAY RUBBISH

Provide such service as is necessary for the clearing away of rubbish as it accumulates and at the end of each working day. Carry out a general tidying up at the end of each week.

PRE.B12.900.9 MAKING GOOD

Make good on completion any work disturbed by the use or removal of the above facilities.

PRE.B12.910.9 SPECIAL BONDING

Provide special bonding to blockwork or brickwork as MAS1.W850 where blockwork or brickwork is discontinued by conduit installation.

PRE.B12.920.A TEMPORARY ELECTRICAL SUPPLY REQUIRED FOR TESTING

Nominated Sub-contractors, Direct Contractors and Utility Undertaking Installation	Capacity	Location
Lift Installation	100A 3 Phase	Each lift machine room serving no more than 2 lifts
	150A 3 Phase	Each lift machine room serving 3 or more lifts
Escalator Installation	60A 3 Phase	Each machine pit
Electrical Installation	60A 3 Phase	Each main switch room
	30A Single Phase	Each transformer room
	30A Single Phase	Each generator room
	15A Single Phase	Three meter rooms per block as directed by the CM (for CABD System)
	15A Single Phase	Three meter rooms per block, as directed by the CM (for door phone installation)
Fire Services and Water Pump Installation	60A 3 Phase	Each booster or fixed pump room
	100A 3 Phase	Each sprinkler pump room
	150A 3 Phase	Each pump room
	60A 3 Phase	Each pump room for water feature
Air conditioning / Mechanical Ventilation Installation	100A 3 Phase	Each air conditioning plant room
	60A 3 Phase	Each air-cooled condenser
	30A 3 Phase	Each air handling unit (AHU) room or fan room
Kitchen and Catering Equipment Installation	30A 3 Phase	Each kitchen to be equipped
Fixed Telecommunication Network Services (FTNS) Installation	30A Single Phase	Telecommunication and broadcasting equipment (TBE) room as directed by the CM for FTNS installation
Refuse Handling System Installation	100A 3 Phase	Refuse collection point
	30A 3 Phase	Refuse storage & material recovery chamber in each building

PRE.B12.930.9 PROVISION OF SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF OPERATIVES AND SITE SUPERVISORY STAFF OF NOMINATED SUB-CONTRACTORS

Pursuant to PRE.B8.235 (1) and (2), the provision of safety helmet with ventilation vents and chin strap, clothing and footwear for personal protection of operatives and site supervisory staff shall also be extended to operatives and site supervisory staff of Nominated Sub-contractors.

PRE.BS PRELIMINARIES FOR BUILDING SERVICES SUB-CONTRACTS

PRE.BS1 PRELIMINARIES 5

PRE.BS1.010.9 PRELIMINARY ITEMS 5
PRE.BS1.020.9 SITE OF THE WORKS 5
PRE.BS1.030.9 EXTENT OF SUB-CONTRACT 5
PRE.BS1.040.9 LUMP SUM TENDER 5
PRE.BS1.050.9 COPIES OF PRICES 6
PRE.BS1.060.9 DEFINITIONS AND INTERPRETATION 6
PRE.BS1.070.9 MAIN CONTRACT CONDITIONS 7
PRE.BS1.080.9 SUB-CONTRACT 7
PRE.BS1.090.9 APPENDIX TO THE GENERAL CONDITIONS OF SUB-CONTRACT 8
PRE.BS1.100.9 SCHEDULE OF RATES 9
PRE.BS1.110.9 SUB-CONTRACT DRAWINGS 9
PRE.BS1.120.9 PROVISION OF EVERYTHING NECESSARY 9
PRE.BS1.130.9 DISCREPANCIES 9
PRE.BS1.140.9 RESPONSIBILITY 10
PRE.BS1.150.9 SITE CONDITION, SITE ACCOMMODATIONS 10
PRE.BS1.160.9 NOTIFIED DATE FOR COMMENCEMENT OF MAIN WORKS AND THE LETTER OF ACCEPTANCE OF SUB-CONTRACT TENDER 10
PRE.BS1.165.9 PHASED ISSUANCE OF WORKING DRAWINGS AND DETAILS 11
PRE.BS1.170.9 PHASED POSSESSION OF SITE / AND COMMENCEMENT OF THE MAIN WORKS 11
PRE.BS1.180.9 SECTIONS FOR PHASED COMPLETION OF THE MAIN WORKS 12
PRE.BS1.190.9 PROGRAMME OF WORK 14
PRE.BS1.200.9 TECHNICAL LITERATURE TO BE PROVIDED 14
PRE.BS1.205.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 15
PRE.BS1.210.9 INSTALLATION DRAWINGS 15
PRE.BS1.220.9 STANDARD DETAILS 16
PRE.BS1.230.9 FAILURE TO SUBMIT INSTALLATION DETAILS AND LAYOUT DRAWINGS IN TIME 16
PRE.BS1.240.9 MAIN CONTRACTOR'S RELATIONSHIP WITH AND ATTENDANCE ON SUB-CONTRACTORS 16
PRE.BS1.250.9 SUB-CONTRACTOR TO INFORM MAIN CONTRACTOR OF "BUILDER'S WORK" 17
PRE.BS1.260.9 BUILDER'S WORK DRAWINGS 17
PRE.BS1.270.9 CHECKING DRAWINGS OF OTHER TRADES 18
PRE.BS1.280.9 DRAWINGS SUBMITTED AFTER INSTALLATION COMPLETED 18
PRE.BS1.290.9 CUTTING AWAY AND MAKING GOOD GENERALLY 18
PRE.BS1.300.9 SLEEVES/SLOTS/HOLES 18
PRE.BS1.310.A WORKS BY MAIN CONTRACTOR AND OTHERS 18
PRE.BS1.320.A SUPERVISING ENGINEER 22
PRE.BS1.330.A SITE SUPERVISOR AND LABOUR STRENGTH REPORT 23
PRE.BS1.340.9 ORDERING 23
PRE.BS1.350.A MATERIALS AND WORKMANSHIP 24
PRE.BS1.360.9 SAMPLES 24
PRE.BS1.370.9 TESTING OF MATERIALS 24
PRE.BS1.380.9 CARE AND PROTECTION OF THE MAIN WORKS AND THIRD PARTY OBLIGATIONS 25
PRE.BS1.390.9 REGULATIONS AND GOVERNMENT LAWS 25
PRE.BS1.400.A SUB-CONTRACTOR TO GIVE NOTICE OF INJURY 25
PRE.BS1.410.9 FIRE HAZARD 26
PRE.BS1.420.9 CLEARING UPON COMPLETION 26
PRE.BS1.430.9 MAINTENANCE PERIOD 26

PRE.BS1.435.9 WORK ON ENERGISED ELECTRICAL INSTALLATION DURING MAINTENANCE PERIOD 27
PRE.BS1.440.9 METHOD OF CONSTRUCTION FOR THE MAIN CONTRACT 28
PRE.BS1.450.A GREEN AND SILVER CARD 28
PRE.BS1.460.9 CONTRACTOR'S EMPLOYEES 29
PRE.BS1.465.9 WORKERS FOR HANDLING REFRIGERANT 33
PRE.BS1.466.A PROTECTION FROM WEATHER 33
PRE.BS1.468.9 PROTECTION OF WORKERS FROM HEAT STROKE 34
PRE.BS1.469.9 PROTECTION OF WORKERS WORKING IN COLD WEATHER 35
PRE.BS1.470.9 FIXING HEAVY PLANT AND EQUIPMENT, ETC. 36
PRE.BS1.480.9 DEFECT RECTIFICATION COORDINATOR(S) (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY) 36
PRE.BS1.490.9 STANDBY WORKFORCE (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY) 36
PRE.BS1.500.9 ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES 37
PRE.BS1.510.9 APPROVAL OF MATERIALS IN CONSTRUCTION STAGE 37
PRE.BS1.515.9 AVOIDANCE AND RESOLUTION OF DISPUTES 37
PRE.BS1.520.9 SUB-CONTRACTING OF THE SUB-CONTRACT WORKS 38
PRE.BS1.530.9 HOUSING CONSTRUCTION MANAGEMENT ENTERPRISE SYSTEM (HOMES) 39
PRE.BS1.535.A DEVELOPMENT AND CONSTRUCTION SITE MOBILE SYSTEM (DCSMS) 40
PRE.BS1.540.9 OBLIGATIONS PERTAINING TO WAGES PAYMENT 42
PRE.BS1.550.9 PAYMENT OF WAGES OF SITE PERSONNEL 42
PRE.BS1.560.9 WAGE BOOKS 44
PRE.BS1.565.N RETURN OF SITE LABOUR DEPLOYMENT AND EMPLOYMENT TO CENSUS AND STATISTICS DEPARTMENT 45
PRE.BS1.570.9 SUB-CONTRACTOR'S MANAGEMENT TEAM 45
PRE.BS1.575.9 ON-DEMAND BOND 46
PRE.BS1.577.9 CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES - E & M WORK TRADE 46
PRE.BS1.580.9 SITE ACCESS CONTROL 48
PRE.BS1.600.A SITE SAFETY 49
PRE.BS1.605.9 CARING OF NEW WORKERS 60
PRE.BS1.610.9 ENVIRONMENTAL MANAGEMENT PLAN 61
PRE.BS1.620.9 ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE AND REPORTING 62
PRE.BS1.630.9 MEASURING INSTRUMENTS FOR CONTRACT MANAGER 63
PRE.BS1.700.A PROVISION OF SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF OPERATIVES AND SITE SUPERVISORY STAFF 65
PRE.BS1.710.9 CONSTRUCTION INDUSTRY COUNCIL GUIDELINES 66
PRE.BS1.720.B PLATFORMS FOR WORKING AT DIFFERENT HEIGHTS 66
PRE.BS1.730.9 SAFETY OF ELECTRIC PORTABLE TOOLS 69

BEAM PLUS ASSESSMENT 69

PRE.BS1.750.9 BEAM PLUS ASSESSMENT 69
PRE.BS1.760.B BEAM PLUS PREREQUISITES AND CREDITS 70
PRE.BS1.770.9 FILING SYSTEM FOR BEAM PLUS ASSESSMENT 74
PRE.BS1.780.9 MONTHLY BEAM PLUS MONITORING REPORT 74
PRE.BS1.790.9 BEAM PLUS COORDINATION MEETING 74
PRE.BS1.800.9 BEAM PLUS REQUIREMENTS ON TESTING, COMMISSIONING, OPERATION AND MAINTENANCE 74

MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIMEP) 81
PRE.BS1.810.N SCOPE OF WORK 81
PRE.BS1.820.N SITE COORDINATION 81
PRE.BS1.830.N COMPLIANCE WITH REGULATIONS AND STANDARDS 81
PRE.BS1.840.N DESIGN REQUIREMENTS 82
PRE.BS1.850.N DELIVERY AND SITE STORAGE 83
PRE.BS1.860.N TRANSPORTATION 83
PRE.BS1.870.N PROTECTION 83
PRE.BS1.880.N ADMINISTRATION AND RECORD 84
PRE.BS1.890.N QUALITY ASSURANCE MEASURES 84
PRE.BS1.900.N INSTALLATION METHOD FOR MIMEP 84

APPENDIX PRE.BS1 86
PRE.BS1.APPEND1.9 APPLICATION FORM FOR APPROVAL OF TESTING LABORATORY 86
PRE.BS1.APPEND2.A SUB-CONTRACTOR'S MATERIAL CHECKING FORMS 87

TRAINING OF WORKERS 97
PRE.BS1.APPEND3.9 SUMMARY TRAINING STATUS REPORT FOR THE CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES – E & M WORK TRADE (CICTS(E&M)) 97

PRE.BS1 PRELIMINARIES

PRE.BS1.010.9 PRELIMINARY ITEMS

1. The Preliminary Items included hereunder apply to the whole of the Sub-contract Works contained in the Specification and the amounts inserted by the Sub-contractor in the Summary of Tender shall be inclusive of such Preliminary Items and shall be deemed to apply to the whole of the Sub-contract Works carried out under this Sub-contract;
2. Where the word "allow" occurs, the cost of the items shall be at the risk of the Sub-contractor and no adjustment shall be made at the settlement of accounts except where such adjustment is expressly provided for in the Conditions of Sub-contract;
3. All the materials to be used in the Sub-contract Works shall be new.

PRE.BS1.020.9 SITE OF THE WORKS

1. The Site of the Works is as stated in the Specification;
2. The Site may be inspected by applying to the responsible Housing Department (HD) officer as indicated in the Special Conditions of Tender. The Sub-contractor will be deemed to have inspected the Site and taken necessary measurements prior to tendering.

PRE.BS1.030.9 EXTENT OF SUB-CONTRACT

1. The Sub-contract Works are described in the Specification, and shall comprise the supply, off-loading, storing, assembly, installation, testing, adjustment, commissioning and maintenance of the complete installation to the satisfaction of the Contract Manager;
2. The words "complete installation" shall mean not only the major items of plant and apparatus conveyed by the Specification, but all the incidental sundry components necessary, for the complete execution of the Sub-contract Works and for the proper operation of the installation, with their labour charges, whether or not these sundry components are mentioned in detail in the tender documents issued in connection with the Sub-contract;
3. The requirements stipulated in any clause and / or sub-clause of the Specification shall be deemed to be applied to every portion of the Sub-contract Works unless otherwise specified to be applied to a particular portion only.

PRE.BS1.040.9 LUMP SUM TENDER

1. The tender shall be a "lump sum tender" for executing the Sub-contract Works in accordance with the Sub-contract. The Sub-contract Sum shall be subject to adjustments for any Prime Cost, Provisional and Contingency Sums, for any variations and for any other adjustments provided for under the Sub-contract;
2. The Sub-contractor's prices shall be deemed to include for the cost of all labour, material, all cutting and waste, duties, royalties, packing, freight, shipping, insurance, godown, or other storage costs, delivery to site, hoisting and fixing in the required position, plant, supervision, profit and all things and matters necessary for the carrying out of all the Sub-contract Conditions and the timely and satisfactory completion of the entire Sub-contract Works contained in the Sub-contract whether in the Drawings or Specification such be expressed or not;

3. The tender shall be fixed priced. There will be no adjustment to the Sub-contract Sum for any changes in the Index Figures under Clause 20.2 of the General Conditions of Main Contract or for rises or falls in the cost of freight, insurance, money exchange rate fluctuations, or any other item occurring after submission of tender;
4. There will be no adjustment to the Sub-contract Sum for any changes in the Index Figures under Clause 20.2 of the Main Contract Conditions or for rises or falls in the cost of freight, insurance, money exchange rate fluctuations, or any other item occurring after submission of the tender;
5. The Sub-contract shall be subject to adjustment for price fluctuations in accordance with Clause NS13.1 of the Special Conditions of Sub-contract;
6. The Sub-contract shall be subject to adjustment for price fluctuations in accordance with Clause NS13.1 of the Special Conditions of Sub-contract and Appendix "R" to the Specification;
7. The Employer or the Main Contractor will not be liable for any expenses incurred by the Sub-contractor in connection with the measurement of variations or the adjustment and settlement of accounts.

PRE.BS1.050.9 COPIES OF PRICES

The Sub-contractor shall permit the requisite number of copies of his prices, extensions and costs be made for the purposes of the Sub-contract.

PRE.BS1.060.9 DEFINITIONS AND INTERPRETATION

This clause provides additional definitions and supplementary information to the definitions in the Sub-contract Conditions.

1. Contractor:
   a. May also be described herein as the "Main Contractor";
   b. May also be described herein as the "Main Contractor". The Main Contractor is ……...……...……..……..
2. Contract Manager:
   a. The Contract Manager is the officer holding the post of Chief Architect/…….of Housing Department;
   b. The Contract Manager shall be Messrs …….....……...……...
      ……..…….....
3. Engineer:
   a. The Engineer shall be the officer holding the post of Building Services Engineer duly appointed by the Contract Manager as a Contract Manager's Representative and to whom the Contract Manager has delegated certain of the powers and duties vested in him in respect of this Sub-contract and in his absence the person designated to fulfil his duties and whose directions and approvals shall be deemed to be those of the Contract Manager;
   b. The Engineer shall be Messrs …… duly appointed by the Contract Manager as a Contract Manager's Representative and to whom the Contract Manager has delegated certain of the powers and duties vested in him in respect of this Sub-contract and in his absence the person designated to fulfil his duties and whose directions and approvals shall be deemed to be those of the Contract Manager.
4. Surveyor:

a. The Surveyor is the officer holding the post of Chief Quantity Surveyor of Housing Department;

b. The Surveyor shall be Messrs. ……

5. Building Services Inspector:

   The Building Services Inspector shall be the officer duly appointed by the Contract Manager to be a Contract Manager's Representative in respect of this Sub-contract.

6. BS and CP:

   BS and CP shall mean British Standards Specification and British Standard Codes of Practice respectively, and shall be deemed to include all amendments, revisions and standards superseding the standards listed herein, which are listed in the BSI catalogue current at the date 42 days prior to the date for return of tenders unless otherwise specified. Copies of these documents are available from the British Standards Institution, U.K..

7. Approved or Approval:

   a. To mean to the approval in writing of the Contract Manager;

   b. In the context of design responsibility, such approval shall be taken to mean the confirmation of the Contract Manager that the requirements of the Employer appear to have been met but shall not be taken to relieve the Sub-contractor or the Main Contractor from the responsibilities imposed by the Sub-contract.

PRE.BS1.070.9 MAIN CONTRACT CONDITIONS

1. The Sub-contractor's attention is particularly drawn to the Conditions of Contract of the Main Contract issued by Housing Department of the Hong Kong Housing Authority which may be inspected at the office of the Contract Officer, 8th floor, Housing Authority Headquarters;

2. The Sub-contractor shall comply with all the provisions of the Main Contract in so far as they apply to the Sub-contract Works and are not inconsistent with the express provisions of the Sub-contract. The Sub-contractor's particular attention is drawn to the requirements of Clause 4.1 of the General Conditions of Sub-contract;

3. For complying with the provision for quality control system as stipulated in Specification clause PRE.B8.1425 of the Main Contract, the Sub-contractor shall submit to the Main Contractor the information as required in the Sub-contractor's Material Checking Forms at Appendix PRE.BS1.APPEND2;

4. The particulars inserted in the Appendix to the Form of Tender for the Main Contract are shown in Appendix "Q" to the Specification;

5. The Main Contract provides for Retention Money Held in respect of the Nominated Sub-contractor of five per cent (5%) of any estimated sums payable in respect of works carried out by the Sub-contractor until the total of any such monies reaches the limit of .....dollars ($..…….....).

PRE.BS1.080.9 SUB-CONTRACT

The Sub-contractor carrying out the Sub-contract Works described in these documents will be required to enter into a Sub-contract with the Main Contractor in accordance with the Hong Kong Housing Authority Articles of Agreement and General Conditions of Nominated Sub-contract to Building Works Contracts 2013 Edition (version 1.1) for use with the Hong Kong Housing Authority General Conditions of Contract for Building Works 2013 Edition (verson 1.1).

PRE.BS1.090.9 APPENDIX TO THE GENERAL CONDITIONS OF SUB-CONTRACT

Appendix to the General Conditions of Sub-contract will be filled in as follows:

Part I

First Recital	Particulars of the works (being a part of the Main Works comprised in the Main Contract) in this Sub-contract referred to as "The Sub-contract Works" viz.:-

Part II

Clause 1.1	Sub-contract Sum:-

Dollars

($)

Part III

Clause 6.1(2) of the General Conditions of Sub-contract

Sections of the Main Works	To be completed on or before the date (or the dates) which is (or are)
a. Blocks	( ) months from and including the notified date for commencement of the Main Works
b. Blocks	( ) months from same
c. Remaining works	( ) months from same
d. Whole Main Works	( ) months from same

PRE.BS1.100.9 SCHEDULE OF RATES

1. The Sub-contractor shall complete the attached Schedule of Rates in compliance with the Specification and Drawings in full detail and submit together with the relevant documents as specified. The use of "lump sums" in the Schedule of Rates is to be avoided wherever possible. The total of quantities multiplied by unit rates shall equal the tendered price. The unit rates will be used for the purpose of tender assessment. Ascertainment of the price of variations and calculation of the amounts of interim payments shall be in accordance with the Sub-contract Conditions;
2. The Sub-contractor shall complete the attached Schedule of Rates in compliance with the Specification and Drawings in full detail and submit together with the relevant documents as specified. The completion of the Schedule of Rates shall be in accordance with the principles laid down in the Preambles included therein. The use of "lump sums" in the Schedule of Rates is to be avoided wherever possible. The total of quantities multiplied by unit rates shall equal the tendered price. The unit rates will be used for the purpose of tender assessment. Ascertainment of the price of variations and calculation of the amounts of interim payments shall be in accordance with the Sub-contract Conditions.

PRE.BS1.110.9 SUB-CONTRACT DRAWINGS

1. The Sub-contract Drawings are as listed in Appendix "P" of the Specification;
2. Sub-contract Drawings are diagrammatic and indicate the general arrangement of the system and work included in the Sub-contract. In addition, the architectural and structural drawings and details supplied for information purposes shall be examined for exact location of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Contract Manager. Architectural and structural drawings will be made available on application to the Engineer and subject to a charge for copying;
3. All the Specification Notes contained on the Drawings are to be read in conjunction with the Specification.

PRE.BS1.120.9 PROVISION OF EVERYTHING NECESSARY

The Specification and the Drawings are to be used jointly and anything not specifically mentioned in either but necessary for fulfilment of the guarantees and requirements called for under this Sub-contract, or necessary for the proper working of the system to the satisfaction of the Contract Manager is to be provided under the Sub-contract.

PRE.BS1.130.9 DISCREPANCIES

Any discrepancy or ambiguity between or amongst the Drawings and the Specification found after the date of the Letter of Acceptance shall be queried, through the Main Contractor, with the Contract Manager, who shall issue to the Main Contractor instructions clarifying such ambiguities or discrepancies.

PRE.BS1.140.9 RESPONSIBILITY

The Sub-contractor shall be responsible for the proper working of the installation to produce the specified requirements in compliance with the Sub-contract documents to the entire satisfaction of the Contract Manager and shall be responsible for compliance with all tests called for herein or required through the Main Contractor by the Contract Manager. In the event of anything described in the Specification or shown on the Drawings being, in the Sub-contractor's opinion, unsuitable or inconsistent with his warranties or responsibilities, the Sub-contractor shall draw the attention of the Contract Manager to these matters at the time of tendering. The Sub-contractor is responsible to the Main Contractor for any design undertaken by him as required by the Specification including but not limited to the choice of material, plant equipment and detailed layout is to be made by the Sub-contractor.

PRE.BS1.150.9 SITE CONDITION, SITE ACCOMMODATIONS

1. The Sub-contractor shall be deemed to have inspected, at the offices of the Contract Manager, drawings showing the extent of the Site and type of building to be erected on that Site and to have visited the Site, and held discussions with the Main Contractor, if appointed, so as to satisfy himself as to the local condition, access, method of construction, extent and character of the Works;
2. No subsequent claim whatsoever will be considered on the ground of ignorance of the conditions under which the Works are to be carried out;
3. The Sub-contractor's employees and workers shall observe all rules and regulations of the Government, the Employer, or the Main Contractor, in regard to access to the Site, security thereof, issuing of passes and the like;
4. The Sub-contractor shall be provided with a reasonable working space within the Site for the use of his site staff and for storage of his materials, all as detailed in Appendix "Q" to the Specification - "Extracts from the Main Contract". The Sub-contractor must allow in his Tender for moving his allocated work area and stores and also his plant, etc. from time to time as may be required to enable the Main Contractor and other trades to proceed with their work in accordance with the building programme;
5. Work people will not be permitted to live on Site.

PRE.BS1.160.9 NOTIFIED DATE FOR COMMENCEMENT OF MAIN WORKS AND THE LETTER OF ACCEPTANCE OF SUB-CONTRACT TENDER

1. The notified date for commencement of Main Works under Clause 8.1 of the General Conditions of Main Contract shall occur within the period of time after the date of the Main Contract Letter of Acceptance as stated in the appendix to the Form of Tender of the Main Contract;
2. The Letter of Acceptance of the Sub-contract Tender shall give the following information:
    a. The notified date(s) for commencement of the Main Works or Sections thereof, the date(s) for completion of the Main Works or Sections thereof, and of the respective date(s) for completion of the corresponding Sub-contract Works in accordance with Clauses 6.1(1) and 6.1(2) of the General Conditions of Sub-contract; and
    b. The date(s) on or before which the Main Contractor shall hand-over to the Sub-contractor the lift wells/machine rooms/escalator pits/working areas* for the Sub-contract Works, as determined in accordance with the above dates and clause LTE1.3.035.
3. The anticipated notified date for commencement of the Main Works is .....;

4. The notified date for commencement of the Main Works was .....;

5. The Letter of Acceptance of the Sub-contract Tender shall give the following information:

   The notified date(s) for commencement of the Main Works or Sections thereof, the date(s) for completion of the Main Works or Sections thereof, and of the respective date(s) for completion of the corresponding Sub-contract Works in accordance with Clauses 6.1(1) and 6.1(2) of the General Conditions of Sub-contract.

PRE.BS1.165.9 PHASED ISSUANCE OF WORKING DRAWINGS AND DETAILS

1. Main Contract working drawings and details will be available for issue to the Main Contractor for construction purposes in phases. Phased issuance of these working drawings and details are listed in Specification clause PRE.B4.030 of the Main Contract;

2. The Sub-contractor is required to programme his Sub-contract Works to suit and allow for any additional costs in connection with the above restrictions.

PRE.BS1.170.9 PHASED POSSESSION OF SITE / AND COMMENCEMENT OF THE MAIN WORKS

1. There are no special provisions in the Main Contract for phased possession of the Site;

2. In accordance with Clause 8.2 of the General Conditions of Main Contract the extent of Portions to which the Main Contractor will be given possession from time to time, and the order in which such Portions shall be made available, are as follows:

   a. Area …….. for Blocks ..... and ..... - available at the notified date for commencement of the Main Works;

   b. Area …… for Blocks ..... and ..... - available within ..... months after the notified date for commencement of the Main Works;

   c. Area(s) …… available at the commencement date specified in the Excavation Permit issued by Highways Department or other duly constituted authority;

   d. ……

3. In the Main Contract there are no special requirements for phased commencement of the Main Works in Sections;

4. In accordance with Clause 8.1 of the General Conditions of Main Contract, the dates for commencement of the following Sections of the Main Works are not the same as the notified date for commencement of the Main Works. The notified dates for commencement of such Sections of the Main Works are as follows:

   a. Section ……. of the Main Works for Blocks ..... and ..... shall have a date for commencement within …….months of the notified date for commencement of the Main Works. The date for commencement of the Section of the Main Works shall be as notified in writing by the CM;

   b. Section ……. of the Main Works for Blocks ..... and ..... shall have a date for commencement within …….months of the notified date for commencement of the Main Works. The date for commencement of the Section of the Main Works shall be as notified in writing by the CM.

5. The Main Contract imposes certain restrictions on commencement of parts of the Main Works as follows:

a. Commencement of those Sections of the Main Works which are "Works Subject to Excision" in accordance with Clause 9.1 of the General Conditions of Contract for the Main Contract are listed in Specification clause PRE.B6.680 of the Main Contract (see also Specification clause PRE.B2.020 of the Main Contract). Further details are included in Appendix "Q" to the Specification - "Extracts from the Main Contract";

b. Restrictions on commencement of the following parts of the Main Works are listed in Specification clause PRE.B4.040 of the Main Contract:

i. Laying of pipes in the open area / roads;

ii. Building Works (except pile installation, pile cap and footing construction);

iii. Excavation and Lateral Support Works (ELSW);

iv. Curtain walling works;

v. …….

c. Restrictions on commencement of the Main Contract pile installation and / or footing construction and / or ELSW works are listed in Specification clause PRE.B4.050 of the Main Contract;

d. Restrictions on commencement of the Main Contract pile caps construction works are listed in Specification clause PRE.B4.060 of the Main Contract;

e. Restrictions on commencement of the Main Contract Site Formation Works are listed in Specification clause PRE.B4.065 of the Main Contract.

6. The Sub-contractor is required to programme his Works to suit.

PRE.BS1.180.9 SECTIONS FOR PHASED COMPLETION OF THE MAIN WORKS

Option 1

1. There are no special provisions in the Main Contract for phased completion of the Main Works in Sections.

Option 2

1. The Main Contractor is required to phase the completion of the Main Works in the following Sections:

Section of Main Works	Time for completion (from and including the notified date for commencement of the Main Works unless otherwise stated)
a. Section 1: Block	..... months;
b. Section 2: Block	..... months;
c. Section 3: ..... at Area	..... months from the date of possession of Area .....;
d. Section 4: Primary School	..... months;
e. Section 5: Remaining Works	..... months.

Completion of each Section shall be deemed to include completion of all associated services, emergency vehicular access roads, drainage, external works and the like.

Completion of the Section shall be conditional upon the passing of final tests and inspections prescribed by the Specification of the Main Contract and the completion of any remedial works arising from such tests and inspections.

2. Special requirements for phasing the Main Works to suit Nominated Sub-contractors and Direct Contractors, Utility Undertaking and Government Departments are given in specification clauses PRE.B12.710 to PRE.B12.740 of the Main Contract inclusive;

3. The Main Contractor is required to complete the placement of fill in the open area / roads to the required finished levels within six months from the notified date for commencement of the Main Works as stated in specification clause PRE.B2.010 sub-clause …….. of the Main Contract;

4. The Main Contractor is required to provide the following sample wing, sample flats and construction of mock-up on the location of the typical floor at 4th floor or above of the appropriate blocks to be proposed by the Main Contractor and agreed with the CM, no later than two months after completion of the tenth floor concrete frame including the eleventh floor slab:

Block	Entire wing of .....
Block	..... floor 1 No. flat type
Block	..... floor 1 No. construction mock-up as described in Specification Clause PRE.B9.440 of the Main Contract.

The Main Contractor is required to conform with the following requirements for the sample wing, sample flats and construction mock-up:

a. Completion to include all finishes and fittings, including all utility connections and building services item, and passing all necessary tests including watertightness and equipotential bonding tests;

b. Externally, complete with external finishes, services pipes, windows with glazing and drying racks;

c. Externally finishes to extend to the level of the floor immediately above and below the floor of the sample wing;

d. Keep clean and clear access to sample wing, sample flats and construction mock-up at all times and allow for access by parties authorized by the CM;

e. Provide security and maintain the Approved sample wing and sample flats until completion of the Main Works, including provision of all necessary temporary lighting inside the flats and at corridors and provide lockable gates at strategic locations to prevent unauthorized entry but not obstructing fire escape routes;

f. Provide security and maintain the Approved construction mock-up including provision of all necessary lighting inside the flats and at corridors and provide lockable gates at strategic locations to prevent unauthorized entry but not obstructing fire escape routes;

g. Obtain the CM's Approval for the removal of the installed finishes and fittings at the construction mock-up and to complete the Works in accordance with Clause 8.3 of the General Conditions of the Main Contract.

5. The Main Contractor is required to provide exhibition and / or show flats in accordance with Clause SCC22.6 of the Special Conditions of the Main Contract and specification clause PRE.B6.830 of the Main Contract;

6. The Main Contractor is required to execute and / or provide works and / or services in relation to the taking care of the Main Works after completion during such times after certified completion as instructed by the CM under the Conditions of the Main Contract;

7. The Sub-contractor shall closely coordinate his programme with that of the Main Contractor and shall complete the installation to suit the phased completion of the Main Works.

PRE.BS1.190.9 PROGRAMME OF WORK

1. The Main Contractor shall submit to the CM a programme showing the sequence, method and timing, including the Sub-contract Works, giving the dates for commencement and completion of the Main Works and Sub-contract Works, and the dates on or before which the lift well and machine rooms (* and other major building services plant rooms like transformer rooms, main switch rooms, meter rooms, pump rooms etc.) shall be handed over by the Main Contractor to the Sub-contractor, in accordance with the Sub-contract provisions;

2. As soon as possible after the submission of the programme by the Main Contractor in accordance with sub-clause (1) above and after the date of the Letter of Acceptance of the Sub-contract Tender, the Main Contractor shall supply to the Sub-contractor the said programme. The Sub-contractor shall within two weeks thereafter submit to the Main Contractor and the CM through the Main Contractor a detailed Sub-contract programme, which shall be in compliance with the programme of the Main Works supplied by the Main Contractor, showing the Sub-contractor's intended method, stages, deliveries of materials and equipment, and order of proceeding with the Sub-contract Works, together with the period of time he has estimated for each and every stage of progress for information;

3. Any comment made by the Main Contractor or the CM in respect of such programme or particulars shall not relieve the Sub-contractor of any of his duties or responsibilities under the Sub-contract;

4. In accordance with Clause 4.5 of the General Conditions of Sub-contract, the Sub-contractor shall closely coordinate his detailed Sub-contract programme with that of the Main Contractor and revise his detailed Sub-contract programme in conjunction with any revisions to the programme of the Main Works as may be supplied by the Main Contractor from time to time;

5. The Sub-contractor shall arrange delivery of the equipment and carry out the installation work with all speed in accordance with the Main Contractor's programme or revised programme and to suit the progress of the Main Works. The Sub-contract Works including testing and commissioning shall be completed on or before the respective date(s) or re-scheduled date(s) for completion in accordance with the Conditions of Sub-contract;

6. Should the Sub-contractor consider that it may become necessary to cause overtime to be worked in order to complete the Sub-contract Works by the respective date(s) or re-scheduled date(s) for completion due to any delay for which no extension of time under the Main Contract or for which no further re-scheduling of respective date(s) for completion under the Sub-contract shall be determined, he should allow for such a contingency in his tender price. No claim for any extra in this connection will be considered.

PRE.BS1.200.9 TECHNICAL LITERATURE TO BE PROVIDED

Unless otherwise specified in other parts of the Specification or instructed by the CM, the Sub-contractor shall provide, within three months from the date of completion of the Sub-contract Works or any part thereof, two hard copies and an electronic copy in PDF format (unless otherwise specified) stored on recordable compact disc of each of the following:

1. Operation and maintenance manuals for the system and equipment installed;

2. Manufacturer's spare parts catalogue of the equipment offered together with a priced schedule for the supply of the manufacturer's recommended spare parts against a separate order. The prices quoted must include for the clear labelling of each item;
3. A priced schedule for the supply of any special tools against a separate order, if these are required for the operation and maintenance of the installation;
4. Testing and commissioning reports on the system and equipment installed;
5. Other documents as detailed and specified in other parts of the Specification.

PRE.BS1.205.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

1. The Sub-contractor shall, when required by the CM or as specified, produce documentary evidences to verify the country / place of manufacture and authenticity of the materials delivered to Site or installed;
2. Such documentary evidences shall be in the form of purchase orders to and shipment / delivery orders or certificates from the manufacturers or the manufacturers' authorized agents in Hong Kong;
3. Materials for the respective works will not be certified for payment until the required evidences have been produced to the satisfaction of the CM;
4. The Tenderer shall indicate in the 'Schedule of Information Supplied by the Tenderer' the country / place of manufacture of the materials being offered at the time of tendering;
5. For material subject to surveillance checking under product certification scheme (e.g. Kitemark, BASEC, etc.), the factory and its detailed location to which the product certificate is licensed against shall be indicated in the documentary evidence to verify the place of manufacture.

PRE.BS1.210.9 INSTALLATION DRAWINGS

1. The Sub-contractor shall, before the relevant work proceeds, prepare and submit, for review and Approval by the CM, all Installation Drawings showing details of his proposal for the execution of the Sub-contract Works. Unless otherwise specified, four copies of the installation drawings are required for each submission;
2. The Sub-contractor shall develop a drawing submission schedule detailing the type, number, programme and contents of all Installation Drawings to be submitted. The drawing submission programme shall be in line with the Contractor's programme for the Main Works and in accordance with the progress of the Main Works and no work shall commence before Approval of the relevant installation drawings is given by the CM. The Sub-contractor shall make due allowance in the submission programme for the need to re-submit a drawing for Approval, shall the previous submission be found unsatisfactory and hence rejected by the CM and under no circumstance, shall a drawing be first submitted for Approval less than 4 weeks before the commencement of the relevant work;
3. The drawing submission schedule shall be prepared and submitted to the CM through the Main Contractor for Approval within one month after the award of the Sub-contract;
4. In the event that any of the Sub-contractor's installation drawings are identical to any of the Sub-contract Drawings and the Sub-contractor wishes to use such Sub-contract Drawings as installation drawings he shall submit a list of such Sub-contract Drawings to the CM through the Main Contractor for Approval within one month after the award of the Sub-contract. If Approved, the submission of installation drawings, in respect of such works, will not be required;

5. The Installation Drawings shall be prepared to a scale of 1:100 for all services in the building and 1:50 for plant rooms, meter rooms, riser ducts and similar spaces. Other drawing scales may be required as and when considered necessary by the CM;
6. After Approval, four copies of the Approved Drawings shall be supplied to the CM through the Main Contractor by the Sub-contractor without additional charge;
7. Approval of installation drawings, including those identical to Sub-contract Drawings, shall not be considered as a guarantee of measurements or building conditions and will not relieve the Sub-contractor of his obligation to perform the Sub-contract Works in strict accordance with the Drawings and Specification or for the proper matching and fitting of his work with contiguous work.

PRE.BS1.220.9 STANDARD DETAILS

All standard installation details shall conform, where applicable and in the following order of priority, to the standard drawings included in the Specification, and the standard drawings prepared by the Building Services Sections, Housing Department.

PRE.BS1.230.9 FAILURE TO SUBMIT INSTALLATION DETAILS AND LAYOUT DRAWINGS IN TIME

1. Failure of the Sub-contractor to submit the installation details and layout drawings in ample time shall not entitle him to any time extension and no claim for extension of the period for completion of the Sub-contract Works by reason of such default will be allowed;
2. Should the Main Contractor be delayed or incur additional costs due to the Sub-contractor's failure to submit the required information in due time then any expense arising will be the liability of the Sub-contractor.

PRE.BS1.240.9 MAIN CONTRACTOR'S RELATIONSHIP WITH AND ATTENDANCE ON SUB-CONTRACTORS

1. The Main Contractor shall be responsible for the whole of the Main Works including works carried out by Nominated Sub-contractors contracting with him. All instructions given by the CM to the Main Contractor referring to the work of the Nominated Sub-contractors shall be forwarded to the Nominated Sub-contractors without delay, and the Main Contractor shall ensure that the instructions are carried out promptly;
2. The Main Contractor shall provide general attendance to all Nominated Sub-contractors all as detailed in Appendix "Q" to the Specification - "Extracts from the Main Contract";
3. The Main Contractor shall make working arrangements with all Nominated Sub-contractors all as detailed in Appendix "Q" to the Specification- "Extracts from the Main Contract";
4. The Main Contractor shall also provide special attendance on the Sub-contractor all as detailed in Appendix "Q" to the Specification - "Extracts from the Main Contract";
5. The Main Contractor is required to coordinate the programme of works to suit the special requirements for phasing the Main Works all as detailed in Appendix "Q" to the Specification - "Extracts from the Main Contract".

PRE.BS1.250.9 SUB-CONTRACTOR TO INFORM MAIN CONTRACTOR OF "BUILDER'S WORK"

1. The Sub-contractor shall inform the Main Contractor of all "Builder's Works" required to be carried out as early as possible so that all chases, holes, openings, recesses, etc. may be formed or cut as the work proceeds. The Sub-contractor shall mark out on Site the position of all holes and chases, and shall supervise that the works are carried out to his requirements;
2. Should the Sub-contractor fail to give the Main Contractor reasonable notice and full particulars of the "Builder's Work" required, all additional costs shall be at the Sub-contractor's expense.

PRE.BS1.260.9 BUILDER'S WORK DRAWINGS

1. Unless otherwise specified, the Sub-contractor shall submit ten copies of drawings or schedules showing details of all builder's work requirements in connection with his installation to the Main Contractor for subsequent transmission to and Approval by the Contract Manager;
2. Such drawings or schedules shall contain the following information:
    a. All openings through walls, beams and slabs, with sizes and exact dimensions relative to floors and walls clearly indicated;
    b. Exact locations, details and sizes of all standard Builder's Work provisions which are included as part of the Main Contract Drawings or Sub-contract Drawings, such as cable ducts, cable pits, lamp pole foundations, etc.;
    c. Exact locations and sizes of all other Builder's Work provisions, such as equipment foundations, which may not be shown on the Main Contract Drawings or Sub-contract Drawings but which may be required to suit the Sub-contract installation.
3. Where preliminary Builder's Work provisions have already been included in the Main Contract or Sub-contract Drawings, such provisions are to be checked by the Sub-contractor;
4. Where deviations to these preliminary provisions are required, the Sub-contractor shall incorporate such provisions in his own drawings or schedules and list a schedule of these deviations on his drawings together with the reasons for such deviations and/or addition;
5. In the event that any of the Sub-contractor's drawings are identical to any of the Main Contract or Sub-contract Drawings, he shall submit a list of such Main Contract or Sub-contract Drawings to the Main Contractor for subsequent transmission to and Approval by the Contract Manager. If Approved, the submission of drawings in respect of such builder's work, as detailed in the first paragraph of this clause, will not be required;
6. It is the intention that all holes, chases, etc., shall be left in structural building work as it proceeds and not cut out subsequently, except in so far as may be necessary due to subsequent authorised variations to the scheme. The Sub-contractor shall, therefore, acquaint himself throughout the construction period of the Main Works with the Main Contractor's detailed construction programme and shall prepare his Builder's Work drawings in such order and at such times and in accordance with a programme agreed with the Main Contractor, as to enable them to be checked and Approved by the Contract Manager and enable instructions to subsequently be issued to the Main Contractor in good time before the actual construction is planned to take place.

PRE.BS1.270.9 CHECKING DRAWINGS OF OTHER TRADES

1. The Sub-contractor shall follow drawings in laying out work and check drawings of other trades to verify spaces in which work will be executed. Where space conditions appear inadequate, the Contract Manager shall be notified before proceeding with the installation;
2. If directed by the Contract Manager, the Sub-contractor shall, without extra charge, make reasonable modifications in the layout as necessary to prevent conflict with work of other trades or for proper execution of the work.

PRE.BS1.280.9 DRAWINGS SUBMITTED AFTER INSTALLATION COMPLETED

Unless otherwise specified in other parts of the Specification or instructed by CM, the Sub-contractor shall provide, within three months from the respective date(s) of completion of the Sub-contract Works or any part thereof, two copies of 'as-fitted' drawings to the Contract Manager and a framed drawing to each switch room, pump room and/or the like showing the schematic diagram(s) of connections and operation of the installed system(s). The framed drawing shall be fixed to the wall in such a way that it can easily be removed for reference.

PRE.BS1.290.9 CUTTING AWAY AND MAKING GOOD GENERALLY

Any cutting away of building structure and builder's work, and making good, which is necessary or required for the Sub-contract Works will be carried out by the Main Contractor, with the exception of the cutting away for the fixing of screws, philplugs, redhead bolts, etc. which shall be completed by the Sub-contractor.

PRE.BS1.300.9 SLEEVES/SLOTS/HOLES

The sleeves, slots, holes, etc. through walls/slabs provided for the Sub-contract Works will be cleared and cleaned by the Main Contractor where required. The slots or holes shall be backfilled and finished by the Main Contractor with the same building materials surrounding the sleeve. The sleeve should be provided by the Sub-contractor and placed to have projection of 100 mm above floor level. The annular space between the sleeve and the cable, trunking, water pipe and/or the like will be sealed up by the Sub-contractor with Approved non-inflammable materials

PRE.BS1.310.A WORKS BY MAIN CONTRACTOR AND OTHERS

1. For Electrical Installation (including CABDS Installation or CABDS/CCTVS Installation, Security Alarm/EAS/Public Address Installation and Door Phone System Installation):
    a. All foundations, footings, pits, chases, ducts, meter rooms, switchrooms, transformer rooms, generator rooms, trenches, holes, drains, hooks for ceiling fans, and similar builder's works required for the installation will be provided by the Main Contractor. The Sub-contractor shall supply, in good time, full particulars of these requirements together with the weights of the various pieces of equipment when installed and operating;
    b. Cable ducts will be laid by the Main Contractor but the Sub-contractor shall ensure that the ducts are adequate in number and size and are in the correct position. Long ducts which are not accessible shall be lubricated with graphite powder supplied by the Main Contractor. Prior to drawing-in, cylindrical ducts shall be kept clean by the Main Contractor. All ducts provided by the Main Contractor will be complete with draw wires. Sealing of the duct ends subsequent to completion of cable installation shall be carried out by the Sub-contractor;

c. Excavation and backfilling of cable trenches and holes and concreting for lamp pole foundation will be carried out by the Main Contractor, but the Sub-contractor shall be responsible for the installation of cable, bedding and covering with layers of fine sand, cable tile and supervision of the backfilling of cable trenches and supervision of construction of lamp pole foundations;

d. Construction of earth pits, draw-in pits and cable turning pits will be carried out by the Main Contractor but the Sub-contractor shall ensure that the positions and dimensions of the pits shall comply with the Specification and Drawings;

e. Provision of necessary holes, chases, earth pits, underground PVC or G.I. duct and making good thereafter will be carried out by the Main Contractor but the Sub-contractor shall supply, in good time, full particulars of these requirements and shall ensure that the positions and dimensions of these provisions shall comply with the Specification and Drawings;

f. Touching up of plaster after wiring work will be carried out by the Main Contractor;

g. Water connection for sink water heaters, water and drain connections for macerators, air ducts in transformer rooms, concrete cowls for fans, etc., will be provided by the Main Contractor for the installation;

h. The openings on slabs or walls or window glazing for mounting roof extractors and/or exhaust fans respectively will be carried out by the Main Contractor, but the Sub-contractor shall submit detail drawings to indicate the setting-out dimensions and sizes of the openings and the proposed method of mounting for approval prior to installation. Such information enabling the Main Contractor to carry out his work shall be submitted in good time by the Sub-contractor;

i. Self-closing doors at main entrances will be provided by the Main Contractor but the associated electric lock shall be supplied, installed and connected by the Sub-contractor.

2. For Fire Services and Water Pump Installation:

a. All foundations, footings, pits, chases, ducts, trenches, holes, drains, PVC shields for control switches and similar builder's works required for the installation will be provided by the Main Contractor. The Sub-contractor shall supply, in good time, full particulars of these requirements together with the weights of the various pieces of equipment when installed and operating;

b. Excavation and backfilling of trenches for underground fire services pipes will be carried out by the Main Contractor, but the Sub-contractor shall provide and lay the underground F.S. pipes and shall be responsible for the supervision of the backfilling of the trenches;

c. Provision of necessary holes and chases will be carried out by the Main Contractor. The Sub-contractor shall supply, in good time, full particulars of these requirements and shall ensure that the positions and dimensions of these shall comply with the Specification and Drawings;

d. Construction of fire services pump rooms and water pump rooms with doors and louvers, sump tanks and/or roof storage tanks each with puddle flanges, drains, air vents and overflows, will be carried out by the Main Contractor. The Sub-contractor shall make any necessary pipe extension from the tank outlets to ensure non-turbulent suction into the pumps;

e. Water pipes/pipe risers from periphery of the water pump room, or from the valve pit above the well, up to the roof storage tanks will be carried out by the Main Contractor. The ultimate connection of the water pumps to puddle flanges of the water tanks and to the bottom end of the pipe riser shall be carried out by the Sub-contractor, as shown on the Drawings. The Sub-contractor shall check that the pipe circuit of the Main Contractor will have no adverse effect on the water pumping installation and ensure that the provisions are adequate in size and appropriate in position, including the detailed check-up of the rising main routes for any risk of air lock and/or water hammer;

f. Construction of the roof storage tanks each with puddle flanges, drains and overflow pipes will be carried out by the Main Contractor and the Sub-contractor shall ensure that the construction is adequate in size and to his requirements and shall make connection of the Fire Services Installation to the puddle flanges of the storage tanks as shown on the Drawings;

g. Providing and fixing of water supply pipe risers up to the roof storage tanks will be done by the Main Contractor as shown on the Drawings;

h. Construction of reinforced concrete pump bases, hoisting beams, etc., in accordance with the Drawings will be carried out by the Main Contractor. The details of the pump bases and the associated Builder's Work requirements shall be furnished by the Sub-contractor within three weeks or a reasonable period as instructed by the Contract Manager after the date of the Letter of Acceptance;

i. Enclosures for fire service inlets, for sprinkler control valves and for hose reels will be done by the Main Contractor;

j. 380 Volts 3-phase 50 Hz electricity supply terminating at isolators in each fire services pump room and water pump room and the lighting therein will be provided by the Sub-contractor for electrical installation;

k. All the exit signs shown on the Drawings will be supplied and installed by the Sub-contractor for electrical installation.

3. For Air Conditioning/Mechanical Ventilation Installation:

a. All foundations, footings, pits, holes, chases, ducts, trenches, drains and similar builder's works required for the installation will be provided by the Main Contractor. The Sub-contractor shall supply, in good time, full particulars of these requirements together with the weights of the various pieces of equipment when installed and operating;

b. All slots/enclosures for chilled water rising mains, holes and chases for supply air ducts, water pipes, plants, etc., including making good after installation of equipment will be provided by the Main Contractor. The Sub-contractor shall ensure that the positions and dimensions of these shall comply with the Specification and Drawings;

c. Construction of all A.H.U. rooms, main A/C plant room and supervisors room together with trenches, covers, plinths, etc., will be carried out by the Main Contractor;

d. Construction of reinforced concrete slabs and machine plinths, concrete supports, hoisting beams, etc. necessary for the installation of the main plant and machinery in accordance with the Drawings will be carried out by the Main Contractor. The details and the associated Builder's Work requirements shall be furnished by the Sub-contractor within three weeks, or such reasonable period as instructed by the Contract Manager, after the date of the Letter of Acceptance;

e. Furnishing of all necessary cement and/or concrete for "grouting-in" brackets, bolts, etc. will be carried out by the Main Contractor;

f. Provision of fresh water connections and drain to make-up tank will be carried out by the Main Contractor;

g. Fresh water connections for testing will be provided by the Main Contractor;

h. Louvers on doors will be provided by the Main Contractor where necessary;

i. Adequate access for the transportation of equipment to plant room, A.H.U. rooms, etc. will be provided by the Main Contractor;

j. 380 Volts 3-phase 50 Hz electricity supply terminating at isolator in each plant room and A.H.U. room and the lighting therein will be provided by the Sub-contractor for electrical installation.

4. For Lift Installation:

a. Construction of the lift well and enclosures with pit and machine room will be carried out by the Main Contractor;

b. Provision of holes, chases, openings, plinths, vents, other facilities and Builder's work required for the installation will be provided by the Main Contractor. The Sub-contractor shall submit, in good time, full particulars of these requirements together with the operating weight of various piece of equipment for approval prior to installation;

c.

i. For lift installation with travel not exceeding 15m or lifts with side counterweight configuration, provision of metal scaffolding in lift wells for the erection of lift machinery and accessories, will be carried out by the Main Contractor. The Sub-contractor shall submit, in good time, full particulars of these requirements;

ii. Provision of 380V 3-phase 50Hz temporary electricity supply terminating at an isolator located on lowest landing for each lift for operation of GSWP and lift material winch, will be carried out by the Main Contractor. The power ratings shall be determined by the Sub-contractor;

iii. Provision of scaffolding at lift pit for each lift well, for installation of GSWP, will be carried out by the Main Contractor.

d. Provision of concrete fill and/or grouting in for brackets, bolts, etc. will be carried out by the Main Contractor;

e. Provision of fill and/or grouting in with fire resisting material for architraves, landing door sills, indicator and control stations will be carried out by the Main Contractor;

f. Provision of a cat ladder giving access to each lift pit will be carried out by the Main Contractor but the design and exact location of such cat ladder shall be determined by the Sub-contractor;

g. Provision of lifting beams for the erection of lift machinery in the machine room and/or lift well will be provided by the Main Contractor. Exact safe working load and locations required shall be advised by the Sub-contractor;

h. Provision of a cat ladder and removable railing to the raised platform of the lift machinery supports in the lift machine room, where required, will be carried out by the Main Contractor;

i. 380V 3-phase 50Hz electricity supply terminating at an isolator in each lift machine room will be provided by Sub-contractor for electrical installation;

j. Concealed conduits as shown on the Drawings for the lift alarm system, where required, will be provided by the Sub-contractor for electrical installation;

k. Machine room lighting, sockets and exhaust fans will be provided by the Sub-contractor for electrical installation;

l. A pair of voltage-free contacts terminated inside a surface mounted box inside the lift machine room will be provided by the Sub-contractor for electrical installation for the operation of lifts upon the actuation of the emergency generator;

m. A layer of dust proof paint to the lift machine room floor and lift pit floor will be applied by the Main Contractor;

n. Provision of permanent anchorage adjacent to lift landing doors at the lowest landing floor, for use by worker to lock fall arrestor and safety harness when required to access lift pit, will be carried out by the Main Contractor.

5. For Escalator Installation:

a. Construction of the escalator pits, wells and concrete supporting beams will be carried out by the Main Contractor;

b. Provision of holes, chases, openings, plinths, vents, other facilities and Builder's work required for the installation will be provided by the Main Contractor. The Sub-contractor shall submit, in good time, full particulars of these requirements together with the operating weight of various piece of equipment for approval prior to installation;

c. The external cladding of the undersides and sides of the escalator covering truss, machine space other than the exterior panelling and balustrade decking, where required, will be provided by the Main Contractor;

d. Solid triangular vertical obstruction guards will be provided by the Main Contractor in the intersection of the angle of the outside balustrade and the ceiling or soffit. The exact locations of such guards shall be determined by the Sub-contractor;

e. A canopy or other similar structure, where shown on the Drawings, for the protection of the weather-proof escalator will be provided by the Main Contractor;

f. A permanent drain point at the bottom escalator pit, where required, will be provided by the Main Contractor for the weather-proof escalator drainage.

PRE.BS1.320.A SUPERVISING ENGINEER

1. Unless otherwise specified, the Sub-contractor is to employ for the supervision of all works on Site, at least one qualified English and Cantonese speaking Supervising Engineer to be approved by the Contract Manager;

2. The Supervising Engineer shall have attained the following mandatory safety training qualification:

a. Safety Training Course for Site Management Staff (nominal course duration 27 hours) provided by the Construction Industry Council or Occupational Safety & Health Council or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

b. Those appointed superintendents having completed a Safety Training Course for Site Management Staff provided by the CIC or the OSHC or equivalent training organization for 5 years or above shall complete the Safety Training Refresher Course for Site Management Staff (nominal course duration 7 hours) provided by the CIC or the Safety Training Course for Site Management Staff (Refresher) (nominal course duration 7 hours) by the OSHC or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard.

3. The Supervising Engineer can be exempted from certain modules of the Safety Training Course for Site Management Staff by fulfilling the exemption criteria laid down by the Construction Industry Council or Occupational Safety & Health Council.

PRE.BS1.330.A SITE SUPERVISOR AND LABOUR STRENGTH REPORT

1. The Sub-contractor is to employ full time a competent, technically qualified, English and Cantonese speaking Site Supervisor, approved by the Contract Manager, with power to receive, via the Contractor, the instructions of the Contract Manager or his Representative. Whenever there is work supervision required, the Site Supervisor shall be available on Site to provide adequate supervision and liaison to the satisfaction of the Contract Manager;

2. The Site Supervisor shall have attended and completed the Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by the Occupational Safety and Health Council or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by the Construction Industry Council. Acceptance of training provided by other organizations is subject to verification that the training is based on course contents of equivalent or above standards and the appointed superintendent has attained the associated qualification;

3. Those appointed superintendents having completed the mandatory safety training for 4 years or above shall complete the Enhancement Course for Construction Safety Supervisors (nominal course duration 12 hours) provided by CIC or the Enhancement Course for Safety Supervisors (Construction) (nominal course duration 12 hours) by the OSHC or equivalent training by other organisations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

4. The Sub-contractor shall submit to the satisfaction of the Contract Manager's Representative via the Main Contractor the on site deployment schedule of the Site Supervisor having regard to the programme and progress of works within one month after issuance of letter of acceptance. The Sub-contractor shall revise the schedule from time to time to suit the supervision and liaison need arising from the progress of works;

5. The Sub-contractor shall submit to the Contract Manager's Representative via the Main Contractor in the morning of every working day the daily labour strength report. Such report shall indicate the number of workers and their deployment on site on that day. Labour strength report is not required when there is no installation works on site.

PRE.BS1.340.9 ORDERING

Immediately on his appointment the Sub-contractor shall obtain Approval of all particulars and details necessary for the placing of orders and thereafter shall, as soon as possible, place orders for all equipment and materials. In placing such orders it shall be the Sub-contractor's responsibility to ensure that his suppliers are fully acquainted with, and work strictly to, the requirements and time limits of the Sub-contract.

PRE.BS1.350.A MATERIALS AND WORKMANSHIP

1. All materials supplied and work carried out shall be the "best" of their respective kinds and to the Approval of the Contract Manager;
2. Appearance or packing of materials to be supplied or services to be provided in connection with the Works containing any messages (whether explicit or implicit) which are likely to constitute or cause the occurrence of any offences endangering national security or which would otherwise be contrary to the interest of national security shall strictly be prohibited.

PRE.BS1.360.9 SAMPLES

A sample board containing samples of materials and accessories shall be supplied by the Sub-contractor, via the Main Contractor, to the Contract Manager for Approval before the commencement of the installation work. A label bearing the name of the Sub-contractor, the title of the Sub-contract and a list of materials and their manufacturers, shall be attached to the sample board. The Approved sample board shall be displayed in the site office throughout the whole of the Sub-contract period. The Sub-contractor shall supply sufficient samples of materials as required for testing purpose.

PRE.BS1.370.9 TESTING OF MATERIALS

1. The Sub-contractor shall include in his rates for the cost of material testing stipulated in the Specifications or Drawings. For test not stipulated in the Specifications or Drawings but instructed by the Contract Manager, the expense of the test shall be valued by the Surveyor pursuant to Clause 7.1 of the General Conditions of Main Contract. However, if the test result shows that the material cannot meet the requirements stipulated in the Specifications or Drawings or pre-agreed standards, the expense of such test shall be borne by the Sub-contractor. The Sub-contractor shall propose and carry out at his own expense further or any other tests as necessary and approved by the Contract Manager to substantiate compliance;
2. For compliance tests required to be conducted by accredited laboratories as stipulated in the Specifications or Drawings or instructed by the Contract Manager, the Sub-contractor shall submit their applications for engagement of accredited laboratories together with confirmation of no affiliation between the Sub-contractor and the laboratories using the standard template at Appendix PRE.BS1.APPEND1 for approval by the Contract Manager;
3. The Sub-contractor shall instruct the engaged laboratories to send the test reports, once available, to the Contract Manager and the Sub-contractor at the same time;
4. Accredited laboratory shall be a laboratory accredited under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) of the Hong Kong Accreditation Services (HKAS) or an equivalent organization which has a mutual recognition agreement with HKAS;
5. The accredited laboratory shall be accredited to carry out a specific test (i.e. accredited test) having the same context of the test required in the Sub-contract, unless otherwise specified;
6. The requirements in sub-clauses (2) and (3) above are not applicable to equipment type tests or tests conducted by laboratories engaged by material / equipment manufacturers.

PRE.BS1.380.9 CARE AND PROTECTION OF THE MAIN WORKS AND THIRD PARTY OBLIGATIONS

1. For the avoidance of doubt, the Main Contract incorporates provisions requiring the Main Contractor to take overall responsibility for safety and security of the Main Works, care of the Main Works, and injury or damage to third parties arising out of or in consequence of the Main Works. The Main Contract further provides that the Main Contractor takes out insurances in respect of care of the Main Works and third party claims. The Main Works means the Works as defined in the Main Contract and include works or services to be carried out by Nominated Sub-contractors. The Main Contractor's responsibilities and insurances will likewise include works or services to be carried out by Nominated Sub-contractors. The Sub-contractor is referred to the Main Contract wherein the scope of the Main Contractor's obligations is more fully described;
2. The Sub-contractor is expected to generally co-operate with the Main Contractor in performance of his obligations and in this respect his attention is particularly drawn to Clause 4.8 and sub-clauses 4.1(1) (b), (c) and (d) of the General Conditions of Sub-contract. He shall furthermore be responsible for taking the following specific measures of co-operation:
    a. Any storage shed constructed on space provided by the Main Contractor is to be of sound, weatherproof construction and provided with a secure locking device;
    b. Where goods are placed in other storage areas, the Sub-contractor is to take such precautionary measures within the areas as are necessary and practical;
    c. Goods are to be stored appropriately;
    d. The Sub-contractor shall complete the proforma of Building Services Material Delivery Inventory Record as shown on Appendix "S" and submit to the Main Contractor with all supporting documents to enable him to carry out his obligations under Specification clause PRE.B8.1460 of the Main Contract;
    e. The Sub-contractor shall close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign materials.

PRE.BS1.390.9 REGULATIONS AND GOVERNMENT LAWS

The Sub-contractor shall comply with all regulations and enactments including those of the Government of the Hong Kong Special Administrative Region, the Fire Services Department, the Buildings Department, the Electrical and Mechanical Services Department, the Water Supplies Department, and other utility undertaking and shall be responsible for giving notifications to the appropriate duly constituted authority and for paying all fees as required under this Sub-contract, such fees shall be included in the Tender.

PRE.BS1.400.A SUB-CONTRACTOR TO GIVE NOTICE OF INJURY

1. In the event of any workers or other persons employed on the Sub-contract Works or in connection with the Sub-contractor suffering any personal injury and whether there be a claim for compensation or not, the Sub-contractor shall, without delay, notify the Commissioner of Labour through the Main Contractor in such form as the Commissioner of Labour may require and shall forward two copies of such notification to the Contract Manager;

2. The Sub-contractor shall comply with the requirements of prohibition of imposing administrative charges for reporting of site accidents and elimination of under-reporting of site accidents as stipulated in Specification clause PRE.B8.211 sub-clause (2) of the Main Contract. For sub-contracts at any tier of sub-contracting, the Sub-contractor shall take all reasonable steps to ensure that the provisions at Specification clause PRE.B8.211 sub-clause (2) of the Main Contract are included *mutatis mutandis* in all sub-contracts.

PRE.BS1.410.9 FIRE HAZARD

Where it is necessary for the Sub-contractor to use any naked flame in the carrying out of his work, adequate protection shall be given to all other materials and to the structure. Suitable fire extinguishers shall be made readily available at the position where such work is proceeding.

PRE.BS1.420.9 CLEARING UPON COMPLETION

1. On completion of the Sub-contract Works the Sub-contractor is to clear away all temporary plant and materials and to make good or reimburse the Main Contractor for any damage caused to the building fabric or services during the execution of the Sub-contract Works;
2. The Sub-contractor shall be responsible for reinstating at his own cost any structural or superficial damage to the Main Contractor's or other Specialists' works caused by the Sub-contract Works under this Sub-contract. This reinstating of damaged work will be carried out from time to time as required by the CM to coordinate with other contracts and Sub-contracts.

PRE.BS1.430.9 MAINTENANCE PERIOD

1. In accordance with Clause 7.1 of the General Conditions of Sub-contract , the Sub-contractor shall be responsible for maintaining, upon the completion of the Sub-contract Works or part thereof, the Sub-contract Works or parts thereof, free of charge, until the completion of the Main Works or any Section thereof as certified under the Main Contract, and for maintaining the same for the Maintenance Period of twenty-four* months commencing on the day following the certified completion date of the Main Works or any Section thereof. The Retention Money Held in respect of the Nominated Sub-contractor shall become due for certification by the Surveyor and release by the Employer in the manners as provided for in the Main Contract;
2. During the Maintenance Period, the Sub-contractor shall attend to all faults and complaints, remedy all defects, replace all malfunctioning items and maintain the entire installation all in accordance with the relevant Main Contract and Sub-contract provisions, and in particular, in accordance with Clause 10.1 of the General Conditions of Main Contract;
3. For maintenance works on energised electrical installation excluding extra low voltage system, the Sub-contractor shall provide at least two maintenance personnel to attend emergency call and at least one of the maintenance personnel shall be REW (registered electrical worker) of the appropriate grade. Safety measures as stipulated in clause PRE.BS1.435 shall be applied.

PRE.BS1.435.9 WORK ON ENERGISED ELECTRICAL INSTALLATION DURING MAINTENANCE PERIOD

1. The Sub-contractor shall strictly follow Code 4 (General Safety Requirement), Appendix 15 (Safety for Live Work) and Appendix 16 (Permit-to-work) of the CoP for the Electricity (Wiring) Regulations in carrying out work on energised electrical system / installation. The Sub-contractor shall also refer to the recommended measures in the Guidance Notes for The Safe Isolation of Electricity Source at Work issued by LD;
2. Where practicable, work on the electrical installation should be carried out after the concerned part of electrical installation or equipment has been isolated and verified dead with a voltage indicator; the Sub-contractor shall establish safety procedures with a responsible person to issue a permit-to-work and a person in-charge to handle the required maintenance works;
3. Where work is to be done on dead electrical installation / equipment, controlled by a circuit breaker or switch, the circuit breaker or switch should be locked off and a warning notice for repair affixed. The keys for locks used to lock off circuit breaker or switch should be kept under the control of the responsible person. The Sub-contractor shall establish effective control measures during the course of work to ensure that all the electricity sources would remain in an isolated condition without possible accidental or inadvertent re-connection of electricity sources;
4. Live work should not be performed unless:
    a. It is necessary in the interests of safety, whether or not electrical safety, for the work to be performed while the electrical equipment is energised; or
    b. A supply of electricity is essential for the proper performance of the electrical measurement (e.g. testing and fault finding); or
    c. There is no reasonable alternative to perform the electrical work by live work (e.g. widespread outages of a building would occur if live work is not allowed); or
    d. It is justified and approved by the registered electrical worker, registered electrical contractor and owner of the installation (e.g. serious public inconvenience would arise from isolating the circuits).
5. Where live work is unavoidable, adequate precautions should be taken to avoid danger for work involving the handling of energised parts or working within touchable distance, direct or indirect, of energised parts at low voltage. The following precautions are to be taken:
    a. Work on energised low voltage electrical equipment should be done only by registered electrical workers who are by virtue of knowledge and training competent to be allowed to carry out live work;
    b. Prior risk assessment should be carried out by the registered electrical contractor, registered electrical worker or a registered safety officer on the performance of the live work;
    c. Personal protective equipment (including insulating gloves, safety shoes and insulating mat) and testing equipment appropriate to the performance of the live work should be properly used by the person performing the electrical work;
    d. Screen or other means to avoid danger from inadvertent contact with energised conductors should be provided;
    e. Fixing of warning notices for repair, barriers and screens;
    f. The duration and the extent of the live work should be minimized as far as practicable;

g. The isolation point of the electricity supply for the subject electrical equipment has been clearly identified.

PRE.BS1.440.9 METHOD OF CONSTRUCTION FOR THE MAIN CONTRACT

1. The Sub-contractor's attention is drawn to the method of construction for the Main Contract wherein large panel formwork, small panel metal formwork, semi-precast slabs including lattice girder semi-precast slabs, and precast concrete facades may be used as opposed to conventional methods of construction. In addition, the Main Contractor may be employing other mechanised methods of construction, e.g. precasting of structural and / or non-structural elements;
2. The Sub-contractor must check the details of the method of construction with the Main Contractor and his tender shall be deemed to include all costs and expense in connection therewith;
3. The Sub-contractor shall closely coordinate his programme with that of the Main Contractor and shall inform the Main Contractor of all "Builder's Works" required as early as possible so that all chases, holes, openings, recesses, etc. are formed, modified as necessary to suit the Main Contractor's method of construction, or cut as the works proceed;
4. Should the Sub-contractor fail to give the Main Contractor reasonable notice and full particulars of the "Builder's Works" required all additional costs shall be at the Sub-contractor's expense.

PRE.BS1.450.A GREEN AND SILVER CARD

In relation to the requirements of Clause 4.7 of the General Conditions of Sub-contract, the Sub-contractor shall comply with all current Regulations concerning safety on the Site in particular the Factories and Industrial Undertakings Regulations and the requirements specified in sub-clauses (1) to (4) of this clause.

1. The Sub-contractor shall provide and employ such technical personnel and such skilled, semi-skilled and unskilled labourers who, upon their first appearance in the Site and throughout their working in the Site, are a holder of either a valid Green Card issued by an organisation or institution recognized by the Labour Department or a valid Construction Workers Registration Card. The Green Card referred to in this sub-clause is a statutory identification document issued to a person by an organization or institution recognized by the Labour Department upon completion of the training on Green Card;
2. The following trades shall be carried out by workers holding Silver Cards issued by the Construction Industry Council upon their first appearance in the Site and throughout their working in the Site:
    a. Painter and Decorator;
    b. Carpenter;
    c. Demolition Worker (Building);
    d. Plumber;
    e. Bar Bender and Fixer;
    f. Plasterer and Tiler;
    g. Bamboo Scaffolder and Metal Scaffolder;
    h. Construction Materials Rigger;
    i. Curtain Wall Installer;
    j. Tower Crane Worker (Erecting, Dismantling, Telescoping & Climbing);

k. Lift Mechanic.

3. The Sub-contractor for lift installation shall arrange and release workers of the trade listed in sub-clause (2)(k) to attend Silver Card training or revalidation training. The Sub-contractor for lift installation shall bear the fees for the training courses and pay workers the wages which they would otherwise earn during that period of attending the training courses had the Sub-contractor for lift installation not released the workers to attend the training courses;

4. Keep record of payment for the fees of the training courses and, if applicable, payment of wages to workers who have attended Silver Card training, with workers' signed acknowledgement of receipt;

5. Keep record of card numbers, card holders' names and expiry dates of the cards, for the inspection of the CM. Ensure that the Green Cards or Silver Cards held by all workers are valid;

6. Provide the Main Contractor for his submission to the CM with a record of Silver Card holders for all workers engaged for the specified trades in the prescribed form and in such time and manner as stipulated therein.

7. Unskilled labourers who are employed by the Sub-contractor, shall upon their first appearance on the Site have satisfactorily completed the training course "Basic Safety for Construction General Workers" organised by OSHC, otherwise arrange those unskilled labourers without having completed the above training course to enrol in the above training course upon their first appearance on the Site. Acceptance of alternative training provided by other organisations is subject to verification by the CM that the alternative training is based on course contents of equivalent or higher standards than the aforesaid course of OSHC. Keep a record of the certificates, including the names of the certificate holders, the issue dates of the certificates and the relevant trade category for inspection by the CM, and report the status at the site meeting. Notwithstanding the above requirement, there is a grace period for arranging unskilled labourers to enrol in the above training course up to 31 December 2026 after which any unskilled labourer who has not yet satisfactorily completed the above training shall be arranged to enrol in the above training course upon their first appearance on the Site.

PRE.BS1.460.9 CONTRACTOR'S EMPLOYEES

1. The Sub-contractor and his sub-contractors shall comply with the Construction Workers Registration Ordinance (Cap. 583), in particular with respect to the requirements that only registered skilled / semi-skilled workers are employed to carry out construction works of those designated trade divisions set out in the Ordinance unless under the conditions specified in the Ordinance which exempt the above requirements;

2. Further to GCC Clause 5.9(1) of the Main Contract, the following qualified workers shall have acquired the respective qualifications:

   a. "Skilled Worker" is a registered skilled worker or registered skilled worker (provisional) as respectively defined in section 2(1) of the Construction Workers Registration Ordinance (Cap. 583);

   b. "Semi-skilled Worker" is a registered semi-skilled worker or registered semi-skilled worker (provisional) as respectively defined in section 2(1) of the Construction Workers Registration Ordinance (Cap. 583).

3. For complying with GCC Clause 5.9(1)(c) of the Main Contract, the Sub-contractor or his subcontractors shall employ the minimum number of Skilled and Semi-skilled Workers calculated in accordance with the stated percentages of the total workforce on Site at any one time in each of the following scheduled trade divisions. For the purpose of this sub-clause, the term "total workforce" means the total number of workers of the relevant trade division but excluding Workers under Instruction as provided for under sub-clause (4) below, workers working across designated trade divisions pursuant to section 3A of the Construction Workers Registration Ordinance (Cap. 583), workers carrying out exempted construction work pursuant to section 63A of the Construction Workers Registration Ordinance (Cap. 583), CICTS(E&M) Trainees under training in accordance with PRE.BS1.577 and ITCTS(E&M) Trainees who completed training under this Sub-contract in accordance with PRE.BS1.577:

Trade division	Requirement of combined percentage for Skilled and Semi-skilled Workers	Max permissible percentage of Semi-skilled Workers
Electrical Fitter	100%	0%*
Control Panel Assembler	100%	33%
Electrical Wireman	100%	33%
Building Security System Mechanic	100%	40%
Communication System Mechanic	100%	40%
Mechanical Fitter (For standby generator)	100%	40%

* Semi-skilled worker is not available in this trade division.

3. For complying with GCC Clause 5.9(1)(c) of the Main Contract, the Sub-contractor or his sub-contractors shall employ the minimum number of Skilled and Semi-skilled Workers calculated in accordance with the stated percentages of the total workforce on Site at any one time in each of the following scheduled trade divisions. For the purpose of this sub-clause, the term "total workforce" means the total number of workers of the relevant trade division but excluding Workers under Instruction as provided for under sub-clause (4) below, workers working across designated trade divisions pursuant to section 3A of the Construction Workers Registration Ordinance (Cap. 583), workers carrying out exempted construction work pursuant to section 63A of the Construction Workers Registration Ordinance (Cap. 583), CICTS(E&M) Trainees under training in accordance with PRE.BS1.577 and ITCTS(E&M) Trainees who completed training under this Sub-contract in accordance with PRE.BS1.577:

Trade division	Requirement of combined percentage for Skilled and Semi-skilled Workers	Max permissible percentage of Semi-skilled Workers
Fire Service Mechanic (Master)	100%	0%*
Fire Service Electrical Fitter	100%	40%
Fire Service Mechanical Fitter	100%	40%
Plumber	100%	40%

Fire Service Portable Equipment Fitter	100%	0%*
Electrical Fitter	100%	0%*
Electrical Wireman	100%	20%

* Semi-skilled worker is not available in this trade division.

3. For complying with GCC Clause 5.9(1)(c) of the Main Contract, the Sub-contractor or his sub-contractors shall employ the minimum number of Skilled and Semi-skilled Workers calculated in accordance with the stated percentages of the total workforce on Site at any one time in each of the following scheduled trade divisions. For the purpose of this sub-clause, the term "total workforce" means the total number of workers of the relevant trade division but excluding Workers under Instruction as provided for under sub-clause (4) below, workers working across designated trade divisions pursuant to section 3A of the Construction Workers Registration Ordinance (Cap. 583) and workers carrying out exempted construction work pursuant to section 63A of the Construction Workers Registration Ordinance (Cap. 583), CICTS(E&M) Trainees under training in accordance with PRE.BS1.577 and ITCTS(E&M) Trainees who completed training under this Sub-contract in accordance with PRE.BS1.577:

Trade division	Requirement of percentage for Skilled Workers* for Lift / Escalator Installation in the same trade division for the installation period**
Lift Mechanic / Escalator Mechanic / Lift and Escalator Mechanic (Master) At Installation Stage (e.g. the first 65% of the installation period)	100%
Lift Mechanic / Escalator Mechanic / Lift and Escalator Mechanic (Master) At Testing and Commissioning Stage (e.g. the remaining 35% of the installation period)	100%

* Semi-skilled worker is not available in this trade division.

**For the purpose of this clause, the installation period starts from commencement of on-site installation works until the completion of testing and commissioning.

3. For complying with GCC Clause 5.9(1)(c) of the Main Contract, the Sub-contractor or his sub-contractors shall employ the minimum number of Skilled and Semi-skilled Workers calculated in accordance with the stated percentages of the total workforce on Site at any one time in each of the following scheduled trade divisions. For the purpose of this sub-clause, the term "total workforce" means the total number of workers of the relevant trade division but excluding Workers under Instruction as provided for under sub-clause (4) below, workers working across designated trade divisions pursuant to section 3A of the Construction Workers Registration Ordinance (Cap. 583), workers carrying out exempted construction work pursuant to section 63A of the Construction Workers Registration Ordinance (Cap. 583), CICTS(E&M) Trainees under training in accordance with PRE.BS1.577 and ITCTS(E&M) Trainees who completed training under this Sub-contract in accordance with PRE.BS1.577:

Trade division	Requirement of combined percentage for Skilled and Semi-skilled Workers	Max permissible percentage of Skilled Workers plus Semi-skilled Workers
Refrigeration / Air conditioning / Ventilation Mechanic (Air System)*	100%	50%
Refrigeration / Air conditioning / Ventilation Mechanic (Electrical Control) *	100%	50%
Refrigeration / Air conditioning / Ventilation Mechanic (Thermal Insulation)*	100%	50%
Refrigeration / Air conditioning / Ventilation Mechanic (Unitary System)*	100%	50%
Refrigeration / Air conditioning / Ventilation Mechanic (Water System)*	100%	50%
Electrical Fitter	100%	0%**
Electrical Wireman	100%	20%

Notes:

1. Skilled workers from the trade of "Refrigeration / Air-conditioning / Ventilation Mechanic (Master)" shall be considered as an equivalent substitution to the skilled workers from those trades marked with * in the above schedule;
2. ** Semi-skilled worker is not available in this trade division.

4. With implementation of reasonable measures of instruction and supervision as provided below, Workers under Instruction are allowed to carry out construction work of their respective trade divisions. The Sub-contractor and his sub-contractors shall follow the latest "Guidelines on Arrangement of Instruction and Supervision and Code of Practice for Reasonable Measures of Instruction and Supervision" published by CIC and implement reasonable measures regarding the arrangement for workers not registered under the relevant trade division (i.e. "Workers under Instruction") to carry out construction work of such trade division under instruction and supervision pursuant to section 4 of the Construction Workers Registration Ordinance (Cap. 583);

5. Complete a return for workers for each trade division prescribed under sub-clause (3) above, giving details of the personal particulars of each of such workers employed, and deliver it to the Main Contractor for submission to the CM in accordance with GCC Clause 5.25(3) of the Main Contract:

   a. Obtain the format of the return from the CM;

   b. A return is to be completed in respect of:

      i. The workers which include Skilled Workers, Semi-skilled Workers, Workers under Instruction, workers working across designated trade divisions and workers carrying out exempted construction work for each trade division employed on the fifteenth (15) day of each month, or in the event of the fifteenth (15) day being a General Holiday on the day immediately following the General Holiday;

ii. The average number of workers which include Skilled Workers, Semi-skilled Workers, Workers under Instruction, workers working across designated trade divisions and workers carrying out exempted construction work for each trade division per day employed in each month.

PRE.BS1.465.9 WORKERS FOR HANDLING REFRIGERANT

When Hydrofluorocarbon (HFC) and blend type refrigerants are installed in the air-conditioning system, tested and commissioned after the installation work, the Sub-contractor shall employ workers for handling refrigerant in accordance with the following requirements:

1. A minimum 25% of the total workforce on Site for handling HFC and blend type refrigerants shall be holders of a valid certificate of having satisfactorily completed the relevant refrigerant handling training courses organized and recognized by The Hong Kong Air Conditioning and Refrigeration Association Limited (HKACRA);
2. Details and particulars of these workers shall be submitted to the Contract Manager for approval when instructed by the Contract Manager.

PRE.BS1.466.A PROTECTION FROM WEATHER

1. In addition to any obligation under GCC Clause 5.11 of the Main Contract or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working under inclement weather conditions as recommended in the latest edition of the CoP in Times of Adverse Weather and "Extreme Conditions" issued by LD and the Guide on Safety at Work in Times of Inclement Weather jointly issued by LD and OSHC. Examine critically the practices and / or measures as recommended in the said CoP and Guide, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said CoP and Guide may be proposed for CM's approval before implementation. The following highlights of the crucial practices and / or measures, albeit not exhaustive, are extracted from the said CoP and Guide:
   a. Conduct risk assessment on working under inclement weather conditions, identify and analyse the hazards;
   b. In collaboration with the Main Contractor, establish practical safety measures and emergency plans with documented procedures on communication of weather information, warning system, traffic arrangement, work arrangement, use of appropriate personal protective equipment, evacuation route, safe shelters, first aid facilities and back up services etc.;
   c. In collaboration with the Main Contractor, formulate training programme with regular drills for all emergency situations to all site personnel to become knowledgeable to all hazards, and all necessary precautions to take under inclement weather conditions;
   d. Resume work after the occurrence of inclement weather conditions only after a thorough examination and completion of all necessary repairs to ensure the safe working condition of lifting appliances, scaffolds, suspended working platforms, electrical installations and other plant.
2. In collaboration with the Main Contractor, appoint an emergency standby team as per PRE.B8.1520 to monitor changes in weather conditions and take appropriate actions as per sub-clause (1);

3. Follow the advice and practical guidelines on work arrangements in times of typhoons and rainstorms as given at the said CoP, taking into account the applicability and suitability to the Works on account of actual site conditions and the specific safety hazards of the Works;
4. Incorporate the practices and measures as per PRE.B8.1510 into the health care plan of the Safety Plan;
5. Cover up, protect and secure the Works and the Direct Works from damage by inclement weather, including providing sufficient staff, adequate plant and any other requirements necessary to ensure protection during typhoon and heavy rainstorm conditions.

PRE.BS1.468.9 PROTECTION OF WORKERS FROM HEAT STROKE

In addition to any obligation under GCC Clause 5.11 of the Main Contract or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working in hot weather as recommended in the latest edition of the Guidelines on Site Safety Measures for Working in Hot Weather issued by the CIC and the leaflet on Prevention of Heat Stroke at Work in a Hot Environment issued by LD. Examine critically the practices and / or measures as recommended in the above mentioned Guidelines, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guidelines and leaflet may be proposed for CM's approval before implementation. The following highlights of the crucial practices and / or measures, albeit not exhaustive, are extracted from the above mentioned Guidelines and leaflet:

1. In relation to PRE.BS1.600, ensure that a safe system of work including the risk assessment and the caring measures for prevention of heat stroke are incorporated in the Safety Plan in respect of the Sub-contract Works;
2. Make reference to Annex A of the said Guidelines issued by CIC for the purpose of conducting the risk assessment as per sub-clause (1); review and adopt as appropriate in the light of applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works;
3. Set up sunshade to block away sunlight at exposed work areas and provide good mechanical ventilation as far as reasonably practicable;
4. Ventilate the workplace by means of fans / blowers / chillers or any other form as appropriate;
5. Where working in enclosed area with poor ventilation, in addition to the provision at sub-clause (4), exhaust the hot air by exhaust pipes or other suitable measures;
6. Keep heat-generating machinery (e.g. diesel air compressors or generators) away from workers or use insulating materials to minimize heat dissipation as far as reasonably practicable;
7. Use mechanical aids for execution of works where appropriate to minimise workers' physical exertion;
8. Establish administration control measures with trained supervisors to take heed of hot weather report and if necessary, to reschedule outdoor work or to arrange job rotation or suitable rest breaks to avoid prolonged working in hot environment;
9. Assign a lower workload or shorter working duration as a start to the workers new to a hot environment, with the workload increased gradually over a number of days to help them to acclimatize to the hot environment;
10. Avoid assigning workers who may have difficulties in coping with heat to work under hot environment. Consider the advice of their attending doctors if necessary;

11. Arrange regular rest periods to reduce the period of exposure to the hot environment to let workers cool down. Apart from the regular 30-minute rest period during the afternoon work session, allow an additional 15-minute rest period during the hot summer months (from May to September every year);
12. Provide relevant training and site safety information to supervisors and workers in understanding the potential risks of working in hot environment inclusive of the knowledge in recognizing symptoms of heat-related disorders, the precautionary measures and the emergency response actions etc.;
13. Sheltered rest areas as per PRE.B8.305 with cooling aids and cool potable water close to the workplace will be provided by the Main Contractor;
14. In addition to sub-clause (13), easily accessible drinking points with cool potable water will be provided by the Main Contractor as per PRE.B8.1570;
15. Encourage workers to take plenty of water or other appropriate beverages to replenish the fluid and electrolytes lost through sweating;
16. Prohibit consumption of alcoholic drinks;
17. Pursuant to PRE.BS1.700, encourage workers wear proper clothing and safety helmet in light colour, wide brim and with ventilation vents to suit the weather;
18. Misting machines shall be provided by the Main Contractor as per PRE.B8.1570 and the water in water tank of misting machine shall be regularly changed for hygiene.

PRE.BS1.469.9 PROTECTION OF WORKERS WORKING IN COLD WEATHER

In addition to any obligation under GCC Clause 5.11 of the Main Contract or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working in cold weather as recommended in the Health Guide for Working during the Cold Weather issued by LD. Examine critically the practices and / or measures as recommended in the said Guide, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guide may be proposed for CM's approval before implementation:

1. In relation to PRE.BS1.600, ensure that the risks of working in cold weather to the workers and the caring measures are incorporated in the Safety Plan in respect of the Sub-contract Works;
2. Take heed of weather report. Inform workers of the necessary safety and health precautions to take and remind workers to wear appropriate warm clothing at work;
3. Reschedule outdoor work or work in remote areas to warmer periods in daytime where practicable;
4. Make arrangements for work shifts to rotate from outdoor to indoor or sheltered work sites where practicable;
5. Hot drinking water or other beverages will be provided by the Main Contractor as per PRE.B8.1575;
6. Provide workers working alone in remote areas with effective communication or other suitable measures for calling for assistance in case of emergency.

PRE.BS1.470.9 FIXING HEAVY PLANT AND EQUIPMENT, ETC.

1. When heavy plant and equipment etc. are to be installed in the Commercial Centre prior to the commencement of the relevant parts of the Works, the Sub-contractor shall submit drawings showing the proposed fixing details to Contract Manager for Approval. The drawings shall be supported by necessary calculations to demonstrate the structural/mechanical adequacy of the proposed fixing details. Method statement and erection procedures shall also form part of the submission;
2. Before the submission, drawings and calculations shall be vetted, endorsed and signed by the Sub-contractor's Supervising Engineer;
3. The requirement of submission shall apply to the following items of equipment:
   a. Luminaires exceeding 10 kg in weight;
   b. Loudspeakers for Atrium;
   c. Split type air conditioning units;
   d. Air handling units mounted at high level;
   e. In-line fans;
   f. Air curtains;
   g. Air diffusers;
   h. Glass balustrade of escalators.
4. The Sub-contractor shall include other items not shown above but deemed necessary by the Contract Manager in the submission.

PRE.BS1.480.9 DEFECT RECTIFICATION COORDINATOR(S) (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY)

Defect Rectification Coordinator(s) will be assigned by the Main Contractor to coordinate, programme, supervise and monitor the execution of Maintenance Works carried out by the Sub-contractor to ensure that the work is fully in compliance with the provisions of the Sub-contract. The Maintenance Works shall include but not limit to any work of repair or rectification of defects / faults identified within the Maintenance period. The Sub-contractor shall render co-operation and provide necessary input and resources to facilitate the Defect Rectification Coordinator(s) in discharging his duties.

PRE.BS1.490.9 STANDBY WORKFORCE (FOR DOMESTIC PORTION OF DOMESTIC BLOCKS ONLY)

The Sub-contractor shall provide a standby workforce on Site during the first six months of the Maintenance Period or where Sections are applicable to the Contract the first six months of the individual Maintenance Period for each Section, according to the following arrangement:

1. Prior to the commencement of Maintenance Period and at the end of each subsequent month, the Sub-contractor shall propose the strength of the standby workforce on the basis of the anticipated Maintenance Works including any works of repair or rectification of defects / faults identified within the Maintenance Period to the Main Contractor's Defect Rectification Coordinator(s) for his onward submission to the CM for prior agreement;
2. The standby workforce shall be resident on Site under the direct supervision of the Main Contractor's Defect Rectification Coordinator(s) and its presence shall be properly recorded for the CM's verification;

3. The Sub-contractor may adjust the strength of the standby workforce to satisfy operational needs with prior agreement of the CM obtained through the Defect Rectification Coordinator(s).

PRE.BS1.500.9 ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES

1. The Sub-contractor shall comply with the following:
   a. Undertake all necessary measures to reduce the environmental impacts and pollution arising from the execution of the Sub-contract Works;
   b. Observe and comply with all the legislation relating to environmental protection, pollution control and site hygiene;
   c. Coordinate with the Main Contractor in the preparation, updating and implementation of a Contractor's Environmental Management Plan (EMP) as described hereafter.
2. The Sub-contractor shall undertake all necessary measures to reduce the environmental impacts and pollution arising from the execution of the Sub-contract Works, observe and comply with all the legislation relating to environmental protection, pollution control and site hygiene;
3. In addition to statutory and regulatory requirements, the Sub-contractor shall comply with the noise control requirements stipulated in the Preliminaries clauses of the Main Contract;
4. The Sub-contractor shall coordinate with the Main Contractor in the preparation of the Environmental Management Plan (EMP). The Sub-contractor shall handle and dispose waste materials in accordance with the EMP approved by the CM and the other requirements stipulated in the relevant Preliminaries clauses of the Main Contract;
5. The Sub-contractor shall follow up on the advice of the Main Contractor's Environmental Manager and Environmental Supervisor in respect of:
   a. Complying with the environmental management plan;
   b. Completing and updating as necessary the Sub-contractor's environmental management, waste management and site hygiene statements.

PRE.BS1.510.9 APPROVAL OF MATERIALS IN CONSTRUCTION STAGE

In construction stage, the equipment and material should be submitted for approval as required by the Specification or as requested by the Contract Manager. Origin of manufacture of the equipment and material should also be submitted for approval. The Sub-contractor shall supply materials from the proposed offers listed in the "Information to be Supplied by Tenderer" submitted with the tender as far as practicable. If subsequent changes of any approved materials or origin of manufacture of materials are necessary, the alternative materials or origin of manufacture shall comply with the Specification and shall also be submitted to the Contract Manager for consideration and approval together with the reason(s) of change.

PRE.BS1.515.9 AVOIDANCE AND RESOLUTION OF DISPUTES

1. The dispute avoidance and resolution procedures as set forth in Clause 12.1 of the General Conditions of Sub-contract is for the following purposes:
   a. Foster co-operation between the Main Contractor and the Sub-contractor;
   b. Minimize the volume of claims, disputes and disruptions to the Sub-contract Works;

c. Ensure the cost-effective and expeditious resolution of disputes that arise between the Main Contractor and the Sub-contractor excepting disputes arising between the Main Contractor and the Employer over the Sub-contract Works which shall be subject to Clause 17.1 of the General Conditions of Main Contract.

2. Pursuant to Clause 12.1(3) of the General Conditions of Sub-contract, the DARA shall be the same personnel appointed from time to time as the DARA for the Main Contract.

PRE.BS1.520.9 SUB-CONTRACTING OF THE SUB-CONTRACT WORKS

1. Pursuant to Clause 2.1(5) of the General Conditions of Sub-contract, the Sub-contractor shall within 30 days of the date of the Letter of Acceptance submit a Sub-contractors Management Plan to the Main Contractor for his submission to the CM for information and comment, if any. Update such Sub-contractors Management Plan on a quarterly basis until the date of issue of partial maintenance certificate of the Sub-contract Works. The first quarter shall commence from the expiry of the month in which such Sub-contractors Management Plan was submitted to the Main Contractor. Submit any updated Sub-contractors Management Plan within one month from the expiry of the quarter;

2. Should there be any changes in the sub-contracting arrangements at any time before the next quarterly submission is due, notify the Main Contractor forthwith of such changes in writing. Such notification shall not affect the obligation to submit an updated Sub-contractors Management Plan under sub-clause (1) above. In the event that there are no changes to the sub-contracting arrangements in any one quarter, notify the Main Contractor of the same and no updated submission for such quarter will be required to be made;

3. Any Sub-contractors Management Plan or updated Sub-contractors Management Plan submitted under sub-clause (1) above shall contain such detailed information as required by the "Guidelines on Scope and Contents of the Sub-contractors Management Plan" in APPENDIX PRE.B6/II of the Main Contract, and the latest "Contractor's Guideline on Wage Monitoring System" published by HA;

4. The CM may, upon receipt of any Sub-contractors Management Plan or updated Sub-contractors Management Plan, provide his comments on such plan. Amend or revise forthwith such Sub-contractors Management Plan or updated Sub-contractors Management Plan upon receipt of such CM comments, to the satisfaction of the CM. The CM shall have no obligation to comment or approve any Sub-contractors Management Plan or updated Sub-contractors Management Plan;

5. Further to Clause 2.1 of the General Conditions of Sub-contract, the following prohibition on sub-contracting the Sub-contract Works or any part thereof shall apply:

   a. Do not sub-contract the provision of management/site supervision team as specified in the Sub-contract;

   b. Do not sub-contract to a single sub-contractor for the provision of labour and materials or labour only to the Sub-contract Works after excepting the provision of management/site supervision team. For the purpose of this clause, separate sub-contracting of works on a piece-work basis to the same sub-contractor will be considered as a whole.

6. In the event that any part of the Sub-contract Works is to be sub-contracted, the Sub-contractor shall ensure that no more than two tiers of sub-contractors are to be engaged to carry out that part of the Sub-contract Works. For the purpose of sub-clause (6) where any part of the Sub-contract Works is to be sub-contracted, the first tier of sub-contracting means the sub-contract between the Sub-contractor and his sub-contractor and the first tier sub-contractor refers to the sub-contractor of the first tier of sub-contracting. The second tier of sub-letting means the sub-contract between the first tier sub-contractor and his sub-contractor;

7. The Sub-contractor shall provide the Main Contractor with full particulars of the sub-contractors employed or to be employed on the Sub-contract Works complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time. Submit these particulars to the CM and LRO at regular intervals as confirmed by the CM until the date of issue of the partial maintenance certificate of the Sub-contract Works. Submission of these particulars to the CM shall be in both printed and electronic copies while those to LRO in electronic copies;

8. When the CM has instructed the replacement of the Sub-contractor's sub-contractor in the event of non-performance of his sub-contractor, or any of his staff who is not performing to the entire satisfaction of the CM, the Sub-contractor shall comply with the following:

   a. The Sub-contractor shall submit particulars of his other sub-contractor or replacement staff of his sub-contractor for the CM's approval within two weeks after receipt of the CM's instruction;

   b. The Sub-contractor shall bear all associated costs and no extension of time will be allowed.

9. The Sub-contractor shall submit the following documents immediately upon the award of the Sub-contract and re-submit any subsequent change via the Main Contractor for the CM's further approval:

   a. Written declaration together with supporting documents (e.g. copies of employment contract, bank payroll record and MPF contribution record) stating that the Sub-contractor's Management Team as required in PRE.BS1.570 is directly employed by the Sub-contractor. The employment terms for members in the Sub-contractor's Management Team shall include a "consent to disclosure" clause in accordance with the data protection principles set out under the Personal Data (Privacy) Ordinance (Cap. 486). Personal data (e.g. HKID number, salary amount) within the supporting documents can be blanked out or covered up when submitted by the Sub-contractor.

10. For the purpose of this clause, the term "sub-contractors" means sub-contractors irrespective of tiers unless otherwise specified.

PRE.BS1.530.9 HOUSING CONSTRUCTION MANAGEMENT ENTERPRISE SYSTEM (HOMES)

1. Pursuant to Clauses NS1.1 and NS14.1 of the Special Conditions of Sub-contract, upon the CM's notification of the Sub-contract HOMES Start Date, follow the HOMES accounts creation procedures, which will be provided with the CM's notification, to obtain the security tokens, and activate the authorized nominated sub-contractor submission account (ANSCSA) and nominated sub-contractor data operation account (NSCDOA) before the Sub-contract HOMES Start Date;

2. Use the HOMES as the electronic communication media for the Sub-contract from the Sub-contract HOMES Start Date onward. When the Sub-contract requires that a specified person is responsible for the submission of specific Forms to certify specified activities, such person shall sign the specific Forms as proper record. The signed Forms shall be scanned in 'pdf' format and submitted via the Main Contractor to the CM through the HOMES accordingly. Original of the signed Forms shall be submitted via the Main Contractor to the CM as proper record;

3. Upon issue of the Partial Maintenance Certificate for the Sub-contract Works, only the ANSCSA will remain active for access to HOMES until the End Date unless otherwise determined by the CM;

4. Train staff up for operating the computer system to input and submit the required information through HOMES. While self-learning training kit CD is distributed to the Sub-contractor free of charge at the Sub-contract HOMES Start Date, the Authority will be organizing training courses for HOMES from time to time and the Sub-contractor may arrange their staff to attend the training course where considered appropriate on payment of the relevant cost and fees;

5. Follow the 'Guide for Housing Construction Management Enterprise System (HOMES) for Hong Kong Housing Authority (for Contractors' use only)' for any necessary process available / required by the HOMES;

6. Ensure the availability of computer systems that can fulfil the minimum requirement as specified in the Guide for HOMES, and bear all costs for the computer systems and the connection of the computer systems to the HOMES through web browser (internet connection);

7. Coordinate with Main Contractor and other contractors directly appointed by HA who are HOMES users for proper and timely execution of the functions in HOMES.

PRE.BS1.535.A DEVELOPMENT AND CONSTRUCTION SITE MOBILE SYSTEM (DCSMS)

1. The Development and Construction Site Mobile System (DCSMS) shall be adopted from within one month after the notified date for commencement of the Main Works to the date of six months after the date of certified completion of the Main Works. The Sub-contractor shall login the DCSMS system with his HOMES accounts and use the following mobile application (App) and/or web application (Web), if applicable, of the DCSMS:

    a. Request for Inspection (RFI) App and Web for submission of inspection request, and followed by submission of signed hard copy of the completed documents to the Main Contractor;

    b. Site Direction /Site Memo Web for receiving of and responding to site direction /site memo. Printing and submission of signed hard copy of site direction /site memo with hard copy attachments to the Main Contractor and CM is required;

    c. Site Alert App and Web for communicating with Site Staff and Main Contractor by receiving and responding to site alerts;

    d. Building Services Works (BS) Final Flats Inspection App and Web for the BS final flat-to-flat inspections, and for receiving the Site Inspection Guide for BS (DBSI) forms that show the inspection results. Printing and submission of signed hard copy of the DBSI forms with hard copy attachments to the Main Contractor and CM is required;

    e. Site Operation Module Web for facilitating submission of Main Contractor’s Daily Report as stipulated in Clause 5.25(3) of the General Conditions of Main Contract and submission of Monthly Labour Return as stipulated in sub-clause (1)(a) of PRE.BS1.565.

2. Ensure the availability of computer systems and/or mobile devices, if applicable, that connect to and login the DCSMS, and bear all costs for the computer systems, mobile devices and the connection of the computer systems and the mobile devices to DCSMS through web browser (internet connection). The mobile devices and computer systems shall fulfil the minimum requirements as specified in sub-clauses (3) and (4) below respectively;

3. The minimum requirements of the mobile devices to access DCSMS are tabled as follows:

a. Operating System	Android 6.0 or above Non-rooted
b. Screen Size	5.0 – 6.0 inches
c. Display	Resolution (pixel): 1920 x 1080 – 2560 x 1440 Capacitive and Multi-touch
d. Dimension	Height <= 6.5 inches Width <= 3.2 inches Thickness <= 0.4 inches
e. Weight	200 g or below
f. CPU	CPU core: 4 - 8 Frequency: 1.6 – 2.45 GHz
g. Memory (RAM)	3 – 6 GB
h. Memory (Storage: ROM)	32 – 64 GB
i. Primary Camera	Image Resolution: 12M – 16M pixel Features: Autofocus, Flash
j. Network	Cellular Network: 4G LTE 1800 / 2300 / 2600 UMTS 850 / 900 / 2100 GSM 900 / 1800 Wi-Fi: 802.11 b/g/n/ac or more Bluetooth: 4.0 or above
k. Tracking / Positioning	A-GPS
l. Battery	Can serve > 10 hrs (3G Talk time) Spare battery for battery detachable smartphone or External battery pack as required
m. Accessories	With protection case With Anti-glare Screen Protector

4. The minimum requirements of the computer systems to access DCSMS are tabled as follows:

a. CPU	Intel Core i5-650 3.20GHz or above
b. Memory	4 GB RAM or above
c. Hard disk	500 MB or above free space
d. Operation System	Microsoft Windows 7 or above
e. Browser	Microsoft Internet Explorer 11 or above

PRE.BS1.540.9 OBLIGATIONS PERTAINING TO WAGES PAYMENT

1. The Sub-contractor shall comply with the requirements stipulated in Clauses 2.1, 4.6, 5.1, and NS5.1 of the Conditions of Sub-contract and the Specification Clauses PRE.BS1.550 to PRE.BS1.580 mentioned below;
2. The Sub-contractor shall render co-operation and provide necessary input and resources to facilitate the Main Contractor in discharging his duties in accordance with Clauses 5.8, 6.2, and 6.3 of the General Conditions of Main Contract, Clauses SCC1.1, SCC3.1, SCC3.2, and SCC6.1 of the Special Conditions of Main Contract and the Specification Clauses PRE.B6.290, PRE.B6.430, PRE.B6.440, PRE.B8.1450 and PRE.B8.2610 to PRE.B8.2660 of the Main Contract.

PRE.BS1.550.9 PAYMENT OF WAGES OF SITE PERSONNEL

In accordance with Clause NS5.1 of the Special Conditions of Sub-contract, the Sub-contractor shall comply with the following:

1. The Sub-contractor shall comply with the following for monitoring the payment of wages and Mandatory Provident Fund (MPF) contribution to Site Personnel:
    a. Employment contract:
        i. The Sub-contractor shall keep a copy of the complete set of the executed employment contracts of all Site Personnel in the wage books as required in PRE.BS1.560. Each copy of the executed employment contracts together with an updated register of the employment contracts shall be kept in the wage books within two days from the date that the Site Personnel commences to work on Site;
        ii. Deliver the original executed employment contracts of any Site Personnel to the office of the CM's representatives for inspection by the CM within one day when requested by the CM;
        iii. Seek written approval from the CM before a Site Personnel without an executed employment contract executes any work on the Site;
        iv. The terms of the employment contract shall not be less favourable to the terms provided in the "Specimen Employment Contract" in the latest "Guidelines on Wage Payment Monitoring and Reimbursement of Contractor's and Sub-contractors' Contributions to the Mandatory Provident Fund for their Site Personnel" published by Development Bureau of HKSAR from time to time.
    b. Wage payment and mandatory provident fund ("MPF") arrangement for Site Personnel:
        i. The Sub-contractor shall ensure that sufficient funds have been reserved in the designated bank account for the payment of all wages and MPF contribution to all Site Personnel employed or engaged by the Sub-contractor. The Sub-contractor shall instruct promptly the designated bank to effect the timely payment to the respective wage payment accounts, employee MPF contribution accounts and the employer MPF contribution accounts of all Site Personnel employed or engaged by the Sub-contractor according to the schedule as prepared in sub-clause (c)(ii);

ii. The Sub-contractor shall ensure that his sub-contractors of all tiers have sufficient funds available in the designated bank accounts for the payment of all wages and MPF contribution to all Site Personnel employed or engaged by them. The Sub-contractor shall also ensure that his sub-contractors of all tiers shall promptly instruct the designated banks to effect the timely payment to the respective wage payment accounts, employee MPF contribution accounts and the employer MPF contribution accounts of all Site Personnel employed or engaged by them according to the schedule as prepared in sub-clause (c)(ii);

iii. The Sub-contractor shall pay, and require his sub-contractors of all tiers to pay the wages to all the Site Personnel by bank's autopay service and make the MPF contribution as stipulated in sub-clause (c);

iv. The Sub-contractor shall require each of the Site Personnel to provide a bank account and an employee MPF contribution account via which wage payment will be paid by bank's autopay service.

c. Wage payment and MPF contribution records:

i. Within 14 days from the date of Letter of Acceptance of the Sub-contract Tender by the Main Contractor, the Sub-contractor shall submit to the CM the name of the designated bank and all related arrangement details for the payment of wages and MPF contribution to all the Site Personnel;

ii. The Sub-contractor shall prepare schedules of wages and corresponding MPF contribution of all the Site Personnel employed or engaged by him based on the verified daily record as required in PRE.BS1.580. The Sub-contractor shall also keep a copy of such schedules in the wage books as required in PRE.BS1.560 within 14 days from the end of the corresponding wages period;

iii. The Sub-contractor shall require his sub-contractors of all tiers to prepare the respective schedules of wages and the corresponding MPF contribution of all the Site Personnel employed or engaged by them based on the verified data from the ACRS as required in PRE.BS1.580. The Sub-contractor shall also keep a copy of such schedules in the wage books as required in PRE.BS1.560 within 14 days from the end of the corresponding wages period;

iv. The Sub-contractor shall keep a copy of the records of transactions in the wage books as required in PRE.BS1.560 within 21 days from the end of the corresponding wages period;

v. The Sub-contractor shall submit and require his sub-contractors of all tiers to submit to the CM for each workers' payment cycle a written declaration that all wages of the Site Personnel have been paid and all MPF contribution have been made. For the records of payment of wages and MPF contribution of the Site Personnel in the managerial grade stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time, it is optional to keep them in the wage books as required in PRE.BS1.570 provided that they are directly employed by the Sub-contractor and the CM has no objection to this arrangement.

2. Labour Relations Officer(s) (LRO) shall be authorized by the Employer and notified to the Main Contractor by the CM to work on Site. After the date of certified completion of the Main Works, the LRO may work outside the Site as notified to the Main Contractor by the CM. The LRO shall monitor the payment of wages of all Site Personnel who are employees of the Main Contractor or any of his sub-contractors of all tiers including Specialist Sub-contractors and Nominated Sub-contractors, and to handle complaints on wages arrears raised by the Site Personnel. Duties and responsibilities of the LRO are listed in the Specification Clause PRE.B6.550 of the Main Contract. To enable the LRO to duly discharge his duties, the Sub-contractor shall provide all necessary assistance in the handling of complaints on arrears of wages raised by all Site Personnel in connection with the Sub-contract Works including but are not limited to the following:

   a. The Sub-contractor shall assign a designated staff whose services shall be maintained until the date of issue of the partial maintenance certificate of the Sub-contract Works to respond to issues raised by the LRO in connection with the discharge of his duties;

   b. Provide to a Site Personnel free of charge a copy of his daily attendance records whenever his written request for same is received. The daily attendance records shall be verified by the Sub-contractor or employer of the Site Personnel;

   c. Address immediately the enquiries and/or complaints lodged by Site Personnel and reply to them the outcome or the follow-up actions taken or to be taken within two days upon receipt of the enquiries and/or complaints.

3. The requirements stipulated in sub-clauses (1) and (2) above may be exempted subject to the compliance with all relevant criteria and procedures stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time or as Approved by the CM on individual case basis.

PRE.BS1.560.9 WAGE BOOKS

1. The Sub-contractor shall keep wage books for monitoring the payment of wages and MPF contribution paid by the Sub-contractor and the sub-contractors of all tiers to all Site Personnel and identify each Site Personnel by the data as specified in PRE.BS1.580. The wage books shall give a full and up-to-date account of the payment of all wages and MPF contribution paid to all Site Personnel for the duration up to and including the month in which the partial maintenance certificate of the Sub-contract Works is issued. For Main Contract with more than one Portion of the Site, the Sub-contractor shall keep wage books for all Site Personnel of each particular Portion of the Site. The wage books shall contain the following:

   a. A complete set of copy of the executed employment contracts of all Site Personnel on Site as required in PRE.BS1.550;

   b. A complete set of signature specimens of all Site Personnel complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;

   c. A complete set of verified daily attendance records as required in PRE.BS1.580;

   d. A complete set of copy of the schedules of wages and the respective records of transactions for payment of wages and MPF contribution as required in PRE.BS1.550;

   e. A complete set of copy of the written declaration that all wages of the Site Personnel have been paid and all MPF contributions have been made as required in PRE.BS1.550.

2. The Sub-contractor shall make wage books available for inspection by the CM or LRO. The Sub-contractor shall also maintain and update an additional copy of wage books in the office of LRO for record;

3. All documents kept in the wage books shall be duly certified by the Sub-contractor or the respective sub-contractors that they are the true copy of the original documents;

4. The Sub-contractor shall keep wage books in a secure place as provided by the Main Contractor and agreed by the CM such as a room or cabinets with locking device before the date of removing the access control device of the entrance/exit control unit in ACRS as stipulated in PRE.B8.2660 of the Main Contract and thereafter keep the wage books in other secure place agreed by the CM up to the date of issue of maintenance certificate of the Main Works or the last partial maintenance certificate (whichever is the latest), or up to an earlier date as otherwise agreed by the CM. The respective keys shall only be held by the members of Sub-contractor's management team as stipulated in PRE.BS1.570. After the date of issue of maintenance certificate of the Main Works or the last partial maintenance certificate (whichever is the latest), and with the consent of the CM, all the documents kept in the wage books including the additional copy in the office of LRO shall be destroyed and disposed properly without disclosing any information contained in them;

5. The above requirements stipulated in sub-clauses (1) to (4) may be exempted subject to the compliance with all relevant criteria and procedures stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time or as Approved by the CM on individual case basis.

PRE.BS1.565.N RETURN OF SITE LABOUR DEPLOYMENT AND EMPLOYMENT TO CENSUS AND STATISTICS DEPARTMENT

1. Submit the following site labour deployment/employment returns using prescribed forms to the CM for onward submission to Census and Statistics Department:

   a. Monthly Return of Site Labour Deployment and Wage Rates for Construction Works (Form GF527);

   b. Monthly Return on Construction Site Employment (Form GF527A);

   c. Quarterly Return on Employment Survey.

PRE.BS1.570.9 SUB-CONTRACTOR'S MANAGEMENT TEAM

1. In accordance with Clause 4.6 of the General Conditions of Sub-contract, the Sub-contractor's management team shall comprise sufficient number of staff in the following disciplines:

   a. Supervising Engineer;

   b. Site Supervisor.

2. The Site Supervisor shall be full time on Site during site working hours.

3. The provision of Sub-contractor’s management team will be considered for certification in the Surveyor’s certificate of interim payment subject to the following:

   a. The Sub-contractor has included the amount for the Sub-contractor’s management team in his application for payment under Clause 10.1 of the General Conditions of Sub-contract which inclusion shall not be earlier than the fourth month of the issue of Letter of Acceptance of the Sub-contract Tender by the Main Contractor;

b. The amount for the Sub-contractor's management team payable shall be up to __ per cent of the Sub-contract Sum (excluding Provisional Sums, the amount inserted by the Sub-contractor against the item of On-demand Bond in the Summary of Tender, the pre-determined amounts in the Schedule of Rates for Site Safety, Environmental Management and Site Hygiene, and the pre-determined amounts in the Schedule of Rates for Construction Tradesman Collaborative Training Scheme (if applicable)) and shall be evenly spread over the overall duration for payment as far as possible. For the purpose of this sub-clause, the overall duration for payment for Sub-contractor's management team shall mean the duration counting from the fourth month of the issue of Letter of Acceptance of the Sub-contract Tender by the Main Contractor to the month of the issue of certificate of completion of the Main Works by the Contract Manager. Where different certificates of completion have been issued for different Sections or parts of the Main Works, the expression "certificate of completion of the Main Works" shall, for the purpose of this sub-clause, mean the last of such certificates. Any sums for Variations included in an interim payment shall be excluded from the computation of the amount of the Sub-contractor's management team under this sub-clause;

c. The certification for payment of the amount of the Sub-contract Sum excluding the amount for the Sub-contractor's management team shall follow the principles stipulated in Clause 10.1(2) of the General Conditions of Sub-contract;

d. For the avoidance of doubt, the amount for Sub-contractor's management team certified in an interim certificate shall be deemed to be value of works completed under the Sub-contract and will be included in the Effective Value for the calculation of contract price fluctuations in accordance with Clause SCC20.1 / SCC20.2 / SCC20.3* of the Special Conditions of Contract of the Main Contract.

PRE.BS1.575.9 ON-DEMAND BOND

1. In accordance with Clause NS4.1 of the Special Conditions of Sub-contract, procure an on-demand bond in favour of the Employer with the bonded sum as follows:
   a. The bonded sum shall initially be 3 per cent of the Sub-contract Sum; and
   b. The bonded sum shall be subsequently decreased to 0.25 per cent of the Sub-contract Sum upon expiry of six months after the date of completion as stated in:
      i. The certificate of completion issued by the Contract Manager in respect of the Main Works; or
      ii. The last certificate of completion issued by the Contract Manager if different certificates of completion are issued for different Sections or parts of the Main Works.
2. Submit the on-demand bond referred to in sub-clause (1) above to the Main Contractor within 21 days of the date of the Letter of Acceptance of the Sub-contract Tender by the Main Contractor. The on-demand bond shall remain in full force and effect unless and until such time as stated in the form as provided in the Appendix to Conditions of Sub-contract.

PRE.BS1.577.9 CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES - E & M WORK TRADE

1. The Sub-contractor shall provide or ensure the provision of the necessary training to trainees of E&M work trades employed by the Sub-contractor or his sub-contractor(s) in accordance with the Construction Industry Collaborative Training Schemes (CICTS) and the requirements specified in this clause. The CICTS for E&M work trades is hereinafter referred to as "CICTS(E&M)";
2. The CICTS(E&M) comprises the following training schemes administered by CIC for on-the-job training of construction workers:
   a. Intermediate Tradesman Collaborative Training Scheme for E&M work trades (hereinafter referred to as "ITCTS(E&M)");
   b. Advanced Construction Manpower Training Scheme for E&M work trades (hereinafter referred to as "ACMTS(E&M)");
   c. Construction Industry Council Approved Technical Talents Training Programme for E&M work trades (hereinafter referred to as "CICATP(E&M)").
3. The Sub-contractor and/or his sub-contractor(s) shall join at least one of the training schemes of the CICTS(E&M) for provision of the necessary training to the employed trainees under the Sub-contract (hereinafter referred to as "CICTS(E&M) Trainees"). Submit to the CM a copy of CIC's approval(s) to undergo the CICTS(E&M) training within 12 months from the date of the Letter of Acceptance of the Sub-contract Tender;
4. Provide, supervise and monitor the necessary training to the CICTS(E&M) Trainees for them to complete training in accordance with this clause;
5. Arrange sufficient qualified trainers in accordance with CICTS(E&M) for the CICTS(E&M) Trainees. Observe and comply with the requirements on trainers in accordance with the CICTS(E&M);
6. Ensure that at least a total of …… number of CICTS(E&M) training quotas is fulfilled with at least 50% of such training quotas met by ITCTS(E&M), before the certified date of completion of the Main Works;
7. For the purpose of sub-clause (6), a CICTS(E&M) Trainee who is employed and trained by the Sub-contractor and/or his sub-contractor(s) shall be counted towards the number of CICTS(E&M) training quota(s) fulfilled as stipulated below:
   a. Each CICTS(E&M) Trainee shall only be counted under one contract at any one time;
   b. One CICTS(E&M) training quota will be counted after a CICTS(E&M) Trainee has completed the ITCTS(E&M) training in accordance with sub-clause (11);
   c. Two CICTS(E&M) training quotas will be counted after a CICTS(E&M) Trainee has passed the mid-term assessment under the ACMTS(E&M) or CICATP(E&M) for the designated trade division(s) under the CIC's approval as referred to in sub-clause (3) above;
   d. Two CICTS(E&M) training quotas will be counted after a CICTS(E&M) Trainee under ACMTS(E&M) or CICATP(E&M) has registered as a registered skilled worker under the Construction Workers Registration Ordinance (Cap. 583) (hereinafter referred to as "CWRO") for the designated trade division(s) under the CIC's approvals as referred to in sub-clause (3) above.
8. In programming the CICTS(E&M) training, the Sub-contractor and/or his sub-contractor(s) shall employ and train the CICTS(E&M) Trainees as early as practicable. Unless with the consent of the CM, the Sub-contractor shall ensure that the training for the CICTS(E&M) Trainees of a trade division shall start within 3 months from the commencement on the Site of works of such trade division;

9. Subject to the terms and conditions of the CICTS(E&M), the Sub-contractor or his sub-contractor(s) as the employer(s) of the CICTS(E&M) Trainees may arrange part of the CICTS(E&M) training to be carried out outside the Site;

10. Submit a training plan to the CM within 3 months from the date of the Letter of Acceptance of the Sub-contract Tender. Update the training plan and submit the updated training plan to the CM on monthly basis. The training plan shall include:

    a. The Sub-contractor's programme to train the CICTS(E&M) Trainees of different trade divisions, and to meet the minimum total number of CICTS(E&M) training quotas to be fulfilled as specified in sub-clause (6) above; and

    b. A register recording using the form at PRE.BS1.APPEND3, for each CICTS(E&M) Trainee, the date of the CIC's approval to undergo the CICTS(E&M) training and the trade division(s) being trained, the attendance records, the date of passing the mid-term assessment (for CICTS(E&M) Trainee under the ACMTS(E&M) or CICATP(E&M) training), the date of completion of the training, the date of passing end-of-training assessment of trained trade division(s) and, if applicable, the CICTS(E&M) Trainee's CWRO registration number when the CICTS(E&M) Trainee has been registered as a registered semi-skilled worker or skilled worker of the relevant trade division(s) under CWRO.

11. If CICTS(E&M) Trainees who receive ITCTS(E&M) training (hereinafter referred to as "ITCTS(E&M) Trainees"), the training of each ITCTS(E&M) Trainee is completed when the ITCTS(E&M) Trainee has completed training in accordance with the ITCTS(E&M) and registered as a registered semi-skilled worker of a relevant trade division under CWRO, or if there is no relevant trade division or the trade division does not have the level of registered semi-skilled worker for registration under CWRO the training is deemed to have been completed when the ITCTS(E&M) Trainee has passed the end-of-training assessment (i.e. the Intermediate Trade Test or Certification Test) under the ITCTS(E&M). The trade division to be registered under CWRO shall match with the trade division of the ITCTS(E&M) training;

12. Report the status of CICTS(E&M) training at the monthly site meetings;

13. Provide further training to the CICTS(E&M) Trainees who have failed the mid-term assessment or the end-of-training assessment, and replenish any drop-out CICTS(E&M) Trainees for fulfilling CICTS(E&M) training quotas under sub-clause (6);

14. For the avoidance of doubt, all CICTS(E&M) Trainees under training in accordance with this clause and ITCTS(E&M) Trainees who have completed training under this Sub-contract in accordance with sub-clause (11) above shall be excluded from the total workforce under this Sub-contract for the purpose of calculating the percentage of Skilled / Semi-skilled Workers of relevant trade division pursuant to PRE.BS1.460;

15. The Employer shall not be liable for any matter, dispute or claim between (a) the Sub-contractor and his sub-contractor(s); (b) the Sub-contractor / his sub-contractor(s) and any CICTS(E&M) Trainee under training or completed training under this Sub-contract; and (c) the Sub-contractor / his sub-contractor(s) and the CIC, in connection with or in respect of any matter or issue in relation to the CICTS(E&M) or the employment or training of any CICTS(E&M) Trainee under training or completed training under this Sub-contract.

PRE.BS1.580.9 SITE ACCESS CONTROL

Access Control and Recording System (ACRS) will be provided by the Main Contractor in accordance with the Specification Clauses PRE.B8.2610 to PRE.B8.2660 of the Main Contract for recording and verifying the information of all personnel entering and leaving the Site. The Sub-contractor shall render co-operation and provide necessary input and resources to facilitate the Main Contractor in discharging his duties.

PRE.BS1.600.A SITE SAFETY

1. Safety Supervisor:

   a. The Sub-contractor is to provide a Safety Supervisor for the Sub-contract. The person designated as Safety Supervisor shall be competent, technically qualified, English and Cantonese speaking and approved by the CM, with power to receive, via the Main Contractor, the instructions of the CM. This Safety Supervisor and the Site Supervisor referred to in PRE.BS1.330 may be the same person;

   b. The designated Safety Supervisor shall have attended the Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by the OSHC or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by the CIC. Acceptance of training provided by other organizations is subject to verification that the training is based on course contents of equivalent or above standards and the appointed superintendent has attained the associated qualification. The Safety Supervisor(s) shall be accredited under the Hong Kong Safety and Health Certification Scheme managed by the OSHC. Enhancement course for Safety Supervisor(s) are conducted by the OSHC and CIC. Before commencement of the Works and whenever there is a change in the appointment of Safety Supervisor(s), report to the CM a written confirmation that Safety Supervisor(s) are employed in accordance with the Sub-contract, the written confirmation shall be appended with the name and a copy of the written certification of accreditation under the Hong Kong Safety and Health Certification Scheme for each Safety Supervisor, and a signed statement by each Safety Supervisor declaring that he is accredited as a Safety Supervisor under the Hong Kong Safety and Health Certification Scheme and the Safety Supervisor will advise the CM in writing immediately if he is no longer so accredited;

   c. In addition to those duties as imposed by the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, the Safety Supervisor shall from time to time perform the safety functions including:

      i. Site inspection:

         - Carry out safety inspections on the Sub-contractor's activities on Site. The safety inspection shall identify any unsafe operation or potential hazards;
         - Prepare safety inspection reports;
         - Liaise with the Safety Officers and Safety Supervisors of the Main Contractor.

      ii. Safety Plan:

         - Monitor implementation and updating of the Safety Plan;
         - Promote awareness and compliance with the Safety Plan to all Sub-contractor's workers on Site.

      iii. Accident / Incident report and investigation:

         Cooperate with the Safety Officers employed by the Main Contractor in the collection of accident / incident data, investigation, determination of the cause and recommendation on means of prevention and improvement in respect of the Sub-contract works;

      iv. Training:

         - Coordinate and supervise the conduct of trade specific safety training and pre-work activities;

- Identify those workers in the specified trades as detailed in PRE.BS1.450 without valid Silver Card and coordinate their enrolment in requisite Silver Card training provided by CIC;
- At the end of each period of relevant interim certificates report, report to the CM and Main Contractor the actual number of workers trained in each of the safety courses and pre-work activities.

v. Site Safety Committee:

- Attend site safety committee meetings and other safety-related meetings organized by the Main Contractor;
- Follow up on necessary actions arising from the Site Safety Committee.

vi. Risk Assessment Report:

- Prepare risk assessment reports before commencement of a new trade and recommend measures to remove or minimize hazards;
- Adopt the methodology given at the leaflet Five Steps to Risk Assessment issued by LD.

vii. Action on LD's contravention notices:

- When called upon by the Safety Officer employed by the Main Contractor, attend to the notices issued by the LD to the Main Contractor associated with contravention made by the Sub-contractor;
- Take all necessary actions to ensure full compliance with statutory requirements;
- Liaise with and report to the Main Contractor on notices received which are associated with contravention made by the Sub-contractor.

viii. Safety audit:

Implement the recommendations of the external Safety Audit Report;

ix. Safety Supervisor's report:

Compile and report the above duties to the CM via Main Contractor at monthly site meetings.

2. Safety plan in respect of the Sub-contract Works:

a. The Sub-contractor's attention is drawn to the provisions of Clause 5.11 of the General Conditions of Main Contract and without prejudice to the generality of the Sub-contractor's responsibilities under the Sub-contract or any statutory regulation with respect to safety and health, the Sub-contractor shall comply with the respective obligations set out in the Safety Plan throughout the whole progress of the Sub-contract Works and shall comply with the provisions of this clause;

b. A "safety plan in respect of the Sub-contract Works" means a safety plan including any supplemental or revised or updated version, submitted by the Sub-contractor and agreed by the Main Contractor, and endorsed by the CM in writing all in accordance with the provisions under this clause;

c. Pursuant to Clause 4.7(2) of the General Conditions of Sub-contract, prepare and submit within 14 days from the date of the Letter of Acceptance a draft safety plan in respect of the Sub-contract Works to the Main Contractor for his agreement and incorporation into the Safety Plan. If the Main Contractor is of the opinion that the draft safety plan in respect of the Sub-contract Works does not meet the requirements of the Sub-contract he shall request the Sub-contractor to remedy the deficiency and submit a revised safety plan in respect of the Sub-contract Works for his agreement. The Main Contractor shall submit the agreed safety plan in respect of the Sub-contract Works to the CM for endorsement. The Main Contractor shall revise or update the Safety Plan to incorporate the safety plan in respect of the Sub-contract Works endorsed by the CM prior to submitting the Safety Plan to the CM;

d. Compile and submit the necessary subsequent updating of the safety plan in respect of the Sub-contract Works to suit the site progress, as determined by the Main Contractor, or the CM, so that it is at all times a comprehensive and contemporary statement of the Sub-contractor's policies, procedures and requirements to achieve the safety and health requirements of the Sub-contract;

e. If the CM is of the opinion that the safety plan in respect of the Sub-contract Works is insufficient and requires revision or modification in the interest of the safety, whether for the Sub-contract Works and / or the safety and health of persons on or adjacent to the Site or protection of any property on or adjacent to the Site or otherwise, the CM may notify the Sub-contractor in writing and the Sub-contractor shall submit a revised or updated safety plan in respect of the Sub-contract Works for the Main Contractor's agreement and submission of the agreed safety plan in respect of the Sub-contract Works to the CM for endorsement within 7 days from the date of the CM's notice;

f. The Main Contractor's agreement to or the CM's endorsement of the safety plan in respect of the Sub-contract Works or any proposed revision or update thereof shall not relieve the Sub-contractor from his obligation or responsibility under the Sub-contract;

g. The safety plan in respect of the Sub-contract Works and its subsequent updates shall be based on guidelines prescribed by OSHC and shall contain, but not limited to details in the following aspects:

   i. Company safety and health policy;

   ii. Safety organisation;

   iii. Safety and health training;

   iv. In-house safety rules and regulations;

   v. Site Safety Committee;

   vi. Programme for inspection, thorough examination and testing of hazardous conditions;

   vii. Job hazard analysis;

   viii. Personal protection programme;

   ix. Accident / Incident report, investigation and follow up actions;

   x. Emergency preparedness;

   xi. Safety promotion;

   xii. Health assurance programme;

   xiii. Evaluation, selection and control of sub-contractor;

xiv. Process control programme;

xv. Non-smoking policy.

xvi. Lift installation work plan including the following:

- Provisions agreed by the Main Contractor such as details of the positions of floor openings in lift machine room, structural links in the ceiling of lift well, independent lifelines, design plan for modification of scaffolding sections to facilitate lift installation work in lift well, etc.;
- The administration mechanism and details of permit-to-work system on hazardous trade processes;
- Risk assessment report, similar to Annex C of Volume 2 of CIC Guidelines;
- Pre-work check reference table, similar to Annex D of Volume 2 of CIC Guidelines;
- The content, frequency and duration of safety and health training for lift workers;
- Lift well handover checklist, similar to Annex E of Volume 2 of CIC Guidelines. The responsibilities for the subsequent management and maintenance of lift well protection measure until removal shall be clearly defined and properly recorded in the Safety Plan;
- Measure / protection to inhibit fire spread between floor compartments through lift well and openings and within lift wells;
- Effective communication system for lift installation work.

3. Housing Authority Safety Auditing System (HASAS):

   The Sub-contractor shall comply with the following:

   a. Deploy his most senior site representative to attend each safety audit to be conducted by Accredited Safety Auditor nominated by the CM and under the management of the OSHC once every 3 months;

   b. Provide all necessary attendance for the safety audit including fully facilitating the inspection of the works and all certificates, records and reports relating to safety and health matters, and fully cooperate with the Accredited Safety Auditor in the carrying out of the safety audit;

   c. Read the Safety Audit Report prepared by the Accredited Safety Auditor and get his Managing Director / Project Manager to sign the report. Submit a copy of signed report to the CM and another copy to OSHC for record;

   d. Implement the recommendations of the Accredited Safety Auditor within the time frame specified in the Safety Audit Report and report the implementation to the CM and the Main Contractor;

   e. Allow for all work undertaken in preparation for the Safety Audit or in the implementation of the Safety Auditor's recommendations. Neither of which shall entitle the Sub-contractor to any extension of time for the completion of the Sub-contract Works.

4. Site Safety Committee:

a. The Sub-contractor shall assign his Safety Supervisor or other staff as may be considered necessary to attend the Site Safety Committee meetings and other safety-related meetings organized by the Main Contractor, at an interval as determined by the Main Contractor;

b. The Sub-contractor shall cooperate with the Main Contractor to follow up on remedial action against deficiencies as revealed by the Site Safety Committee;

c. The Sub-contractor shall arrange submission of forms GF527 and GF527A or other pertinent forms on the employment statistics of the Contract on a monthly basis as detailed in PRE.BS1.565.

5. Trade Specific Training and Lunchtime's Safety Talk:

a. Trade Specific Training:

i. The Sub-contractor shall provide adequate trade specific safety training to all its site workers in accordance with a training plan provided in the safety plan in respect of the Sub-contract Works or separately submitted to the CM, via the Main Contractor, for prior approval if the proposed training has not been included in the safety plan in respect of the Sub-contract Works. The training duration shall not be less than 1 hour and 45 minutes;

ii. The Sub-contractor shall provide regular safety and health training to its workers and brief them on the risk assessment report, the safety procedural steps of method statements and the implementation of permit-to-work system. The safety and health training shall include drills on steps and procedures to be followed in case of emergency or accident.

b. Lunchtime's Safety Talk:

i. The Sub-contractor shall provide lunchtime's safety talks to workers monthly. The topics and contents of lunchtime's safety talks shall be proposed by the Safety Supervisor and contain but not limited to accident / incident review, findings of Safety BSPASS, findings of safety audit and surprise inspection by OSHC and findings of inspection by LD;

ii. The Sub-contractor shall ensure that lunchtime's safety talks are conducted by Safety Supervisors, foremen or gangers who have received training organised by HKCA, Federation of Electrical and Mechanical Contractors Limited or other approved training organisations, or by the training officers of trade associations or workers' unions which are member organisations of Housing Department Site Safety Subcommittee.

c. The Sub-contractor shall perform the following in connection with the trade specific training and lunchtime's safety talk:

i. Allow the CM or CM's representative to attend any of the training courses and lunchtime's safety talks to verify that they are conducted according to Specification;

ii. Maintain all safety attendance records on site for all training and lunchtime's safety talks conducted or arranged. These records shall include the topics and dates of the events, the names of the trainers, names and trades of the persons receiving the training and their signatures. Electronic means of keeping these records with print-outs for submission will be acceptable subject to the approval of the CM. These records shall be made available for the CM's inspection upon request by the CM;

iii. The Safety Supervisor shall certify the accuracy of attendance records of the training before they are submitted monthly to the CM.

6. Trade Specific Pre-work Activities:

   a. The Sub-contractor shall conduct pre-work activities including Hazard Identification Activity (HIA) meetings and Pre-work Safety Checks for all his workers;

   b. HIA meetings can be held in small groups according to the trades, work teams or works areas set out by the Sub-contractor for the Site. If so, the Sub-contractor shall ensure that the assigned persons are competent to lead the HIA meetings. Persons who have attended one-day training course on HIA leadership provided by OSHC are considered competent to lead the HIA meetings. The issues discussed at the HIA meetings shall cover, but not limited to, hazards and control measures specific to the works or trades, special safety concerns, assurance of safety requirements and measures, reprimand of repeated irregularities and malpractices etc.;

   c. The Pre-work Safety Checks shall be carried out by foremen, gangers, Safety Supervisors or the Safety Representatives of the attendees according to the trades, work teams or works areas. The Pre-work Safety Checks shall include the checking of personal protective equipment worn by attendees before they start working on that day such as safety helmet, reflective vest, ear protectors, eye protectors, safety harness, safety footwear etc.;

   d. HIA meetings are to be held prior to the commencement of a particular type of work, but in any case the frequency shall not be less than once every 2 weeks. HIA meetings shall be attended by the workers prior to their carrying out of the associated particular work on site;

   e. Pre-work Safety Checks are to be held prior to the commencement of a particular type of work, but in any case the frequency shall not be less than once a week. For routine work, Pre-work Safety Checks shall be conducted on a half-day basis;

   f. Records of HIA meetings and Pre-work Safety Checks, including the names and trades of workers attended / checked, are to be certified by the Safety Supervisor and submitted for inspection by the CM.

7. Site Safety Regulations:

   The Sub-contractor shall, throughout the duration of the Sub-contract, report monthly to the CM for the following attributable to him from LD:

   a. Warning letters or offences notifications;

   b. Convictions during the period under any site safety regulations or legislation;

   c. Abatement / Improvement / Suspension Notice.

8. Trade Specific Site Safety Item:

   For Lift Installation:

In addition to any obligation under relevant clauses of the General Conditions of Sub-contract and Special Conditions of Sub-contract or similar obligations under any enactment or Regulation, the Sub-contractor shall adopt the practices and / or measures in respect of lift well works as recommended in the latest edition of the Guidelines on Safety of Lift Shaft Works issued by the CIC and as stated in this sub-clause (8). All references to "lift shaft" in the Guidelines shall mean "lift well" for the purpose of this sub-clause (8). Examine critically the practices and / or measures as recommended in the above-mentioned Guidelines, especially their applicability and suitability to the Sub-contract Works on account of the actual site conditions and the specific safety hazards of the Sub-contract Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guidelines may be proposed for the CM's approval before implementation. In addition, the Sub-contractor shall carry out the trade-specific precautionary site safety measures including but not limited to the following which are highlights of the above mentioned Guidelines with more specific or stringent requirements:

a. Provision and Maintenance of Temporary Work, Services and Protective Measures:

   i. Keep proper inspection records for safety provisions;

   ii. Properly use and maintain the scaffolding in lift well in good conditions at all times and timely report to the Main Contractor for any identified damage on scaffolding for immediate repair or replacement. The Sub-contractor shall not alter any members of scaffolding;

   iii. Keep keys and locks of lift well protection cages in a neatly and orderly manner. The locations of the door keys or the person-in-charge for holding such keys shall be registered in a log;

   iv. Be responsible for erection, testing, examination, maintenance and dismantling of winches, chain block systems and other lifting appliances and lifting gears used inside lift well for lift installation work. A competent lift worker or a competent worker who has received training of installation of anchor bolts organised by the anchor bolts provider under the supervision of a competent lift worker shall be employed to install anchor bolts of the lifting appliances;

   v. For anchorages which are installed by the Sub-contractor for any use, appoint a registered professional engineer to check the design and method statement for the construction and to certify the load bearing capacity and the fixing details of the anchorages. Anchorage near the lift well openings at the lowest landing floor will be provided by the Main Contractor for use by worker to lock fall arrestor and safety harness when required to access lift pit. Anchorage near the lift well openings at other landing floors will be provided by the Main Contractor if necessary for use by worker to lock fall arrestor and safety harness when working near or in the lift well;

   vi. Provide a switch lock on the inspection / operation switch at the lift car top or similar device for workers working on lift car top of an assembled lift during the lift installation work. Engage a registered lift engineer to examine the assembled lift before it is used to carry lift workers inside its lift car or on its car top for the first time. The examination shall be properly documented in an examination form similar to Annex G of Volume 2 of CIC Guidelines;

vii. Ensure adequate illumination by 110V temporary lighting connected to an isolated transformer having the centre tap of the secondary winding earthed, ventilation and effective communication systems are provided inside the lift well during the whole lift installation period;

viii. Effectively earth all electric appliances including portable electric tools, lighting devices and mechanical ventilation equipment used unless it is an approved type that does not require earthing. Lighting devices shall be properly protected against impact damage;

ix. Install safety nets inside lift well against falling objects. The catching nets shall be made of fire retardant material with net eyes not more than 20 mm x 20 mm. String diameter of the catching net shall be adequately sized or selected for the intended impact load of falling objects as advised by registered safety officer employed by the Sub-contractor. The nets shall be installed at not more than 20 m intervals throughout lift well and fixed with adequate fire retardant strings or other means with sufficient strength on the scaffoldings or other fixed secured means / anchorage as advised by registered safety officer employed by the Sub-contractor. Gaps between the nets and the lift well walls shall be fully protected against falling objects. The Sub-contractor shall inspect the safety nets and the provisions against falling objects on daily basis to ensure safety and proper functioning of the nets, including clearance of debris trapped by the nets and repairing any damaged portion of the nets. When guided-suspended working platform is adopted for lift installation, the Sub-contractor shall install a metal cover to protect workers working on the platform against falling objects but the cover and its supports shall not obstruct the operation of the working platform;

x. Allow no lift worker and other trade worker to work simultaneously inside a lift well;

xi. Keep to a minimum the number of workers working within a lift well at the same time to the extent that simultaneous working at different levels is strongly not advisable. If simultaneous working at different levels is practically unavoidable, it shall only be limited to one work activity and prior approval from the CM shall be obtained;

xii. For access to lift pits through cat ladder installed inside the lift well at the wall adjacent to the lift landing, provide a retractable type fall arrestor for use by workers to lock to the anchorage provided by the Main Contractor near the lift well opening at the lowest landing floor. The retractable type fall arrestor shall comply with EN 360:2002 or equivalent, complete with a retractable lanyard of suitable length according to the depth of the lift pits and manufacturer's recommendation. All manufacturer's instructions regarding usage, inspection, maintenance and storage of the equipment shall be followed. Suitable training shall be provided to the workers before they are allowed to use the system;

xiii. Do not allow hot work and electric arc process inside lift well generally. If it is practically unavoidable, provide adequate measure / protection to inhibit fire spread to or between floor compartments through the lift well and openings and within the lift well. Fire retarding sheet shall be used to prevent sparks of hot work or electric arc process from falling onto combustible materials or suspension / safety ropes. At the work spot, suitable protective screen of fire retardant nature, such as tarpaulin, shall be used. If tarpaulin is being used as protective screen, its fire retardant characteristics shall meet the requirements of BS 5867-2:2008 (Type B performance requirements) or other equivalent standards;

xiv. Do not allow hot or electric arc cutting of guide rail sections on Site generally. If it is practically unavoidable, obtain the CM's prior approval. Provide adequate measure / protection to prevent spread of sparks. At the work spot, suitable protective screen of fire retardant nature, such as tarpaulin, shall be used. If tarpaulin is being used as protective screen, its fire retardant characteristics shall meet the requirements of BS 5867-2:2008 (Type B performance requirements) or other equivalent standards.

b. Risk Assessment and Method Statement:

i. Conduct risk assessment for hazards relevant to lift installation works such as falling objects, fall-from-height, collapse of platform / supporting structures for lifting appliances, defective lifting appliance and lifting gear, improper rigging, absence of lighting and ventilation, electrocution, fire etc.. With reference to each operation involved in the lift installation process, the assessment shall recommend safety precautions and state the person responsible to execute the safety measures;

ii. Develop the risk assessment report similar to Annex C of Volume 2 of CIC Guidelines;

iii. Prepare method statement for each lift installation process, taking into consideration of all safety measures from the risk assessment report.

c. Implementation of Permit-to-work System:

i. Endorse together with the Main Contractor permits of the permit-to-work system for hazardous trade processes for lift installation work;

ii. Hazardous trade processes for lift installation work shall include but not limited to the following:

- Working in a lift pit;
- Hot work or electric arc process conducted inside or near a lift well;
- Working on the car top of an assembled lift car;
- Setting templates and plumb lines;
- Installing guide rail brackets and guide rails;
- Electrical equipment, wiring and trunking installation in lift well;
- Installing architraves, landing sills, landing doors and accessories;
- Installing lift traction machine and control panel;
- Installing counterweight assembly;
- Installing car cage assembly;

- Adjustment, testing and commissioning at lift well.

iii. Each permit of the permit-to-work system shall specify details of its length of validity in terms of shift and the type of trade workers who are required to work inside the lift well;

iv. The permit of permit-to-work system shall be similar to the sample form at Annex C of Volume 1 of CIC Guidelines.

d. Provision of Effective Communication System and Personal Protective Equipment:

i. Provide adequate and effective communication means / equipment, such as walkie-talkie, layout plan showing the designated work area for different work groups, etc., for use by the working personnel during the lift installation work. Key words / signals shall be specified for clarity of use during communication. Mobile phones shall not be considered an effective communication for workers working inside a lift well;

ii. Do not allow lift workers to work alone inside a lift well generally. If it is practically unavoidable, provide sufficient communication / warning devices such as motion sensor to generate alarm in addition to walkie-talkie for the worker to communicate with a nearby co-worker;

iii. Inform the Main Contractor of the required position of independent lifelines inside lift well to be installed and fixed by the Main Contractor. At least 3 sets of independent lifelines anchored to eyebolts will be installed by the Main Contractor inside a lift well before handing over to the Sub-contractor;

iv. Provide workers with suitable safety harnesses and fall arrestors when they are required to work inside a lift well.

For Electrical Installation:

In addition to any obligation under relevant clauses of the General Conditions of Contract and Special Conditions of Sub-contract or similar obligations under any enactment or Regulation, the Sub-contractor shall adopt the practices and / or measures in the latest edition of the Code of Practice for the Electricity (Wiring) Regulations in respect of electrical works and as stated in this sub-clause (8).

e. Temporary Provision of Residual Current Operated Circuit Breakers (RCCBs) for Lighting Circuits:

i. Provide a temporary RCCB at the main incoming supply of each Miniature Circuit Breaker (MCB) distribution board connected with lighting circuits during construction stage;

ii. The RCCB shall have a rated residual operating current not exceeding 30mA and comply with requirement as stipulated in ELE3.6;

iii. The RCCBs shall be properly housed within an enclosure;

iv. Adequate cable length should be allowed to re-instate to permanent connection to the MCB board after the removal of temporary RCCBs. Trunking and conduit provision should also be installed in such a way to allow easy dismantle and re-instatement after the removal of temporary RCCB enclosures;

v. The temporary RCCBs and associated accessories shall be dismantled and removed at a time just prior to the final testing and handover of electrical installation;

vi. The temporary RCCB can be re-used from previous project subject to the RCCB shall be properly functional and fully comply with the requirement as stated in paragraph (ii) above.

For Escalator Installation:

In addition to any obligation under relevant clauses of the General Conditions of Sub-contract and Special Conditions of Sub-contract or similar obligations under any enactment or Regulation, the Sub-contractor shall adopt the practices and / or measures in respect of escalator works in the latest edition of the Code of Practice for Safety at Work (Lift and Escalator) issued by the Labour Department. In addition, the Sub-contractor shall carry out the trade-specific precautionary site safety measures including but not limited to the following:

f. Provision and Maintenance of Temporary Work, Services and Protective Measures:

i. Keep proper inspection records for safety provisions;

ii. Be responsible for erection, testing, examination, maintenance and dismantling of winches, chain block systems and other lifting appliances and lifting gears used for escalator installation work. A competent escalator worker or a competent worker who has received training of installation of anchor bolts organised by the anchor bolts provider under the supervision of a competent escalator worker shall be employed to install anchor bolts for the lifting appliances;

iii. For anchorages which are installed by the Sub-contractor for any use, appoint a registered professional engineer to check the design and method statement for the construction and to certify the load bearing capacity and the fixing details of the anchorages;

iv. Test all emergency stop switches, overspeed and other protection devices before the first run of escalator;

v. Provide a lock and a tag on the main switch of the escalator so that the escalator can be turned off, locked and tagged by the person-in-charge to set the escalator into stationary condition for workers to work on the escalator.

9. Where a Safety Supervisor shall have to be designated by the Sub-contractor by reason of the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, the personnel of the Sub-contractor so designated shall, in addition to those duties as imposed by the said Regulations, have to perform the additional safety functions of liaising with the Safety Officers and Safety Supervisors of the Main Contractor and attending the Site Safety Committee Meetings chaired by the Main Contractor, on all site safety matters;

10. Where there is no requirement for a Safety Supervisor to be designated by the Sub-contractor, the said additional safety functions will have to be performed by the Site Supervisor;

11. The Sub-contractor is to designate one of his personnel on Site as the Safety Supervisor within the meaning of the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, notwithstanding that there might not be such a requirement imposed on the Sub-contractor by the said Regulations on the basis of the total number of persons employed by the Sub-contractor on the Site;

12. Further to those duties as imposed on a Safety Supervisor by the said Regulations, the Safety Supervisor employed by the Sub-contractor shall from time to time liaise with the Safety Officers and Safety Supervisors of the Main Contractor and attend the Site Safety Committee Meetings chaired by the Main Contractor, on all site safety matters;

13. Safety Awareness

    Subject to the consent of the Main Contractor as may be required, the Sub-contractor is encouraged to participate in the following designated safety campaigns:

    a. Construction Safety Promotional Campaign organised by the OSHC;

    b. Occupational Health Award organised by the OSHC;

    c. Hong Kong Occupational Safety and Health Award organised by OSHC;

    d. Construction Industry Safety Award Scheme organised by the LD;

    e. Considerate Contractors Site Award Scheme organised by the Development Bureau with the CIC.

14. During the construction stage (including testing and commissioning) or Maintenance Period with works to be carried out in the vicinity of work areas where required to ensure safe working condition, the Sub-contractor should coordinate with the responsible person of the respective electrical installation for isolation of electrical supply for equipment and / or energised electrical installation. During the construction stage, the Sub-contractor shall also strictly follow the same requirements for Maintenance Period as stipulated in PRE.BS1.435.

PRE.BS1.605.9 CARING OF NEW WORKERS

Provide caring programme for new workers making reference to the practices recommended by the Guidelines on The Implementation of “P” and “N” Caring Programme issued by CIC, including but not limited to the following:

1. Probationers (workers who newly join the construction industry or with relevant job experience of less than 6 months):

    a. Provide identification with "P" labels;

    b. Assign mentors (with a ratio of 1 mentor to not more than 4 probationers) who possess good experience on the Site to take care of the Probationers and provide guidance on site safety with a caring period not less than 3 months;

    c. Provide a safety orientation programme covering the essential safety aspects related to the Site, guidance for work and arrangement for familiarization of the Site;

    d. Subject to the mentor being satisfied with the Probationer's safety performance, remove identification label from safety helmet after the 3 months' caring period.

2. Newcomers (workers with relevant job experience of more than 6 months but newly arrive at the Site):

    a. Provide identification with "N" labels;

    b. The display of "N" labels shall not be less than 2 weeks;

    c. Provide a safety orientation programme covering the essential safety aspects related to the Site, guidance for work and arrangement for familiarization of the Site.

3. Requirements of labels for Probationers and Newcomers:

    a. Each label shall be adhered on a conspicuous part of a safety helmet;

    b. The size of label shall not be less than 50 mm (L) x 50 mm (H);

    c. The name and telephone number of the mentor shall be shown on the label;

    d. The date on which the worker joined the Site shall be shown on the label.

PRE.BS1.610.9 ENVIRONMENTAL MANAGEMENT PLAN

1. The Sub-contractor shall within 14 days from the date of the Letter of Acceptance prepare and submit to the Main Contractor with a copy to the CM the environmental management, waste management and site hygiene statements in respect of the Sub-contract Works. The Sub-contractor shall coordinate with the Main Contractor and compile and submit the necessary subsequent updating of the environmental management, waste management and site hygiene statements to suit the site progress, as determined by the Main Contractor, or the CM, so that it is at all times a comprehensive and contemporary statement of the Sub-contractor's policies, procedures and requirements for the implementation and fulfilment of the Sub-contractor's obligations as to environmental management, waste management and site hygiene in the Sub-contract Works. The Main Contractor shall have liberty to amend or modify the Sub-contractor's environmental management, waste management and site hygiene statements in respect of the Sub-contract Works as necessary in his preparation of the Environmental Management Plan including any subsequent revision or update thereto;
2. The environmental management, waste management and site hygiene statements in respect of the Sub-contract Works and its subsequent updates shall contain, but not be limited to the following items:
    a. General environmental management of the Sub-contract:
        i. A signed environmental and site hygiene policy statement committing the Sub-contractor to environmental protection for the project;
        ii. A Sub-contractor's staff organisation chart with duties, responsibilities and accountability defined together with the name and position of the person to oversee the discharge of Sub-contractor's duties under the environmental management, waste management and site hygiene statements in respect of the Sub-contract Works. Such person shall work full time on Site and be designated to coordinate with the Main Contractor in this respect;
        iii. Staff awareness and training proposals for Sub-contractor's staff with auditable records of trained persons;
        iv. Environmental impacts, targets and mitigation objectives to minimize impacts;
        v. Records containing relevant licences, permits, complaint and record of corrective actions where non-compliance has been identified;
        vi. List of environmental and site hygiene regulations and description of methodology to ensure compliance.
    b. Input to the Main Contractor's waste management plan:
        i. An analysis of construction waste likely to be generated from Sub-contractor's work processes with types and quantity of each waste material identified to be salvaged and reused or recycled;
        ii. A statement of measures taken to reduce, salvage, reuse and recycle waste material;
        iii. A description of the methods of sorting, segregation, labelling, storing, protecting and disposing of all the various types of waste materials generated;
        iv. A method statement of how debris could be minimized;

v. Control measures to ensure that the sorted recyclable materials such as metal, paper, plastics, etc. are delivered to the designated sorting and storage areas on site for disposal by the Main Contractor for recycling process;

vi. For materials delivered to site, a statement that reusable and recyclable packaging materials and pallets will be reused, recycled or returned to the supplier. Identify those suppliers who will not accept the return of pallets and reusable and recyclable packaging materials.

c. Air quality (if applicable):

i. Measures and methods to control dust and debris on and off site. If dust extraction and filtering device is used for dust control, clear the dust collector when it is full;

ii. Method of monitoring and report on air quality conditions on site.

d. Noise control (if applicable):

i. Type of noise reduction equipment to be used and their applications;

ii. Details of noise restrictions as they affect the Sub-contract;

iii. Description of noise mitigation measures.

e. Water pollution control and conservation (if applicable):

i. Measures to conserve water and record on water consumption;

ii. Methods of minimising water consumption;

iii. Methods to avoid contamination and blockage of public drains and sewers and comply with the Water Pollution Control Ordinance;

iv. Method to prevent flooding and blocking of site drainage system;

v. List and describe necessary permits, approvals to be obtained and complied with;

vi. Details of necessary drainage diversions and temporary drainage systems.

f. Site cleanliness, tidiness and hygiene:

Description of proposed measures to maintain cleanliness and tidiness of the site including details of means to protect materials, locations of stockpiles and on-site sorting and disposal areas.

g. Emergency procedures:

Emergency procedures formulated to deal with any environmental emergency such as typhoons or rainstorms.

3. The Sub-contractor shall re-submit the environmental management, waste management and site hygiene statements in respect of the Sub-contract Works within 14 days from the date of receiving comments on the submitted environmental management, waste management and site hygiene statements in respect of the Sub-contract Works from the CM.

PRE.BS1.620.9 ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE AND REPORTING

The Sub-contractor shall, throughout the duration of the Sub-contract:

1. Carry out to the satisfaction of the Contract Manager, all environmental protection / management and site hygiene measures as described in the EMP;

2. Carry out environmental inspections to review, monitor and report monthly to the Contract Manager (or when directed by the Contract Manager), via the Main Contractor, on the effectiveness of the implementation of the EMP;
3. Report monthly to the Contract Manager via the Main Contractor for the following attributable to him from Environmental Protection Department (EPD) or Food and Environmental Hygiene Department (FEHD):
   a. Warning letters or offences notifications;
   b. Convictions during the period under any environmental and site hygiene regulations or legislation; and
   c. Abatement Notice.
4. Take all necessary follow-up actions in collaboration with the Main Contractor to ensure that any defects or deficiencies are made good; and
5. Attend monthly Environmental and Site Hygiene Management Meetings or when directed by the Contract Manager.

PRE.BS1.630.9 MEASURING INSTRUMENTS FOR CONTRACT MANAGER

1. Provide for the sole use of the CM and the CM's representatives (CMRs) a set of measuring instruments as given in the schedule below at the time specified in the schedule;
2. This set of measuring instruments will primarily be used for the BSPASS. The Sub-contractor may be responsible for the operation of the measuring instrument(s) and the testing, etc. as required by the assessment;
3. In addition to sub-clause (2) above, this set of measuring instruments will also be used for any purposes by the CM, CMRs or their delegated personnel in connection with this Contract or otherwise;
4. The set of measuring instruments shall be reverted to the Sub-contractor three months after the issue of the certificate for completion of the last Section of the Main Works;
5. The instruments shall be in good condition, suitable for the intended purpose under the operation range and conditions of the installations. The instruments shall be of age not more than 3 years, freshly calibrated and with valid calibration certificates (of near one year validity from the date of provision);
6. Maintain and calibrate the instruments against the appropriate national and international standards at the intervals as specified below;
7. Provide Calibration Certificates (issued by independent accredited laboratories) as listed in the schedule below so as to satisfy the instrument calibration requirements of the ISO 9001;
8. Attach to each instrument an indelible Identification Label and an indelible Calibration Status Label;
9. Arrange to repair any of the instrument(s) at the Sub-contractor's own cost for normal wear and tear, and as required by the CM;
10. Provide an equivalent substitute for any measuring instrument(s) when the instrument(s) is/are not available, or out of service for maintenance, calibration or repair;
11. The schedule for measuring instruments is as follows:

Description	Time of Provision	Calibration Certificate	Calibration Interval
a. No. Insulation Resistance Tester	One year before the date for completion of the earliest Section as specified in the Main Contract	Required	1 year
b. 1 No. Earth-fault Loop Impedance Tester		Required	1 year
c. 1 No. RCCB Tester.		Required	1 year
d. 1 No. Digital Multimeter		Required	1 year
e. 1 No. Steel Measuring Tape, 3 m long.	Six weeks from the notified date for commencement of the Main Works	Required if the measuring tape is not brand new	-
f. 1 No. Vernier Calliper		Required if the vernier calliper is not brand new	-

12. The schedule for measuring instruments is as follows:

Description	Time of Provision	Calibration Certificate	Calibration Interval
a. Pressure Gauges Provide adequate pairs of pressure gauges for the fire services and water pump system(s). Each pair of gauges shall be suitable for the system pressure of the system where the pressure gauges are put to measure, be calibrated in kPa to a maximum of not less than 1-1/3 times and not more than 2 times the operating pressure.	Six months before the date for completion of the earliest Section as specified in the Main Contract	Required	1 year
b. 1 No. Dial Gauges for shaft coupling alignment measurement		Required	1 year
c. Magnet stand for item (b) above		-	-
d. 1 No. Steel Measuring Tape, 3 m long.	Six weeks from the notified date for commencement of the Main Works	Required if the measuring tape is not brand new	-
e. 1 No. Vernier Calliper		Required if the vernier calliper is not brand new	-

f. 1 No. Carpenter (Spirit) Level		Required if the carpenter (spirit) level is not brand new	1 year

13. The schedule for measuring instruments is as follows:

Description	Time of Provision	Calibration Certificate	Calibration Interval
a. 1 No. Steel Measuring Tape, 3 m long.	Six weeks from the notified date for commencement of the Main Works	Required if the measuring tape is not brand new	-
b. 1 No. Vernier Calliper		Required if the vernier calliper is not brand new	-
c. 1 No. Carpenter (Spirit) Level	Six weeks from the notified date for commencement of the MainWorks	Required if the carpenter (spirit) level is not brand new	1 year
d. 1No. Taper Ruler/Feeler Gauge		Required if the taper ruler/feeler gauge is not brand new	-

PRE.BS1.700.A PROVISION OF SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF OPERATIVES AND SITE SUPERVISORY STAFF

1. Pursuant to PRE.B8.235 (1) of the Main Contract, the Sub-contractor shall coordinate with the Main Contractor for collection of the safety helmet with Y-type chin strap conforming to the following requirements, for personal protection of their operatives and site supervisory staff and ensure that each of them wears the safety helmet on Site:

   a. Comply with the latest guidance notes on the selection, use and maintenance of safety helmets issued by LD;

   b. With ventilation vents and wears the Y-type chin strap as prerequisite and with sunshade accessories such as brim or neck protector where appropriate;

   c. The Y-type chin strap shall be supplied by the same manufacturer of the safety helmet used and have a clear identification label, the manufacturer name, model number, and a proof that the safety helmet with the chin strap comply with BS EN397 or other international and national standard recognised by Labour Department. If the manufacturer of safety helmet does not produce Y-type chin strap, then the manufacturer of safety helmet shall produce test certificate and test report issued by a BSI / CSA / or an approved third party accredited laboratory for compatible Y-type chin straps to demonstrate compliance with BS EN397;

   d. Replacement cycle shall not be more than 2 years from date of manufacture unless the manufacturers of safety helmet can provide proof such as BSI test certificate and test report to substantiate a longer life span of their helmets.

2. Pursuant to PRE.B8.235 (2) and (3) of the Main Contract, the Sub-contractor shall co-ordinate with the Main Contractor for collection of the clothing and footwear for personal protection of their operatives and site supervisory staff and ensure that each of them wears the clothing and footwear on the Site. Notwithstanding the above, the Sub-contractor may propose his corporate uniform for construction works to replace the items of clothing in PRE.B8.235 (2)(a) to (d) of the Main Contract, subject to the CM's approval;
3. Protection for hands: Ensure, albeit not exhaustive, that an operative wears -
    a. protective cotton gloves to facilitate better grip of objects by absorbing sweat when handling sharp edges and corners;
    b. fire retardant leather gloves during gas welding;
    c. cut-resistant gloves during cutting or handling metal trunkings;
    d. chemical-proof gloves with high mechanical strength when handling chemicals;
    e. plastic gloves when handling corrosives;
    f. heat insulating gloves when handling hot objects;
    g. leather gloves when handling steel reinforcement or sharp objects;
    h. electric insulating gloves when carrying out electrical works and electric welding;
    i. anti-shock gloves when operating vibrating machines;
    j. anti-slip gloves to facilitate better grip of bamboo sticks when dismantling bamboo scaffolds.

PRE.BS1.710.9 CONSTRUCTION INDUSTRY COUNCIL GUIDELINES

1. The Construction Industry Council (CIC) from time to time issues "Guidelines". Such "Guidelines" set out the recommendations on standards and procedures for all relevant industry participants to adopt and to adhere to all times. Industry participants have to prepare for justifying any course of action that deviates from these recommendations;
2. Comply with this Specification and with the relevant guidelines promulgated by the CIC. This Specification shall prevail if there is conflict between the Specification and the CIC requirements.

PRE.BS1.720.B PLATFORMS FOR WORKING AT DIFFERENT HEIGHTS

1. Provide the following equipment for working involving a possible fall of:
    a. 2 meters or more: working platform with guard-rails, toe boards and a fall arresting system as warranted after conducting risk assessment;
    b. Less than 2 meters but more than 900mm:
        i. Light-duty working platform such as hop-up platform or step platform with guard rails, and provide toe boards when the working platform is used near a building edge or floor opening to avoid risk of falling object from height;
        ii. A fall arresting system as warranted after conducting risk assessment for working at a height of 1350mm - 2000mm.
    c. Less than or equal to 900mm: hop-up platform or step platform with or without guard rails;
    d. A height under abnormal circumstances where use of working platform, hop-up platform or step platform is not reasonably practicable: alternative proposal incorporating a fall arresting system after conducting risk assessment.

2. Ensure that the following safety measures are fulfilled:
   a. the right type of light-duty working platform is used for the job;
   b. the workers who use the light-duty working platforms have been provided with adequate information, instruction, training and supervision;
   c. the workers are fully aware of the risks and control measures;
   d. follow a safe system of work (including a pre-use check) so as to use the platform safely;
   e. the workers are not allowed to work on the access steps of a light-duty working platform;
   f. the fall arresting system shall comprise a full body harness with double hook lanyard to allow a user to stay linked to at least a rigid anchor point. The anchor point shall be planned in advance, installed and tested.
3. Guard-rails shall be situated at 450mm - 600mm and 900mm - 1150mm high from the platform and form a barrier to prevent the worker standing on the platform from falling down;
4. Toe boards shall be not less than 200mm high;
5. Locking device shall be provided to movable working platforms to ensure that the platforms are stable when in use;
6. Step ladders, straight ladders and extension ladders are used purely as a means of access and egress to working platforms;
7. Portable ladders provided shall comply with the safety requirements of at least one of the following standards (the latest version):
   a. BS EN131-7 for timber, metal and glass-fibre reinforced plastic ladder;
   b. BS 2037 for metal ladder;
   c. EATS13/1 for glass-fibre reinforced plastic ladder;
   d. BS EN14183 for step platform; or
   e. Other international standards approved by the CM.
8. A safe system of work shall be developed and implemented for using a mobile elevating work platform (MEWP). The planning of the operation shall include but not limit to the selection, provision and use of a suitable MEWP. Refer to "Guidance Notes on Safe Use of Power-operated Elevating Work Platforms" issued by Labour Department on selection;
9. When a risk of contact with an obstacle in the use of MEWP is identified by the risk assessment, the Sub-contractor shall consider the need of smart device as secondary guarding device (SGD) for protecting the operator from the risk of entrapment. The SGD shall be one of the SSSS component following the requirements in PRE.B8.267 (wireless communication technologies). The Sub-contractor shall maintain a register to monitor whether all MEWPs on Site are fitted with SGD and the register shall be included in the monthly safety report. Provide the SGD with the following consideration:
   a. If the SGD is not an integral part of the original MEWP from the manufacturer, then the Main Contractor, who intends to fit SGD as an attachment to existing MEWP shall be liable for the adaptation, addition, modification and safe operation of a MEWP with SGD;

b. The smart device shall be an anti-collision sensor fitted at a MEWP for detecting any obstacles around and above the MEWP. When the distance between any operator or worker on the MEWP and any obstacle around or above the MEWP becomes less than 500mm or other distance as pre-determined by the risk assessment, the device is to trigger a warning siren with a minimum of 70 dB noise level and a flashing red light to alert the operator and workers on the MEWP. When the distance between any operator or worker on the MEWP becomes less than the distance as pre-determined by the risk assessment, which poses an imminent danger, the smart device could automatically carry out a function of stopping the MEWP operation at emergency. All warning signal shall be automatically turned off when the MEWP operator resume the plant operation and address the warning signals. The device shall have a minimum battery life of two working days per charge under continuous operation and a lighting display showing its battery is in normal operation mode. All warning signals and the status of the smart device during operation shall be automatically transmitted to a CMP for record, review and data analysis where the data transmitted shall be digitalised signal in chronological sequence and marked with the time and date and be available for integration by Open Application Programming Interface (API) format. Conduct all necessary maintenance, repair and / or replacement of smart device within 24 hours upon reporting of any device abnormality, malfunction or damage of the smart device;

c. Display warning notices at prominent location of all MEWPs on Site to alert all operators and workers to the potential hazards on using MEWPs such as the hazard of entrapment;

d. The SGD shall only be retracted or collapsed when:

   i. the MEWP is at stationary status;

   ii. the presence of SGD will render works to be carried out not practicable;

   iii. other types of safety precautionary measures are in place to completely eliminate the risk of entrapment of any operator or workers on MEWP;

   iv. the retract and collapse of SGD shall be done under supervision of a Safety Supervisor / Safety Officer.

10. All workers on a MEWP shall have attended the training course provided by the supplier of the MEWP on the use of the respective type of MEWP. When a trained worker is newly employed for operating a MEWP, the Main Contractor shall verify the adequacy of the training and relevant experience of such trained worker for the use of respective type of MEWP. Provide the trained workers with all necessary information, instructions, training and supervision regarding the safety of work at heights. Prepare emergency procedures for accidents / incidents arising from or in connection with the use of MEWP. Assign worker(s) to receive the same training so that there is always a trained worker available on Site during the operation of the respective type of MEWP to operate the control set at ground or chassis level of the MEWP to lower the platform of MEWP in an emergency. Maintain the training record of the workers using MEWP provided by the supplier of MEWP on Site for inspection by the CM.

11. The Sub-contractor shall use the permit-to-work system to conduct checking of implementation of all necessary safety precautionary measures for the use of MEWP. Use of MEWP on Site shall be permitted only after the issue of a permit-to-work certification by the Contractor. These certificates shall be made available for inspection upon request by CM.

12. Arrange gangers who will have workers to work on MEWP and foremen to complete the Mobile Elevating Work Platforms Operator Safety Training provided by the OSHC or equivalent training by other organisations. The gangers or foremen who have received training in the said course shall provide talks to workers who are required to operate MEWP. Maintain the record of talks to the workers using MEWP provided by gangers or foremen on Site for inspection by the CM.

PRE.BS1.730.9 SAFETY OF ELECTRIC PORTABLE TOOLS

1. Ensure the use of cordless electric portable tools by operatives, including: circular saws for cutting wood or metal, reciprocating saws, angle grinders, rotary hammers, combination hammers for drilling, impact drivers and impact wrenches. Prohibit the use of the above tools that are with cords;
2. Inspection records that verify the cordless electric portable tools are in safe and serviceable conditions shall be kept on site for checking by the CM's representatives. Verification record shall be either:
   a. annual certificates issued by the original manufacturer; or
   b. quarterly records certified by Registered Electrical Worker;
3. Centralised charging facilities shall be arranged by the Main Contractor as per PRE.B8.266 to ensure safe use of electricity.

BEAM PLUS ASSESSMENT

PRE.BS1.750.9 BEAM PLUS ASSESSMENT

"BEAM Plus" means the Hong Kong's comprehensive and voluntary environmental assessment scheme to enhance environmental sustainability of buildings. The assessment shall be based on the "Latest BEAM Plus Manual", which, for the purpose of depicting the BEAM Plus requirements under the Sub-contract, is defined as the prevailing edition of "BEAM Plus New Buildings (Version 2.0)" promulgated by the BEAM Society, together with all subsequent amendments, revisions, standards and circular letters in respect of BEAM Plus requirements issued by the BEAM Society. Copies of these documents are available from the BEAM Society. The Sub-contractor shall:

1. Assist the CM to conduct BEAM Plus assessment for the Sub-contract Works according to the Latest BEAM Plus Manual;
2. Assist the CM to satisfy all the target BEAM Plus prerequisites and credits listed in PRE.BS1.760 and PRE.BS1.800 and provide relevant supporting documents;
3. Carry out site measurements, consolidate the design criteria provided by the CM as appropriate and prepare the reports as detailed in PRE.BS1.760 and PRE.BS1.800 for the CM's submission to BEAM Assessor;
4. Assist the CM to provide substantiation for the enquiries raised by BEAM Assessor in relation to the Sub-contractor's submissions for BEAM Plus as detailed in PRE.BS1.760 and PRE.BS1.800;
5. Assign a BEAM Liaison Officer (BLO) who is familiar with BEAM Plus assessment to liaise, coordinate and perform all relevant works of BEAM Plus assessment as detailed in PRE.BS1.760 to PRE.BS1.800. Such person can be the Commissioning Agent (Cx Agent) specified in PRE.BS1.800;
6. Take note of the requirements for the Main Works for BEAM Plus Assessment as detailed in Appendix Q;

7. Coordinate with and provide necessary information to the BEAM Plus consultant who is appointed by the Employer for monitoring the implementation of BEAM Plus credits and prerequisites;
8. Attend site inspection with the BEAM Assessor and provide necessary facilities, access and assistance to the BEAM Assessor for BEAM Plus assessment.

PRE.BS1.760.B BEAM PLUS PREREQUISITES AND CREDITS

The target BEAM Plus prerequisites and credits relevant to the Sub-contract Works are as follows:

1. Carry out the following works:
    a. Environmental Management Plan (BEAM Plus credit IDCM P2 refers)
        i. Implement necessary environmental mitigation measures during construction as specified in the Environmental Management Plan in PRE.BS1.610 to PRE.BS1.620;
    b. Commissioning Review Report (BEAM Plus credit IDCM 5c refers)
        i. Provide the documentation as detailed in PRE.BS1.800 and BEAM Plus New Buildings (Version 2.0) manual prior to construction;
    c. Commissioning Report (BEAM Plus credit IDCM 5d refers)
        i. Carry out testing and commissioning work and provide the documentation as detailed in PRE.BS1.800 and BEAM Plus New Buildings (Version 2.0) manual.
    d. Building Management Manuals (BEAM Plus credit IDCM 11 refers)
        i. Prepare and submit documentation, O&M Manual and Energy Management Manual as detailed in PRE.BS1.800 and BEAM Plus New Buildings (Version 2.0) manual.
    e. Operator Training plus Chemical Storage and Mixing Room (BEAM Plus credit IDCM 12 refers)
        i. Provide training for operation and maintenance staff within 6 months after obtaining the OP in accordance with BEAM Plus requirement;
        ii. Provide supporting documents including training programme and record to verify that training of the operation and maintenance staff was undertaken for all commissioned systems and major equipment, using the operations and maintenance (O&M) manual, and the energy management manual (EMM) as the basis for the training;
        iii. Provide water supply points, exhaust ventilation to the designated chemical storage and / or chemical-mixing facilities to maintain negative pressure and provide related catalogue and supporting documents with ventilation calculation as specified in BEAM Plus New Buildings (Version 2.0) manual.
    f. Light Pollution Control - Control of obtrusive artificial light (BEAM Plus credit SS 6a refers)
        i. Prepare and submit report using recognised software to demonstrate that the exterior lighting would not create unwanted and unnecessary light pollution for the environmental zone in which the Site is located;
        ii. Provide product catalogues and other supporting documents to demonstrate compliance as specified in BEAM Plus New Buildings (Version 2.0) manual.

g. Metering and Monitoring (BEAM Plus credit EU 4 refers)

   i. Install energy monitoring system for the equipment and system in common areas as specified in BEAM Plus New Buildings (Version 2.0) manual;

   ii. Electricity metering shall comply with BS EN 62053-11:2003 accuracy class 1 or equivalent;

   iii. Provide data storage device / provision to enable all data recorded by the sub-metering system and monitoring system can be collected monthly and be kept for at least 36 months;

   iv. Prepare and submit documentation, such as schematic drawings, testing and commissioning records and operation manuals for the metering system.

h. On-site Renewable Energy Application (BEAM Plus credit EU 5b refers)

   i. Provide as-built drawings of on-site renewable energy systems, installation details and control diagram;

   ii. Provide supporting documents including calculations, catalogue, performance data sheet, testing and commissioning report of on-site renewable energy system, and any other necessary information in case requested by BEAM Society.

i. Indoor Vibration (BEAM Plus credit HWB 7 refers)

   i. Provide deflection spring isolators, for all water pumps in Potable Pump Room and Flushing Pump Room;

   ii. All jockey pumps shall be isolated from structure by floating plinth;

   iii. Lift motor shall be equipped with appropriate lift isolation pad and isolated from structure by floating plinth;

   iv. Provide product catalogues and other supporting documents to demonstrate compliance as specified in BEAM Plus New Buildings (Version 2.0) manual.

j. Air Quality in Car Park (BEAM Plus credit HWB 8b refers)

   i. For mechanical ventilated carpark, submit report including design criteria, pollutants calculation, CO sensor control logic design etc. to show the provision of the ventilation system and CO sensor automatic control comply with ProPECC 2/96 and other requirement as specified in BEAM Plus New Buildings (Version 2.0) manual;

   ii. Carry out site measurement during carpark operation and submit report to show the actual air quality of the car park comply with ProPECC PN 2/96.

k. Biological Contamination (BEAM Plus credit HWB 12 refers)

   i. Demonstrate compliance with the corresponding sections of the Code of Practice for Prevention of Legionnaires' Disease 2016 / 2021 Edition, if relevant systems are present, e.g. Cold Water Supply Systems (Section 4.5.1), Air Handling Unit / Fan Coil Unit (Section 4.3.1) and Cooling Tower (Section 4.2.1).

l. Minimum Ventilation Performance – Minimum Ventilation (BEAM Plus credit HWB P1b refers) and Enhanced Ventilation – Fresh air (BEAM Plus credit HWB 4a refers)

i. For normally occupied spaces with mechanical ventilation, submit report to demonstrate compliance that the minimum ventilation rate stipulated in ASHRAE Standard 62.1-2022 is exceeded by at least 30%;

ii. For not normally occupied spaces with mechanical ventilation, submit report to demonstrate compliance with the minimum ventilation rate stipulated in ASHRAE Standard 62.1-2022;

iii. For bare shell spaces, submit reports to demonstrate that fresh air louvre(s) sizing and numbers conform to ASHRAE Handbook-Fundamentals;

iv. Provide catalogues, T&C records and other supporting documents to demonstrate compliance as specified in BEAM Plus New Buildings (Version 2.0) manual.

m. Enhanced Ventilation – Exhaust Air (BEAM Plus credit HWB 4b refers)

i. Install local exhaust where concentrated pollutant sources are likely to be present, and submit summary report to demonstrate compliance with the requirement stipulated in ASHRAE Standard 62.1 – 2022, CIBSE Guide B 2016;

ii. Provide catalogues, calculations, drawings, T&C records and other supporting documents to demonstrate compliance as specified in BEAM Plus New Buildings (Version 2.0) manual.

n. Artificial Lighting - Artificial lighting in not normally occupied spaces and unoccupied spaces (BEAM Plus credit HWB 10b refers)

i. Prepare and submit report to demonstrate either by measurement and / or by using recognized lighting simulation software on compliance with the design criteria of the followings as specified in BEAM Plus New Buildings (Version 2.0) manual:

- Prescribed lighting performance in respect of maintained illuminance and illuminance variation;
- Within the unified glare rating limit;
- Minimum illuminance uniformity;
- Light sources have an appropriate colour rendering index.

ii. Provide lighting catalogues, T&C records, simulation settings and other supporting documents to demonstrate compliance as specified in BEAM Plus New Buildings (Version 2.0) manual.

2. Comply with the following requirements for the supply and use of materials / equipment for the Sub-contract Works. Provide supporting documents that the requirements are complied with:

a. Pedestrian Oriented and Low Carbon Transport - Charging facilities for Electric Vehicle (EV) (BEAM Plus credit SS1d refers)

i. Demonstrate that 50% of all parking spaces have been installed with EV medium charges and all parking spaces (including visitor parking spaces) have been installed with EV charging - enabling facilities;

ii. The facilities provide 1 phase 32A current (7kW power output) or above for medium charging of EV;

iii. Medium chargers with European IEC standard sockets / connectors shall be provided for all visitor carparks;

iv. Provide descriptions with illustrations, schematic drawings and photos of the EV charging-enabling facilities for ALL the car parking spaces with reference to the requirement in Technical Guidelines for EV charging-enabling for Car parks of New Building Developments issued by Environment and Ecology Bureau;

v. Provide supporting document of EV facilities as specified in BEAM Plus New Buildings (Version 2.0) manual.

b. Noise from Building Equipment (BEAM Plus credit SS 5 refers)

i. Use equipment (e.g. pump, fan, motor, generator, air conditioning unit) with acceptable noise level such that the level of the intruding noise caused by the equipment at 1 m from the façade of the potential noise sensitive receivers is at least 5dB(A) below the appropriate Acceptance Noise Level (ANL) shown in Table 2 of the Technical Memorandum for the Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites issued by EPD or, in the case of the background being 5 dB(A) lower than the ANL, shall not be higher than the background, in accordance with paragraph 4.2.13, Chapter 9 of the Hong Kong Planning Standards and Guidelines;

ii. Prepare and submit report in the form of calculation and / or measurements and analysis to show the actual level of intruding noise at the façade of the existing and planned future noise sensitive receivers as specified in BEAM Plus New Buildings (Version 2.0) manual.

c. Ozone Depleting Substances – Refrigerant (BEAM Plus credit MW 7a refers)

i. Use refrigerants with a value less than or equal to the threshold of the combined contribution to ozone depletion and global warming potentials as specified in BEAM Plus New Buildings (Version 2.0) manual;

ii. Provide supporting documents including catalogue and test reports of refrigerants used in air conditioning and refrigeration equipment etc..

3. Provide the following supporting documents

a. Minimum Energy Performance (BEAM Plus credit EU P1 refers)

i. Select equipment that achieved the following performance improvement compare to the latest edition of Code of Practice for Energy Efficiency of Building Services Installation (BEC):

- Improve 2% of code specified minimum coefficient of performance (COP) for air-conditioning equipment unit and / or minimum cooling seasonal performance factor (CSPF) for room air-conditioner;

- Reduce 3% of code specified maximum allowable lighting power density for lighting installation.

ii. Provide necessary information and document including equipment catalogues, data sheets, calculation and commissioning records, etc., which are required to be quoted in the submissions under the Building Energy Efficiency Ordinance, for BEAM Plus submission.

b. Reduction of CO2 Emissions (BEAM Plus credit EU 2 refers)

i. Select equipment that can fulfil EU 2 requirement by prescriptive approach of compliance;

ii. For prescriptive approach, the selected equipment shall achieve the following performance improvement compare to the applicable edition of BEC:

- Improve 6% of code specified minimum coefficient of performance (COP) for air-conditioning equipment unit;
- Reduce 10% of code specified maximum allowable lighting power density for lighting installation;
- Reduce 5% of code specified maximum allowable electrical power consumed by lift and escalator installation.

c. Peak Electricity Demand Reduction (BEAM Plus credit EU 3 refers)

i. Provide necessary information and document such as catalogue to substantiate the actual peak energy consumption of the equipment.

PRE.BS1.770.9 FILING SYSTEM FOR BEAM PLUS ASSESSMENT

1. Establish and maintain organized filing system to facilitate BEAM Plus assessment for BEAM Plus prerequisites and credits;
2. The filing system shall include supporting documents to justify satisfactory compliance with the BEAM Plus prerequisites and credit requirements.

PRE.BS1.780.9 MONTHLY BEAM PLUS MONITORING REPORT

1. Submit monthly BEAM Plus Monitoring Report to the Main Contractor before end of each month for their consolidation and submission to CM and BEAM Plus consultant for review;
2. The format and framework of the BEAM Plus Monitoring Report shall follow the one prepared by the Main Contractor as far as practicable;
3. The BEAM Plus Monitoring Report shall cover all BEAM Plus credits and prerequisites in PRE.BS1.760 and PRE.BS1.800 and report the progress of tasks and anticipated commencement dates and completion dates of the task.

PRE.BS1.790.9 BEAM PLUS COORDINATION MEETING

1. Attend regular BEAM Plus Coordination Meeting arranged by BEAM Plus consultant to report, discuss, resolve and record BEAM Plus related issues;
2. The BLO shall be present in the monthly BEAM Plus Coordination Meeting;
3. Provide additional supporting information as requested by CM or BEAM Plus consultant to demonstrate the requirements of BEAM Plus credits and prerequisites have been met.

PRE.BS1.800.9 BEAM PLUS REQUIREMENTS ON TESTING, COMMISSIONING, OPERATION AND MAINTENANCE

1. Definitions

a. Commissioning Authority

Commissioning Authority (CxA) shall be the HKHA's officers duly appointed by the Employer or his representative;

b. Commissioning Team

Commissioning Team (Cx Team) shall be the team comprising of Employer or his representative, Project Architect, Project Building Services Engineer, Project Building Services Inspector, the Contractor, Sub-contractor or his Cx Agent, sub-contractors of other trade and equipment suppliers and be responsible for the testing and commissioning (T&C) of the project works including the Sub-contract Works;

c. Commissioning Agent

i. Commissioning Agent (Cx Agent) shall be the Supervising Engineer or Site Supervisor or other project staff at Site Supervisor level or above nominated by the Sub-contractor and approved by the CM to perform all T&C tasks of the Sub-contract Works and fulfil the duties of "Commissioning Agent" as stipulated in the BEAM Plus;

ii. The Cx Agent shall have basic understanding of the T&C requirements of BEAM Plus. In general, the Cx Agent shall perform the following duties:

- Join the Cx Team and attend the Cx Team's meeting;
- Support and coordinate with other members of the Cx Team to perform the T&C works and achieve the BEAM Plus credits;
- Incorporate activities of commissioning process in the Sub-contractor's installation programme;
- Provide all necessary submittals as required for the BEAM Plus accreditation;
- Provide information and documentation to facilitate the commissioning process;
- Prepare and submit method statements for pre-functional tests and functional performance tests to the CM for review and his submission to the CxA for approval;
- Develop the checklists for pre-functional tests and functional performance tests;
- Notify the CM when systems and equipment are ready for testing;
- Complete the pre-functional checklists as the work progresses and submit the completed checklists to the CM for review and his submission to the CxA for information;
- Coordinate and carry out local and overseas factory tests as stipulated in the Specification;
- Carry out start-up and field inspection for equipment and systems on-site as stipulated in the Specification;
- Conduct the commissioning tasks and tests as specified;
- Demonstrate the performance of equipment and / or operation of the systems as stipulated in the Specification to the Cx Team and CxA for verification purpose;
- Provide training and implement the training program as detailed in the Specification;
- Prepare the comprehensive Operation and Maintenance (O&M) Manual and Energy Management Manual.

d. Commissioning Management Plan (CxM Plan)

Commissioning Management Plan (CxM Plan) is a plan developed by the CxA and lists out all systems and equipment to be commissioned, all commissioning tasks, all functional performance tests to be performed, all related reference documents and all responsible parties involved in the commissioning process. The CxM Plan is attached in Appendix Z for information.

2. General

a. The Sub-contractor shall provide all necessary information including T&C specifications and reports, operation and maintenance manuals, and details of noise and vibration sources from various building services systems / components and noise and vibration attenuation provisions, etc. to the CM for the purpose of BEAM Plus assessment;

b. The Sub-contractor and his Cx Agent shall carry out the T&C works in accordance with the requirements stipulated in this clause and the requirements stipulated in other parts of the Sub-contract documents;

c. The Sub-contractor and his Cx Agent shall carry out the T&C works meeting all the requirements of target credits as stipulated in IDCM 5 of the BEAM Plus and provide necessary supporting documents including but not limited to those stipulated in this clause and the Specification in order to achieve the BEAM Plus accreditation;

d. Documents relating to T&C works shall be submitted by the Cx Agent to the CM's Representative (CMR) for review and his submission to the CxA for approval;

e. The Cx Agent shall document and provide substantiation information as required by the BEAM Plus and the CMR to facilitate the BEAM Plus final submission;

f. The Cx Agent shall timely collect, prepare and consolidate all the reports and documents used for the BEAM Plus final submission for CMR's review and his submission to CxA for approval. The reports and documents referred herein shall include but not limited to the following:

i. Commissioning report (IDCM 5d of the BEAM Plus refers).

g. Should there be any discrepancies between the BEAM Plus requirements and the T&C requirements stipulated in this clause and other parts of the Sub-contract documents, the Sub-contractor or his Cx Agent shall in the first instance report the discrepancies to the CM and seek the CM's direction.

3. Responsibility of All Parties Involving in Commissioning Process

Responsibilities of CxA in sub-clause (1)(a) above and members of Cx Team in sub-clause (1)(b) above are detailed in the CxM Plan;

4. Commissioning of Systems and Equipment for BEAM Plus Submission

The Sub-contractor shall commission all the energy related building services systems in accordance with the BEAM Plus requirements. For the purpose of achieving the BEAM Plus accreditation, the Sub-contractor shall timely complete the T&C works of the following systems and components to meet the BEAM Plus submission schedule. The T&C works for other systems, equipment and components of the Sub-contract Works shall be carried out according to the requirements as stipulated in other parts of the Sub-contract documents as appropriate.

a. Lighting systems and components include but not limited to:

i. Lighting fixtures and control devices;

ii. Daylight control and sensing devices.

b. ACMV systems and components include but not limited to:
   i. Ventilation fans (both supply and exhaust);
   ii. Ducts and associated dampers;
   iii. Unitary and split-air conditioners;
   iv. Piping and associated valves.

c. Renewable energy systems and components include but not limited to:
   i. PV panel;
   ii. Wind turbines;
   iii. Batteries, inverters, capacitor and associated electrical components and wirings;
   iv. Sensors and actuators;
   v. Control panel; etc..

d. Water supply and conservation systems include but not limited to:
   i. Pumps;
   ii. Variable frequency drives;
   iii. Piping and associated valves;
   iv. Sensors and actuators;
   v. Control Panels;
   vi. Rainwater harvest system;
   vii. Greywater harvest system;
   viii. Other water treatment plant; etc..

e. ACMV systems and components include but not limited to:
   i. Chillers;
   ii. Cooling Towers;
   iii. Control for ACMV systems, including central plant, energy management system (EMS) and building automation system (BAS), if applicable;
   iv. Unitary and split-air conditioners;
   v. Ventilation fans (both supply and exhaust);
   vi. Chilled water pumps and condensing water pumps;
   vii. Variable frequency drives;
   viii. Heat exchangers;
   ix. Boilers;
   x. Domestic hot water and hot water heaters;
   xi. Ducts and associated dampers;
   xii. Piping and associated valves;
   xiii. Waste heat recovery, thermal storage, etc..

f. Renewable energy systems and components include but not limited to:

i. Solar hot water system;

ii. Pumps;

iii. Control panel etc..

g. Energy conservation systems and components include but not limited to:

i. Demand control ventilation system using sensors (e.g. NO2/ CO2/ CO sensors), etc..

h. Energy conservation systems include but not limited to:

i. Lifts incorporated with regenerative feature.

5. Scope of commissioning work and deliverables

The Cx Agent shall document and submit the start-up and inspection checklist to the CMR for comment and his submission to the CxA for review. The submittals applicable to the commissioned systems shall comply with the design, meet the operation and maintenance requirements and facilitate functional performance testing.

a. Preparation of Method Statement for Testing and Commissioning Work

i. The Cx Agent shall develop Method Statement for each system and major equipment and components to be commissioned in order to fulfil the "Commissioning Plan" requirements of the BEAM Plus. Content of the Method Statement shall include but not limited to:

- Start-up and inspection checklists and procedures;
- Functional performance testing procedures and checklists;
- Testing, adjustment, and balancing procedures;
- Safety precautions;
- Organization chart of the commissioning team for the Sub-contract Works;
- Emergency contact persons and any other essential contact points for safety issues.

ii. For each system to be commissioned, the Method Statement shall provide details of the following information:

- An overview of the tasks to be executed during commissioning;
- A list of all features to be commissioned;
- A list of reference documents related to commissioning, including Specification references, drawing list, and submittal drawings;
- A list of parties involved in the commissioning process and their responsibilities;
- Description of checklists and tests to be performed, with reference to Specification;
- Pre-start and start-up checklists;
- List of the functional performance tests to be performed;
- Description of the training to be provided to the operation and maintenance staff.

iii. The Method Statement shall be consistent with those stipulated in the CxM Plan and be updated from time-to-time whenever required. Finalized Method Statement shall be endorsed by the Employer or his representative.

b. Start-up and Check-out

i. Start-up and inspection checklist shall comprise of all necessary tests and checks to determine that all components, equipment, subsystems, systems, and interfaces between systems operate in accordance with the Specification and construction documents. It shall cover all modes and sequences of control operation, interlocks and conditional control responses, and specified responses to abnormal or emergency conditions;

ii. The results of the start-up and check-out shall be documented and must be performed according to the manufacturer's written instructions for the systems and equipment being commissioned, and the as-fitted construction documents;

iii. Certificates of readiness shall be prepared by the Cx Agent verifying that start-up and inspections have been successfully completed and that all equipment, systems, and control are complete and ready for functional performance testing.

c. Commissioning Process

i. The Cx Agent shall perform site acceptance test according to the Method Statement and the T&C specification as stipulated in the Sub-contract documents. The Cx Agent shall develop checklists or forms for all the systems or equipment and components to be commissioned;

ii. After initial inspection and checking has been verified, each operating sequence of systems shall be tested. The operating sequences to be tested shall at least include the following ones, if applicable:

- Start-up;
- Shutdown;
- Unoccupied and manual modes;
- Modulation up and down the unit's range of capacity, if applicable;
- Staging, if applicable;
- Power failure / power down;
- Alarms;
- Backup upon failure;
- Interlocks with other equipment.

iii. To facilitate verification work by the CM or the CxA, the Cx Agent shall ensure completion of checking and carry out verification work as detailed in the CxM Plan;

iv. The Cx Agent shall set the sampling size for the verification test of T&C works for each type of system, equipment, and component as detailed above and seek the CM's approval for the proposed sampling size;

v. As far as practicable, equipment shall be tested to verify their performance at near-design conditions. If seasonal variation in environmental conditions causes it unsuitable for carrying out the test at project completion stage, deferred testing of equipment can be proposed as an alternative;

vi. The efficiency of central plant shall be recorded for reference by operation staff;

vii. Functional performance testing can be carried out using manual methods, control system trend logs, stand-alone data loggers, etc., as considered appropriate;

viii. The Cx Agent shall prepare all the checklists and summaries for each test, and submitted to the CM and the CxA for their review and for the approval of Employer or his representative. All the commissioning items shall be consistent with the BEAM Plus requirements;

ix. The Cx Agent shall also be required to submit the schedule of commissioning tests to the Cx Team as and when directed by the CM and give advance notifications for necessary witness of the tests by the Cx Team.

d. Preparation of Commissioning Review Report

i. The Cx Agent shall prepare the commissioning review report in compliance with the format and requirements stipulated in credit IDCM 5c in the Latest BEAM Plus Manual. The commissioning review report shall be submitted to the CM and CxA for approval;

e. Preparation of Commissioning Report

i. The Cx Agent shall prepare the final commissioning report in compliance with the format and requirements stipulated in credit IDCM 5d in the Latest BEAM Plus Manual. The final commissioning report shall be submitted to the CM and CxA for approval;

ii. If any tests need to be carried out after works completion due to seasonal variation in environmental conditions, the Cx Agent shall prepare the records for these tests in the same format as that for the commissioning report submitted at project completion and issue an addendum to the commissioning report to cover these records.

f. Preparation of Operation and Maintenance (O&M) Manual and Energy Management Manual for BEAM Plus Submission

i. The Cx Agent shall prepare the O&M Manual and Energy Management Manual in compliance with the requirements stipulated in credit IDCM 11 of the Latest BEAM Plus Manual.

g. Coordination of Operator Training and Facilities

i. The Sub-contractor shall provide training for operation and maintenance staff in compliance with the requirements stipulated in IDCM 12 of the Latest BEAM Plus Manual and other requirements as stipulated in the Specification. Adequate facilities shall be provided for operations and maintenance works.

MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MiMEP)

PRE.BS1.810.N SCOPE OF WORK

1. The Specification in this Worksection is only applicable to off-site prefabricated modules integrating equipment, components, pipework, fittings, control and electrical works and the associated supporting frame / hanger system;
2. The Contractor shall adopt wider use of MultiTrade Integrated Mechanical, Electrical and Plumbing (MiMEP) approach to improve site safety, more efficient and better quality control, shortened construction period, less construction waste, less demand for on-site labour, less disturbance and nuisance to the neighbourhood, etc. as far as practicable.

PRE.BS1.820.N SITE COORDINATION

1. The Sub-contractor shall coordinate with the Main Contractor to ensure proper site provisions, including but not limited to the following, are in place at suitable time for the smooth execution of the whole MiMEP construction process:
    a. Sufficient loading and unloading area;
    b. Hoisting / Lifting facilities;
    c. Vehicular access;
    d. Barrier-free logistic route;
    e. Temporary openings and ramps for delivery;
    f. Plant room space.
2. The Sub-contractor shall be responsible for coordination with the Main Contractor to allow sufficient time for manufacture of MiMEP modules and subsequent delivery on site to meet the master construction programme;
3. The construction sequences of builder's works such as erection of water tank, wall, door and curbs etc. at relevant working locations / plant room shall be coordinated and adjusted as appropriate to suit the on-site assembly and installation of MiMEP modules;
4. The detailed production cycle and the on-site installation and assembly programme of MiMEP modules and its relation with the relevant builder's works schedule shall be illustrated in the master construction programme.

PRE.BS1.830.N COMPLIANCE WITH REGULATIONS AND STANDARDS

1. All off-site prefabricated MiMEP modules shall comply, where applicable, with the following statutory regulations, requirements and guidelines:
    a. Statutory requirements as specified in Section ELE1.4 and FWP1.3;
    b. Guidance Note on Fixed Electrical Installations with Modular Integrated Construction Method issued by the Electrical and Mechanical Services Department (EMSD);
    c. Guidance Note on Household Electrical Products with Modular Integrated Construction Method issued by the Electrical and Mechanical Services Department (EMSD);
    d. Guidelines on the Statutory Requirements for Modular Integrated Construction Projects issued by the Construction Industry Council (CIC);

e. Road Traffic (Traffic Control) Regulations;

f. Guidelines on Application of Construction Noise Permit for using Modular Integrated Construction (MiC) Method" by the Environmental Protection Department (EPD);

g. FSD Circular Letter No. 3/2019 Guidance Notes on Submission, Approval and Acceptance Inspection of Fire Service Installations and Equipment in Modular Integrated Construction Building Projects issued by the Fire Services Department (FSD);

h. Any other statutory requirements and guidelines in relating to the MiMEP construction method.

PRE.BS1.840.N DESIGN REQUIREMENTS

1. The Sub-contractor shall address the following considerations in the design of individual off-site prefabricated MiMEP modules:

   a. Compliance with all relevant statutory requirements;

   b. Layout and configuration of Plant should be well planned and coordinated in a fashion of an effective modular design to ease on-site assembly and installation with minimisation of pipework joints as far as practicable;

   c. Off-site prefabricated modules shall be standardised as far as practicable to maximise the benefits of MiMEP construction method;

   d. The configuration and geometry of system components shall be simplified to avoid complicated routing, excessive bends and joints;

   e. Due consideration on different types of joint and flexible joints to facilitate the services connections among MiMEP modules and with associated on-site installation. Tolerance of gradient and necessary extended short length of services for alignment shall be allowed at joints;

   f. The volumetric size and geometry of individual MiMEP modules should be optimized to suit the particular site environment for proper transportation, hoisting, delivery and assembly on site;

   g. Integrity and performance of respective installation shall not be compromised due to connections and joints;

   h. Adequate access to the system components for inspection, operation and maintenance shall be allowed after the assembly of MiMEP modules;

   i. Supporting frame / hanger shall be designed for individual MiMEP module. The steel frame / hanger shall be of robust and adjustable framing design featured with fixing and bracketry facilities for mounting of different system components in position. The flexible fixing facilities shall be able to accommodate certain degree of services fixing adjustment in order to suit the alignment of MiMEP module interfacing with on-site installation or among modules themselves;

   j. The framework shall be designed and constructed without any obstruction to operation and maintenance of all components and devices inside the module;

   k. Metal framework and overall loading of MiMEP modules imposed on building structure shall be submitted for approval by the Contract Manager;

   l. Lifting lugs shall be incorporated in the design of the MiMEP modules to facilitate transportation and delivery;

m. The design of steel frame and hangers for the sole purpose of maintaining structural integrity during transportation and delivery shall be able to taken down after on-site assembly to enhance accessibility for maintenance and to be reuse as far as practicable;

n. 10% loading capacity for the integrated supporting frame / rack shall be allowed for the addition and alteration works for the system components;

o. Electrical installation layout and configuration should be well planned and coordinated in a fashion of an effective modular design to ease on-site assembly and installation with minimisation of joints as far as practicable.

2. The Sub-contractor shall submit report to identify the extent of BS installation and components to adopt the MiMEP method and obtain Contract Manager's Approval at the notified date for commencement of the Works.

PRE.BS1.850.N DELIVERY AND SITE STORAGE

1. The Sub-contractor shall be responsible for the delivery, logistic, sub-frame / support for delivery, protection and temporary storage of the MiMEP modules from the off-site workshop to the Site for assembly;

2. The Sub-contractor shall coordinate with the Main Contractor to make available a proper logistic route and associated builder's works provisions to enable the seamless delivery of individual MiMEP modules of different dimensions and weight;

3. Construction sequences of builder's works such as water tank, wall, door and curbs etc. at respective working locations / plant rooms of assembly and along the logistic route shall be adjusted as appropriate to suit the delivery programme;

4. Upon delivery of the MiMEP modules to the Site, the Sub-contractor shall arrange inspection with various parties. Any parts or components damaged during delivery shall be recorded and replaced before on-site assembly work, unless the damaged part is fully accessible for rectification or replacement after the module is put in place on site.

PRE.BS1.860.N TRANSPORTATION

1. The Sub-contractor shall allow proper protection and make necessary provisions for road transport / shipping delivery of MiMEP modules to the Site and hoisting into place for assembly;

2. The Sub-contractor shall coordinate with the Main Contractor to liaise with the Police, Transport Department and all relevant authorities ahead for permit and / or escort of laden or unladen vehicles for delivery of MiMEP modules, in case of vehicles with excessive width, weight or length;

3. The Sub-contractor shall bear all the time and cost involved to satisfy the conditions that relevant authorities may impose including limitation on working hours for transportation of MiMEP modules.

PRE.BS1.870.N PROTECTION

1. MiMEP modules shall be covered with shrink wrap / protection sheet or equivalent means to the Contractor Manager's satisfaction in order to protect them from exposure to weather and to prevent from damage prior to site assembly work;

2. All system components forming part of the MiMEP modules shall be protected from the ingress of water and foreign matters.

PRE.BS1.880.N ADMINISTRATION AND RECORD

1. The Sub-contractor shall keep an inspection log book, including the identification of various parties responsible for conducting the quality assurance supervision, and details of the inspection, auditing and testing of the off-site installation works, and provide the log book for ready inspection when requested;
2. The Sub-contractor shall keep paper record and / or digital records on platform as required by the Contract Manager, including photographs and videos during inspection and testing in off-site workshop and on-site assembly process, for ready examination by the Contract Manager and the representatives of the statutory authorities;
3. The Sub-contractor shall propose an identification method for each MiMEP in the design, fabrication and assembly process to facilitate the traceability of the MiMEP module. Details such as room name, floor level, equipment number, etc. shall be included in the label to ensure all modules are properly positioned as designed.

PRE.BS1.890.N QUALITY ASSURANCE MEASURES

1. The Sub-contractor shall allow the CM or his representatives for the regular access to the off-site workshop / off-site prefabrication yard, to carry out routine supervision and inspections;
2. The Sub-contractor shall provide necessary transportation and temporary office accommodation in the workshop to facilitate the CM or his representatives to execute the inspection duties;
3. The Sub-contractor shall verify on Site regarding the necessary builder's works provisions as detailed in PRE.BS1.820 prior to the delivery of the MiMEP modules;
4. After the MiMEP modules delivered to the Site and before the on-site assembling process, the Sub-contractor shall arrange necessary inspection and checking with relevant parties, especially if there is concern over possible deformation damage or the like during transit and difficulty in replacing / repairing the components after assembly on Site;
5. The Sub-contractor shall also arrange joint inspection by relevant parties to monitor the on-site assembling process;
6. The Sub-contractor shall submit structural drawings and design calculation endorsed by an independent Registered Structural Engineer (RSE) on permanent and temporary works of the MiMEP modules, including but not limited to the mounting and the supporting frames for suspending the MiMEP modules and the related structural plans for the supporting frames.

PRE.BS1.900.N INSTALLATION METHOD FOR MiMEP

1. The Sub-contractor shall submit an installation method for MiMEP modules to define the detailed scope of building services components adopting MiMEP construction method for the approval by the Contract Manager before fabrication;
2. The information shall include, but not limited to, the following:
    a. The scope of the installation / system(s) to be constructed by MiMEP construction method;
    b. The detailed demarcation of the building services components of the MiMEP modules shall be provided in coloured drawing plans showing which portion (s) to be fabricated / assembled / installed in the off-site workshop or in-situ;
    c. Construction details of the MiMEP modules, in particular the materials, size, weight and the maximum load the modules can sustain;

d. The use of materials, equipment, configurations, routings and positions of MiMEP modules and the associated supporting frame / hanger system;

e. The preparation work for the fixing, jointing and assembly of the installations and associated supporting frame / hanger system on site;

f. The provision of site facilities including sufficient loading & unloading area, lifting, access route, module dimensions and weight, and plant room space to facilitate the adoption of MiMEP construction method;

g. The plinth, footing and fixing details to the designated pedestals of the building structure, where applicable;

h. Testing and commissioning procedure to be conducted at workshop;

i. Temporary protective measures for building services installation of MiMEP modules in the course of transportation for delivery to the Site.

3. The MiMEP modules are part of the building services system components. The necessary testing and commissioning of them shall be carried out together with the complete system installed on Site.

APPENDIX PRE.BS1

PRE.BS1.APPEND1.9 APPLICATION FORM FOR APPROVAL OF TESTING LABORATORY

Application for Approval of Testing Laboratory (Original)

Contract No. : _____

Contract Title : _____

To Contract Manager,
(Attn:)

I apply for your approval the commissioning of _____
(Name of testing laboratory)
to carry out the following test(s):

Description of the test(s)	Relevant specification clauses
_____	_____
_____	_____
_____	_____
_____	_____

I confirm that our company has no affiliation with the proposed testing laboratory; and the test reports will be sent directly to you and to our company at the same time.

Signature : _____

Name: _____

(BLOCK LETTER)
Post/Name of Company : _____

(with company chop)
Date : _____

PRE.BS1.APPEND2.A SUB-CONTRACTOR'S MATERIAL CHECKING FORMS

1. **Material Checking Forms**

1.1. The Sub-contractor is required to implement its quality control system for ensuring compliance of materials with the Specification through the submission of properly completed Material Checking Forms, or other documental records that contain the essential information required, to the Main Contractor as detailed in sub-clause (1.2) below;

1.2. The submission as required in sub-clause (1.1) above is to record checking and inspection with proper endorsement, for submission to the Main Contractor for effective control. The essential information required for different stages of checking and inspection are listed in the standard forms below, and they are the minimum amount of information to be submitted to the Main Contractor;

a. Overall Material Schedule (Form 1(BS))

i. Incorporate HD's latest risk assessment and categorization obtained from the CM or his representatives as the baseline reference and include the same risk level stated therein for each material in the Overall Materials Schedule;

ii. Incorporate Specification requirements related to the four core stages (purchase, delivery, storage and use);

iii. Incorporate sub-contract's project specific risk evaluation / treatments by the Sub-contractor;

iv. Key items: specification clauses, HD risk categorisation, HD specification risk treatment, the Sub-contractor's own risk assessment and treatment, remarks (substantiation for nil additional risk treatment proposed by the Sub-contractor);

v. To be prepared by Project Manager / Supervising Engineer of the Sub-contractor for submission to the Main Contractor. To be signed by Project Manager of the Main Contractor;

vi. To be updated as required and report at monthly site co-ordination meeting;

vii. First submission within 3 months from the date of nomination from the Contract Manager;

viii. Records to be digitized and properly documented. Submit the records to the Main Contractor when required.

b. Material Purchase Requisition Form (Form 2(BS))

i. To be adopted when risk treatment is identified in the purchasing stage shown in Form 1;

ii. Key items: documental checks (including name of manufacturer / supplier, brand name and model number, country of manufacture, product certificate (if available)), project specific risk such as change of origin;

iii. To be prepared by Project Manager / Supervising Engineer of the Sub-contractor for submission to the Main Contractor;

iv. Records to be digitized and properly documented. Submit the records to the Main Contractor when required.

c. On-Site Delivery Verification (Form 3(BS))

i. To be adopted when risk treatment is identified in the delivery stage shown in Form 1;

ii. Key items: documental check, material check against approved sample, project specific risk, additional sampling check / test;

iii. To be prepared by Supervising Engineer / Authorized Project Engineer of the Sub-contractor for submission to the Main Contractor;

iv. Records to be digitized and properly documented. Submit the records to the Main Contractor when required.

d. Storage of Materials (for Regular Check) (Form 4(BS))

i. To be adopted when risk treatment is identified in the storage stage shown in Form 1;

ii. Key items: regular check against approval sample, storage location / condition;

iii. To be prepared by Authorized Site Supervisory Staff of the Sub-contractor for submission to the Main Contractor;

iv. Records to be digitized and properly documented. Submit the records to the Main Contractor when required.

e. Storage of Materials (Inventory Record) (Form 5(BS))

i. To be adopted when quantity checking / other risk treatment are identified in the storage stage shown in Form 1;

ii. Key item: inventory record;

iii. To be prepared by Site Supervisor / Authorized Site Supervisory Staff of the Sub-contractor for submission to the Main Contractor;

iv. Records to be digitized and properly documented. Submit the records to the Main Contractor when required.

f. On-Site Checking on Use of Material (Form 6(BS))

i. To be adopted when risk treatment is identified in the use stage shown in Form 1;

ii. Key items: check against approved sample before use of material, compliance with method statement;

iii. To be prepared by Authorized Project Engineer of the Sub-contractor for submission to the Main Contractor;

iv. Records to be digitized and properly documented. Submit the records to the Main Contractor when required.

g. Record of Meetings / Briefings on All Risk Treatment Measures (Form 7(BS))

i. To be adopted for the formal record of meetings with suppliers / Sub-contractors on risk evaluation and control measures;

ii. Key items: record of meetings / briefings on key risk evaluation and treatments in the 4 core stages of materials purchasing, delivery, storage and use;

iii. To be prepared by Project Manager / Supervising Engineer of the Sub-contractor for submission to the Main Contractor;

iv. Records to be digitized and properly documented. Submit the records to the Main Contractor when required.

a. Overall Material Schedule (Form 1(BS))

Form 1(BS)(Rev.0223)

OVERALL MATERIAL SCHEDULE

Contract Title & No.: _____ Name of NSC: _____

BS NSC Installation: _____

Reference No.: _____ Revision No.: _____

Item No.	Material/Component Item	Location	Risk Treatment in Specification					Project Risk Assessment (by Contractor)					Contractor's Risk Treatment (to provide substantiation in the Remarks Column for all additional risk treatment to identified project specific risks)				Supply by Main Contractor (MC)/Domestic Sub-Contractor (DSC)/Nominated Sub-Contractor (NSC)	Manufacturer and Supplier	Brand Name / Model no	Shop Drawing Submitted Approval Date & Version	Material Submission Date	Material Approval Date	Remarks
			Category Note 1	Specification Clause No.	Specification Requirement and Clause No.				New Sub-contractor* (Yes / No)	New Manufacturer/ Supplier* (Yes / No)	Performance of Sub-contractor/Manufacturer/ Supplier based on Past Records (Good/Moderate/Poor)	Global Market Trend	Other Project Specific Risk (e.g. quantity checking)	Purchase	Delivery	Storage	Use						
					Purchase	Delivery	Storage	Use															

Project Manager/Supervising Engineer of NSC (Name & Signature)
Date: _____

Project Manager of MC (Name & Signature)
Date: _____

This summary should be updated upon the new material(s) was approved.

Note 1 - Please refer to the latest comprehensive Material List in HOMES and include the same risk level for each material shown in the material risk assessment template.

** New sub-contractor/manufacturer/supplier refers to sub-contractor/manufacturer/supplier who lacks past work experience in HA's building services nominated sub-contractor who has not been shortlisted the sub-contractor by building services nominated sub-contractor or has not supplied materials to HA's building services nominated sub-contractors within the past four years from the date of commencement of this Contract*

b. Material Purchase Requisition Form (Form 2(BS))

Form 2 (BS)

MATERIAL PURCHASE REQUISITION FORM

Contract Title & No. :			
BS NSC Installation :		**Name of NSC** :	
Material :		**Category** :	**A / B / C**
Material Item No. in Form 1 :		**Name of Sub-contractor (if applicable)** :	
Model/Type (approved by CM) :			
Date of Issue :		**Required 1st Delivery Date** :	
		Quantity :	

Material to be purchased			
Material Description			
Project Specific Risk#	Shortage of Material	Yes / No	If yes, pls elaborate:
	Change of Origin	Yes / No	If yes, pls elaborate:
	Other	Yes / No	If yes, pls elaborate:
Briefing to Sub-Contractor (if applicable)	Yes / No *e.g. Arranged with [Name of sub-contractor by Project Manager/Supervising Engineer of NSC on DD/MM/YYYY & recorded in Form 7*		
Manufacturer and supplier	(Remarks: NSC to provide relevant details or refer to material submission schedule)		
Brand Name/Model No.	(Remarks: NSC to provide relevant details or refer to material submission schedule)		
Country of Manufacture	(Remarks: NSC to provide relevant details or refer to material submission schedule)		
Product Certificate (as specification requirement)			
Remarks			

Confirmed by Nominated Sub-contractor			
	(Name & Signature)	**(Company's chop)**	**Date**

Approved Model/Type and/or Sample Checked:		**Any deviation found:**	Yes / No
Checking Date :		**Checked By** :	
		(BSE / BS-Co)##	
		(Name & Signature)	

Confirm to Place Order for the above Material

Project Manager/Supervising Engineer of NSC (Name & Signature)	**Date**

 # Details should be recorded in Form 1
Check approved model/type and/or sample before signing

c. On-Site Delivery Verification (**Form 3(BS)**)

Form 3 (BS)

ON- SITE DELIVERY VERIFICATION

Contract Title & No.	:		
BS NSC Installation	:	**Name of NSC**	:
Material	:	**Category**	: A / B / C
		Name of Sub-contractor / Manufacturer / Supplier (if applicable)	:
Material Submission Ref. No.	:		
Model/Type (approved by CM)	:		
Country of Manufacture	:	**Brand Name**	:
Delivery Note No.	:	**Delivery Date**	:
		Batch No.	:

INSPECTION

Description	Compliance	Remark / Detail of non- conformity
1 **Document Check**		
i) documentary evidences to verify the country/place of manufacture and authenticity of material (as specified/as required by CM)	**Yes / No / N/A**	
ii) delivery note (indicating model/type as approved)	**Yes / No**	
2 **Material Visual Check (against approved model/type and/or sample)**	**Yes / No**	
3 **Other Project Specific Risk Treatment#**		
i) Additional sample inspection	**Yes / No / N/A**	
ii) Additional test	**Yes / No / N/A**	

Checked by : _____ **Date** : _____

(NSC's Site Supervisor/Authorized Site Supervisory Staff)

(Name and Signature)

For this batch of material delivered to site: ☐ ***pls tick as appropriate***

☐ 1. All material delivered to Site accepted
☐ 2. Material delivered to Site but returned _____ % defective items
☐ 3. All returned to Supplier. *Pls specify reason* _____
☐ 4. Submitted to Project Manager for follow-up action. *Pls elaborate* _____

Attached Photo(s) : _____

Endorsed By : _____ **Date** : _____

Supervising Engineer/Authorized Project Engineer of NSC
(Name and Signature)

Acknowledged By : _____ **Date** : _____

Site Agent/BSE/BS-Co of MC
(Name and Signature)

** Pls fill in as appropriate*
 # Details should be recorded in ***Form 1***

d. Storage of Materials (for Regular Check) (**Form 4(BS)**)

Form 4 (BS)

STORAGE OF MATERIALS (FOR REGULAR CHECK) [Note 1]

Contract Title & No. : _____ **Name of NSC :** _____

BS NSC Installation : _____

Item	Material Description	Material Submission Ref. No.	Category (A/B/C)	Designated Location*	As Approved Sample (Checked and Input by NSC's Site Supervisor) (Yes / No / N/A)	Acceptable Storage Condition# (Yes/No)	Checking Date	Signed by NSC's Authorized Site Supervisory Staff	Remarks

* Main Contractor shall provide adequate and appropriate storage area; details should refer to the up-to-date Overall Storage Plan

The following conditions shall be checked:-

(i) Protection to the stored material
(ii) Damage found in the stored material
(iii) Over-loading
(iv) Material Stacking
(v) Safety custody
(vi) Other Project Specific Risk (pls elaborate in Remarks)

Note 1: Frequency of checking should refer to Contractor's Risk Treatment listed out in Form 1.

Acknowledged By : _____

Site Agent/BSE/BS-Co of MC
(Name and Signature)

Date : _____

e. Storage of Materials (Inventory Record) (**Form 5(BS)**)

Form 5 (BS)

STORAGE OF MATERIALS (INVENTORY RECORD) [Note 1]

Contract Title & No. : _____ **Name of NSC :** _____

BS NSC Installation : _____

Item	Description of Material	Material Submission Ref. No.	Category (A/B/C)	Material IN (Date)	Material IN (Quantity)	Designated Location*	Material-In Record Checked and Signed by *NSC's Site Supervisor / Authorized Site Supervisory Staff (Yes / No / N/A)*	As Approved Sample Checked and Input by	Material OUT (Date)#	Material OUT (Quantity)#	Material-Out Record Checked and Signed by NSC's Site Supervisor	Checking Date	Remarks

* Main Contractor shall provide adequate and appropriate storage area; details should refer to the up-to-date Overall Storage Plan

Information input is subject to the requirement stated in Form 1

Note 1: For material quantity checking identified as one of the Contractor's Risk Treatment listed out in Form 1.

Acknowledged By : _____

Site Agent/BSE/BS-Co of MC
(Name and Signature)

Date : _____

f. On-Site Checking on Use of Material (**Form 6(BS)**)

Form 6 (BS)

ON-SITE CHECKING ON USE OF MATERIAL

Contract Title & No. : _____

BS NSC Installation : _____ **Name of NSC :** _____

Material : _____ **Category :** A / B / C

Material Submission Ref. No. : _____ **Name of Sub-contractor / Manufacturer / Supplier (if applicable) :** _____

Location /Block /External Area	Floor	As Approved Sample (Checked and Input by NSC's Site Supervisor/ Authorized Site Supervisory Staff) (Yes / No / N/A)	Compliance with Method Statement & Manufacturer's Recommendation (Yes / No/ N/A)*	Inspected by NSC's Authorized Site Supervisory Staff	Date of Inspection	Remarks

Date : _____ **NSC's Site Supervisor :** _____
(Name & Signature)

Endorsed by : **Acknowledged By :**

_____ _____
Authorized Project Engineer of NSC **Date** **Site Agent/BSE/BS-Co of MC**
(Name & Signature) **(Name & Signature)**

* Pls elaborate in details if non-compliance found and report follow-up action in Remarks **Date :** _____

Note: Submission of this form shall be on a monthly basis and done before monthly BS coordination meeting

g. Record of Meetings / Briefings on All Risk Treatment Measures (**Form 7(BS)**)

Form 7 (BS)

RECORD OF MEETINGS/BRIEFINGS ON ALL RISK TREATMENT MEASURES

Contract Title & No. :

BS NSC Installation :

Name of NSC :

Material :

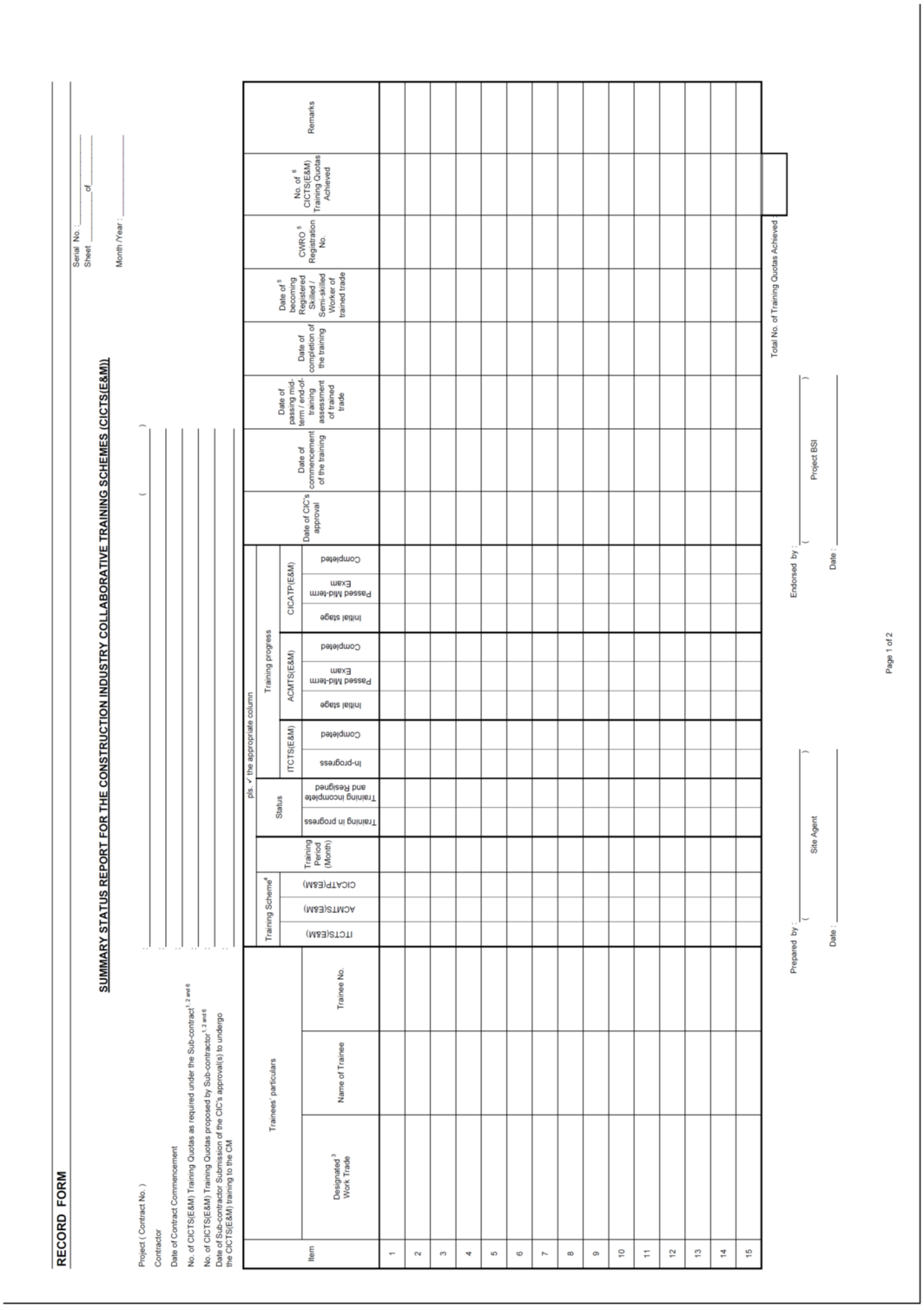
Category : A / B / C

Name of Sub-contractor / Manufacturer / Supplier :

Item	Meeting/Briefing Record (Date, Time and Venue)	NSC's Representative (Name of Attendee)	Suppliers/ Manufacturer /Sub-Contractors (Name of Attendee)	Specification Requirement & Clause no.	Project Specific Risk	Contractor's Risk Treatment	Any Non-conformity in Purchase, Delivery, Storage and Use Stages (Yes / No)*	Remarks

TRAINING OF WORKERS

PRE.BS1.APPEND3.9 SUMMARY TRAINING STATUS REPORT FOR THE CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES – E & M WORK TRADE (CICTS(E&M))



RECORD FORM

Serial No.: _____
Sheet _____ of _____

SUMMARY STATUS REPORT FOR THE CONSTRUCTION INDUSTRY COLLABORATIVE TRAINING SCHEMES (CICTS(E&M))

Month /Year: _____

Project (Contract No.) : _____ (_____)
Contractor : _____
Date of Contract Commencement : _____
No. of CICTS(E&M) Training Quotas as required under the Sub-contract [1,2 and 6] : _____
No. of CICTS(E&M) Training Quotas proposed by Sub-contractor [1,2 and 6] : _____
Date of Sub-contractor Submission of the CIC's approval(s) to undergo the CICTS(E&M) training to the CM : _____

Item	Trainees' particulars			Training Scheme[4] (pls. ✓ the appropriate column)			Training Period (Month)	Status		Training progress							Date of CIC's approval	Date of commencement of the training	Date of passing mid-term / end-of-training assessment of the said trade	Date of completion of the training	Date of [5] becoming Registered Skilled / Semi-skilled Worker of trained trade	CWRO [5] Registration No.	No. of [6] CICTS(E&M) Training Quotas Achieved	Remarks
	Designated [3] Work Trade	Name of Trainee	Trainee No.	ITCTS(E&M)	ACMTS(E&M)	CICATP(E&M)		Training in progress	Training incomplete and Resigned	ITCTS(E&M) In-progress	ITCTS(E&M) Completed	ACMTS(E&M) Initial stage	ACMTS(E&M) Passed Mid-term Exam	ACMTS(E&M) Completed	CICATP(E&M) Initial stage	CICATP(E&M) Passed Mid-term Exam	CICATP(E&M) Completed							
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							
13																							
14																							
15																							

Total No. of Training Quotas Achieved : _____

Prepared by : _____ (Site Agent)
Date : _____

Endorsed by : _____ (Project BSI)
Date : _____

Page 1 of 2

RECORD FORM

GUIDELINE

1. Refer PRE.BS1.577 for the implementation of "Construction Industry Collaborative Training Schemes - E&M Work Trade (CICTS(E&M))".

2. The Sub-contractor and/or his sub-contractor(s) shall join at least one of the training schemes of the CICTS(E&M) for provision of the necessary training to the employed trainees under the Sub-contract (hereinafter referred to as "CICTS(E&M) Trainees"). Submit to the CM a copy of CIC's approval(s) to undergo the CICTS(E&M) training within 12 months from the notified date for commencement of the Works.

3. Contractor shall record the CICTS(E&M) Trainees with respect to the CIC designated trade division(s) shown in the Construction Industry Council (CIC) website.

4. The CICTS(E&M) comprises the following training schemes administered by CIC for on-the-job training of construction workers:

   ITCTS(E&M) : Intermediate Tradesman Collaborative Training Scheme for E&M work trades;
   ACMTS(E&M) : Advanced Construction Manpower Training Scheme for E&M work trades;
   CICATP(E&M) : Construction Industry Council Approved Technical Talents Training Programme for E&M work trades.

5. For the CICTS(E&M) Trainee who has completed training and has not yet registered as a registered skilled / semi-skilled worker of the relevant trade division(s) under CWRO:

   a) If the CICTS(E&M) Trainee received ITCTS(E&M) training, "N/A" shall be filled in "Date of becoming registered skilled / semi-skilled worker of trained trade" and "CWRO Registration No." if there is no relevant trade division or the trade division does not have the level of registered semi-skilled worker for registration under CWRO;

   b) "--" shall be filled in "Date of becoming registered skilled / semi-skilled worker of trained trade" and "CWRO Registration No." if the trainee has passed the end-of-training assessment but not yet registered as skilled / semi-skilled worker of trained trade division(s).

6. A CICTS(E&M) Trainee who is employed and trained by the Sub-contractor and/or his sub-contractor(s) excepting Nominated Sub-contractor(s) shall be counted towards the number of CICTS(E&M) training quota(s) as stipulated below:

   a) each CICTS(E&M) Trainee shall only be counted under one contract at any one time;

   b) one CICTS(E&M) training quota will be counted after a CICTS(E&M) Trainee has completed the ITCTS(E&M) training in accordance with sub-clause (11) of PRE.BS1.577;

   c) two CICTS(E&M) training quotas will be counted after a CICTS(E&M) Trainee has passed the mid-term assessment under the ACMTS(E&M) or CICATP(E&M) for the trained trade division(s);

   d) two CICTS(E&M) training quotas will be counted after a CICTS(E&M) Trainee has completed the ACMTS(E&M) or CICATP(E&M) training of the trade division(s) and has registered as a registered skilled worker for the same designated trade division(s) under CWRO; and

   e) ensure that at least 50% of such training quotas met by ITCTS(E&M) before the certified date of completion of the Works.

7. Contractor shall complete this Summary Training Status Report with updated information, and submit to the CM on monthly basis on or before the Monthly Site Meeting with the following:

   a) Copy of the CIC's approval(s) to undergo the CICTS(E&M) training; and

   b) Summary Status Report of the CICTS(E&M) Trainees who joined the scheme in the contract period, no matter they are being trained / has resigned and not yet passed the trade test / has completed the training.

8. Contractor shall incorporate this Form in the Contractor's Report for Monthly Site Meeting.

PRE.C PRELIMINARIES FOR CIVIL AND GEOTECHNICAL ENGINEERING CONTRACTS

PRE.C1 PROJECT PARTICULARS 15
PRE.C1.010.9 THE PROJECT 15
PRE.C1.020.9 THE CONTRACT MANAGER 15

PRE.C2 THE WORKS 16
PRE.C2.010.A GENERAL DESCRIPTION OF THE WORKS 16
PRE.C2.020.9 WORKS SUBJECT TO EXCISION 17
PRE.C2.030.9 PREPARATORY WORKS 17
PRE.C2.040.A CONCURRENT WORKS 17
PRE.C2.050.A COORDINATION WITH CONCURRENT WORKS 17
PRE.C2.060.A WORKS ON STREET MAINTAINED BY THE HIGHWAYS DEPARTMENT 18
PRE.C2.070.A WORKS BY NOMINATED SUB-CONTRACTORS 19
PRE.C2.080.A MATERIALS BY NOMINATED SUB-CONTRACTORS 19
PRE.C2.090.9 SPECIALIST WORKS BY SPECIALIST CONTRACTORS 19
PRE.C2.100.9 SPECIALIST WORKS BY GOVERNMENT DEPARTMENTS AND UTILITY UNDERTAKING 20
PRE.C2.110.9 GROUND INVESTIGATION WORKS 20
SITE FORMATION WORKS 21
PRE.C2.120.9 SITE FORMATION WORKS 21

PRE.C3 THE SITE 23
PRE.C3.010.9 SITE LOCATION 23
PRE.C3.020.A SITE DEFINITION 23
PRE.C3.030.9 SITE AVAILABILITY 23
PRE.C3.040.9 ADDITIONAL AREAS 23
PRE.C3.050.9 LIMITATIONS OF WORKING AREAS 23
PRE.C3.060.9 GEOLOGICAL INFORMATION 24
PRE.C3.070.9 HIGH WATER LEVELS 24
PRE.C3.080.9 EXISTING FACILITIES 24
PRE.C3.090.A EXISTING RIGHTS OF WAY 24
PRE.C3.100.A EXISTING BUILDINGS 25
PRE.C3.110.A EXISTING SERVICES 25
PRE.C3.120.9 ACCESS TO THE SITE 27

PRE.C4 POSSESSION AND COMPLETION 28
PRE.C4.010.A PHASED POSSESSION OF THE SITE 28
PRE.C4.015.9 DATES FOR COMMENCEMENT OF SECTIONS 28
PRE.C4.020.9 RESTRICTIONS ON COMMENCEMENT 28
PRE.C4.021.9 RESTRICTIONS ON COMMENCEMENT OF SITE FORMATION WORKS 29
PRE.C4.028.9 REPORT ON COMPLETION OF SITE FORMATION WORKS 29
PRE.C4.030.9 RESTRICTIONS ON COMMENCEMENT OF PILE INSTALLATION AND / OR FOOTING CONSTRUCTION AND / OR ELSW 29
PRE.C4.040.9 RESTRICTIONS ON COMMENCEMENT OF CONSTRUCTION OF PILE CAPS 31
PRE.C4.050.9 RESTRICTIONS ON COMMENCEMENT OF GROUND INVESTIGATION FIELD WORKS 31
PRE.C4.060.9 TIME FOR COMPLETION 32
PRE.C4.070.9 SECTIONS FOR PHASED COMPLETION 32
PRE.C4.080.9 PARTS FOR PHASED COMPLETION 33
PRE.C4.090.9 RELEASE OF SITE ON COMPLETION 33

PRE.C5 THE CONTRACT 34

CONDITIONS OF CONTRACT 34
PRE.C5.010.9 GENERAL CONDITIONS OF CONTRACT 34
PRE.C5.020.9 SPECIAL CONDITIONS OF CONTRACT 34

CONTRACT TERMINOLOGY 34
PRE.C5.110.9 CONTRACT DEFINITIONS 34
PRE.C5.115.9 EMPLOYER 34
PRE.C5.120.9 CONTRACT MANAGER (CM) 34

PRE.C6 INFORMATION REQUIRED BY CONDITIONS OF CONTRACT 35

GENERAL CONDITIONS OF CONTRACT 35
PRE.C6.010.9 STATUS 35
PRE.C6.020.A LOCATION OF INFORMATION PROVIDED 35
PRE.C6.025.N GCC 2.1 - DUTIES AND POWERS OF THE CONTRACT MANAGER AND THE CONTRACT MANAGER'S REPRESENTATIVE 35
PRE.C6.030.9 GCC 3.1 -ASSIGNMENT 36
PRE.C6.040.C GCC 3.2 - SUB-CONTRACTING 36
PRE.C6.045.9 GCC 5.3 - ON-DEMAND BOND 40
PRE.C6.050.9 GCC 5.7 - PROGRAMME TO BE FURNISHED 40
PRE.C6.060.B GCC 5.8 - CONTRACTOR'S SUPERINTENDENCE 41
PRE.C6.065.A GCC 5.9 - CONTRACTOR'S EMPLOYEES 42
PRE.C6.070.9 GCC 5.11 - SAFETY, SECURITY AND ENVIRONMENTAL MANAGEMENT OF THE WORKS 42
PRE.C6.080.9 GCC 5.14 - THIRD PARTY INSURANCE 43
PRE.C6.090.9 GCC 5.15 - DESIGN RESPONSIBILITY 43
PRE.C6.100.9 GCC 5.27 - FACILITIES FOR OTHER PERSONS 43
PRE.C6.110.9 GCC 6.3 - PASSES 44
PRE.C6.115.N GCC 8.4 – EXTENSION OF TIME FOR COMPLETION 44
PRE.C6.120.9 GCC 9.1 - WORKS SUBJECT TO EXCISION 44
PRE.C6.125.N GCC 11.6 - ASCERTAINMENT OF CLAIMS 44
PRE.C6.130.9 GCC 20.2 - CONTRACT PRICE FLUCTUATIONS 45

SPECIAL CONDITIONS OF CONTRACT 45
PRE.C6.140.A STATUS 45
PRE.C6.145.N SCC4.0 – INDEPENDENT CHECKING OF TEMPORARY WORKS 46
PRE.C6.150.9 SCC5.1 - ENHANCED SITE CLEANLINESS AND TIDINESS 46
PRE.C6.170.9 SCC6.1 - PAYMENT OF WAGES OF SITE PERSONNEL 49
PRE.C6.180.9 SCC8.1 - POSSESSION OF THE SITE (FIXED RATE FOR DELAY) 52
PRE.C6.185.9 SCC8.2- USE OF THE SITE BY POLICE AND OTHER DISCIPLINED SERVICES 52
PRE.C6.190.9 SCC8.3 - ADDITIONAL LIQUIDATED DAMAGES FOR DELAY 52
PRE.C6.200.9 SCC8.4 - TAKING CARE OF THE WORKS AFTER COMPLETION 53
PRE.C6.205.9 SCC9.1 - WORKS SUBJECT TO EXCISION 54
PRE.C6.208.9 SCC11.2 - SCHEDULE OF RATES (FOR PART OF THE WORKS) 54
PRE.C6.210.9 SCC14.1 - PAYMENT FOR PRE-DETERMINED AMOUNTS FOR SITE SAFETY, ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE 54
PRE.C6.212.N SCC14.3 – SECURITY OF PAYMENT 55
PRE.C6.214.N SCC14.4 – PAYMENTS BY ELECTRONIC METHOD 55
PRE.C6.220.A SCC22.3 - EXCAVATION PERMIT FOR WORKS 57
PRE.C6.230.9 SCC22.4 - HOUSING CONSTRUCTION MANAGEMENT ENTERPRISE SYSTEM 58
PRE.C6.240.9 SCC22.6 – WORKS WITHIN THE RAILWAY PROTECTION AREA 59

APPENDIX PRE.C6/I **60**
SPECIAL CONDITIONS OF CONTRACT **60**
PRE.C6.APPEND1.D GUIDELINES ON SCOPE AND CONTENTS OF SUB-CONTRACTORS MANAGEMENT PLAN 60

APPENDIX PRE.C6/II **64**
PRE.C6.APPEND2.A HOMES FUNCTIONS AND DETAILS OF IMPLEMENTATION ARRANGEMENT 64

APPENDIX PRE.C6/III **65**
PRE.C6.APPEND3.N AUTHORITY FOR PAYMENT TO THE BANK (SAMPLE ONLY) 65

PRE.C7 DOCUMENTATION AND RECORDS **66**
DEFINITIONS AND ABBREVIATIONS **66**
PRE.C7.010.A ABBREVIATIONS 66
PRE.C7.020.9 SPECIFICATION 68
PRE.C7.030.9 MAINTENANCE PERIOD 68
PRE.C7.040.9 APPROVAL 68
PRE.C7.050.9 INSTRUCTED 68
PRE.C7.055.9 PROPRIETARY NAMES 68
PRE.C7.060.9 SPECIFIED 68
PRE.C7.065.A MANUFACTURER'S RECOMMENDATIONS 69
PRE.C7.070.9 REGULATIONS 69
PRE.C7.075.9 INDEPENDENT CHECKING UNIT 69
PRE.C7.080.9 BUILDING WORKS 69
PRE.C7.085.9 SITE FORMATION WORKS 69
DRAWINGS **69**
PRE.C7.110.A DRAWING LIST 69
PRE.C7.120.9 ADDITIONAL/AMENDED DRAWINGS 69
PRE.C7.130.A APPLICATION OF REVISIONS 69
PRE.C7.140.9 CHECKING DRAWINGS 69
PRE.C7.150.9 SCALING OF DIMENSIONS 69
PRE.C7.160.A SURVEYS FOR 'AS-BUILT' PLANS 70
PRE.C7.170.9 AS-BUILT DRAWINGS AND ROAD INVENTORY RECORDS FOR HIGHWAY STRUCTURES 70
SURVEY DATUM **71**
PRE.C7.210.9 DATUM REFERENCES 71
PRE.C7.220.9 REFERENCES FOR SETTING OUT THE WORKS 71
PRE.C7.230.9 RESPONSIBILITY FOR SURVEY CONTROL INFORMATION 71

PRE.C8 QUALITY STANDARDS **72**
QUALITY MANAGEMENT SYSTEM **72**
PRE.C8.010.9 ESTABLISHMENT OF QUALITY ASSURANCE PLAN 72
PRE.C8.020.9 APPROVAL OF QUALITY ASSURANCE PLAN 72
PRE.C8.030.9 COMPLIANCE WITH QUALITY ASSURANCE PLAN 72
PRE.C8.040.9 MINIMUM CONTENT OF QUALITY ASSURANCE PLAN 72
PRE.C8.050.9 ORGANIZATION AND RESPONSIBILITY 72
PRE.C8.060.9 DESIGN CONTROL 72
PRE.C8.070.9 PURCHASING OF MATERIALS AND SERVICES 73
PRE.C8.080.9 CONSTRUCTION PROCESS CONTROL 73
PRE.C8.081.9 TEMPORARY WORKS PROCESS CONTROL 73
PRE.C8.090.9 INSPECTION, MEASURING AND TESTING EQUIPMENT 73
PRE.C8.100.9 CONTROL OF NON-CONFORMING MATERIALS AND WORKS 74

PRE.C8.110.9 TRAINING 74
PRE.C8.120.9 QUALITY ASSURANCE PLAN REVIEW 74
PRE.C8.130.9 ISO 9001 CERTIFICATION FOR SUB-CONTRACTOR 74

ALTERNATIVE DESIGNS 74
PRE.C8.210.9 BASIS OF ASSESSMENT 74
PRE.C8.220.9 DESIGN RESPONSIBILITY 75
PRE.C8.230.9 DESIGN STANDARDS 75
PRE.C8.240.9 COSTS ARISING FROM DESIGN NON-VIABILITY 75

MATERIALS AND WORKMANSHIP 75
PRE.C8.310.9 GOOD PRACTICE 75
PRE.C8.320.A MATERIAL 75
PRE.C8.330.9 CONSISTENCY OF MATERIALS 75
PRE.C8.340.9 MIX PROPORTIONS 76
PRE.C8.350.9 MANUFACTURER'S RECOMMENDATIONS 76
PRE.C8.360.9 EQUIVALENT MATERIALS AND IMPERIAL SIZES 76
PRE.C8.370.9 BRITISH STANDARDS 76
PRE.C8.380.9 OTHER NATIONAL AND INTERNATIONAL STANDARDS 76
PRE.C8.390.9 EQUIVALENT STANDARDS 76

TESTING 77
PRE.C8.510.9 LABORATORY TESTING 77

INDEPENDENT CHECKING UNIT (ICU) 78
PRE.C8.602.9 GENERAL 78
PRE.C8.603.9 SERVICES AND FACILITIES REQUIRED BY ICU 78
PRE.C8.610.9 INDEPENDENT CHECKING UNIT (ICU) 78

PERFORMANCE ASSESSMENT SCORING SYSTEM (PASS) 79
PRE.C8.710.9 GIPASS 79

QUALITY CONTROL MEASURES FOR WELDING CONSUMABLES FOR STRUCTURAL STEELWORKS 79
PRE.C8.810.9 WELDING CONSUMABLES FOR STRUCTURAL STEELWORKS 79

APPENDIX PRE.C8/I 82
PRE.C8.APPEND1.A APPLICATION FORM FOR APPROVAL OF TESTING LABORATORY 82

PRE.C9 CONTRACTOR'S OBLIGATIONS 85

AUTHENTICITY OF INFORMATION 85
PRE.C9.005.N CONSENT TO THE EMPLOYER FOR VERIFICATION OF DOCUMENTS SUBMITTED BY THE CONTRACTOR 85

USE OF SITE 86
PRE.C9.010.9 PURPOSE 86
PRE.C9.020.9 RESTRICTIONS ON ADVERTISING 86
PRE.C9.030.9 RESTRICTIONS ON STOCKPILING 86
PRE.C9.040.9 WORKERS 86
PRE.C9.050.9 OCCUPANCY AND RENTAL OF PRIVATE LAND OF ECOLOGICAL VALUES 86
PRE.C9.082.9 MAINTENANCE WORKS PROCESS CONTROL 86

SECURITY 87
PRE.C9.110.A SECURITY GUARDS 87
PRE.C9.120.9 ACCOMMODATION FOR SECURITY GUARDS 87
PRE.C9.130.9 INTEGRITY OF SITE PERIMETER 87
PRE.C9.140.9 WAGE BOOKS 87
PRE.C9.170.A SITE SECURITY PLAN 88

SAFETY 90
PRE.C9.205.E COMPLIANCE WITH SAFETY REGULATIONS AND CONTRACT REQUIREMENTS 90
PRE.C9.210.9 GENERAL REQUIREMENTS 110
PRE.C9.211.N PROHIBITION OF IMPOSING ADMINISTRATIVE CHARGES FOR REPORTING OF SITE ACCIDENTS AND ELIMINATION OF UNDER-REPORTING OF SITE ACCIDENTS 110
PRE.C9.215.N SAFETY IN CONFINED SPACE RELATED TO UNDERGROUND DRAINAGE WORK 112
PRE.C9.230.9 PROVISION OF SAFETY REGULATIONS 116
PRE.C9.235.9 SAFETY POSTERS 117
PRE.C9.240.9 SAFETY TRAINING 117
PREC9.241.N INSPECTION AND CERTIFICATION OF OVERHAUL OF MAJOR CONSTRUCTION PLANT ON SITE 117
PRE.C9.245.9 CARING OF NEW WORKERS 120
PRE.C9.250.D SAFETY OF CRANES, HOISTS ETC. 121
PRE.C9.260.B SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF OPERATIVES AND SITE SUPERVISORY STAFF 124
PRE.C9.270.A SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF THE CM, HIS REPRESENTATIVES AND VISITORS 126
PRE.C9.280.B DELIVERY OF MATERIALS BY VEHICLES TO SITE 127
PRE.C9.290.C PLATFORMS FOR WORKING AT DIFFERENT HEIGHTS 128
PRE.C9.291.9 SAFETY OF REINFORCEMENT BAR BENDING MACHINES 131
PRE.C9.292.9 INSTALLATIONS TO REDUCE RISK OF MANUAL HANDLING AND WORKING AT HEIGHT 131
PRE.C9.293.C SAFETY OF ELECTRIC PORTABLE TOOLS 132
PRE.C9.294.D WIRELESS COMMUNICATION TECHNOLOGIES 132
PRE.C9.295.9 TEMPORARY STAIRCASES 144
PRE.C9.298.9 LOCKOUT AND TAGOUT PROCEDURES FOR ELECTRICAL WORKS 144
HEALTH 145
PRE.C9.300.9 PROVISION OF AUTOMATED EXTERNAL DEFIBRILLATOR (AED) 145
PRE.C9.305.X DELETED 145
FIRE PRECAUTIONS 145
PRE.C9.310.9 FIRE REGULATIONS 145
PRE.C9.320.9 STREET FIRE HYDRANTS 145
PRE.C9.330.9 DANGEROUS GOODS STORE 145
PRE.C9.340.9 PORTABLE FIRE FIGHTING APPLIANCES 146
PRE.C9.350.9 PROHIBITING SMOKING ON SITE 146
PRE.C9.360.N SCREEN FOR WELDING AND FLAME CUTTING 146
GENERAL NUISANCE 146
PRE.C9.410.9 AVOIDANCE OF NUISANCE 146
PRE.C9.420.9 COMPLIANCE WITH REGULATIONS 146
PRE.C9.430.A BONFIRE RESTRICTIONS 147
PRE.C9.440.9 AIR POLLUTION REGULATIONS 147
PRE.C9.450.9 POLLUTION BY VEHICLES 147
PRE.C9.460.A WATER POLLUTION 147
DISPOSAL OF CONSTRUCTION AND DEMOLITION (C&D) MATERIALS 148
PRE.C9.470.A DISPOSAL OF INERT C&D MATERIALS 148
PRE.C9.480.A DISPOSAL OF NON-INERT C&D MATERIALS 148

PRE.C9.490.9 TRIP TICKET SYSTEM FOR DISPOSAL OF C&D MATERIALS AT PUBLIC FILL RECEPTION FACILITIES/LANDFILLS/OUTLYING ISLANDS TRANSFER FACILITIES 149
PRE.C9.493.A TRIP TICKET SYSTEM FOR DISPOSAL OF C&D MATERIALS AT DISPOSAL FACILITIES OTHER THAN PUBLIC FILL RECEPTION FACILITIES/LANDFILLS/OUTLYING ISLANDS TRANSFER FACILITIES 150
PRE.C9.495.9 SITE VIDEO RECORDING SYSTEM 150
PRE.C9.498.9 MECHANICAL COVER SYSTEM FOR DUMP TRUCK FOR TRANSPORTING CONSTRUCTION AND DEMOLITION (C&D) MATERIALS 151
PRE.C9.500.A ALTERNATIVE DISPOSAL GROUNDS 152
PRE.C9.510.A REMOVAL OF C&D MATERIALS FROM UNAUTHORIZED DISPOSAL GROUND 153

PREVENTION OF MOSQUITO BREEDING 154
PRE.C9.610.9 DISPLAY OF POSTERS 154
PRE.C9.620.9 REMOVAL AND TREATMENT OF STANDING WATER 154
PRE.C9.630.9 TREATMENT OF WATER RECEPTACLES 154
PRE.C9.640.9 DISPOSAL OF WATER RECEPTACLES 154
PRE.C9.650.A PESTICIDES AND LARVICIDES 154

CONTROL OF DUST AND DEBRIS 154
PRE.C9.710.A DUST CONTROL GENERALLY 154
PRE.C9.720.9 VEHICLE PREPARATIONS 155
PRE.C9.730.9 STOCKPILING 155
PRE.C9.740.9 AIR SAMPLERS 156
PRE.C9.750.9 DUST SUPPRESSION EQUIPMENT 156
PRE.C9.760.9 RESTRICTION ON CONCRETE BATCHING AND ROCK CRUSHING PLANTS ON SITE 156

CONTROL OF NOISE 156
PRE.C9.810.9 GENERAL CARE 156
PRE.C9.820.9 NOISE CONTROL REGULATIONS 156
PRE.C9.830.9 CONSTRUCTION NOISE PERMIT 157
PRE.C9.840.9 SOUND LEVEL METER 157
PRE.C9.850.A ADDITIONAL REQUIREMENTS 157
PRE.C9.855.N CONSTRUCTION NOISE MANAGEMENT PLAN (CNMP) 157
PRE.C9.860.9 METHODS OF OPERATION 158
PRE.C9.870.9 APPROVAL OF METHODS OF OPERATION 158
PRE.C9.880.9 SOUND REDUCTION EQUIPMENT 159
PRE.C9.890.9 APPROVED EXCEPTIONS 159
PRE.C9.900.9 RESTRICTED USE OF EXCAVATOR MOUNTED BREAKERS 159
PRE.C9.910.9 NOISE SENSITIVE RECEIVERS 159
PRE.C9.920.9 RESTRICTED USE OF ROCK DRILLING EQUIPMENT 159
PRE.C9.930.9 BLASTING RESTRICTIONS 159
PRE.C9.940.9 HAND-HELD BREAKERS AND PORTABLE AIR COMPRESSORS 159
PRE.C9.950.9 GENERATORS FOR SUPPLY OF TEMPORARY ELECTRICITY TO SITE 159
PRE.C9.960.A HEALTH CARE PLAN 160
PRE.C9.965.A REST AREAS FOR WORKERS 160

CLEANLINESS 161
PRE.C9.1010.9 DISPOSAL OF RUBBISH 161
PRE.C9.1020.9 HEALTH AND SANITATION 161
PRE.C9.1030.9 MAINTAINING CLEARANCE OF DRAINAGE CHANNELS 161
PRE.C9.1040.9 MAINTAINING CLEARANCE OF RIGHTS OF WAY 161

PRE.C9.1050.9 WHEEL CLEANING FACILITY 161

PROTECTION 162
PRE.C9.1110.A PROTECTION FROM WEATHER 162
PRE.C9.1120.9 WORK RESTRICTIONS 162
PRE.C9.1130.9 MONITORING WEATHER FORECASTS 163
PRE.C9.1140.9 MONITORING WATER LEVEL MEASURING DEVICES 163
PRE.C9.1150.9 WATER DISPERSAL 163
PRE.C9.1160.A DISCHARGES GENERATED FROM SITE ACTIVITIES 163
PRE.C9.1170.A REUSE OF WATER FROM BORING AND DRILLING 164
PRE.C9.1180.9 REUSE AND DISPOSAL OF BENTONITE SLURRY 164
PRE.C9.1190.9 TEMPORARY DRAINAGE SYSTEMS 164
PRE.C9.1200.9 REMOVAL OF SEDIMENT/DEBRIS 164
PRE.C9.1210.9 METHOD OF WORKING 165
PRE.C9.1220.9 REINSTATING DAMAGE WORKS 165
PRE.C9.1230.9 EMERGENCY COMMUNICATION AND STANDBY TEAM 165
PRE.C9.1260.B PROTECTION OF WORKERS FROM HEAT STROKE 166
PRE.C9.1270.9 PROTECTION OF WORKERS WORKING IN COLD WEATHER 167

PROTECTION AND PRESERVATION OF EXISTING TREES AND SHRUBS 168
PRE.C9.1310.B PROTECTION GENERALLY 168
PRE.C9.1312.B DEFINITIONS 169
PRE.C9.1313.X DELETED 170
PRE.C9.1314.A SPECIALIST CONTRACTOR 170
PRE.C9.1315.A COMPETENT MEMBER OF SITE SUPERVISORY STAFF TO OVERSEE TREE WORKS 170
PRE.C9.1316.A PRESERVATION AND PROTECTION OF EXISTING TREES AND VEGETATION GENERALLY 171
PRE.C9.1320.A PROGRAMMING OF PROTECTION WORKS 172
PRE.C9.1330.A EXISTING PROTECTIVE FENCING 173
PRE.C9.1340.A PROTECTIVE BAMBOO FENCING 173
PRE.C9.1350.A PROTECTIVE CHAIN LINK FENCING 173
PRE.C9.1360.A ALIGNMENT OF PROTECTIVE FENCING 174
PRE.C9.1362.A PROTECTION FROM CHANGE IN GROUND LEVEL 174
PRE.C9.1363.B PROTECTION FROM EXCAVATION INCLUDING TRENCHING 174
PRE.C9.1364.A PROTECTION FROM DRILLING 176
PRE.C9.1365.A PROTECTION FROM INSTABILITY 177
PRE.C9.1370.B PRESERVATION AND TREATMENT / REPLACEMENT OF EXISTING TREES AND SHRUBS 178
PRE.C9.1380.N TREE INVENTORY REPORT 178

TREE RISK ASSESSMENT AND INSPECTION AFTER INCLEMENT WEATHER 179
PRE.C9.1410.A TREE RISK ASSESSMENT AND ARBORICULTURAL WORKS 179
PRE.C9.1420.B TIMING FOR CARRYING OUT OF TREE RISK ASSESSMENT AND ARBORICULTURAL WORK 179
PRE.C9.1430.B QUALIFICATION AND EXPERIENCE REQUIREMENTS OF THE QUALIFIED ARBORIST 180
PRE.C9.1440.A PRACTICE ON TREE RISK ASSESSMENT AND MANAGEMENT 181
PRE.C9.1450.A INSPECTION AFTER INCLEMENT WEATHER 183
PRE.C9.1460.C ARBORICULTURAL WORKS IN RELATION TO TREE RISK ASSESSMENT AND INSPECTION AFTER INCLEMENT WEATHER AS APPROVED BY THE CM 183

PRESERVATION AND MAINTENANCE OF EXISTING FEATURES 187
PRE.C9.1510.9 AMENITIES TO BE PRESERVED 187
PRE.C9.1520.9 PROTECTION OF EXISTING ROADS, BUILDINGS AND OTHER STRUCTURES 187

PRE.C9.1530.9 RESTRICTIONS ON USE OF HIGHWAYS 187
PRE.C9.1540.9 EXISTING PIEZOMETERS 187
PRE.C9.1550.9 REMOVAL OF TREES, PIPES, CABLES, ETC 187
PRE.C9.1560.9 REINSTATEMENT OF THE SITE 188
PRE.C9.1570.A PROTECTION OF NATURAL STREAMS/RIVERS 188

PRESERVATION AND MAINTENANCE OF EXISTING UTILITY AND OTHER SERVICES 188
PRE.C9.1610.A LIAISON WITH STATUTORY AUTHORITIES 188
PRE.C9.1620.9 DUTY OF CARE 188
PRE.C9.1630.A PRELIMINARY INVESTIGATIONS 188
PRE.C9.1640.9 LOCATION OF UTILITY SERVICES 189
PRE.C9.1650.A IDENTIFICATION OF SERVICES 189
PRE.C9.1660.9 ALTERATIONS TO SERVICES 189
PRE.C9.1670.9 SAFE KEEPING OF EQUIPMENT 190
PRE.C9.1680.9 MAINTENANCE OF DRAINAGE SYSTEM 190
PRE.C9.1690.9 RESPONSIBILITY FOR DAMAGE TO SERVICES 190
PRE.C9.1700.9 EXCAVATION BY HAND 190

CONTRACTOR'S SUPERINTENDENCE 190
PRE.C9.1810.9 GENERALLY 190
PRE.C9.1820.9 AUTHORISED REPRESENTATIVE 190
PRE.C9.1830.A LAND SURVEYORS 191
PRE.C9.1840.A ENGINEERING GEOLOGIST(S) 191
PRE.C9.1850.A BLASTING CONTROL ENGINEER 192
PRE.C9.1860.9 INDEPENDENT DIVING SPECIALIST 193
PRE.C9.1870.9 INDEPENDENT ENVIRONMENTAL CONSULTANT 193
PRE.C9.1880.A QUALITY CONTROL ENGINEER 193
PRE.C9.1881.N COMPETENT PERSON FOR HAND-DUG TUNNELLING WORK 194
PRE.C9.1882.N INDEPENDENT CHECKING ENGINEER FOR HAND-DUG TUNNELLING WORK 194
PRE.C9.1890.A COMPACTION CONTROL ENGINEER 194
PRE.C9.1900.9 REGISTERED STRUCTURAL ENGINEER (RSE) 195
PRE.C9.1902.9 REGISTERED GEOTECHNICAL ENGINEER (RGE) 195
PRE.C9.1903.B ENVIRONMENTAL MANAGER (EM) 195
PRE.C9.1904.9 ENVIRONMENTAL SUPERVISOR (ES) 197
PRE.C9.1905.9 CONTRACTOR'S LABOUR OFFICER (CLO) 198
PRE.C9.1910.9 CONTRACTOR'S EMPLOYEES 198
PRE.C9.1920.9 GENERAL FOREMAN 200
PRE.C9.1930.9 AUTHORIZED SIGNATORY (AS) 201
PRE.C9.1950.9 DESIGN CERTIFYING CONSULTANT 201
PRE.C9.1965.9 TECHNICALLY COMPETENT PERSONS (TCP) FOR SP 201
PRE.C9.1970.9 TECHNICAL DIRECTOR (TD) 201
PRE.C9.1980.A MANDATORY SAFETY TRAINING FOR APPOINTED SUPERINTENDENTS 201

SITE ORGANISATION AND SUPERVISION PLAN 202
PRE.C9.2010.9 SUBMISSIONS OF ORGANISATION CHART AND SP 202
PRE.C9.2020.9 PROBITY AND CODE OF ETHICS 203

SITE ADMINISTRATION 204
PRE.C9.2110.9 NORMAL WORKING HOURS 204
PRE.C9.2120.9 NOTIFICATION OF OPERATIONS 204
PRE.C9.2130.9 ESTIMATED LABOUR AND PLANT RESOURCES 204
PRE.C9.2140.9 MONTHLY PROGRESS REPORTS 204
PRE.C9.2150.9 FORMS FOR CONTRACTOR'S MONTHLY INTERIM STATEMENTS 205
PRE.C9.2160.9 PROGRESS PHOTOGRAPHS 205

PRE.C9.2170.9 STEEL BAR REINFORCEMENT RECORD PHOTOGRAPHS 206
PRE.C9.2180.9 DOCUMENTATION FOR STEEL BAR REINFORCEMENT 206
PRE.C9.2190.9 PUBLICITY 206
PRE.C9.2200.9 GOVERNMENT PLANT 206
PRE.C9.2210.9 MATERIALS SUPPLIED BY HOUSING AUTHORITY 206
PRE.C9.2220.A LABOUR RETURNS 207
PRE.C9.2225.N RETURN OF SITE LABOUR DEPLOYMENT AND EMPLOYMENT TO CENSUS AND STATISTICS DEPARTMENT 207
PRE.C9.2230.A CALIBRATION OF EQUIPMENT 208
PRE.C9.2240.A EQUIPMENT CALIBRATION SCHEDULE 208
PRE.C9.2250.X DELETED 209
PRE.C9.2260.9 ENVIRONMENTAL PERMIT 209
PRE.C9.2270.9 CONFIRMATION OF VERBAL INSTRUCTION (CVI) 209
PRE.C9.2280.C DEVELOPMENT AND CONSTRUCTION SITE MOBILE SYSTEM (DCSMS) 209

CONSTRUCTION WASTE MANAGEMENT 211
PRE.C9.2310.9 CONSTRUCTION WASTE MANAGEMENT - GENERAL 211
PRE.C9.2320.9 SPECIAL WASTE MANAGEMENT RESPONSIBILITIES 211
PRE.C9.2330.9 PACKAGING MATERIAL 211
PRE.C9.2340.A ON-SITE SORTING OF C&D MATERIAL 212
PRE.C9.2350.9 REMOVAL OF WASTE MATERIALS 212
PRE.C9.2360.9 WASTE REDUCTION TARGETS 212

ENVIRONMENTAL MANAGEMENT PLAN 213
PRE.C9.2410.A ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES 213
PRE.C9.2415.9 SUBMISSION AND UPDATING OF ENVIRONMENTAL MANAGEMENT PLAN 213
PRE.C9.2420.A ENVIRONMENTAL MANAGEMENT PLAN (EMP) 214
PRE.C9.2430.9 DISTRIBUTION OF AND COMPLIANCE WITH THE ENVIRONMENTAL MANAGEMENT PLAN 219
PRE.C9.2435.9 ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE 219
PRE.C9.2440.A ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE MONITORING AND REPORTING 220
PRE.C9.2460.A PROVISION OF ENVIRONMENT AND HYGIENE TRAINING 220
PRE.C9.2470.D PAYMENT FOR PRE-DETERMINED AMOUNTS FOR SITE SAFETY, ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE 221

SITE ACCESS CONTROL OF PERSONNEL 233
PRE.C9.2510.9 SITE ACCESS CONTROL AND RECORDING SYSTEM 233
PRE.C9.2512.9 ARRANGEMENT FOR PRE-OPERATION OF ACRS 234
PRE.C9.2514.9 DESIGN, OPERATION AND SUBMISSION REQUIREMENTS 234
PRE.C9.2520.A SYSTEM REQUIREMENTS 234
PRE.C9.2530.9 ENTRANCE/EXIT CONTROL UNIT 235
PRE.C9.2540.9 CENTRAL DATA COMPUTER UNIT 236
PRE.C9.2550.9 INFORMATION TO BE CAPTURED AND SAVED IN ACRS 236
PRE.C9.2560.9 SYSTEM RUNNING AND TERMINATION 238

WORKS WITHIN THE RAILWAY PROTECTION AREA 238
PRE.C9.2600.9 GENERAL 238
PRE.C9.2605.9 PROCEDURE FOR POSSESSION 238
PRE.C9.2610.9 WORKING IN THE VICINITY OF THE RAILWAY TRACK 238
PRE.C9.2615.9 TRESPASSING ON RAILWAY PREMISES 239
PRE.C9.2620.9 PREVENTION OF ACCIDENTS 239
PRE.C9.2625.9 WORKS DESIGNED BY CONTRACTOR 239
PRE.C9.2630.A METHOD OF CARRYING OUT THE WORKS AND USE OF PLANT 240

PRE.C9.2635.A INTERFERENCE WITH DRAINS AND SERVICES....242
PRE.C9.2640.9 CROSSING THE TRACK....242
PRE.C9.2645.9 OVERHEAD ELECTRICIAL EQUIPMENT....242
PRE.C9.2650.9 USE OF EXPLOSIVES....243
PRE.C9.2655.9 EMERGENCY CREW....243
PRE.C9.2660.9 STACKING OF MATERIAL....243
PRE.C9.2665.9 SCREENING OF LIGHTS....243
PRE.C9.2670.9 FIRE PREVENTION....243
PRE.C9.2675.9 NOTICE OF ACCIDENTS....244
PRE.C9.2680.9 ADVERTISEMENTS....244
PRE.C9.2685.A CLEARANCE OF LAND AND PROPERTY WITHIN THE RAILWAY PREMISES....244
PRE.C9.2690.A CONDITIONS FOR WORKING WITHIN / IN THE VICINITY OF THE RAILWAY PREMISES....244
PRE.C9.2695.9 RATE OF CHARGE FOR SERVICE / INFORMATION PROVIDED BY MTRCL....244

APPENDIX PRE.C9/I....245
PRE.C9.APPEND1.9 WASTE FLOW TABLE....245

APPENDIX PRE.C9/II....249
PRE.C9.APPEND2.9 DAILY RECORD SUMMARY....249

APPENDIX PRE.C9/III....251
PRE.C9.APPEND3.9 FORMS EPS-F3 AND EPS-F4....251

APPENDIX PRE.C9/IV....256
PRE.C9.APPEND4.9 DISPOSAL DELIVERY FORM....256

APPENDIX PRE.C9/V....257
PRE.C9.APPEND5.9 MONTHLY RECORDING OF DAILY FLOW RATE OF WASTE WATER DISCHARGED ON SITE....257

APPENDIX PRE.C9/VI....259
PRE.C9.APPEND6.9 SUMMARY RECORD OF DELIVERY AND CONSUMPTION OF B5 DIESEL OR EURO V DIESEL / ULTRA LOW SULPHUR DIESEL ON SITE....259

APPENDIX PRE.C9/VII....260
PRE.C9.APPEND7.9 SAMPLE COMPANY CODE OF ETHICS FOR HONG KONG HOUSING AUTHORITY CONTRACTORS....260

APPENDIX PRE.C9/VIII....266
PRE.C9.APPEND8.9 STANDARD TEMPLATE FOR CONFIRMATION OF VERBAL INSTRUCTION....266

APPENDIX PRE.C9/IX....268
PRE.C9.APPEND9.9 STANDARD TEMPLATE FOR ABORTIVE WORKS RECORD SHEET....268

APPENDIX PRE.C9/X....270
PRE.C9.APPEND10.9 STANDARD TEMPLATE FOR CVI SUMMARY TABLE FOR MONTHLY SITE MEETINGS....270

APPENDIX PRE.C9/XI....272
PRE.C9.APPEND11.9 TECHNICAL NOTES FOR GUIDANCE IN ASSESSING THE EFFECTS OF CIVIL ENGINEERING CONSTRUCTION / BUILDING DEVELOPMENT ON RAILWAY STRUCTURES AND OPERATIONS....272

APPENDIX PRE.C9/XII....275

PRE.C9.APPEND12.A KEY INDUSTRIAL SAFETY PRECAUTIONS FOR CONTRACTORS WORKING WITHIN RAILWAY PREMISES 275

APPENDIX PRE.C9/XIII 279
PRE.C9.APPEND13.9 MTRCL'S INDEMNITY FORM 279

APPENDIX PRE.C9/XIV 280
PRE.C9.APPEND14.9 LETTER OF UNDERTAKING 280

APPENDIX PRE.C9/XV 281
PRE.C9.APPEND15.X DELETED 281

APPENDIX PRE.C9/XVI 282
PRE.C9.APPEND16.N CERTIFICATE OF OVERHAUL OF MAJOR CONSTRUCTION PLANT ON SITE 282

APPENDIX PRE.C9/XVII 287
PRE.C9.APPEND17.N CHECKLISTS ON CRITICAL PARTS FOR OVERHAUL MAINTENANCE FOR MAJOR CONSTRUCTION PLANT ON SITE 287

APPENDIX PRE.C9/XVIII 298
PRE.C9.APPEND18.N FORM OF DECLARATION AND CONSENT TO THE EMPLOYER 298

PRE.C10 TRAFFIC ARRANGEMENTS 299

TRAFFIC CONTROL 299
PRE.C10.010.9 SITE TRAFFIC 299
PRE.C10.020.9 COMPLIANCE WITH REGULATIONS 299
PRE.C10.030.9 COMPLIANCE WITH AUTHORITIES' REQUIREMENTS 299
PRE.C10.040.9 COMPLIANCE WITH PROCEDURES AND REQUIREMENTS 299
PRE.C10.050.9 CONTRACTOR'S PROPOSALS 299
PRE.C10.060.9 GATES AT VEHICULAR INGRESS / EGRESS FOR TRAFFIC CONTROL 300
PRE.C10.070.9 TAKING OVER EXISTING GATES AT VEHICULAR INGRESS / EGRESS FOR TRAFFIC CONTROL 301

TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL 302
PRE.C10.110.9 CONTRACTOR'S RESPONSIBILITY 302
PRE.C10.120.9 COMPLIANCE WITH AUTHORITIES' REQUIREMENTS 302
PRE.C10.130.9 OBTAINING AUTHORITIES' APPROVALS 302
PRE.C10.140.9 APPLICATION 302
PRE.C10.150.9 COMPLIANCE WITH CODE OF PRACTICE 302
PRE.C10.160.9 INSPECTION AND MAINTENANCE 302
PRE.C10.170.9 SUBMISSION FOR CM'S APPROVAL 302

TRAFFIC CONTROL EQUIPMENT 303
PRE.C10.210.9 MAINTENANCE OF EQUIPMENT 303
PRE.C10.220.9 CHECKING EQUIPMENT 303
PRE.C10.230.9 REPAIRING/REPLACING EQUIPMENT 303
PRE.C10.240.9 ELECTRIC LAMPS 303
PRE.C10.250.9 TEMPORARY TRAFFIC LIGHT SIGNALS 304
PRE.C10.260.9 TEMPORARY TRAFFIC SIGNS 304
PRE.C10.270.9 TEMPORARY CONCRETE PROFILE BARRIERS 304
PRE.C10.280.C SAFETY OF SITE VEHICLES AND MOBILE PLANT 304
PRE.C10.285.N SAFETY OF AIR HOSE CONNECTED TO AIR COMPRESSOR 305

WORK IN ROADS AND FOOTWAYS 305
PRE.C10.310.9 WORK IN SECTIONS 305
PRE.C10.320.9 DEFINING AREAS OF EXCAVATION 305
PRE.C10.330.9 STORING EXCAVATED MATERIAL 306

PRE.C10.340.9 BRIDGING EXCAVATIONS....306
PRE.C10.350.9 REMOVAL OF TEMPORARY EQUIPMENT....306
PRE.C10.360.9 ADJUSTING THE ROAD HARDWARE LEVELS....306
PRE.C10.370.9 EXISTING STREET LIGHTING....306

PRE.C11 TEMPORARY WORKS AND FACILITIES....307

TEMPORARY WORKS....307
PRE.C11.010.9 PRIOR APPROVAL....307
PRE.C11.020.9 EARTH SUPPORT TO RETAINING WALL EXCAVATIONS....307
PRE.C11.030.9 PROVISION OF ACCESS ROADS....307
PRE.C11.040.A TUNNELLING....308
PRE.C11.050.9 APPROVAL OF ACCESS POINTS....308
PRE.C11.060.9 DIVERSION OF STREAMS OR DRAINS....308
PRE.C11.070.9 NEW SIGNBOARDS....308
PRE.C11.080.9 PAINTING AND SIGNWRITING ON SIGNBOARDS....308
PRE.C11.090.9 SUPPLY OF WATER....309
PRE.C11.095.9 TEMPORARY LIGHTING....309

SITE ACCOMMODATION FOR THE CONTRACTOR....309
PRE.C11.110.A ACCOMMODATION GENERALLY....309
PRE.C11.120.9 LOCATION OF STRUCTURES....310
PRE.C11.130.9 LOCATION OF STORAGE AREAS....310
PRE.C11.140.9 TEMPORARY ACCOMMODATION FOR WORKMAN....310
PRE.C11.150.A TEMPORARY SITE LABORATORY FOR ON-SITE FILL TESTING....310

PRINCIPAL OFFICE ACCOMMODATION FOR THE CM....311
PRE.C11.210.9 OFFICE BUILDINGS....311
PRE.C11.220.9 LAYOUT, DESIGN AND SUSTAINABLE PROVISIONS OF SITE ACCOMMODATION....311
PRE.C11.230.9 COVERED HARDSTANDINGS....312
PRE.C11.240.9 OFFICE FITTINGS, SERVICES, FURNITURE, EQUIPMENT AND MACHINERY....312
PRE.C11.250.9 OFFICE SERVICES....312
PRE.C11.260.9 OFFICE FITTINGS....312
PRE.C11.270.9 OFFICE FURNITURE....313
PRE.C11.280.9 OFFICE EQUIPMENT....313
PRE.C11.290.9 OFFICE MACHINERY....313
PRE.C11.292.9 COPIER-PRINTER-SCANNER EQUIPMENT....314
PRE.C11.295.9 DIGITAL CAMERAS....314
PRE.C11.300.9 ESTABLISHMENT OF ACCOMMODATION....314

RELOCATABLE OFFICE ACCOMMODATION FOR THE CM....315
PRE.C11.410.A CONTAINER OFFICE(S)....315
PRE.C11.420.9 FURNITURE, FITTINGS ETC. TO CONTAINER OFFICE(S)....315
PRE.C11.430.9 PERIOD REQUIRED....315
PRE.C11.440.9 RELOCATION....316

MAINTENANCE AND REMOVAL OF OFFICE ACCOMMODATION....316
PRE.C11.510.9 REPAINTING....316
PRE.C11.520.9 REMOVAL....316

SITE ACCOMMODATION ASSOCIATED WITH IN-SITU CONCRETING WORK....316
PRE.C11.610.9 CONTAINER OFFICE....316
PRE.C11.620.9 CONTAINER STORE ROOMS....316
PRE.C11.630.9 CONTAINER CURING ROOMS AND TANKS....317
PRE.C11.640.9 STEEL CONTAINER ROOM....317
PRE.C11.650.9 STEEL CURING TANK....317
PRE.C11.660.9 CURING TANK MAINTENANCE....318

PRE.C11.670.9 CURING RECORDS 318
PRE.C11.680.9 ACCESS BY TESTING CONTRACTOR 318
PRE.C11.690.9 ACCOMMODATION MAINTENANCE 318
PRE.C11.700.9 STEEL CONTAINERS FOR TEST SAMPLES OF BAR REINFORCEMENT/FABRIC REINFORCEMENT 319

SITE FACILITIES FOR THE CM 319
PRE.C11.810.9 GENERAL FACILITIES 319
PRE.C11.820.9 SURVEY SUPPORT 319
PRE.C11.830.9 TYPIST / CLERK 319
PRE.C11.835.9 UNINTERRUPTIBLE POWER SUPPLY 319
PRE.C11.840.9 PROVISION OF INSTRUMENTS AND EQUIPMENT GENERALLY 320
PRE.C11.850.9 RADIO COMMUNICATION SYSTEM 320
PRE.C11.860.9 SURVEY EQUIPMENT 320
PRE.C11.870.9 HYDROGRAPHIC EQUIPMENT 322
PRE.C11.880.9 DATA LOGGER UNIT 323
PRE.C11.890.9 HAND-HELD TRANSCEIVER 323
PRE.C11.900.9 PORTABLE COMPUTER EQUIPMENT 323
PRE.C11.910.9 CONSUMABLES 324

TRANSPORT FACILITIES FOR THE CM 324
PRE.C11.1010.B VEHICULAR TRANSPORT 324
PRE.C11.1020.9 CM'S MARINE TRANSPORT 326

PRE.C12 ATTENDANCE 328

SUB-CONTRACTORS, SPECIALIST CONTRACTORS AND UTILITY UNDERTAKING 328
PRE.C12.020.9 PLANNING AND PROGRAMMING GENERALLY 328
PRE.C12.030.9 PLANNING AND PROGRAMMING NOMINATED SUB-CONTRACTOR'S WORKS 328
PRE.C12.040.9 PLANNING AND PROGRAMMING UTILITY UNDERTAKING'S WORKS 329

GENERAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS, SPECIALIST CONTRACTORS AND UTILITY UNDERTAKING 329
PRE.C12.110.9 GENERAL ATTENDANCE 329
PRE.C12.120.9 FREEDOM OF MOVEMENT 330
PRE.C12.130.9 USE OF EXISTING PLANT 330
PRE.C12.140.A SPACE FOR STORAGE 330
PRE.C12.150.9 WATER AND ELECTRIC LIGHTING 330
PRE.C12.160.9 SITE CONVENIENCES 330
PRE.C12.170.9 UNLOADING 330
PRE.C12.180.9 SECURITY PROTECTION 330
PRE.C12.190.9 CLEARING AWAY RUBBISH 330
PRE.C12.200.9 REINSTATEMENT 330

SPECIAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS AND SPECIALIST CONTRACTORS 331
PRE.C12.210.9 GENERALLY 331
PRE.C12.220.9 TEMPORARY ELECTRICAL SUPPLY REQUIRED FOR TESTING 331
PRE.C12.230.9 SPECIAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS 331
PRE.C12.240.9 ATTENDANCE ON SPECIALIST CONTRACTORS OF PILING WORKS 331
PRE.C12.250.9 CONCRETE CORING AND TESTING EXCLUDING CORE TESTING OF TYPE 1(C) & TYPE 3 PILES 331
PRE.C12.260.9 NON-DESTRUCTIVE TESTS ON PILES & ULTRASONIC ECHO SOUNDER TEST FOR TYPE 3 PILE 331

PRE.C12.270.9 CORE TESTING OF TYPE 1(C) & TYPE 3 PILES 332
PRE.C12.280.9 CONFIRMATORY CORE TESTING OF FOUNDING STRATA OF TYPE 3 PILES 332
PRE.C12.290.9 PROVING BEDROCK AFTER INSTALLATION - TYPES 5 & 6 PILES 333
PRE.C12.300.9 NON-DESTRUCTIVE TESTS ON WELDS OF PILES 333
PRE.C12.310.9 LOADING TESTS OF WORKING PILES 333

PARTICULAR REQUIREMENTS OF UTILITY UNDERTAKING 333
PRE.C12.410.9 GENERAL OBLIGATIONS 333
PRE.C12.420.9 SITE PREPARATION 334
PRE.C12.430.9 ACCESS 334
PRE.C12.440.9 TRAFFIC DIVERSIONS 334
PRE.C12.450.9 SETTING OUT 334
PRE.C12.460.9 PROVISION OF TEMPORARY WORKS AREAS 334
PRE.C12.470.9 LOCATIONS OF TEMPORARY WORKS AREAS 334
PRE.C12.480.9 SPECIFIC REQUIREMENTS 335

ATTENDANCE ON CONTRACTORS TENDERING FOR SPECIALIST AND NOMINATED SUB-CONTRACT WORKS 335
PRE.C12.510.9 FACILITIES 335
PRE.C12.520.9 INFORMATION 335

GENERAL OBLIGATIONS 335
PRE.C12.610.9 REMEDIAL WORKS OR EXPENSES 335

PRE.C13 APPENDIX 1 336

COMPUTER AND IT MULTI-MEDIA FACILITIES 336
PRE.C13.A030.9 OTHER REQUIREMENTS 336

PRE.C14 APPENDIX 2 337

STANDARD FEATURE CODE FOR ENGINEERING SURVEY 337
PRE.C14.A010.9 STANDARD FEATURE CODE FOR ENGINEERING SURVEY 337

PRE.C15 APPENDIX 3 341

TECHNICAL SPECIFICATION FOR TOPOGRAPHICAL SURVEY 341
DETAIL SURVEY 341
PRE.C15.A010.9 ACCURACY FOR PLANIMETRIC DETAILS 341
PRE.C15.A020.9 ACCURACY FOR VERTICAL INFORMATION 341
PRE.C15.A030.9 PLANIMETRIC FEATURES TO BE SURVEYED 341
PRE.C15.A040.9 SPOT LEVELS 343

SURVEY RESULTS 343
PRE.C15.A110.9 SURVEY 343
PRE.C15.A120.9 DIGITAL DATA 343

PRE.C1 PROJECT PARTICULARS

PRE.C1.010.9 THE PROJECT

1. The Hong Kong Housing Authority is implementing the construction of a Public Housing Development at .....
2. This Contract comprises the ..... for the project.

PRE.C1.020.9 THE CONTRACT MANAGER

Option 1

The Contract Manager (CM) shall be the Chief Civil Engineer/…… of the Housing Department.

Option 2

The Contract Manager (CM) shall be the Chief Geotechnical Engineer/…… of the Housing Department.

Option 3

The Contract Manager (CM) shall be Messrs .....

PRE.C2 THE WORKS

PRE.C2.010.A GENERAL DESCRIPTION OF THE WORKS

The Works included in this Contract comprise:

1. The following preparatory works:
    a. Demolition of all existing building structures within the Site boundary and disposal of debris;
    b. Removal and disposal of all asbestos-containing material contained in existing building structures and other parts of the Site;
    c. Ground investigation works including drillholes and installation and monitoring of ground instruments;

    Note: In accordance with GCC Clause 9.1, this Section is "Works Subject to Excision".
2. The following temporary works:
    a. Design, construction, maintenance and removal of a temporary conveyor system and associated foundation works;
    b. Taking over, modification, maintenance and removal of a barge loading area, jetty and associated works.
3. The following earthworks:
    a. Excavation and removal of materials for the formation of approximately ..... hectare of cut platform and approximately ..... hectare of associated cut slopes;
    b. Formation of approximately ..... hectare of fill platform and road area and associated fill slopes;
    c. Disposal of surplus materials to designated and/or Instructed disposal areas and/or Contractor's tip.
4. The following slope/retaining works:
    a. Stabilisation works on slopes;
    b. Stabilisation works for boulders;
    c. Slope reinstatement and stabilisation works;
    d. Construction of boulder barriers;
    e. Construction of gabion boulder barriers;
    f. Construction of retaining walls;
    g. Construction of seawall and disposal of dredged material.
5. The following roadworks:
    a. Construction of carriageway, footpaths, lay-bys and associated road and drainage works;
    b. Realignment and widening of existing carriageways, roads, footpaths and associated drainage works.
6. Works to the following services:
    a. Construction of storm water and foul drains and sub- soil, slope and platform drainage;

b. Construction of fresh and flushing water mains;

c. Laying of fresh and flushing water mains.

7. Soft Landscaping Works:

a. Protection, transplanting and maintenance of trees;

b. Planting of trees and shrubs and associated establishment works.

8. All such works and/or services in relation to the taking care of the Works after completion as may be instructed by the CM in accordance with Clause SCC8.4 and PRE.C6.200;

9. Work outside the boundary of the Site, including:

a. Soil and surface water drainage connection works. Area ..... refers;

b. Water supply connection works. Area ..... refers;

c. Road run-in and footpath works. Area ..... refers.

10. Other Works:

All other works required under the Contract, or which may be ordered by the CM in accordance with the terms of the Contract..

PRE.C2.020.9 WORKS SUBJECT TO EXCISION

Sections which are "Works Subject to Excision" in accordance with GCC Clause 9.1 are listed in PRE.C6.205.

PRE.C2.030.9 PREPARATORY WORKS

Option 1

There are no preparatory works for this project.

Option 2

The following preparatory work has been (is being) executed under (a) previous separate contract(s):

.....

PRE.C2.040.A CONCURRENT WORKS

1. The Site is in ..... new town development area and a number of separate general infrastructure and housing development contracts are expected to be carried out concurrently with this one. The following works are scheduled to be carried out adjacent to the Site:

Contract	Anticipated Period

2. Existing squatter areas around the Site are expected to be cleared progressively during the course of the Contract.

PRE.C2.050.A COORDINATION WITH CONCURRENT WORKS

1. Other contracts are being carried out concurrently on adjoining sites as follows:

.....;

2. In accordance with GCC Clause 5.27, liaise with and coordinate and sequence the Works with the contractors for these separate contracts and with the Specialist Contractors, Government departments and Utility Undertakings engaged in the development of this and the adjoining sites, and allow for necessary time and costs in connection. The adjoining sites may include parts / Sections already completed and handed over by the Employer to following contractors. In particular, follow the following requirements:

    a. The Works in this Contract connect directly with and / or have interdependent phasing with the Works for the ..... contract. Allow for all time taken in liaison, coordination planning and programming with the separate contractors;

    b. Works by others will be carried out on and adjacent to the Site boundary. Allow for providing access for these works and for temporary shifting and reinstatement of fencing and site hoardings to suit the requirements of separate contracts.

3. Programme the works including the above utilities and services installation to suit the construction programme of adjacent ..... building contracts. Completion of the aforesaid utilities and services installations shall be deemed to be ready for connection, final inspection, testing and commissioning of the respective services / utilities serving adjacent ..... redevelopment.

PRE.C2.060.A WORKS ON STREET MAINTAINED BY THE HIGHWAYS DEPARTMENT

1. Carry out works on Street Maintained by the Highways Department at .....;

2. Render all necessary assistance to the Employer in processing any application for an Excavation Permit or any extension in respect thereof including supplying all necessary information to the CM. The information required for processing the Excavation Permit is contained in the Excavation Permit Processing Manual issued by Highways Department. The information includes but is not limited to excavation locations, detailed construction programme for permit period assessment, utilities coordination programme, temporary traffic measures and substantiations for extension of permit period etc.. Coordinate with the Utility Undertakings in compiling the utilities coordination programme and obtain approval from relevant departments on the temporary traffic measures;

3. Allow sufficient time in the programme for the Employer to obtain the Excavation Permit and that should include all activities in the application process as outlined in the Excavation Permit Processing Manual issued by Highways Department and any proposed revisions from the Contractor to those proposals already submitted by the Employer to the Designated Authority for applying the Excavation Permit;

4. Comply with the conditions of the Excavation Permit in the capacity of the Nominated Permittee and assist the Employer and the CM to comply with the same. Ensure all safety precautions are carried out to protect the public and that all works are carried out in such a manner as to cause as little inconvenience as possible to the public. Ensure that existing utilities are not damaged, temporary traffic arrangements are properly implemented, vehicular and pedestrian accesses are maintained, working sites are not left unattended, the Site is kept clean at all times, road works reinstatements and their maintenance are carried out in accordance with the conditions of the Excavation Permit. Carry out all remedial works for road works reinstatements within 12 months from the date of submission of a Completion Notice under the Excavation Permit and bear all associated costs and time;

5. Ensure that sufficient site supervising personnel are provided to supervise the works on Street Maintained by the Highways Department in particular on site safety. At least 4 weeks before commencement of the works on Street Maintained by the Highways Department, submit a supervision plan documenting the supervision system which should include detailed information on how to supervise, monitor and prevent the Contractor's personnel from committing an act or making an omission in contravention of the Land (Miscellaneous Provisions) Ordinance (CAP. 28) and the conditions of the Excavation Permit. The supervision plan shall outline all safety precautions including excavation support details to protect the public from any danger or injury during execution of works on Street Maintained by the Highways Department. The supervision plan and the information contained in the plan shall be acceptable to the CM. The consent by the CM of any such particulars shall not relieve the Contractor of any duty or responsibility under the Contract and any liability under the Land (Miscellaneous Provisions) Ordinance (CAP. 28);
6. Appoint a competent person to supervise all works on Street Maintained by the Highways Department and to ensure that the supervision plan is adhered to. The competent person shall be a registered professional or a safety officer as defined in Section 10T of the Land (Miscellaneous Provisions) Ordinance (CAP. 28). The competent person shall be full time on Site for supervision of the works on Street Maintained by the Highways Department;
7. Construct run-in and run-out in compliance with Highways Department's standards at the proposed site entrance and exit respectively. When no longer required, remove the run-in and run-out and reinstate the affected road and footpath to the CM's satisfaction and bear all associated costs and time.

PRE.C2.070.A WORKS BY NOMINATED SUB-CONTRACTORS

No Works will be carried out by Nominated Sub-contractors in this Contract.

PRE.C2.080.A MATERIALS BY NOMINATED SUB-CONTRACTORS

No materials will be supplied by Nominated Sub-contractors in this Contract.

PRE.C2.090.9 SPECIALIST WORKS BY SPECIALIST CONTRACTORS

The following Specialist Works will be carried out by Specialist Contractors employed direct by the Employer and/or Housing Department Materials Testing Laboratory:

	Estimated Value (HK$)
1. Site Investigation.	.....
2. Non-destructive tests on piles including Pile Driving Analyser Test, Pile Integrity Test and Sonic Logging Test.	.....
3. Non-destructive test on welds.	.....
4. Coring of Concrete and testing of concrete cores.	.....
5. Landscaping.	.....
6. Tests on concrete materials and workmanship, (Cube tests, slump tests etc. as detailed in Worksection EXT2) excluding coring of concrete and testing of concrete cores.	.....
7. Tests on reinforcement steel, structural steelwork and steel pile samples.	.....

8. TV survey to completed underground drainage work.	.....
9. Static pile loading tests on working piles.	.....
10. Confirmatory core test of founding strata of Type 3 piles (this test is also required to be carried out by approved Ground Investigation Contractor employed by the Contractor).	.....
11. Proving bedrock after installation of Types 5 & 6 piles.	.....
12. Ultrasonic Echo Sounder Test for Type 3 piles (this test is also required to be carried out by Approved Laboratory employed by the Contractor).	.....

PRE.C2.100.9 SPECIALIST WORKS BY GOVERNMENT DEPARTMENTS AND UTILITY UNDERTAKING

The following Specialist Works will be carried out by Government Departments and Utility Undertaking:

	Estimated Value
Laying of water mains	$
Laying of towngas mains	$
Laying of electricity mains	$
Laying of telephone mains	$
Landfill gas monitoring	$
Laying of cable communication mains	$

PRE.C2.110.9 GROUND INVESTIGATION WORKS

1. For all ground investigation works required under the Contract, employ a Ground Investigation Contractor, who shall have been registered under the Housing Authority List of Ground Investigation Contractors and the BD's List of RSC(GIFW), to carry out the works;
2. Unless otherwise specified, the Ground Investigation Contractor shall carry out all ground investigation works in accordance with the following requirements:
   a. Carry out the works in accordance with the recommendations, methods and procedures described in 'Geoguide 2: Guide to Site Investigation', Hong Kong Government, 2017, unless otherwise specified;
   b. In the logging and reporting of the works, adopt all material descriptions, classifications, symbols and definitions of terms in accordance with 'Geoguide 3: Guide to Rock and Soil description', Hong Kong Government, 2017, unless otherwise specified;
   c. Provide Technically Competent Persons (TCP) for ground investigation field works (GIFW), who shall comply with the minimum requirements on the qualifications and experience required for each grade of TCP for GIFW set out in the TMSP and the CoPSS, to carry out supervision of the GIFW in accordance with the supervision requirements stated in the TMSP and CoPSS regarding RSC(GIFW);

d. Engage a Competent Person (Logging), who shall comply with the minimum requirements on the qualifications and experiences required for the Competent Person (Logging) set out in the CoPSS, to carry out logging of samples and preparation of borehole logs;

e. Comply with the administration procedures for GIFW set out in the CoPSS, including completing and submitting prescribed plans and relevant ICU Forms to be specified by the CM;

f. The reports on the works shall contain a certificate signed by the Authorized Signatory of the Ground Investigation Contractor confirming the standards of works carried out. Detailed requirements for the certification shall comply with the CoPSS;

g. Store all drill hole cores and samples properly in core boxes/containers and protected them from the weather to the satisfaction of the CM and in such a manner that inspection of the cores can easily be made.

3. The number of Ground Investigation Contractor shall be limited to one unless otherwise approved by the CM;

4. Submit to the CM the name of the Ground Investigation Contractor and the names of the personnel provided in accordance with sub-clauses (2)(c) and (2)(d) above;

5. Incorporate the following conditions into the contract between the Contractor and the Ground Investigation Contractor:

a. Assignment of ground investigation works by the Ground Investigation Contractor is forbidden;

b. A probity clause which shall be drafted for the respective contract in similar wording as given in the following sample clause:

"If the Ground Investigation Contractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Employer (i.e. the Contractor), agents or employees or members of Hong Kong Housing Authority, or employees of Hong Kong Special Administrative Region working in the Housing Department, the Employer shall be at liberty forthwith terminate the employment of the Ground Investigation Contractor under the Contract and to hold the Ground Investigation Contractor liable for any loss or damage which the Employer may thereby sustain."

SITE FORMATION WORKS

PRE.C2.120.9 SITE FORMATION WORKS

1. For all Site Formation Works required under the Contract, employ a Site Formation Contractor, who shall have been registered under the BD's List of RSC(SF) and DEVB's List of LANP, to carry out the works;

2. The Site Formation Contractor shall:

a. Complete and submit SP for Site Formation Works in accordance with PRE.C9.2010;

b. Complete and submit Form ICU 10 in accordance with PRE.C9.2010;

c. Carry out supervision of the Site Formation Works in accordance with the submitted supervision plan, relevant PNAPs, PNRCs and etc.;

d. Complete and submit Form ICU 14 together with all test / assessment reports, monitoring results and as-built record plans for the Site Formation Works as required under the Contract upon completion of the Site Formation Works.

3. The number of Site Formation Contractor employed shall be limited to one unless otherwise approved by the CM;

4. Submit to the CM the name of the Site Formation Contractor and the names of the personnel provided in accordance with the Contract for Site Formation Works;

5. Incorporate the following conditions into the contract between the Contractor and the Site Formation Contractor:

   a. Assignment of Site Formation Works by the Site Formation Contractor is forbidden;

   b. A probity clause which shall be drafted for the respective contract in similar wording as given in the following sample clause:

      "If the Site Formation Contractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Employer, agents or employees or members of Hong Kong Housing Authority, or employees of Hong Kong Special Administrative Region working in the Housing Department, the Employer shall be at liberty forthwith terminate the employment of the Site Formation Contractor under the Contract and to hold the Site Formation Contractor liable for any loss or damage which the Employer may thereby sustain."

PRE.C3 THE SITE

PRE.C3.010.9 SITE LOCATION

The Site is at ....., as indicated on Drawing No. .....

PRE.C3.020.A SITE DEFINITION

1. The boundary of the Site as defined by the Conditions of Contract is delineated on Drawing No. .....;
2. The boundaries of the Site and each Portion and Section shown on the Drawings are approximate only;
3. The exact boundaries will be confirmed on Site by the CM;
4. The Site includes the "works areas" and "borrow areas", if any, indicated on the Drawings and includes such other areas of roads, footpaths and lands which, in the opinion of the CM are necessary for the execution of theWorks.

PRE.C3.030.9 SITE AVAILABILITY

The Site will be made available to the Contractor free of charge for the purpose of the Contract.

PRE.C3.040.9 ADDITIONAL AREAS

Option 1

1. The Contractor may apply to the CM in writing for an additional area to be included in the Site;
2. If, in the opinion of the CM, such an additional area is required to meet special circumstances which have arisen due to a change in the extent or nature of the works then if a suitable area is available, the CM shall arrange for the area to be allocated to the Contractor free of charge;
3. Other than in accordance with the provisions of this clause, the Contractor shall make his own arrangement for any additional area he requires.

Option 2

1. Additional Works Area and / or Borrow Area(s) as delineated on Drawing No. ..... will be made available to the Contractor, if required, free of charge but availability cannot be guaranteed beyond .....;
2. The Area(s) must be cleared and returned to the Employer within two weeks of the CM's instruction to that effect.

PRE.C3.050.9 LIMITATIONS OF WORKING AREAS

1. Limitations of working area and storage spaces are as shown on Drawing No. .....;
2. Confine material storage, plant, equipment and stockpiles of excavated materials and any other temporary works to the working areas of the Site. No dumping of debris, stockpiling of excavated materials, nor any other temporary structures, huts, workshops, etc. shall be allowed outside the working areas of the Site;
3. Make allowance in the programme and work sequence to cater for these limitations.

PRE.C3.060.9 GEOLOGICAL INFORMATION

1. Tenderers may make preliminary investigations as they require and at their own cost. Arrangements can be made as noted in the Special Conditions of Tender on an application to the CM;
2.
    a. Certain logs of exploratory boreholes previously made on site and reports of laboratory soil test results are available for inspection by appointment at the CM's office during normal working hours;
    b. Copies of the logs may be made available to tenderers upon their application to the CM in writing and subject to payment of a charge for photocopying.
3. The above information is given in good faith for reference only and is not meant to be exhaustive or to be representative of the whole or any part of the Site or in any way limiting the obligations and liabilities of the Contractor under the Contract. No guarantee can be given nor responsibility be taken by the Employer or the CM for their accuracy, consistency or sufficiency, and no claim whatsoever will be entertained on account of any errors, discrepancies and insufficiency in relation to the information given;
4. The onus is on the Contractor to satisfy himself as to the nature of the Site sub-soil conditions and to make any site investigation to obtain all information which may affect the Works. No claim whatsoever will be considered arising from the Contractor pleading ignorance of the Site;
5. Where specific additional soil investigation work is required by the CM, these will be part of the Works.

PRE.C3.070.9 HIGH WATER LEVELS

1. This Site is close to the sea waterfront and works for ..... may be required to be carried out below high water levels;
2. The Contractor will be required to obtain a copy of the times and heights of high and low water for Hong Kong, adjusted as necessary for .....;
3. Notwithstanding the published tide tables, which indicate the maximum high water level, the Contractor should also satisfy himself of the abnormal high tide build up above these levels that can occur in this area due to extreme weather conditions.

PRE.C3.080.9 EXISTING FACILITIES

1. The existing facilities (carriageway, footpaths, drainage) of ..... area for the Works are shown on Drawings No. ..... The above information is given in good faith for reference only and is not meant to be exhaustive or to be representative of the whole or any part of the Site or in any way limiting the obligations and liabilities of the Contractor under the Contract. No guarantee can be given nor responsibility be taken by the Employer or the CM for their accuracy, consistency or sufficiency, and no claim whatsoever will be entertained on account of any errors, discrepancies and insufficiency in relation to the information given;
2. Any such facilities as indicated are to be maintained in operation at all times during the Contract. The Contractor is to ensure that any temporary diversion complies with relevant Regulations and is to obtain the CM's Approval of the proposed routing before any diversion works are carried out.

PRE.C3.090.A EXISTING RIGHTS OF WAY

Option 1

1. There is an existing right-of-way between ……..... and ..... Maintain at all times, either the existing or approved diverted right-of-way in a safe and clean condition;
2. Do not use the right-of-way, except when carrying out the works in connection with it.

Option 2

1. The portions of ..... Street, ... Street, ... Path, ... Street ..... Street and ..... Street are public roads within the Site which will be used by others;
2. Provide and maintain at all times for the duration of the Contract a safe and clean pedestrian and vehicular access on these roads;
3. Provide all necessary lighting, hoarding, pedestrian crossing points and the like;
4. The Contractor shall have no exclusive right to the use of these roads;
5. Free access shall be made available at all times for the public and for staff and/or contractors of Government departments and/or Utility Undertakings and/or parties authorised by the CM to carry out operation, maintenance and repair works to existing utility services along these roads.

PRE.C3.100.A EXISTING BUILDINGS

Attention is drawn to the following buildings adjacent to or abutting on the Site: .....

PRE.C3.110.A EXISTING SERVICES

Option 1

1. The following utilities services, drains etc. are known to be within the Site (See also PRE.C9.1610 to PRE.C9.1700) .....

Option 2

1. Plan(s) indicating known existing underground utilities / services may be viewed at the CM's office during normal office hours by prior appointment (See also PRE.C9.1610 to PRE.C9.1700);
2. The Contractor shall at his own cost and time carry out utilities / services investigation survey to:
   a. Verify the alignments, extent and invert levels of any existing utilities / services within the Site and its vicinity;
   b. Identify the locations and alignments of potential clashes of existing utilities / services with the Works during the utilities / services investigation survey;
   c. Take necessary precautionary measures to avoid causing disturbances and damage to existing utilities / services during the utilities / services investigation survey.
3. The Contractor shall submit the methodology, arrangement, programme and details of the utilities / services investigation survey to the CM for review and to incorporate the CM's comments before implementation. The survey methodology may include but not be limited to all or any combination of the following:
   a. Obtain the latest information of existing underground utilities / services installation from Utility Undertakings and Government departments immediately at commencement of the Works;

b. Locate existing underground utilities / services by visual inspection of surface features such as manhole and utility pit covers, etc.;

c. Carry out survey using methods such as electromagnetic detection methods and ground probing radar in areas where non-destructive means are required to investigate potential clashes of existing utilities/services with the Works;

d. Carry out trial pit and / or trenching works at a scale sufficient for locating the existing utilities / services;

e. Carry out additional investigation by trial pit and / or trenching works as directed by the CM;

f. Verify and agree with Government departments and Utilities Undertakings on the alignment and extent of the existing underground utilities / services.

4. The Contractor shall complete all utilities / services survey investigation including submission of reports, record drawings and photographs of the survey findings within …… months from the date of possession of the Site or Portions thereof and reinstate the affected areas of the Site or Portions thereof to the CM's satisfaction;

5. The Contractor is required to identify and locate any existing and live public utilities / services including surface and underground drainage systems within the Site, to be responsible for protecting them from being damaged, and to alter and adapt his works to suit. No claims for costs, time or whatsoever will be entertained by the Employer for any difference between the existing utilities / services shown on the drawings and those actually found on the Site;

6. The Contractor shall note that the extent and locations of existing utilities / services may render conventional trench excavation impracticable and require unconventional method such as hand-dug tunnelling to suit the actual site conditions in the construction of the drainage works. The Contractor shall allow sufficient time for such unconventional method of excavation in their programme for implementing the required temporary works and construction sequence for the Works. No claims for costs, time or whatsoever in this connection will be entertained by the Employer. Hand-dug tunnelling shall comply with the latest Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department.

   The following terms used in the Guidance Notes shall be construed as follows for the purpose of the Specification:

Term used in the Guidance Notes	Terms in the Specification
the proprietor	Direct Contractor
project engineer	Qualified Engineer
contractor	Contractor

7. The above information is given in good faith for reference only and is not meant to be exhaustive or to be representative of the whole or any part of the Site or in any way limiting the obligations and liabilities of the Contractor under the Contract. No guarantee can be given nor responsibility be taken by the Employer or the CM for their accuracy, consistency or sufficiency, and no claim whatsoever will be entertained on account of any errors, discrepancies and insufficiency in relation to the information given.

PRE.C3.120.9 ACCESS TO THE SITE

1. Access route, access points, entry into and exit from the Site and the suitability of such shall be the responsibility of the Contractor;
2. The Contractor's attention is drawn to Worksection MAR as regards marine access.

PRE.C4 POSSESSION AND COMPLETION

PRE.C4.010.A PHASED POSSESSION OF THE SITE

Option 1

There are no special provisions for phased possession of the Site in Portions for this Project.

Option 2

1. In accordance with GCC Clause 8.2, possession of the Site will be given in Portions at the following times and in the following order:
   a. Portion A for ..... - available at the notified date for commencement of the Works;
   b. Portion B for ..... - available no later than ..... months after the notified date for commencement of the Works;
   c. Portion C for ..... - available upon completion of ..... by the Contractor but no earlier than ..... months after the notified date for commencement of the Works;
   d. The Portions are approximately indicated on Drawing No. .....;
   e. Area(s) ..... - available at the commencement date specified in the Excavation Permit issued by Highways Department or other duly constituted authority.
2. Existing squatter areas within Portion…… as shown on Drawing No. ..... will be vacated progressively prior to handover of that Portion to the Contractor for commencement of relevant Works.

PRE.C4.015.9 DATES FOR COMMENCEMENT OF SECTIONS

Option 1

There are no special requirements for phased commencement of the Works in Sections for this Contract.

Option 2

In accordance with GCC Clause 8.1, the dates for commencement of the following Sections are not the same as the notified date for commencement of the Works. The notified dates for commencement of such Sections shall be as follows:

1. Section……..... for …….. shall have a date for commencement within …….months of the notified date for commencement of the Works. The date for commencement of the Section shall be as notified in writing by the CM;
2. Section……. for ……..…… shall have a date for commencement within …….months of the notified date for commencement of the Works. The date for commencement of the Section shall be as notified in writing by the CM.

PRE.C4.020.9 RESTRICTIONS ON COMMENCEMENT

The Contractor's attention is drawn to the following restrictions on commencement of parts of the Works:

1. The ..... Works as in Section ..... are "Works Subject to Excision" and commencement will be subject to an instruction given in accordance with GCC Clause 9.1 no later than ..... months after the notified date for commencement of the Works;
2. Do not commence the ..... in the ..... until at least ..... months after the notified date for commencement of the Works;
3. Design and complete the temporary boulder barrier fence in ..... of the Site in accordance with clause PRE.C..... before the stabilisation works are commenced;
4. Working drawings for the construction of the fresh and flushing water mains included in this Contract will be issued to the Contractor not later than ..... months after the notified date for commencement of the Works. No work including ordering of materials or anything in connection with this part of the Works shall be carried out until such Drawings have been issued by the CM;
5. Reinforced concrete detailed drawings for any reinforced concrete structures will be issued to the Contractor at times to suit the Contractor's programme and progress of the Works, but in any event no sooner than ..... months after the notified date for commencement of the Works.

PRE.C4.021.9 RESTRICTIONS ON COMMENCEMENT OF SITE FORMATION WORKS

Attention is drawn to the following restrictions on commencement of Site Formation Works:

1. Commencement of the Site Formation Works is subject to the CM's written permission, which shall be obtained as follows:
   a. Submit SP for the Site Formation Works in accordance with PRE.C9.2010;
   b. Apply for the CM's written permission to commence the Site Formation Works at least 22 days before the commencement of the Site Formation Works. CM's written permission will not be granted before the SP as per sub-clause (a) has been submitted;
   c. Complete and submit Form ICU 10 for commencing the Site Formation Works to the CM at least 14 days prior to the commencement of the Site Formation Works.
2. Programme the Works by taking into account of the submissions required under the above sub-clauses.

PRE.C4.028.9 REPORT ON COMPLETION OF SITE FORMATION WORKS

Complete and submit Form ICU 14 together with all test/assessment reports, monitoring results and as-built record plans for the Site Formation Works as required under the Contract upon completion of the Site Formation Works.

PRE.C4.030.9 RESTRICTIONS ON COMMENCEMENT OF PILE INSTALLATION AND / OR FOOTING CONSTRUCTION AND / OR ELSW

1. Commencement of pile installation and / or footing construction is subject to the CM's written permission which shall be obtained as follows:
   a. Submit the piling and / or footing design in accordance with PIL1.D210;
   b. Submit Supervision Plan (SP) in accordance with PRE.C9.2010;
   c. Apply for the CM's written permission to commence pile installation and / or footing construction at least 22 days before the commencement of pile installation and / or footing construction. CM's written permission will not be given before:

i. The piling and / or footing design as per sub-clause (a) has been Approved;

ii. The conditions imposed by the CM in the approval of the piling and / or footing design have been fulfilled;

iii. The SP as per sub-clause (b) has been submitted;

iv. The hoarding and gantries works specified in the Specification have been completed.

d. Complete and submit Form ICU 10 for commencing the pile installation and / or footing construction to the CM at least 14 days prior to the commencement of the pile installation and / or footing construction.

2. Commencement of pile installation and / or footing construction is subject to the CM's written permission which shall be obtained as follows:

a. Submit Supervision Plan (SP) in accordance with PRE.C9.2010;

b. Submit proposal of method statement for pile installation and / or footing construction for Approval;

c. Apply for the CM's written permission to commence pile installation and / or footing construction at least 22 days before the commencement of pile installation and / or footing construction. CM's written permission will not be given before:

i. The SP as per sub-clause (a) has been submitted;

ii. The proposed method statement as per sub-clause (b) has been Approved;

iii. The hoarding and gantries works specified in the Specification have been completed.

d. Complete and submit Form ICU 10 for commencing the pile installation and / or footing construction to the CM at least 14 days prior to the commencement of the pile installation and / or footing construction.

3. Commencement of the part(s) of piling and / or footing works affected by amendment of piling and / or footing design is subject to the CM's written permission which shall be obtained as follows:

a. Submit the amendment of piling and / or footing design in accordance with PIL1.D220;

b. Apply for the CM's written permission to commence the part(s) of piling and / or footing works affected by amendment of piling and / or footing design at least 22 days before the commencement of such works. CM's written permission will not be given before the amendment of piling and / or footing design as per sub-clause (a) has been Approved.

4. Commencement of the ELSW is subject to the CM's written permission which shall be obtained as follows:

a. Submit ELSP in accordance with EAR1.D030;

b. Submit SP in accordance with PRE.C9.2010;

c. Apply for the CM's written permission to commence ELSW at least 22 days before the commencement of ELSW. CM's written permission will not be granted before:

i. The ELSP as per sub-clause (a) has been Approved;

ii. The conditions imposed by the CM in the approval of the ELSP have been fulfilled;

iii. The SP as per sub-clause (b) has been submitted;

iv. The hoarding and gantries works specified in the Specification have been completed.

d. Complete and submit Form ICU 10 for commencing ELSW to the CM at least 14 days prior to the commencement of ELSW.

5. Programme the Works by taking into account of the submissions that may be required under the above sub-clauses.

PRE.C4.040.9 RESTRICTIONS ON COMMENCEMENT OF CONSTRUCTION OF PILE CAPS

1. Commencement of pile caps construction is subject to CM's written permission which shall be obtained as follows:

   a. Make all necessary submissions in accordance with …….. including Form ICU14;

   b. Submit the pile cap design in accordance with PIL1.D830;

   c. Submit Supervision Plan (SP) in accordance with PRE.C9.2010;

   d. Apply for CM's written permission to commence pile caps construction at least 22 days before the commencement of pile caps construction. CM's written permission will not be given before:

      i. The submissions as per sub-clause (a) have been Approved and the proof test results comply with the Specification's requirements;

      ii. The pile cap design as per sub-clause (b) have been Approved;

      iii. The conditions imposed by the CM in the approval of the pile cap design have been fulfilled;

      iv. The SP as per sub-clause (c) has been submitted.

   e. Obtain CM's written permission to proceed with the construction of pile caps on a block by block basis unless otherwise agreed by the CM.

2. Commencement of the part(s) of pile cap works affected by amendment of pile cap design is subject to CM's written permission which shall be obtained as follows:

   a. Submit the amendment of pile caps design to the CM at least 42 days before the commencement of the part(s) of pile cap works affected by the amendment of pile cap design. Allow a further 42 days for each re-submission;

   b. Apply for CM's written permission to commence the part(s) of pile cap works affected by the amendment of pile cap design at least 22 days before the commencement of such works. CM's written permission will not be given before the amendment of pile cap design as per sub-clause (a) has been Approved.

3. Programme the Works by taking into account the submissions and any re-submissions as may be required under the above sub-clauses.

PRE.C4.050.9 RESTRICTIONS ON COMMENCEMENT OF GROUND INVESTIGATION FIELD WORKS

1. Commencement of ground investigation field works (GIFW) is subject to the CM's written permission which shall be obtained as follows:

   a. Submit Supervision Plan (SP) for the GIFW in accordance with PRE.C9.2010;

   b. Apply for the CM's written permission to commence the GIFW at least 22 days before the commencement of the GIFW. CM's written permission will not be given before the SP as per sub-clause (a) has been submitted;

c. Complete and submit Form ICU 10 to the CM for commencement of ground investigation field works at least 14 days before the commencement of the ground investigation field works.

2. Programme the GIFW by taking into account the submissions required under the above sub-clauses.

PRE.C4.060.9 TIME FOR COMPLETION

In accordance with GCC Clause 8.3 the time for completion of the whole of the Works, but excluding any works and / or services in relation to taking care of the Works after completion, is ..... weeks.

PRE.C4.070.9 SECTIONS FOR PHASED COMPLETION

Option 1

There are no special provisions for phased completion of the Works in Sections for this Contract.

Option 2

Phase the completion of the Works in the following Sections as indicated on Drawing No .....

Section	Time for completion (from and including the notified date for commencement of the Works unless otherwise stated)
1. Section 1 comprising	- ..... weeks
2. Section 2 comprising	- ..... weeks
3. Section 3 comprising	- * from and including the date of possession of Area ..... and for the validity period specified in the Excavation Permit
4. Section 4 comprising ……..	- …….. weeks from and including the notified date for commencement of Section 4

5. Remaining Works - ..... weeks

Completion of any Section shall be required to include completion of associated drainage and other ancillary works and satisfactory testing as necessary for handover to the Employer for commencement of work by the following Contractor.

* Completion of the Section shall be conditional upon the passing of final tests and inspections prescribed by the Specification and the completion of any remedial work arising from such tests and inspections.

PRE.C4.080.9 PARTS FOR PHASED COMPLETION

The Contractor's attention is drawn to the following requirements for phasing and completion of parts of the Works:

1. The Contractor is required to complete the ..... in the ..... within ..... weeks from and including the notified date for commencement of the Works;
2. Special requirements for phasing the Works to suit Nominated Sub-contractors and Specialist Contractors are given in PRE.C12.

PRE.C4.090.9 RELEASE OF SITE ON COMPLETION

The Contractor will not be permitted to retain possession of any area within the Site after the issue of the certificate of completion unless otherwise specified in the Contract.

PRE.C5 THE CONTRACT

CONDITIONS OF CONTRACT

PRE.C5.010.9 GENERAL CONDITIONS OF CONTRACT

The General Conditions of Contract are the “Hong Kong Housing Authority General Conditions of Contract for Civil Engineering Works 2013 Edition (version 1.1)".

PRE.C5.020.9 SPECIAL CONDITIONS OF CONTRACT

The Special Conditions of Contract are as scheduled and detailed in the "Contract booklet" for this Contract.

CONTRACT TERMINOLOGY

PRE.C5.110.9 CONTRACT DEFINITIONS

All definitions in the General Conditions of Contract and Special Conditions of Contract also apply to this Specification unless otherwise defined.

PRE.C5.115.9 EMPLOYER

The Employer is the Hong Kong Housing Authority, as defined in the Conditions of Contract, and may be referred to in this Specification as "The Authority" or "Housing Authority".

PRE.C5.120.9 CONTRACT MANAGER (CM)

Where any reference is made in the Contract Documents to 'Engineer', it shall have the same meaning as 'Contract Manager'.

PRE.C6 INFORMATION REQUIRED BY CONDITIONS OF CONTRACT

GENERAL CONDITIONS OF CONTRACT

PRE.C6.010.9 STATUS

The information given in clauses PRE.C6.030 and PRE.C6.130 is to be read in conjunction with the General Conditions of Contract and is to form part of the Contract.

PRE.C6.020.A LOCATION OF INFORMATION PROVIDED

A quick reference to key information detailed elsewhere in the Contract is given below:

GCC Clause No.			Information detailed
1.1	Maintenance Period	✸	Form of Tender
5.3	Amount of Bond (On-demand Bond)	✸	Form of Tender
8.1	Period of time after the date of the Letter of Acceptance within which the notified date for commencement shall occur	✸	Form of Tender
8.1	Date for commencement of Sections		Specification clause PRE.C4.015
8.2	Extent of Portions of the Site for possession		Specification clause PRE.C4.010
8.3	Time for completion of the Works	✸	Form of Tender
	Time for completion of earlier sections (Refer to PRE.C4.070 and PRE.C4.080)	✸	Form of Tender
8.6	Amount of liquidated damages for the Works	✸	Form of Tender
	Amount of liquidated damages for each Section	✸	Form of Tender
14.2(1)	Percentage of certified value retained	✸	Form of Tender
14.2(1)	Limit of retention money	✸	Form of Tender

✸ = Appendix to Form of Tender

PRE.C6.025.N GCC 2.1 - DUTIES AND POWERS OF THE CONTRACT MANAGER AND THE CONTRACT MANAGER'S REPRESENTATIVE

The information as referred to in GCC Clause 2.1(6) that the CM shall have the power to order the Contractor to provide which in the opinion of the CM is relevant to the CM's execution of his duties under the Contract may include but not be limited to the types of information and records as specified in Worksection PRE.C6.

PRE.C6.030.9 GCC 3.1 -ASSIGNMENT

Submit details to support an application for the assignment of the Contractor's financial benefit in the Contract in accordance with GCC Clause 3.1(2) as follows:

1. Written confirmation that the assignment is for financing the execution and completion of the Works under the Contract;
2. Written confirmation from the financial institution to which the benefit is to be assigned that it is a bank with a Full Banking Licence in Hong Kong under the Banking Ordinance and its Full Banking Licence number;
3. Written confirmation that the Contractor and the financial institution will enter into a Deed of Assignment in the terms and conditions approved by the Employer.

PRE.C6.040.C GCC 3.2 - SUB-CONTRACTING

1. The trade contractors registration scheme referred to in GCC Clause 3.2(10)(a) means the Registered Specialist Trade Contractors Scheme administered by CIC. The latest version of the Registered Specialist Trade Contractors Scheme as may be revised and promulgated by CIC from time to time throughout the course of the Contract shall apply to the Contract;
2. For the purpose of GCC Clause 3.2(10), if a sub-contractor is registered under a trade as a Group 1 contractor in the Register of Specialist Trade Contractors and if the value of the relevant sub-contract exceeds the tender limit of Group 1 contractors of the trade under the Registered Specialist Trade Contractors Scheme, the sub-contractor shall have been admitted into Group 1 (Advanced) or Group 2 before the commencement of the works under the relevant sub-contract; and if a sub-contractor is registered under a trade as a Group 1 (Advanced) contractor in the Register of Specialist Trade Contractors and if the value of the relevant subcontract exceeds the tender limit of Group 1 (Advanced) contractors of the trade under the Registered Specialist Trade Contractors Scheme, the sub-contractor shall have been admitted into Group 2, before the commencement of the works under the relevant sub-contract;
3. The Contractor shall submit a Sub-contractors Management Plan to the CM within 30 days of the date of the Letter of Acceptance. Update such Sub-contractors Management Plan on a quarterly basis during the currency of the Works until the date of certified completion of the Works. The first quarter shall commence from the expiry of the month in which such Sub-contractors Management Plan was submitted to the CM. Submit any updated Sub-contractors Management Plan within one month from the expiry of the quarter;
4. Should there be any changes in the sub-contracting arrangements at any time before the next quarterly submission is due, notify the CM forthwith of such changes in writing. Such notification shall not affect the obligation to submit an updated Sub-contractors Management Plan under sub-clause (3) above. In the event that there are no changes to the sub-contracting arrangements in any one quarter, notify the CM of the same and no updated submission for such quarter will be required to be made;
5. Any Sub-contractors Management Plan or updated Sub-contractors Management Plan submitted under sub-clause (3) above shall contain such detailed information as required by the "Guidelines on Scope and Contents of the Sub-contractors Management Plan" in APPENDIX PRE.C6/I to this Worksection, and the latest "Contractor's Guideline on Wage Monitoring System" published by HA;

6. The CM may, upon receipt of any Sub-contractors Management Plan or updated Sub-contractors Management Plan, provide his comments on such plan. Amend or revise forthwith such Sub-contractors Management Plan or updated Sub-contractors Management Plan upon receipt of such the CM's comments, to the satisfaction of the CM. The CM shall have no obligation to comment or approve any Sub-contractors Management Plan or updated Sub-contractors Management Plan;

7. The Contractor shall, upon written request by the CM, produce to the CM documentary proof to demonstrate to the satisfaction of the CM that the Contractor has complied with all the provisions in the latest Sub-contractors Management Plan. Such documentary proof shall include, but is not limited to, documents of sub-contracts, reports from sub-contractors on their further sub-contracting arrangement and daily attendance records of site workers. For the purpose of determining the extent of documentary proof, the CM may make reference to the "Guidelines on Documentary Proof to Demonstrate the Compliance of the Provisions in the Sub-contractors Management Plan" in Annex 2 to APPENDIX PRE.C6/I to this Worksection. The CM may make as many separate written requests as he thinks fit. The provisions of this sub-clause shall be without prejudice to other provisions under this Clause;

8. For the purpose of sub-clauses (3) to (7), the term "Sub-contractors" in Sub-contractors Management Plan means all types of sub-contractors irrespective of the tiers and including but not limited to Nominated Sub-contractors;

9. The following prohibition on sub-contracting the Works or any part thereof shall apply:

    a. Do not sub-contract the provision of management / site supervision team as specified in the Contract;

    b. Do not sub-contract to a single sub-contractor for the provision of labour and materials or labour only to the Works after excepting the works undertaken by the Nominated Sub-contractors and the provision of management / site supervision team. For the purpose of this clause, separate sub-contracting of works on a piece-work basis to the same sub-contractor will be considered as a whole.

10. In the event that any part of the Works is to be sub-contracted, the sub-contracting of any part of the Works by the Contractor shall be limited as follows:

    a. sub-contracting of any part of the Works requiring entry of human beings into confined space, the same meaning adopted in the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE), that forms part of a sewerage or drainage system *or any part of the Works involving …... shall be limited to the first tier of sub-contracting;

    b. sub-contracting of any part of the Works involving site formation works shall be limited to the first tier of sub-contracting;

    c. sub-contracting of any part of the Works not falling under sub-clauses (10)(a) and (10)(b) above shall be limited to two tiers (i.e. the first tier and second tier) of sub-contracting.

11. For the purpose of sub-clause (10) where any part of the Works is to be sub-contracted, the first tier of sub-contracting means the sub-contracts between the Contractor and his sub-contractors and the first tier sub-contractor refers to the sub-contractor of the first tier of sub-contracting. The second tier of sub-contracting means the sub-contracts between the first tier sub-contractor and his sub-contractor;

12. Further to sub-clause (10),

a. The Contractor may submit a proposal to the CM for an extra tier of sub-contracting for any part of the Works which has been sub-contracted in compliance with the limit in sub-clauses (10)(a), (10)(b) or 10(c), whichever is applicable;

b. The CM shall not be obliged to consider the Contractor's proposal for an extra tier of sub-contracting unless the proposal is submitted in writing to the CM at least 14 days before the sub-contractor of the relevant tier of sub-contracting enters into any sub-contract for the extra tier of sub-contracting and the proposal is accompanied by an explanation with supporting evidence on the need for the extra tier of sub-contracting;

c. The rejection or acceptance of the Contractor's proposal for any reason by the CM shall not entitle the Contractor to any extension of time or additional payment nor does it relieve the Contractor from any liability or obligation under the Contract.

13. The following parts of the Works are to be executed by the contractors included on the appropriate approved lists:

a. Landscaping (Hydroseeding and Tree Transplanting);

b. Ground Investigation Field Work;

c. Asbestos Removal;

d. Land Piling Works (including foundation design);

e. Supply of Bituminous Pavement Materials and Construction of Special Bituminous Surfacing;

f. Site formation works;

g. Demolition works.

14.

a. The works listed in sub-clause (13)(a) above shall be carried out by approved listed contractors in the appropriate category in the Works Branch Development Bureau List of Approved Suppliers of Materials and Specialist Contractors for Public Works and from the prevailing "Housing Authority List of Soft Landscape Contractors Groups 1 or 2";

b. The works listed in sub-clause (13)(b) above shall be carried out by approved listed contractors registered under the Housing Authority List of Ground Investigation Contractors and the Building Department's List of Registered Specialist Contractor in the Ground Investigation Field Works Category;

c. The works listed in sub-clause (13)(c) above shall be executed by contractors included in the Register of Asbestos Contractors kept by Environmental Protection Department;

d. The works listed in sub-clause (13)(d) above shall be carried out by a contractor who is on the appropriate Category of Housing Authority List of Piling Contractors as follows:

i. Type 1, 2 & 4 Piles - Percussive Piles Category;

ii. Type 3 Pile - Large Diameter Bored Piles Category;

iii. Any acceptable pile types other than Type 1, 2, 3 & 4 Piles - Large Diameter Bored Piles Category or Percussive Piles Category.

e. The works listed in sub-clause (13)(e) above shall be carried out by approved listed contractors in the Highways Department Specialist Contractors List of Supply of Bituminous Pavement Materials and Construction of Special Bituminous Surfacing;

f. The works listed in sub-clause (13)(f) above shall be carried out by approved listed contractors in the Building Department's List of Registered Specialist Contractor in the Site Formation Works Category and the Development Bureau's List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Landslip Preventive / Remedial Works to Slopes / Retaining Walls;

g. Further to sub-clause (10), in the event that any part of the demolition works listed in sub-clause (13)(g) above is to be sub-contracted, demolition works mean any work carried out on any building or structure to be demolished, comply with the following:

i. The Contractor shall select a Demolition Sub-contractor who shall be registered on the Housing Authority List of Demolition Contractors and the Buildings Department List of Registered Specialist Contractors (Demolition Works) in the first tier of sub-contracting to carry out the demolition works;

ii. In the event that the demolition works are to be further sub-contracted by the Demolition Sub-contractor, the second tier sub-contractor shall be registered on the Housing Authority List of Demolition Contractors or the Buildings Department List of Registered Specialist Contractors (Demolition Works);

iii. Submit information regarding the subcontracting works in accordance with DEM1.G010 and DEM1.G020 for the first or second tier of subcontractor who carrying out the demolition works.

15. If the Contractor is not included in the List of Approved Contractors for Public Works in Group A, B or C for Waterworks, then he shall enter into written sub-contracts with approved listed contractors, in the relevant Group, for the execution of the respective part of the Works;

16. If the Contractor is not included in the appropriate Category of Housing Authority List of Piling Contractors, then he shall enter into written sub-contracts with contractors from the appropriate Category of Housing Authority List of Piling Contractors for the execution of the respective part of the Works;

17. Provide particulars of the sub-contractors of all tiers employed or to be employed on the Works complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time. Submit these particulars to the CM and Labour Relations Officer (LRO) within 14 days from the date for commencement of the Works, and thereafter within 2 days of any change thereon or within the time frames as stated in the aforesaid Contractor's Guideline. Submission of these particulars to the CM shall be in both printed and electronic copies while those to LRO in electronic copies;

18. When the CM has instructed the replacement of the sub-contractor in the event of non-performance of the sub-contractor, or any of his staff who is not performing to the entire satisfaction of the CM, comply with the following:

a. Submit particulars of another sub-contractor or replacement staff of the sub-contractor for the CM's approval within two weeks after receipt of the CM's instruction;

b. Bear all associated costs and the extra time required.

19. The Contractor shall submit for the approval of the CM, the names, experience, company profiles and all other details of the approved listed contractors / piling contractor / waterworks contractor. Approval by the CM on engaging the approved listed contractors / piling contractor / waterworks contractor shall under no circumstances relieve the Contractor's responsibility whatsoever under the Contract;

20. In the event of non-performance of the approved listed contractors / piling contractor / waterworks contractor, or any of their staff who is not performing to the entire satisfaction of the CM, he may instruct the replacement of the approved listed contractors / piling contractor / waterworks contractor, or any of their staff. In this event, the Contractor shall submit within two weeks of receipt of the CM's instruction another approved listed contractor / piling contractor / waterworks contractor or replacement staff of the approved listed contractors / piling contractor / waterworks contractors for the approval of the CM. The Contractor is deemed to have made provision for all associated costs and the extra time required in this respect.

PRE.C6.045.9 GCC 5.3 - ON-DEMAND BOND

1. Procure an on-demand bond in favour of the Employer in an amount of 6 per cent of the Contract Sum excluding the Prime Cost Sums for works by Nominated Sub-contractors. Submit the on-demand bond to the Employer within 21 days of the date of the Letter of Acceptance;

2. Obtain from each Nominated Sub-contractor an on-demand bond in favour of the Employer in an amount of 6 per cent of the sub-contract sum and to the requirements of the sub-contract between the Contractor and the Nominated Sub-contractor. Submit the on-demand bond to the Employer within 42 days of the acceptance of the Nominated Sub-contractor's tender by the Contractor.

PRE.C6.050.9 GCC 5.7 - PROGRAMME TO BE FURNISHED

1. In addition to the programme to be submitted to the CM in accordance with GCC Clause 5.7 submit, within a further 2 weeks, a programme showing a detailed breakdown of the work to be carried out in the first 3 months, and an outline for the remainder of the work. A programme showing the work completed to date, a detailed breakdown of the work to be carried out in the next 3 months and an update outline for the remainder of the work shall be submitted to the CM no later than 4 weeks before the commencement of each subsequent 3-monthly period. This programme shall be immediately revised and submitted to the CM in accordance with the requirements of GCC Clauses 8.4(3) and 8.5(1);

2. The programme shall be divided into time intervals of no longer than 1 week and shall be in the form of a network from which shall be derived a series of bar charts. The critical path shall be supplied listing the earliest and latest start and finish times, the total float and free float for each activity. The completion time of each Section shall be shown on the network as a milestone;

3. The breakdown of the work to be shown for each Section on the programme shall be comprehensive. It shall include the key activities and key dates from the programme submitted under GCC Clause 5.7, the information required under GCC Clause 4.2 and the effects of the matters listed in GCC Clause 11.5, together with the following, where appropriate:

    a. Commencement and completion of the Works;

    b. Approval for ELSP;

    c. Submission of SP;

    d. Work to be carried out, including testing and commissioning;

    e. Fabrication, delivery and installation of materials to be fabricated off the Site;

f. Delivery of critical materials originating from outside Hong Kong;

g. Activities for which the Authority or the CM is responsible, including the issue of critical drawings and other information and approval of drawings and proposals and delivery of materials to be supplied by the Authority;

h. Work to be carried out by Utility Undertaking and other contractors.

4. Be responsible for arranging, coordinating and agreeing with the Utility Undertaking a programme for their works. Make full allowance for time and provision of facilities for the Utility Undertaking in the preparation of his programmes;

5. Submit detailed analysis of those items or programme which the CM may request.

PRE.C6.060.B GCC 5.8 - CONTRACTOR'S SUPERINTENDENCE

Set up a Contractor's management team and provide the services of superintendents as required in the sub-clauses below. Submit the names, qualifications, experience and documentary proof of employment status of the superintendents for approval of the CM. Such superintendents shall be approved by the CM before in service, or shall be deemed to be approved if not expressly disapproved by the CM in writing within 14 days of the submission for approval.

1. Within 14 days from the notified date for commencement of the Works, submit to the CM with all necessary details in accordance with a list of sufficient number of members in the following disciplines for the management team:

   a. Project Manager;

   b. The following superintendents as specified in sub-clause (3) of this clause:

      i. Authorised Representative;

      ii. Quality Control Engineer;

      iii. Environmental Manager;

      iv. Environmental Supervisor;

      v. General Foremen.

2. Except for the following personnel, all members of the Contractor's management team shall be full time on Site when they are deployed to the Site:

   a. Project Manager;

   b. Environmental Manager.

3. Provide the services of the following superintendents and submit, within 14 days from the date of the Letter of Acceptance, their names, qualifications, experience and documentary proof of employment status for approval of the CM:

   a. Authorised Representative;

   b. Land Surveyor;

   c. Engineering Geologist(s);

   d. Blast Control Engineer;

   e. Diving Specialist;

   f. Environmental Consultant;

   g. Quality Control Engineer;

   h. Compaction Control Engineer;

   i. Registered Structural Engineer (RSE);

j. Registered Geotechnical Engineer (RGE);

k. General Foreman;

l. Authorized Signatory (AS);

m. Design Certifying Consultant;

n. Technically Competent Persons (TCP) for SP;

o. Environmental Manager (EM);

p. Environmental Supervisor (ES);

q. Contractor's Labour Officer (CLO);

r. Competent person for hand-dug tunnelling work;

s. Independent Checking Engineer (ICE) for hand-dug tunnelling work.

4. Full details of duties and qualifications necessary for the superintendents are specified in PRE.C9;

5. Competent Person (CP) for confined space shall possess at least 1-year relevant post qualification experience as stipulated under Factories and Industrial Undertakings (Confined Spaces) Regulation and the Contractor shall submit the documentary proof of relevant working experience for CM's approval;

6. Maintain an attendance record of the superintendents who are required to be full time on Site under this clause. Such attendance record shall be in the format agreed by the CM and be made available at all times for checking and verification by the CM.

PRE.C6.065.A GCC 5.9 - CONTRACTOR'S EMPLOYEES

1. The requirements on the minimum number of registered skilled / semi-skilled workers to be employed by the Contractor or his sub-contractors in accordance with GCC Clause 5.9(1)(c) are specified in PRE.C9.1910.

2. Welder for Electric Arc Welding and Flame Cutting:

   a. The general welder shall have at least attained the level of intermediate tradesman and registered as Registered Semi-skilled Worker under the Construction Workers Registration Ordinance;

   b. The general welder undertaking flame cutting and gas welding work shall have attained the training qualification of a gas welding safety training course approved by Labour Department and holds a valid training certificate.

PRE.C6.070.9 GCC 5.11 - SAFETY, SECURITY AND ENVIRONMENTAL MANAGEMENT OF THE WORKS

1. The safety and security requirements in respect of the Works and all operations on the Site are specified in in PRE.C9.110 to PRE.C9.350 and elsewhere in Worksection PRE.C9;

2. The environmental management and site hygiene requirements in respect of the Works and all operations on the Site are specified in PRE.C9.410 to PRE.C9.1700, PRE.C9.2310 to PRE.C9.2460 and elsewhere in Worksection PRE.C9;

3. Pursuant to GCC Clause 5.11, the Contractor shall submit the Safety Plan and the Environmental Management Plan and their subsequent revisions or updates to the CM in accordance with the requirements as specified in PRE.C9.205 and PRE.C9.2415 respectively.

PRE.C6.080.9 GCC 5.14 - THIRD PARTY INSURANCE

1. The list of insurers approved by the Employer shall be the List of Authorized Insurers published by the Insurance Authority. Any insurer not on this list or not authorized by the Insurance Authority will not be approved. The Insurer must provide, together with the insurance policy, a covering letter undertaking to inform the Employer of any cessation of the insurance policy due to any reason whatsoever. No insurance shall be approved without such a covering letter;
2. The minimum amount of third party insurance is stated in the Appendix to the Form of Tender. The amount stated is deemed to be in respect of any one accident and unlimited in the aggregate amount for the period of insurance;

   The expression "accident" means any one accident, or series of accidents, arising out of any one event irrespective of the number of claims that may arise therefrom but unlimited in number for the period of insurance.

PRE.C6.090.9 GCC 5.15 - DESIGN RESPONSIBILITY

Accept liability for:

1. The suitability of purpose of the materials and equipment incorporated in the Works by any Nominated Sub-contractor;
2. All design responsibilities included in Nominated Sub-contracts. The design requirements for each of the Nominated Sub-contracts are generally set out in the typical sub-contract documents, available for inspection at the Housing Department Office, and the Contractor must satisfy himself of these responsibilities;

   The Nominated Sub-contracts which carry a design responsibility and for which the Contractor is responsible are:

   a. .....;

   b. .....
3. Other permanent works for which the Contractor is responsible for the design as provided for in the Contract. Particular attention is drawn to the following:

   a. .....;

   b. .....
4. The principles of design will be as set out in the Contract documents and the Contractor shall not vary these without first obtaining the written permission of the CM; and
5. Any design for which the Contractor is responsible shall be submitted to the CM prior to execution of any work in accordance with the design for the CM's written confirmation that the requirements of the Employer appear to have been met, and after the CM's confirmation the Contractor shall not vary such design without the written consent of the CM. The submission to the CM of such design and the CM's confirmation shall not relieve the Contractor of any duty or responsibility under the Contract.

PRE.C6.100.9 GCC 5.27 - FACILITIES FOR OTHER PERSONS

1. Facilities required to be provided to others under the Contract are specified in PRE.C11 and PRE.C12;
2. Further services required to be provided include:

   a. .....;

   b. .....

PRE.C6.110.9 GCC 6.3 - PASSES

The requirements of Passes shall conform to the smart cards as stipulated in PRE.C9.2510 and PRE.C9.2550.

PRE.C6.115.N GCC 8.4 – EXTENSION OF TIME FOR COMPLETION

Without prejudice to GCC Clause 8.4(2)(a), the Contractor shall submit the following to the CM at the same time when serving the written notice of claim for extension of time (EOT) as referred to in GCC Clause 8.4(2)(a) in order for the CM to decide whether the Contractor is fairly entitled to an EOT for the completion of the Works or relevant Section(s) according to GCC Clause 8.4(2)(d):

1. Relevant contract clause(s) for the EOT claim with justification;
2. Date of cause of delay to the progress of the Works or any Section became apparent;
3. Cause of delay and summary of the event;
4. Affected period (including the start and end dates, and number of working days involved);
5. Analysis of the actual delay caused to the completion of works;
6. Critical path analysis justifying the delay was critical to the completion of works;
7. Concurrent delay analysis accompanied with programme;
8. Calendar chart(s) (for the Works / each relevant Section) illustrating:
    a. The counting of number of working days claimed for the delaying event;
    b. The working of number of working days and calendar days of EOT submitted under the claim.
9. Estimated amount of claim for expenditure / additional payment in relation to the EOT claim (if any);
10. Plans / photos / drawings and any other documents or materials to substantiate the EOT claim.

PRE.C6.120.9 GCC 9.1 - WORKS SUBJECT TO EXCISION

There are no parts of the Works subject to excision.

PRE.C6.125.N GCC 11.6 - ASCERTAINMENT OF CLAIMS

1. The contemporary records that may reasonably be required from the Contractor to support or substantiate any claim for expenditure or additional payment, with the details to be submitted to or inspected by the CM for the purpose of the CM's ascertainment of the claim as referred to in GCC Clause 11.6(1), shall include but not be limited to the following types wherever applicable to the compilation of the claim:
    a. Records of site superintendents' engagement;
    b. Records of labour force and / or sub-contractor usage;
    c. Records of Constructional Plant deployed (self-owned and / or rented);
    d. Records of on-site and / or off-site logistics;
    e. Records of items of site overheads;
    f. Records of items of head office overheads;
    g. Records of idling time or reduced productivity of resources;
    h. Records for verification of build-up for depreciation of plant or other assets.

2. The above records (other than sub-clauses (1)(f) and (1)(h) above), as well as other contemporary records reasonably required by the CM, have to be verified and endorsed by the Site Staff, CM or his representatives whenever possible on submission to or inspection by the CM;

3. The Contractor shall accept the responsibility that any failure of him to submit or produce for inspection the records in sub-clause (1) above or other contemporary records as required by the CM as soon as is reasonable under GCC Clause 11.6 sub-clause (2)(a) or, as the case may be, within the time interval as required by the CM under GCC Clause 11.6 sub-clause (2)(b), without reasonable justifications acceptable to the CM, may jeopardise the outcome of the ascertainment of the claim by the CM. The Contractor shall bear any loss of or shortfall in cost recovery or payment entitlement of the claim arising from his failure in this connection irrespective of whether there will be any further submissions of better or supplementary records by him beyond the reasonable time or the required time as aforesaid. The CM is also entitled not to take into account the further submissions of records, if any, by the Contractor in ascertaining the Cost or additional payment for the claim pursuant to GCC Clause 11.6(4) as amended by Clause SCC11.3.

PRE.C6.130.9 GCC 20.2 - CONTRACT PRICE FLUCTUATIONS

1. The "Schedule of Proportions" to be used in calculating the "Price Fluctuation Factor" is included at Schedule I to the Form of Tender;

2. The list of items of labour and selected materials included in the "Schedule of Proportions" is pre-determined and shall not be changed during the currency of the Contract;

3. The "Schedule of Proportions" shall be completed in accordance with the instructions contained in the Schedule I;

4. The "Price Fluctuation Factor" for each payment certificate shall be calculated by the CM. The following shall apply to such calculations:

   a. The figure of 0.1500 given in the column (4) of the "Schedule of Proportions" represents 15% of the "Effective Value" that will not be subject to fluctuation adjustment. The figure of 0.1500 will therefore not be used in the calculation of the "Price Fluctuation Factor";

   b. The products obtained by multiplying each of the calculated proportions given in column (4) of the "Schedule of Proportions" by the (index) fractions shall be to eight decimal places. Decimal places in excess of eight shall be rounded up or down to the nearest eight decimal place;

   c. The final calculated "Price Fluctuation Factor" shall be to six decimal places. Decimal places in excess of six shall be rounded up or down to the nearest sixth decimal place.

SPECIAL CONDITIONS OF CONTRACT

PRE.C6.140.A STATUS

The information given in clauses PRE.C6.150 to PRE.C6.240 is to be read in conjunction with the Special Conditions of Contract and is to form part of the Contract.

PRE.C6.145.N SCC4.0 – INDEPENDENT CHECKING OF TEMPORARY WORKS

1. Pursuant to GCC Clause 5.11(2), the Contractor shall take full responsibility for the safety and stability of all operations on the Site which include the design, and the method statement for erection, use, and removal of all Temporary Works. The design of the permanent works as represented by the Drawings and Specification and the existing structures on Site do not include any Temporary Works designed by the CM unless specifically stated. The Contractor shall take full responsibility to the effect that any Temporary works as designed by him may have on the design, function and performance of the permanent works and the existing structures;

2. The Independent Checking Engineer shall be a professionally qualified engineer with membership of the Hong Kong Institution of Engineers or the Institution of Civil Engineers of United Kingdom or equivalent, or a Registered Professional Engineer in the Structural, Geotechnical or Civil discipline and shall possess at least 10 years of relevant experience appropriate to the Temporary Works to be certified;

3. Pursuant to Clause SCC4.0 of the Special Conditions of Contract, the design of Temporary Works and the method statement for erection, use, and removal of Temporary Works to be certified by the Independent Checking Engineer includes but not limited to the following:

   a. Support to trench excavation exceeding 1.2m deep;

   b. Support to utilities for execution of the Works;

   c. .....

4. Any Temporary Works erected in close proximity to traffic shall be protected against impact from vehicles by suitably designed protective measures. The Contractor shall design such protective measures with regard to the conditions prevailing on the Site and the effect of any such impact. Such protective measures are to be designed as part of the Temporary Works subject to checking by an Independent Checking Engineer.

PRE.C6.150.9 SCC5.1 - ENHANCED SITE CLEANLINESS AND TIDINESS

1. Perform Daily Cleaning and Weekly Tidying of the Site including Public Cleaning Areas. The extent of the Public Cleaning Areas required for cleaning are delineated in the Drawing No. …….. /deemed to be within ……. metres on the periphery outside the barriers or hoardings, or determined by the CM on site for each work location based on the requirements in the Specification, and taking into account the actual site condition before work commences;

2. Draw up, in the Environmental Management Plan where appropriate, a system on waste management, and maintenance of cleanliness and tidiness of the Site including, but is not limited to, the methods and provisions including the proposed areas for on-site sorting, separation, storage and disposal of waste materials, and the proposal of how to maintain the Site in clean and tidy condition. Provide the necessary facilities, receptacles and transport for the temporary storage, disposal and removal of different types of wastes;

3. Daily Cleaning

   a. "Daily Cleaning" shall include cleaning and tidying up after work of tools, equipment, unused materials, storage areas and common areas such as passageways, daily removal of waste materials from works areas, removal of any rubbish and debris dumped into the Site by the public and, without derogating from the generality of the foregoing, shall include, but is not limited to, all the items subject to checking as listed in sub-clause (3)(b);

b. Develop inspection checklist for Daily Cleaning for the approval of the CM. The inspection checklist shall be reviewed and updated whenever there is a change in work nature or work location and re-submitted for approval by the CM. The inspection checklist shall include an assessment on the cleanliness and tidiness of all work locations, plus the Public Cleaning Areas. Items to be checked against for each work location shall include, but are not limited to, the following:

   i. Maintenance of passageways, common accesses and public areas free of obstruction;

   ii. Proper storage and stacking of materials;

   iii. Proper placement and storage of tools and equipment after work;

   iv. Proper sorting, storage and/or disposal of waste materials, in accordance with the Environmental Management Plan where appropriate;

   v. Proper securing of hoarding, barriers, guarding, lighting, and signing of works;

   vi. Prevention and removal of water ponds and flooding;

   vii. Clearing of stockpiling and wastes arising from the Works;

   viii. Conditions of cleanliness and tidiness of the Site including Public Cleaning Areas in the perspective of the general public;

   ix. Other cleaning requirements as instructed by the CM.

c. Assign person(s) to inspect the Site after each Cleaning Day's work. The assigned person shall check and ensure the cleanliness and tidiness of the Site, complete the inspection checklist, record the areas requiring improvements, and take photographs of areas where cleaning and tidying up works have been done and where improvement actions are required;

d. Notify the CM the time schedule for Daily Cleaning on every Cleaning Day and the name of the assigned person as referred to in sub-clause (3)(c) above responsible for inspection and checking after each Cleaning Day;

e. Submit, in the morning of the day (which is not a General Holiday) following a Cleaning Day, the inspection checklist, records and photographs prepared pursuant to sub-clause (3)(c) above to the CM for checking and recording;

f. The CM may carry out inspections and surprise checks to verify the Contractor's performance on cleanliness and tidiness of the Site before the noon of the day (which is not a General Holiday) following a Cleaning Day. The Contractor shall not be entitled to any payment for the item for "Daily Cleaning" for a Cleaning Day if the performance of the Contractor on cleanliness and tidiness for any part of the Site on that Cleaning Day is not carried out to the satisfaction of the CM. The CM shall notify the Contractor and record in the Site Diary for any non-payment of the item for "Daily Cleaning" on a Cleaning Day and the areas of dissatisfaction for improvement by the Contractor;

g. In the morning of every Cleaning Day before work commences, inspect and remove any rubbish and debris that may be littered by the public over the night within any area of which the Contractor is required to maintain cleanliness and tidiness under this Contract before the inspection by the CM.

4. Weekly Tidying

a. "Weekly Tidying" shall include the cleansing and tidying up of the common areas and accesses, cleansing and/or re-conditioning of hoardings, barriers, guarding, lighting, signage and/or traffic cones, cleansing of external covers for plant and equipment, removal of waste and debris etc. so as to ensure that the plant and equipment, hoardings, as well as the Site as a whole, to be clean and tidy in the perspective of the general public and, without derogating from the generality of the foregoing, shall include, but is not limited to, all the items subject to checking as listed in sub-clause (4)(b);

b. Develop inspection checklist for Weekly Tidying for the approval of the CM. The inspection checklist shall be reviewed and updated whenever there is a change in work nature or work location and re-submitted for approval by the CM. The inspection checklist shall include an assessment on the cleanliness and tidiness of the Site conditions at various work locations, plus including the Public Cleaning Areas. Items to be checked against for each work location shall include, but are not limited to, the following:

   i. Thorough cleansing of passageways, common accesses and public areas;

   ii. Re-organizing of storage materials for better utilization of storage spaces and safe stacking if appropriate;

   iii. Maintenance and re-conditioning of tools and equipment;

   iv. Cleansing of external covers for plant and equipment;

   v. Collection and removal of disposed waste materials off site in accordance with the Environmental Management Plan;

   vi. Cleansing, re-conditioning and/or replacement of hoarding, barriers, guarding, lighting and signage of works to good working conditions;

   vii. Clearing of drains and channels to prevent flooding;

   viii. Other cleansing requirements as instructed by the CM in the perspective of the general public.

c. Assign person(s) to inspect the Site after each Cleaning Week Day's work. The assigned person shall check and ensure the overall cleanliness and tidiness of the Site, complete the inspection checklist, record the areas requiring improvements, and take photographs of areas where overall site cleaning and tidying up actions have been done and where improvement actions are required;

d. Notify the CM the time schedule for Weekly Tidying on every Cleaning Week Day, and the name of assigned person as referred to in sub-clause (4)(c) above responsible for inspection and checking after each Cleaning Week Day;

e. Submit, in the morning of the day (which is not a General Holiday) following the Cleaning Week Day, the inspection checklist, records and photographs prepared pursuant to sub-clause (4)(c) above to the CM for checking and recording;

f. The CM shall, together with the Site Agent, check and inspect the overall cleanliness and tidiness of the Site on the day (which is not a General Holiday) following the Cleaning Week Day. The CM shall advise the Contractor whether his performance is to his/her satisfaction, or if not, where improvement actions are required;

g. Promptly rectify the defects identified by the assigned person as referred to in sub-clause (4)(c) above, and/or the CM. The Contractor shall not be entitled to any payment for the item for "Weekly Tidying" for a Cleaning Week Day if the Contractor fails to rectify the identified defects pursuant to sub-clauses (4)(c) and (4)(f) above to the satisfaction of the CM before the end of the day (which is not a General Holiday) following the Cleaning Week Day;

h. In the morning of every Cleaning Week Day before work commences, inspect and remove any rubbish and debris that may be littered by the public over the night within any area of which the Contractor is required to maintain cleanliness and tidiness under this Contract before the inspection by the CM.

PRE.C6.170.9 SCC6.1 - PAYMENT OF WAGES OF SITE PERSONNEL

1. Labour Relations Officer (LRO):
   a. One LRO shall be authorized by the Employer and notified to the Contractor by the CM to work on Site. The LRO shall be responsible to the CM and accommodated in the office of representatives of the CM;
   b. The duties and responsibilities of the LRO shall include but not necessarily be limited to the following:
      i. Check and verify the proper operation of the ACRS;
      ii. Conduct checking of the records as required in PRE.C9.140;
      iii. Prepare and submit directly to the CM a monthly report on the payment of the wages and MPF contribution, and the daily records of ACRS based on the wage books prepared by the Contractor;
      iv. Conduct random inspection on Site to verify the identity of the Site Personnel and to promote effective communication with the Site Personnel;
      v. Be responsible for receiving complaints from the Site Personnel on any matters relating to the payment of wages and other employment conditions;
      vi. Check the validity of the complaints based on the compiled records;
      vii. Provide all necessary assistance to the Site Personnel for referring the complaint cases to the Labour Department if necessary and work in collaboration with the Labour Department to investigate and verify the validity of the complaints;
      viii. Inform the CM of anomalies and to refer the same to the Contractor for investigation and appropriate follow-up actions;
      ix. Witness the surveys of Site Personnel on behalf of the CM pursuant to sub-clause 2(d) below.
   c. Provide all necessary facilities including direct telephone lines, office accommodation and furniture for the use of LRO working on Site to carry out his/her duties;
   d. Provide all necessary assistance to the LRO for carrying out his/her duties on Site.
2. Comply with the following for monitoring the payment of wages and Mandatory Provident Fund (MPF) contribution to Site Personnel:
   a. Employment contract:
      i. Keep a copy of the complete set of the executed employment contracts of all Site Personnel in the wage books as required in PRE.C9.140. Each copy of the executed employment contracts together with an updated register of the employment contracts shall be kept in the wage books within two days from the date that the Site Personnel commences to work on Site;
      ii. Deliver the original executed employment contracts of any Site Personnel to the office of representatives of the CM for inspection by the CM within one day when requested by the CM;

iii. Seek written approval from the CM before a Site Personnel without an executed employment contract executes any work on the Site;

iv. The terms of the employment contract shall not be less favourable to the terms provided in the "Specimen Employment Contract" in the latest "Guidelines on Wage Payment Monitoring and Reimbursement of Contractor's and Sub-contractors' Contributions to the Mandatory Provident Fund for their Site Personnel" published by Development Bureau of HKSAR from time to time.

b. Wage payment and mandatory provident fund ("MPF") arrangement for Site Personnel:

i. Ensure that sufficient funds have been reserved in the designated bank account for the payment of all wages and MPF contribution to all Site Personnel employed or engaged by the Contractor. Instruct promptly the designated bank to effect the timely payment to the respective wage payment accounts, employee MPF contribution accounts and the employer MPF contribution accounts of all Site Personnel employed or engaged by the Contractor according to the schedule as prepared in sub-clause (c)(ii);

ii. Ensure that sub-contractors of all tiers have sufficient funds available in the designated bank accounts for the payment of all wages and MPF contribution to all Site Personnel employed or engaged by them. Also ensure that sub-contractors of all tiers shall promptly instruct the designated banks to effect the timely payment to the respective wage payment accounts, employee MPF contribution accounts and the employer MPF contribution accounts of all Site Personnel employed or engaged by them according to the schedule as prepared in sub-clause (c)(ii);

iii. Pay, and require the sub-contractors of all tiers to pay the wages to all the Site Personnel by bank's autopay service and make the MPF contribution as stipulated in sub-clause (c);

iv. Require each of the Site Personnel to provide a bank account and an employee MPF contribution account via which wage payment will be paid by bank's autopay service.

c. Wage payment and MPF contribution records:

i. Within 14 days from the notified date for commencement of the Works, submit to the CM the name of the designated bank and all related arrangement details for the payment of wages and MPF contribution to all the Site Personnel;

ii. Prepare schedules of wages and the corresponding MPF contribution of all the Site Personnel employed or engaged by the Contractor based on the verified daily record as required in PRE.C9.2510. Keep a copy of such schedules in the wage books as required in PRE.C9.140 within 14 days from the end of the corresponding wages period;

iii. Require the sub-contractors of all tiers to prepare the respective schedules of wages and the corresponding MPF contribution of all the Site Personnel employed or engaged by them based on the verified data from the ACRS as required in PRE.C9.2510. Keep a copy of such schedules in the wage books as required in PRE.C9.140 within 14 days from the end of the corresponding wages period;

iv. Keep a copy of the records of transactions in the wage books as required in PRE.C9.140 within 21 days from the end of the corresponding wages period;

v. Submit and require sub-contractors of all tiers to submit to the CM for each worker's payment cycle a written declaration that all wages of the Site Personnel have been paid and all MPF contribution have been made. For the records of payment of wages and MPF contribution of the Site Personnel in the managerial grade as stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time, it is optional to keep them in the wage books as required in PRE.C9.140 provided that they are directly employed by the Contractor and the CM has no objection to this arrangement.

d. Wage payment status survey:

Assign designated staff (not less than 2 persons and one of them shall be at Site Foreman grade or above) to conduct surveys with Site Personnel on Site under the witness of the LRO for checking their status of wage payment at least at monthly interval commencing from the second month from the notified date for commencement of the Works up to and including the month in which the operation of ACRS is terminated as stipulated in PRE.C9.2560. For Contracts with more than one Portion of the Site, the survey on each Portion of the Site shall be conducted at least at monthly interval commencing from the second month from the commencement of the works of that particular Portion of the Site up to and including the month in which the operation of ACRS is terminated as stipulated in PRE.C9.2560. The number of Site Personnel to be surveyed in each month shall not be less than the percentage agreed with the CM of the total number of Site Personnel who have or had worked on Site without exemption of wage payment record submission, irrespective of duration, for the monthly period preceding the date of commencement of the survey, or otherwise a smaller number if agreed by the CM. The outcome of these surveys shall be submitted to the CM and LRO for record no later than 1 week from the first day of each monthly survey exercise. Prior agreement on detailed arrangement of the surveys is required from the CM.

3. Provide all necessary assistance in the handling of complaints on arrears of wages raised by all Site Personnel:

a. Provide site office telephone lines or other off-Site contact telephone lines installed with voice mail system solely for receiving workers' enquiries or complaints about wages arrears and provide the telephone numbers to the LRO;

b. Assign designated staff (not less than 2 persons) to receive the calls. Record workers' enquiries or complaints and report the same to the CM, LRO and other relevant parties as instructed by the CM;

c. Display the posters provided by the LRO at workstations for reminding workers about the hotlines for enquiring or complaining arrears of workers' wages;

d. Display notices on Site at prominent locations notifying the Site Personnel to seek assistance from the LRO on matters concerning wages arrears and disputes, and showing the contact details of the LRO;

e. Assign a designated staff to respond to issues raised by the LRO in connection with the discharge of his duties;

f. Provide to a Site Personnel free of charge a copy of his daily attendance records whenever his written request for same is received. The daily attendance records shall be verified by the Contractor or employer of the Site Personnel;

g. Address immediately the enquiries and/or complaints lodged by Site Personnel to the Contractor, the CM or LRO and reply to them the outcome or the follow-up actions taken or to be taken within two days upon receipt of the enquiries and/or complaints.

4. The requirements stipulated in sub-clauses (2) and (3) above may be exempted subject to the compliance with all relevant criteria and procedures stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time or as Approved by the CM on individual case basis.

PRE.C6.180.9 SCC8.1 - POSSESSION OF THE SITE (FIXED RATE FOR DELAY)

The specified rate inserted by the Contractor related to SCC8.1 of the Special Conditions of Contract is deemed to have included any costs and expenditure incurred by the Contractor as a result of delay in giving possession of Portions of the Site and such costs and expenditure shall include, inter alia, the cost of any prolonged obligations on the part of the Contractor under the Contract including any prolonged maintenance, protection and insurance etc. of the completed parts of the Works; any uneconomical use of labour, plant and materials; disruption to progress of the Works; and fluctuations in the cost of labour and materials for the remaining works.

PRE.C6.185.9 SCC8.2- USE OF THE SITE BY POLICE AND OTHER DISCIPLINED SERVICES

1. When Instructed, allow the Hong Kong Police Force or other disciplined services of the Government to use part(s) or area(s) of the Site for the purpose of training(s) for a period not more than five days or for periods not more than five days in total provided that such training(s) shall be carried out within one month of the taking possession of the Site;

2. Such training(s) will include but not be limited to tactical movement through the part of the Site and the use of mechanical breaking equipment and methods to practise operational techniques;

3. Immediately upon receiving the CM’s written instruction, liaise and coordinate with the representatives of the Hong Kong Police Force or such other disciplined services regarding such training(s) and, taking into account the planning and progress of the Works, determine the part(s) or area(s) of the Site and the period(s) of time in accordance with sub-clause (1) above required for such training(s);

4. Provide all necessary assistance and support as requested by the Hong Kong Police Force or such other disciplined services of the Government in connection with such training(s);

5. Should the CM issue a written instruction in respect of use of the Site for such training(s) and the Site or any part(s) or area(s) thereof be used for such training(s) by the Hong Kong Police Force or other disciplined services of the Government, the Contractor shall be paid in accordance with the tendered daily rate set out in the Contract (which rate shall be deemed to be inclusive of all costs of the Contractor in fulfilling all his obligations and the requirements under the Contract for the provision or use of the Site or any part(s) or area(s) thereof in connection with or in respect of such training(s)) and the Contractor shall be deemed to have made sufficient pricing and allowance in terms of both costs and time in the said tendered daily rate and the programme of the Works respectively.

PRE.C6.190.9 SCC8.3 - ADDITIONAL LIQUIDATED DAMAGES FOR DELAY

1. In accordance with Clause SCC8.3(1) the Specified Section(s) is/are:

   a. Section .....;

b. Section .....

2. In accordance with Clause SCC8.3(1) the rate per day for Additional Liquidated Damages (ALD) shall be as follows:

Relevant Section	$ per day
Section	*(Insert rate)*
Section	Nil
Total ALD for the works	*(Insert Total)*

PRE.C6.200.9 SCC8.4 - TAKING CARE OF THE WORKS AFTER COMPLETION

In accordance with Clause SCC8.4 of the Special Conditions of Contract and where instructed by the CM, execute the following works and/or provide the following services for the purpose of the taking care of the Works after completion:

1. The Site Security Services which shall include, in respect of the parts of the Works and the Site specified in the notice (hereinafter referred to as the Property), the following:
   a. Take full responsibility for the care of the Property. In case of any damage, loss or any injury from any cause whatsoever, except the "excepted risks' as defined in GCC Clause 5.12, the Contractor shall at his own expense and with all possible speed make good or at the option of the Employer shall pay to the Employer the cost of making good any damage to the Property;
   b. Indemnify and keep indemnified the Employer against all losses and claims for injury or damage to any person including any employee of the Employer or property including the Property or any other property of the Employer whatsoever which may arise from any incident occurring on, in, or arising from the Property;
   c. Take out and maintain an insurance policy with an insurer approved by the Employer to cover the risks described at 1.b. above. The insurance shall be in the joint names of the Contractor and the Employer and shall contain a Cross-Liability clause as between the Contractor and the Employer, and shall provide insurance cover for any third party liability. Provided that the insurance to be effected and maintained under this Special Condition shall conform to all requirements as are applicable to the insurance for the purpose of the Works as GCC Clause 5.14, and shall be for an amount no less than the respective sums insured under such insurance;
   d. Take all legally valid available means of preventing trespassers entering the Site;
   e. Supply, on Site at all times, at least one security guard;
   f. Operate (including provision of electricity supply), at any time whenever it is dark, lighting associated with walkways, hoardings, and accesses;
   g. Keep the Site closed with all accesses locked;
   h. Do not permit visitors to enter the Site unless approved by the CM.
2. For each day of the Site Security Services Period, the Contractor shall be paid at the respective tendered daily rates included in the Contract in respect of the Works and the Site or part thereof as appropriate. Such payments shall be included in the statement to be delivered under GCC Clause 14.1 and certified under GCC Clause 14.2.

PRE.C6.205.9 SCC9.1 - WORKS SUBJECT TO EXCISION

Option 1

1. The following Sections are "Works Subject to Excision":
   a. #..... The written instruction to proceed pertaining to the Section shall be given within *..... months from the notified date for commencement of the Works;
   b. #..... The written instruction to proceed pertaining to the Section shall be given within *..... months from the notified date for commencement of the Works.
2. In the event of any work being excised in respect of this clause there will not be any adjustment to the rates in Bill No. 2 – Preliminaries.

Option 2

1. The following Sections are "Works Subject to Excision":
   a. #..... The written instruction to proceed pertaining to the Section shall be given within *..... months from the notified date for commencement of the Works;
   b. #..... The written instruction to proceed pertaining to the Section shall be given within *..... months from the notified date for commencement of the Works.
2. In accordance with Clause SCC9.1 the following adjustment shall apply. In the event of the "Works Subject to Excision" being excised in respect of this clause, the rates in Bill No. 2 - Preliminaries shall be reduced by a percentage (the adjustment percentage) represented by the ratio of the following values included in the Contract Sum:

   "the value of the Works Subject to Excision which are excised to the total value of Works in the Contract Sum", where "Works in the Contract Sum" are the works included in the Contract excluding Preliminaries, Daywork, Prime Cost and Provisional Sums including the profit and attendance on Nominated Sub-contractors and Specialist Contractors, if any.

   The Contractor's attention is drawn to Preambles items ..... which provide further details for the payment of Preliminaries.
3. In addition to the foregoing, Preliminaries will be certified in interim certificates and paid at the rates entered by the Contractor LESS the adjustment percentage as worked out under sub-clause (2). In the event that the Works Subject to Excision are not excised by the CM in accordance with Clause SCC9.1, the shortfall between the full value of the Preliminaries that ought to be due at the time of the CM's instruction to proceed and the certified value of Preliminaries after deduction by the adjustment percentage to that point of time will be paid to the Contractor by way of a lump sum in the next interim certificate, and Preliminaries will then be certified in interim certificates and paid at the rates entered by the Contractor without deduction of the adjustment percentage.

PRE.C6.208.9 SCC11.2 - SCHEDULE OF RATES (FOR PART OF THE WORKS)

Schedule of Rates for the following part(s) of the Works are provided in the Contract:

1. .....;
2. .....

PRE.C6.210.9 SCC14.1 - PAYMENT FOR PRE-DETERMINED AMOUNTS FOR SITE SAFETY, ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE

The payment for pre-determined amounts for site safety, environmental management and site hygiene is specified in PRE.C9.2470.

PRE.C6.212.N SCC14.3 – SECURITY OF PAYMENT

In respect of the Construction Industry Security of Payment Ordinance (Cap. 652) (the "SOP Ordinance"), the following provisions shall apply to the Contract as part of the Specification:

1. The adjudication documents and / or other documents (other than a payment claim) relating to the SOP Ordinance's implementation which have to be served by the Contractor on the Employer shall be served to an officer representing the Employer as advised by the CM in writing no later than the initial contract meeting for the Contract. Such documents shall be served by leaving them at, or sending them by registered post to the officer's normal place of business as advised by the CM on the same occasion, or by hand to the officer in person, except otherwise specified in section 68 of the SOP Ordinance. Where the Contractor serves such documents on the Employer, he shall also serve a copy of the same on the CM on the same day on which it is served on the Employer in a manner to be notified to the Contractor in the initial contract meeting for the Contract. On the other hand, the Contractor shall advise the CM no later than the initial contract meeting for the Contract the superintendent designated for receiving the adjudication documents and / or other documents relating to the SOP Ordinance on behalf of the Contractor as well as his normal place of business for delivery or posting purpose;

2. A payment claim to be served by the Contractor on the Employer under the SOP Ordinance shall be served to the officer as advised by the CM under sub-clause (1) above, with a copy to the CM served on the same day, in the same manner as specified in sub-clause (1) above;

3. Where the Contractor wishes to exercise his rights to delay work or supply of the Contract under the SOP Ordinance, he shall state his intended starting date of such delay in the notice of intention to be served to the Employer in addition to other details as required by the SOP Ordinance;

4. For any sub-contractor of any tier of subcontracting who may wish to exercise his rights to delay work or supply for his sub-contract under the SOP Ordinance, the Contractor shall sustain effective communication channels to the CM's satisfaction by which the sub-contractor can notify:

   a. the Employer (as the owner of the Site), through the CM's representative as advised by the CM in writing no later than the initial contract meeting for the Contract;

   b. the Contractor, through a designated superintendent as his representative;

   about the sub-contractor's imminent exercise of such rights within the time limit prescribed by the SOP Ordinance. In this regard, the Contractor shall ensure that each of his sub-contractors, irrespective of tiers, acknowledges the above communication channels in the first month of his execution of sub-contract works on Site or supply of goods and services to the Contract. The Contractor shall also collect relevant data about the status of any adjudication proceedings of his sub-contractors at all tiers for reporting to the CM at monthly site meetings in a format to be agreed with the CM.

PRE.C6.214.N SCC14.4 – PAYMENTS BY ELECTRONIC METHOD

1. The Contractor shall select from one of the following electronic payment methods and notify the Contract Manager within 14 days of the date of the Letter of Acceptance in accordance with Clause SCC14.4(2) of the Special Conditions of Contract:

a. bank transfer into the designated bank account;
b. telegraphic transfer into the designated bank account; or
c. payment through the Faster Payment System (FPS) proxy,

provided that for an overseas Contractor without any bank account or FPS proxy in Hong Kong, the Contractor shall always select the electronic payment method prescribed in item (b) above;

2. Depending on the method selected under sub-clause (1) above, the Contractor shall provide the details of the designated bank account (if the method prescribed in sub-clause (1)(a) or (1)(b) above is selected) or the details of the FPS proxy (if the method prescribed in sub-clause (1)(c) above is selected) by filling in all required details in the prevailing form of "Authority for Payment to the Bank" (i.e. "Annex 5b", a sample of which is attached in Appendix PRE.C6/III for reference only), and shall submit the duly completed "Annex 5b" together with all supporting documents as required in "Annex 5b" within 14 days of the date of the Letter of Acceptance in accordance with Clause SCC14.4(2) of the Special Conditions of Contract. A copy of the prevailing "Annex 5b" will be enclosed with the Letter of Acceptance for the Contractor's return;

3. The Employer shall not be held responsible or liable for any delay in payment of any sums due or payable under the Contract or in respect of the Works if such delay is caused by or arises from any failure (in whatever way) of bank transfer or telegraphic transfer of payment into the designated bank account, or of the FPS proxy (as the case may be) for whatever reason, including any default of the Contractor or any third party (save and except for any fault on the part of the Employer), and no claims for any interest, charges or damages (in whatever description or form) shall be entitled by the Contractor for any late payment caused by or arising from any such failure or default;

4. In the event of any payment(s) to be made into a designated bank account or through the FPS proxy, whether under Clause SCC14.4 of the Special Conditions of Contract or otherwise or whether the designated bank account or the FPS proxy is in Hong Kong or overseas, any charges, fees or sums imposed for such payment(s) by any bank(s) or stored value facility operator(s), including but not limited to the Contractor's bank(s), the Employer's bank(s) and any other bank(s) which process, make or deal with (in whatever way) such payment(s) or transfer(s), shall all be borne by the Contractor. Regardless of the applicable payment method, any charges, fees or sums imposed by a bank or a stored value facility operator in Hong Kong or an overseas bank for refusing or rejecting any payment even when the payment is made in accordance with the payment instruction provided by the Contractor in "Annex 5b" or for carrying out any special request(s) by the Contractor shall also be borne by the Contractor. In the circumstances where any charges, fees or sums shall be borne by the Contractor under the foregoing provisions, the Contractor shall reimburse the Employer for the same immediately upon the Employer having settled such charges, fees or sums (as the case may be) with the bank or the stored value facility operator. Without prejudice to the Employer's entitlement to immediate reimbursement from the Contractor as aforesaid, the Employer may, in addition thereto, set off any amounts payable under the Contract against such charges, fees or sums (as the case may be), and the Contractor hereby agrees and confirms that the Employer shall be entitled to such right of set-off;

5. To avoid any unnecessary delay in payment or any charges, fees or sums imposed by banks or otherwise as stated in sub-clause (4) above, the Contractor shall pay extra

care to find out the transaction and stored value limits for receiving payment via FPS from its own bank or stored value facility operator before selecting and notifying the Employer of the electronic payment method selected in accordance with Clause SCC14.4 of the Special Conditions of Contract;

6. Where any change(s) are to be made to the payment instruction provided by the Contractor in "Annex 5b", the Contractor shall obtain a copy of prevailing "Annex 5b" from the Contract Manager as soon as possible and shall serve at least one month's written notice on the Contract Manager before such changes shall take effect, and shall, at the time of the service of the said notice, resubmit to the Contract Manager a revised duly completed "Annex 5b" with all relevant details, including such change(s), provided therein together with the relevant supporting documents as mentioned in sub-clause (2) above. Where the Contractor has failed to comply with the foregoing provisions, the Employer shall be entitled to make payment according to the payment instruction set out in the "Annex 5b" as previously provided by the Contractor in accordance with Clause SCC14.4 of the Special Conditions of Contract and sub-clause (2) above until any change(s) to the payment instruction has/have been made and taken effect as aforesaid, and the Employer shall not be liable for any delay in payment, or any charges, fees, sums or damages (in whatever form) arising from refusal of any bank or stored value facility operator or any third party to accept payment made by the Employer to the Contractor as a result of the Contractor's failure to comply with this sub-clause (6) including but not limited to any late notification of changes to the payment instruction, submission of an incomplete "Annex 5b" and failure to provide relevant supporting documents required;

7. For the purpose of this clause:
   a. "designated bank account" means the bank account the details of which shall be provided by the Contractor in accordance with Clause SCC14.4(2) of the Special Conditions of Contract and sub-clause (2) above;
   b. "Faster Payment System" or "FPS" means the Faster Payment System operated by the Hong Kong Interbank Clearing Limited;
   c. "FPS proxy" means the Hong Kong Identity Card number or FPS identifier registered with the FPS and linked with a bank or a stored value facility to be provided by the Contractor in accordance with Clause SCC14.4(2) of the Special Conditions of Contract and sub-clause (2) above for receiving payment via FPS;
   d. "stored value facility" has the meaning as set out in section 2A of the Payment Systems and Stored Value Facilities Ordinance (Cap. 584).

PRE.C6.220.A SCC22.3 - EXCAVATION PERMIT FOR WORKS

1. Without limiting the areas subject to Clause SCC22.3(11) possession of the actual area for the following Portion(s) are to be given by Designated Authority and are subject to the conditions of the Excavation Permits to be applied for by the Employer:
   a. Area .....;
   b. Area .....;
2. Refer to PRE.C2.060 for detailed requirements for Works on Street Maintained by the Highways Department;
3. For Works on land other than Street Maintained by the Highways Department that require an Excavation Permit, apply the Excavation Permit in accordance with Clauses SCC22.3(1)(b) and SCC22.3(5).

PRE.C6.230.9 SCC22.4 - HOUSING CONSTRUCTION MANAGEMENT ENTERPRISE SYSTEM

1. Follow the HOMES accounts creation procedures, which will be provided to the Contractor when the CM informs the Start Date, for obtaining the authorized main contractor submission account (AMCSA) and the associated security token for HOMES before the Start Date, and the quality control account (QCA) and main contractor data operation account (MCDOA) upon approval to the appointment of QCE;
2. Ensure the availability of computer systems that can fulfill the minimum requirements as specified in the Guide for HOMES, and bear all costs for the computer systems and the connection of the computer systems to HOMES through web browser (internet connection);
3. Use the HOMES as the electronic communication media for the Contract from the Start Date onward. In the event the Contract stipulates that a specified personnel except QCE, is responsible for the submission of the specified documents or certification of specified activities, such personnel should sign on the required documents as proper record. The signed documents shall be scanned in 'pdf' format and submitted to the CM through HOMES via the AMCSA. Original of the signed documents shall be submitted to the CM for proper record;
4. The QCE shall use the quality control account (QCA) for submissions in HOMES;
5. Upon issue of the maintenance certificate of the Works, only the AMCSA will remain active for access to HOMES until the End Date unless otherwise determined by the CM;
6. Train staff up for operating the computer system to input and submit the required information through HOMES. While self-learning training kit CD is distributed to the Contractor free of charge at the Start Date, the Employer will be organizing training courses for HOMES from time to time and the Contractor may arrange their staff to attend the training course where considered appropriate on payment of the relevant cost and fees;
7. Follow the 'Guide for Housing Construction Management Enterprise System (HOMES) for Hong Kong Housing Authority (for Contractors' use only)' for any necessary process available / required by the HOMES;
8. Coordinate with other contractors directly appointed by the Employer who are HOMES users for proper and timely execution of the functions in HOMES.
9. Further to the provisions in Clauses SCC22.4(1) and SCC22.4(2) of the Special Conditions of Contract, while the Contract Manager shall have the full power to determine and adjust the extent of the application of HOMES in contract administration before the End Date and to order the adoption of communications in hardcopy form which shall be deemed to be formal and authentic copy of the communication, hardcopy communication shall be adopted, further to those specified under Clause SCC22.4(6), for use in at least the following areas unless otherwise instructed by the Contract Manager:
    a. Provision of Drawings and Specification (GCC Clause 4.2);
    b. Commencement, Completion and Delays (GCC Clause 8);
    c. Works Subject to Excision (GCC Clause 9.1);
    d. Notice of Claims (GCC Clause 11.5);
    e. Ascertainment of Claims (GCC Clause 11.6);
    f. Payments to Nominated Sub-contractors (GCC Clause 12.5);
    g. Avoidance and Resolution of Disputes (GCC Clause 17).

10. Further to the provisions in Clause SCC22.4 of the Special Conditions of Contract, the HOMES functions are in place on the Start Date of HOMES (excluding those mentioned in sub-clause (9) above) and the details of their implementation arrangement shall be as required in APPENDIX PRE.C6/II to this Worksection.

PRE.C6.240.9 SCC22.6 – WORKS WITHIN THE RAILWAY PROTECTION AREA

1. The area of the Site deemed to be within the Railway Protection Area is shown on Drawing No. ..... in Appendix A to this Specification;
2. MTRCL has notified periods of Restriction, Possession and/or Isolation during which relevant part(s) of the Works may be allowed to be carried out and details of the periods are as follows:

   …….

   …….

APPENDIX PRE.C6/I

SPECIAL CONDITIONS OF CONTRACT

PRE.C6.APPEND1.D GUIDELINES ON SCOPE AND CONTENTS OF SUB-CONTRACTORS MANAGEMENT PLAN

The Sub-contractors Management Plan shall include (but not limited to) the following:

1. Scope of works to be sub-contracted including the form and extent of sub-contracting arrangement such as labour only, labour and plant, labour and material, plant only, lump sum or any other combination of types. Proof of ownership of construction plant and material shall be addressed. The scope of works to be sub-contracted shall comply with the relevant contractual provisions for limiting the tiers of sub-contracting;
2. Particulars of sub-contracts (irrespective of tiers) as required under the template in Table 1 below;
3. The Contractor's approach to demand / ensure his sub-contractors to:
   a. abstain from sub-contracting the whole of the works sub-contracted to them;
   b. report upwards their sub-contracting arrangement and any subsequent changes with written declarations of no "hidden" sub-contracts for any part of the Works sub-contracted to him.
4. The Contractor's proposed measures for supervision of the works and monitoring of the performance of sub-contractors, particularly the aspects of the works programming, quality and safety of the works and environmental protection;
5. The Contractor's proposed measures for monitoring the performance of the sub-contractors in complying with the requirements in the Contract in reporting site accidents;
6. Criteria for selection of sub-contractors involving trades not available in the Registered Specialist Trade Contractors Scheme (RSTCS);
7. The Contractor's approach to ensure all his sub-contractors (irrespective of tiers) to adopt written contracts in their sub-contracting and that all the sub-contractors comply with the requirements as stipulated in Clause SCC3.2 of the Special Conditions of Contract "Sub-contract conditions". In respect of the Construction Industry Security of Payment Ordinance (Cap. 652), the Contractor shall also cause all his sub-contractors to acknowledge the communication channels for notifying imminent delay in work or supply and the obligation to notify the Contractor about the latest status of any adjudication proceedings for their sub-contracts stipulated under PRE.C6.212 sub-clause (4);
8. Details of the Contractor's superintendence and management team as required in Clause 5.8 of the General Conditions of Contract "Contractor's superintendence", employed on direct supervision and management of sub-contractors. An organization chart showing the responsibilities of the Contractor's direct staff in supervision and management of his sub-contractors should be submitted;
9. Declaration through the standard declaration form in Annex 1 to this APPENDIX PRE.C6/I that members of staff on the Contractor's management team are prohibited to be given a sub-contract to any part of the Works or to have a vested interest in any of the sub-contractors irrespective of tiers;

10. The Contractor's proposed measures to ensure the compliance with the implementation of the system of payment of wages to the Site Personnel as stipulated in Clause SCC6.1 of the Special Conditions of Contract "Payment of wages of Site Personnel". The Contractor's proposed measures for ensuring timely payments to sub-contractors and payments by sub-contractors to sub-contractors of lower tiers.

Table 1 - Particulars of Sub-contracts(1)

No.	Contract No	Contract Title	Contract Sum ($)	Contact Point	Company Name of Sub-contractor	Commencement Date	Program	No. of Tier	Form of Sub-contractor	Type(2) (RSTC or RS)	Trade(3)	Specialty(3) (NA for RSTC)	Registration No.	Expiry Date	Value(4)	Grouping(5) (1, 1 (Advanced), 2 or NA)
e.g.	CV/XXXX/XX	Construction of XXX	100,000,000	Mr. XXX, E/XX	ABC Company Ltd.	1-10-2020	9 months	1	labour, plant & material	RSTC	Concreting Formwork	NA	XXXXXX	31-3-2022	E	1
	CV/XXXX/XX	Construction of XXX	100,000,000	Mr. XXX, E/XX	123 Company Ltd.	1-10-2020	12 months	2	labour & plant	RS	Fire Services Installation	Fire services pipe work	XXXXXX	31-3-2022	D	NA
1																
2																

Notes:

1. **Apart from the above information, the Contractor shall provide additional information and supporting document upon requested.**
2. **RSTC refers to the Registered Specialist Trade Contractors under the Registered Specialist Trade Contractors Scheme (RSTCS) of the Construction Industry Council (CIC). RS refers to the Registered Subcontractors under the RSTCS.**
3. **One row for one particular trade or specialty. Sub-contract with multiple trades or specialties shall be reported individually in several rows. For details of the classification of trade and specialty, please refer to the website of the RSTCS at www.rstc.cic.hk managed by the CIC. RSTCS covers 22 designated trade groups, viz. (1) Concreting, (2) Concreting Formwork, (3) Curtain Wall, (4) Demolition, (5) Erection of Concrete Precast Component, (6) Reinforcement Bar Fixing, (7) Scaffolding, (8) Plastering, (9) Suspended Ceiling, (10) Tower Crane (Erecting, Dismantling, Altering Height), (11) Building Drainage Installation, (12) Levelling and Setting Out, (13) Building Maintenance, (14) Interior Fitting-out, (15) Painting, (16) Metal Work, (17) Structural Steelwork, (18) Horticultural Works, (19) Arboriculture Works, (20) Skyrise Greenery Works, (21) Truss-out Scaffolding and (22) Site Lifting Operations.**
4. **One value for one particular trade group and specialty. The ranges of Value A to G are shown below:**
   A: Value < $1M
   B: $1M ≤ Value < $3M
   C: $3M ≤ Value < $6M
   D: $6M ≤ Value < $15M
   E: $15M ≤ Value < $30M
   F: $30M ≤ Value < $50M
   G: Value ≥ $50M
5. **Group 1, Group 1 (Advanced), and Group 2 refer to the tender limits set by CIC for the 22 designated trades mentioned in (3) above, which are only applicable to RSTC. For details of the tender limits, please refer to the website of the RSTCS at www.rstc.cic.hk managed by the CIC.**

Annex 1 to APPENDIX PRE.C6/I

Standard Declaration Form by the Contractor on Compliance with Provisions in Sub-contractors Management Plan

To : Contract Manager

Contract No. : _____

Contract Title : _____

In accordance with the Guidelines on Scope and Contents of Sub-contractors Management Plan referred to in Clause PRE.C6.040 of the Specification, I / we declare and confirm that we have complied with and undertake to continue to comply with the following provisions, and declare and confirm that I / we have ensured and undertake to continue to ensure that our members of staff on the Contractor's management team as referred to in item (9) of APPENDIX PRE.C6/I to the Specification are aware of the following provisions:

(a) Members of staff on the Contractor's management team are prohibited from being given a sub-contract to any part of the Works or having a vested interest in any of the sub-contractors irrespective of tiers;

(b) Members of staff on the Contractor's management team are required to submit written declarations to the Contract Manager upon his written request from time to time or at any time that they do not have a sub-contract to any part of the Works or any vested interest in any of the sub-contractors irrespective of tiers.

(Name of the Contractor):

(Name of the Signatory):

(Position of the Signatory):

(Date):

Annex 2 to APPENDIX PRE.C6/I

Guidelines on Documentary Proof to Demonstrate the Compliance of the Provisions in the Sub-contractors Management Plan

1. The CM should base on his professional judgement in selecting samples of sub-contract document / report for documentary proof;

2. Documentary proof should be limited to relevant information for the demonstration of the compliance of the provisions in the submitted Sub-contractors Management Plan i.e. information as stipulated in the Guidelines on Scope and Contents of Sub-contractors Management Plan at APPENDIX PRE.C6/I to the Specification;

3. Documentary proof should exclude sensitive commercial information such as price, payment conditions (except for purpose of proving compliance with the requirements as stipulated in the Contract (i.e. Clause SCC3.2 of the Special Conditions of Contract "Sub-contract conditions" and those under PRE.C6.212 in respect of the Construction Industry Security of Payment Ordinance)), bills of quantity, etc.

APPENDIX PRE.C6/II

PRE.C6.APPEND2.A HOMES FUNCTIONS AND DETAILS OF IMPLEMENTATION ARRANGEMENT

	HOMES Function	Hard-copy	E-copy to HOMES	Remark
(i)	Letters [excluding those concerning such functions as described in sub-clause (9) of PRE.C6.230]			*
(ii)	Site Instructions			*
(iii)	Contractor's Organization Chart			*
(iv)	Contractor's Programme and Site Progress Programme submission Weekly site progress photo			 * *
(v)	Drawings			**
(vi)	Documents for material management			***
(vii)	Site Direction / Memo			*
(viii)	Site Inspection Form			*
Legend : "√" = Applicable ; "x" = Not Applicable				

APPENDIX PRE.C6/III

PRE.C6.APPEND3.N AUTHORITY FOR PAYMENT TO THE BANK (SAMPLE ONLY)

PRE.C7 DOCUMENTATION AND RECORDS

DEFINITIONS AND ABBREVIATIONS

PRE.C7.010.A ABBREVIATIONS

Abbreviations, where used, have the following meanings:

ASTM	-	American Standard of Testing Materials
BS	-	British Standard
BS EN	-	European Standard adopted as British Standard
BS EN ISO	-	European Standard and International Organization for Standardization Standard adopted as British Standard
B of Q	-	Bill of Quantities (or Schedule of Prices where applicable)
CEDD	-	Civil Engineering and Development Department of the Government of the Hong Kong Special Administrative Region.
CIC	-	Construction Industry Council
CLP	-	CLP Power Hong Kong Limited
CM	-	Contract Manager
CoPSS	-	Code of Practice for Site Supervision 2009 (issued by Buildings Department)
CP	-	Code of Practice
CS	-	Hong Kong Construction Standard
DEVB	-	Development Bureau of the Government of the Hong Kong Special Administrative Region
DG	-	Decomposed Granite
DSD	-	Drainage Services Department of the Government of the Hong Kong Special Administrative Region
ELSP	-	Excavation and Lateral Support Plan
ELSW	-	Excavation and Lateral Support Works
EPD	-	Environmental Protection Department of the Government of the Hong Kong Special Administrative Region.
ETWB	-	Former Environment, Transport and Works Bureau of the Government of the Hong Kong Special Administrative Region
FSD	-	Fire Services Department of the Government of the Hong Kong Special Administrative Region
GCC	-	General Conditions of Contract
GEO	-	Geotechnical Engineering Office
GIFW	-	Ground Investigation Field Works
GIPASS	-	Ground Investigation Contractors Performance Assessment Scoring System
HA	-	Hong Kong Housing Authority

HD	-	Housing Department of the Government of the Hong Kong Special Administrative Region
HKCA	-	Hong Kong Construction Association
HOKLAS	-	Hong Kong Laboratory Accreditation Scheme
Hong Kong Government	-	The Government of the Hong Kong Special Administrative Region
HyD	-	Highways Department of the Government of the Hong Kong Special Administrative Region
ICU	-	Independent Checking Unit under the Office of the Permanent Secretary for Housing of the Government of the Hong Kong Special Administrative Region
LANP	-	Development Bureau's List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Landslip Preventive / Remedial Works to Slopes / Retaining Walls
LD	-	Labour Department of the Government of the Hong Kong Special Administrative Region
MTRCL	-	MTR Corporation Limited
NSC	-	Nominated Sub-contractor
OSHC	-	Occupational Safety and Health Council
OVT	-	Old and Valuable Tree
PNAP	-	Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (issued by Buildings Department)
PNRC	-	Practice Note for Registered Contractors (issued by Buildings Department)
RGE	-	Registered Geotechnical Engineer
RSC	-	Registered Specialist Contractor
RSC(F)	-	Registered Specialist Contractor in the Foundation Works Category
RSC(GIFW)	-	Registered Specialist Contractor in the Ground Investigation Field Works Category
RSC(SF)	-	Registered Specialist Contractor in the Site Formation Works Category
SCC	-	Special Conditions of Contract
SMM	-	Standard Method of Measurement
SP	-	Supervision Plan
TCP	-	Technically Competent Person (defined in TMSP)
TMSP	-	Technical Memorandum for Supervision Plan 2009 (issued by Buildings Department)
WSD	-	Water Supplies Department of the Government of the Hong Kong Special Administrative Region

PRE.C7.020.9 SPECIFICATION

1. This Specification is applicable to the whole of the Works in so far as it is not overridden by the General Conditions of Contract, Special Conditions of Contract, Drawings or the instructions of the Contract Manager;
2. Materials and Workmanship specified in one Worksection of the Specification will apply to the same items in other Worksections unless particularly stated otherwise.

PRE.C7.030.9 MAINTENANCE PERIOD

Where the words "Period of Maintenance" or "Defects Liability Period" occur in the Specification these shall be read as "Maintenance Period" as defined in the Contract.

PRE.C7.040.9 APPROVAL

"Approval" or "Approved" means the approval in writing by the CM as required under the Contract. "Approval" or "Approved" shall not relieve the Contractor from any responsibility imposed by the Contract and shall not be relied upon by the Contractor to alter, transfer or otherwise change, diminish or void any liability or obligation imposed on him by the Contract.

PRE.C7.050.9 INSTRUCTED

"Instructed" means an instruction in writing by the CM, but shall not relieve the Contractor from his responsibilities imposed by the Contract.

PRE.C7.055.9 PROPRIETARY NAMES

1. The phrase "or products having equivalent functions or performance" is deemed to be included whenever materials are specified by using
   a. Proprietary names;
   b. Proprietary names in conjunction with the phrases "or Approved equivalent", "or equivalent", "equivalent and approved", "equal or equivalent", "equal or approved", "equal and approved" and other similar phrases.
2. When the phrase "or products having equivalent functions or performance" is deemed to be included or is used in conjunction with the name of a proprietary material, materials of different manufacture but having equivalent functions or performance may be substituted if prior Approval has been obtained, provided that:
   a. Proof of equivalent functions or performance including details of functions or performance standards of the specified product and the proposed alternative is provided to CM for comparison;
   b. Rates and prices will not be changed from those for the proprietary materials specified.
3. If the Contractor intends to use the intellectual property rights of another party in performing his obligations under the Contract, appropriate licences should be obtained from relevant owners.

PRE.C7.060.9 SPECIFIED

“When specified” or “or specified” means the incorporation of a particular clause or alternative by specific reference in the Drawings or Specifications. When alternatives are given in this Specification the Contractor is at liberty to make his own choice from the alternatives listed.

PRE.C7.065.A MANUFACTURER'S RECOMMENDATIONS

"Manufacturer's recommendations" means those recommendations or instructions, printed or in writing and produced by the manufacturer of any specified product, current at 42 days prior to the date for the return of tenders.

PRE.C7.070.9 REGULATIONS

"Regulations" means any Ordinance or Regulation published by Government, bylaws of any local or duly constituted authority and rules or regulation of public bodies and companies which may be applicable to the Works.

PRE.C7.075.9 INDEPENDENT CHECKING UNIT

"Independent Checking Unit" means the Independent Checking Unit of the Housing Department of the Hong Kong Special Administrative Region.

PRE.C7.080.9 BUILDING WORKS

The words 'Building Works' means 'building works' referred under 'Interpretation', Section 2 of Buildings Ordinance, Chapter 123.

PRE.C7.085.9 SITE FORMATION WORKS

The words 'Site Formation Works' means 'site formation works' referred under 'Interpretation', Section 2 of Buildings Ordinance, Chapter 123.

DRAWINGS

PRE.C7.110.A DRAWING LIST

The Drawings are listed in Appendices A, B and C to this Specification.

PRE.C7.120.9 ADDITIONAL/AMENDED DRAWINGS

The CM may issue such additional and amended Drawings as he considers necessary during the progress of the works, and all such Drawings shall form part of the Contract.

PRE.C7.130.A APPLICATION OF REVISIONS

Where reference is made in the Specification to a drawing, it refers to the revision of the drawing given in Appendices A, B and C to this Specification.

PRE.C7.140.9 CHECKING DRAWINGS

Carefully check all Drawings and advise the CM of any discrepancies, omissions, errors or ambiguities should any be found.

PRE.C7.150.9 SCALING OF DIMENSIONS

Although the Drawings are prepared to scale, all works must be set-out from dimensions given in the Drawings and scaled dimensions must not be used. No claim resulting from scaling of dimensions by the Contractor will be considered.

PRE.C7.160.A SURVEYS FOR 'AS-BUILT' PLANS

1. Carry out as-built surveys, prepare and submit the original of the as-built survey record plans at scale 1:500 within 30 calendar days when a Section of the Works is completed or as required by the CM. When directed by the CM, submit soft digitised copies of the as-built survey record plans in AutoCAD*.DWG or Microstation*.DGN format;
2. These plans shall include details of all works but not be limited to drainage systems, platform levels, cuttings and embankments, retaining structures, roads and street furniture, manhole position and cover / invert levels, utilities etc. constructed by the Contractor and other parties within and adjacent to the Site;
3. Upon the completion of Contract, the CM shall compile from these records a final as-built survey record plan(s) at 1:500 or any other scale determined by the CM;
4. The plan(s) shall be signed by the CM and the Contractor and become the record plan for documentation purpose;
5. When directed by the CM, make arrangement for a representative of the CM to be present at all these surveys, and for the field documents to be initialled by the Contractor and representative of the CM;
6. The field data shall be recorded by the Contractor in optical media (e.g. CD / DVD) which shall have data format compatible with the Engineering Survey Computation Suite (ESCS) or in a data format agreed by the CM or his representatives;
7. The field data shall be captured in accordance with the Standard Feature Code for Engineering Survey (see PRE.C14 Appendix 2);
8. The work standard of the as-built surveys shall be in accordance with the Technical Specification for Topographical Survey attached in PRE.C15 Appendix 3;
9. All planimetric details shall be in terms of Hong Kong 1980 Grid System;
10. All levels, heights, depths and contours shall be in terms of Hong Kong Principal Datum.

PRE.C7.170.9 AS-BUILT DRAWINGS AND ROAD INVENTORY RECORDS FOR HIGHWAY STRUCTURES

1. When directed by the CM, submit a set of microfilms, negatives and digital data files in optical media (e.g. CD / DVD) of as-built drawings and as-built road inventory records of the highway structures to be handed over to Highways Department;
2. Microfilms shall be 35 mm in size with the image mounted on the lower right hand side of a 188 mm x 83 mm aperture card. Details such as Project Title, Contract Number, Drawing Number, etc. shall be typed on the aperture card for reference and indexing purposes;
3. The digital data files of as-built drawings submitted in optical media (e.g. CD / DVD) shall be in AutoCAD*.DWG or Microstation*.DGN format unless otherwise specified by the CM. The as-built drawings shall be in compliance with both the CAD Standard for Works Projects (CSWP) as posted on the Development Bureau's web-site and the Drafting Specification for Engineering Survey as posted on Civil Engineering and Development Department's web-site respectively;
4. The digital data files of as-built road inventory records submitted in optical media (e.g. CD / DVD) shall be in ArcGIS or other GIS format fully compatible with the Road Data Maintenance System of Highways Department. The as-built road inventory records shall be in compliance with the Geographical Information System (GIS) Specifications for Engineering Surveys of Highways Department as posted on Highways Department's web-site.

SURVEY DATUM

PRE.C7.210.9 DATUM REFERENCES

1. Survey Datum levels refer to either:
   a. Hong Kong Principal Datum which is used as the reference datum for all heights and contours on land. It is 0.146 metres above Chart Datum; or
   b. Chart Datum which is used for all soundings and submarine contours.
2. All setting out and surveys are to be based on the Hong Kong 1980 Grid System, and all plans produced are to be presented on Hong Kong 1980 grid.

PRE.C7.220.9 REFERENCES FOR SETTING OUT THE WORKS

1. Upon receipt of Contractor's request, the CM shall provide to the Contractor a Bench Mark level and survey control points close to the Site for use in setting out the Works;
2. Carry out all survey and levelling work necessary for the setting out of the Works in compliance with GCC Clause 5.10.

PRE.C7.230.9 RESPONSIBILITY FOR SURVEY CONTROL INFORMATION

The survey control information is given to the Contractor for information only; no guarantee is given nor responsibility be assumed by the Employer or the CM for their accuracy, consistency or sufficiency. Before the commencement of construction of any part of the Works, carry out a proving survey to check and verify the accuracy of the given information. The survey record has to be agreed by the CM and shall form the basis for the setting out of the Works. The Contractor shall be responsible for the preservation, maintenance and reinstatement of the survey control points used for the Contract. Any damage or obstruction of these survey control points shall be reinstated or relocated at the Contractor's own cost and to the CM's satisfaction as soon as possible unless specified otherwise.

PRE.C8 QUALITY STANDARDS

QUALITY MANAGEMENT SYSTEM

PRE.C8.010.9 ESTABLISHMENT OF QUALITY ASSURANCE PLAN

1. The Contractor who has not achieved ISO 9001 certification or whose ISO 9001 certification has been withdrawn by the certification body during the progress of the works, shall establish and implement a quality assurance plan to ensure completion of the Works in accordance with the requirements of the Contract;
2. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

PRE.C8.020.9 APPROVAL OF QUALITY ASSURANCE PLAN

Within 14 days of the date of the Letter of Acceptance or within 14 days of withdrawal of the ISO 9001 certification by the certification body, submit for Approval a quality assurance plan for the execution of all elements of the Works, including those carried out by his sub-contractors.

PRE.C8.030.9 COMPLIANCE WITH QUALITY ASSURANCE PLAN

Upon obtaining the Approval to the quality assurance plan, adhere to the principles and procedures contained therein and submit for further Approval any revisions subsequently made to this document.

PRE.C8.040.9 MINIMUM CONTENT OF QUALITY ASSURANCE PLAN

The quality assurance plan shall include, but not be limited to, the items specified in the following clauses PRE.C8.050 to PRE.C8.120.

PRE.C8.050.9 ORGANIZATION AND RESPONSIBILITY

1. The quality assurance organization for the Works under the Contract and the responsibilities of the main participants shall be clearly defined;
2. An organization chart shall be produced to illustrate the sub-division of the work into elements for effective technical and management control, the reporting structure and the interface relationships between all parties involved;
3. Names, addresses, telephone and fax numbers of all principal contacts shall be listed.

PRE.C8.060.9 DESIGN CONTROL

The procedures for the control and verification of the design of the Contractor's design work, including the design of Temporary Works so specified, to ensure their compliance with the requirements of the Specification, which, inter alia, meet the following requirements:

1. The design and verification activities are planned and carried out by qualified personnel with suitable resources;
2. The design input requirements relating to the Contractor's design work, including the design of Temporary Works so specified, are identified and documented;
3. The design output satisfies the design input requirements;

4. Any changes and modifications to the design are identified, actioned, documented, reviewed and approved by the appropriate personnel;
5. Design documents such as calculations, drawings, reports, bar schedules, etc. are properly controlled.

PRE.C8.070.9 PURCHASING OF MATERIALS AND SERVICES

The procedures for the procurement of materials and services to ensure that they comply with the requirements of the Specification, which, inter alia, meet the following requirements:

1. Sub-contractors and suppliers of materials and technical services are selected on the basis of their ability to satisfy the requirements of the Specification;
2. Records of suitable sub-contractors and suppliers are maintained;
3. Purchasing documents clearly describe the material or service being ordered;
4. Purchasing documents are retained as records.

PRE.C8.080.9 CONSTRUCTION PROCESS CONTROL

The procedures for the control of the construction processes to ensure their compliance with the requirements of the Specification, which, inter alia, meet the following requirements:

1. Documented work instructions are produced to cover the construction processes which directly affect the quality of work;
2. These processes are monitored and controlled to ensure that the Works are carried out in accordance with the requirements of the Specification and quality plans with the use of suitable equipment.

PRE.C8.081.9 TEMPORARY WORKS PROCESS CONTROL

The procedures for the control of the Temporary Works construction to ensure there would be no adverse impact to the execution of permanent works, which, inter alia, meet the following requirements:

1. Documented work instructions are produced to cover the design and execution of Temporary Works, including planning, coordination among different trades and sequencing of works during various stages and, where applicable, the checking or verification processes;
2. Monitoring and controlling these Temporary Works processes to ensure that the Temporary Works are carried out in accordance with the requirements of the Specification and quality plans with the use of suitable equipment.

PRE.C8.090.9 INSPECTION, MEASURING AND TESTING EQUIPMENT

The procedures for the control, calibration and maintaining the inspection, measuring and testing equipment, which, inter alia, meet the following requirements:

1. Inspection, measuring and testing equipment is used in such a way that the accuracy is known and within the required limit;
2. Inspection, measuring and testing equipment is maintained and calibrated against certified equipment having a known relationship to nationally recognised standards. Where no such standards exist, the basis used for calibration is to be acceptable to the CM;
3. Calibration and maintenance records for inspection, measuring and testing equipment are kept.

PRE.C8.100.9 CONTROL OF NON-CONFORMING MATERIALS AND WORKS

The procedures for the identification and control of non-conforming materials and works, which, inter alia, meet the following requirements:

1. Non-conforming materials and works are positively identified and segregated;
2. Records are kept of all non-conforming materials and works and of the subsequent corrective actions taken;
3. All personnel concerned are notified that a non-conformance exists;
4. Reworked/rectified items are inspected in accordance with documented procedures.

PRE.C8.110.9 TRAINING

The procedures for identifying training requirements and for the provision of training to all personnel performing activities which affect the quality of work, which, inter alia, meet the following requirements:

1. Personnel carrying out specific assigned tasks shall be suitably qualified (i.e. with formal qualifications, training or suitable experience);
2. Records of staff training and qualifications are maintained.

PRE.C8.120.9 QUALITY ASSURANCE PLAN REVIEW

The procedures for the regular evaluation and updating of the quality assurance plan to safeguard the continuing effectiveness of the quality management system.

PRE.C8.130.9 ISO 9001 CERTIFICATION FOR SUB-CONTRACTOR

1. Where any sub-contractor engaged for the specialist works specified under GCC Clause 3.2(11) has not achieved ISO 9001 certification or whose ISO 9001 certification has been withdrawn by the certification body during the progress of the works or such certification has expired before certification to the latest edition of the ISO 9001 is achieved, the Contractor shall ensure that such sub-contractor shall establish and implement a quality assurance plan for the works, for which the sub-contractor is engaged, in a like manner as the Contractor himself is required to do in compliance with PRE.C8.010 to PRE.C8.120 inclusive;
2. The Contractor shall ensure that the implementation of such quality assurance plan by the sub-contractor shall continue until the sub-contractor has achieved or reinstated ISO 9001 certification and provided a copy of such ISO 9001 certificate to the Contract Manager.

ALTERNATIVE DESIGNS

PRE.C8.210.9 BASIS OF ASSESSMENT

1. Any proposal by the Contractor involving modifications to design will be assessed on its merits and, if considered viable by the CM, may be accepted;
2. A decision to adopt a technically modified design will be governed by the amount of the overall saving which can be reliably expected to accrue;
3. In assessing the overall saving, account will be taken of the effect of any change to the Contract programme, and the cost to Housing Authority of additional engineering and administrative resources involved in assessing the alternative design and in implementing it through to completion of the Contract.

PRE.C8.220.9 DESIGN RESPONSIBILITY

Drawings or other documents provided by the Contractor shall be deemed to come within the provisions of GCC Clause 4.3 and the Contractor shall accept responsibility for his own design as provided for under GCC Clause 5.15.

PRE.C8.230.9 DESIGN STANDARDS

1. Any alternative designs must conform with standards prescribed by the CM;
2. An alternative design which appears viable will be Approved in principle prior to detailed design;
3. Final Approval will be given after an independent check of the detailed design arranged by the CM has shown it to be satisfactory;
4. The cost of any amendments shown by this check to be necessary must be borne by the Contractor.

PRE.C8.240.9 COSTS ARISING FROM DESIGN NON-VIABILITY

1. In the event of the CM's check of the detailed design showing that the design is not viable, then the Contractor shall pay to the Housing Authority the costs of the CM's check by way of deductions by the Housing Authority from any monies due, or which may become due, to the Contractor;
2. In the event that the CM's fees for checking the detailed design exceed the saving of constructional cost, then the excess shall be paid by the Contractor to the Housing Authority by a similar deduction.

MATERIALS AND WORKMANSHIP

PRE.C8.310.9 GOOD PRACTICE

Materials and workmanship generally to be consistent with good practice in Hong Kong and to comply with this specification and with the relevant BS, BS EN, BS EN ISO or CP, except when specified otherwise, and/or Approved.

PRE.C8.320.A MATERIAL

1. Material for inclusion in the permanent works to be new or other material as stated in the Contract or approved by the CM;
2. Appearance or packing of materials to be supplied or services to be provided in connection with the Works containing any messages (whether explicit or implicit) which are likely to constitute or cause the occurrence of any offences endangering national security or which would otherwise be contrary to the interest of national security shall strictly be prohibited.

PRE.C8.330.9 CONSISTENCY OF MATERIALS

1. When a choice of manufacturer is permitted for any material, obtain the entire quantity required to complete the work from one manufacturer. Unless otherwise Approved, also obtain such material from the same source of supply;
2. When a choice of proprietary material is permitted from a List of Approved Proprietary Names for any specified materials, use the same brand of material throughout unless otherwise Approved;

3. When a choice of type, colour or size of material is permitted (e.g. glazed wall tiles, mosaic tiles), use the same type, colour and size throughout for all work in like locations unless otherwise Approved.

PRE.C8.340.9 MIX PROPORTIONS

Unless otherwise specified, mix proportions to be by volume.

PRE.C8.350.9 MANUFACTURER'S RECOMMENDATIONS

Handle, store and fix each material in accordance with manufacturer's recommendations. Submit copies of these recommendations to the CM, when requested, before work is commenced.

PRE.C8.360.9 EQUIVALENT MATERIALS AND IMPERIAL SIZES

1. When materials or products to the appropriate standard are not available, materials or products conforming with equivalent standards will be acceptable subject to Approval;
2. When a material is available in Hong Kong in metric size, an imperial size equivalent will not be acceptable;
3. If a material is unobtainable in metric size, a material of an imperial size equivalent which will fully meet the specification may be substituted if prior Approval has been obtained, but the rates and prices will not be changed from those submitted for the materials specified.

PRE.C8.370.9 BRITISH STANDARDS

1. BS, BS EN, BS EN ISO and CP shall, except for head standards, be deemed to include for the latest revision and any amendments to that revision that are listed in the BSI Standards Catalogue and its Supplements published before the date 42 days prior to the date for the return of tenders unless the year of revision is specified in this Specification;
2. "Head standards" to BS, BS EN, BS EN ISO and CP shall be deemed to include for all dated revisions to their parts and amendments which are listed in the BSI Standards Catalogue and its Supplements published before the date 42 days prior to the date for the return of tenders unless otherwise specified;
3. "Head standards" (HS) are not dated because they do not contain any technical content. However reference to a head standard invokes all extant "parts" of that standard which are themselves dated. Reference to head standards is a practicable method of using a general BS, BS EN or BS EN ISO reference in situations where detailed reference to each part would be cumbersome.

PRE.C8.380.9 OTHER NATIONAL AND INTERNATIONAL STANDARDS

Hong Kong Construction Standards (CS), International Standards Organization (ISO) Standards and standards issued by the American Society for Testing and Materials (ASTM) and similar standards shall be deemed to include for the latest revision and any amendments to that revision, that are published 42 days prior to the date for the return of tenders unless the year of revision is specified in this Specification.

PRE.C8.390.9 EQUIVALENT STANDARDS

In the event of Approval being sought, pursuant to PRE.C8.310, for materials or workmanship, for which compliance is claimed to a standard, other than that specified, submit full details to the CM one month before such materials are required for manufacture or incorporation into the works.

TESTING

PRE.C8.510.9 LABORATORY TESTING

1. With the exception of testing for concrete and steel reinforcement which should comply with Worksections CON1 and CON3 of this Specification, laboratory testing required shall be carried out by the Contractor using laboratories listed on the Development Bureau's List of Approved Suppliers of Materials and Specialist Contractors for Public Works: Soil and Rock Testing, or Government Public Works Laboratory and which are accredited by HOKLAS and Approved by the CM;
2. The Contractor shall appoint at least four such Approved laboratories on a three months roster system to carry out the tests;

Option 1

3. The Contractor shall submit for Approval the names of the laboratories four weeks before any testing work is carried out on the Contract;

Option 2

3. The Contractor shall submit for Approval the names of the laboratories four weeks before any testing work is carried out on the Contract and in conjunction with the sub-contractor to confirm no affiliation with the proposed testing laboratory using the standard template at Appendix PRE.C8.APPEND1;

Option 1

4. Provide test samples under the supervision of the CM and where required submit samples to the Approved testing laboratory and unless otherwise specified, pay all fees and charges;

Option 2

4. Provide test samples under the supervision of the CM and where required submit samples to the Approved testing laboratory and unless otherwise specified, pay all fees and charges. In addition, comply with the following requirements in delivery of test samples:
   a. Deliver the samples to the Approved testing laboratory on the same day of selection and taking of samples;
   b. If the samples cannot be delivered to the Approved testing laboratory on the same day of sample taking, inform the CM the reason and apply to the CM for permission to adopt the Approved secured storage arrangement for such samples before delivery to the laboratory on the other day;
   c. Within two months from the notified date for commencement of the Works, submit for CM's approval a proposal on secured storage arrangement for samples. Upon CM's approval, the Approved secured storage arrangement may be adopted on any day during the progress of the Works subject to CM's permission in accordance with sub-clause (4)(b) above;
   d. Bear all additional cost incurred for compliance with sub-clauses (4)(a) to (4)(c) above and no extension of time will be granted.
5. Mark samples, and clearly indicate on test records, the location or delivery from which the test was taken;
6. Request the Approved testing laboratory to submit the original of test certificates to the CM and the Contractor at the same time and keep a copy of all records on Site;
7. Submit samples of materials, carry out tests and obtain Approval, before the materials are used in the Works;

8. When requested by the CM provide test certificates or obtain guarantees from the manufacturers, that materials specified to a BS or other specified standard, conform to the relevant standard.

INDEPENDENT CHECKING UNIT (ICU)

PRE.C8.602.9 GENERAL

Obtain relevant ICU forms from CM and submit at time frame specified by CM.

PRE.C8.603.9 SERVICES AND FACILITIES REQUIRED BY ICU

1. In facilitating ICU's inspection and checking:
   a. Provide attendance to facilitate the checking of personnel and attendance records of supervisory staff against the SP;
   b. Provide attendance on any other site activities and tests for ICU's inspection as and when necessary;
   c. Provide any other information as required by the CM.
2. Inform the CM at least 7 working days prior to carrying out any tests to be specified by the CM for inspection by ICU.

PRE.C8.610.9 INDEPENDENT CHECKING UNIT (ICU)

1. Staff of ICU of the Housing Department, in the presence of the CM, will carry out the following checking or inspection on Site:
   a. Foundation Work
      i. Witness pile installation and loading test, if any, of preliminary pile or first working pile;
      ii. Witness pre-drilling of Types 3, 5 & 6 piles;
      iii. Inspect bearing strata of footings;
      iv. Witness core drilling process for Type 3 pile;
      v. Witness post construction proof drilling for Types 5 & 6 piles;
      vi. Witness loading test of the piles selected by ICU;
      vii. Witness or inspect any other site activities as and when necessary.
   b. Witness any works carried out on Site as and when necessary;
   c. Check personnel and attendance records of supervisory staff against the SP;
   d. Check third party safety audit reports against the Safety Plan required under GCC Clause 5.11 and PRE.C9.220.
2. The CM will select certain piles to undergo loading tests, core tests or any other tests as necessary for the ICU's inspection;
3. Inform the CM at least 7 working days before:
   a. The preliminary pile or first working pile is ready to be installed or load tested;
   b. The testing of the piles selected by the CM for the ICU's inspection is ready to be performed.
4. Attend inspection and checking with the ICU and provide information to the ICU to facilitate the inspection and checking;

5. Bear all additional expenditure incurred by reason of the progress of the Works or any part thereof having been materially affected by the time taken by ICU's inspection and checking. Any delay caused thereby will not be accepted as a justification for granting an extension of time.

PERFORMANCE ASSESSMENT SCORING SYSTEM (PASS)

PRE.C8.710.9 GIPASS

1. The performance of the Contractor under this Contract is to be assessed by the Ground Investigation Contractors Performance Assessment Scoring System, abbreviated as GIPASS, which is a means of comparing the performance of individual Ground Investigation Contractors in the Housing Authority List of Ground Investigation Contractors. It will also be used to guide the Contractor on aspects which require improvement and will be a practical and continuous assessment tool in persuading the Contractor to improve his performance;
2. The assessment shall be carried out quarterly unless the performance of the Contractor warrants a shorter assessment period as determined by the CM;
3. Attend site meetings to discuss the assessment as required;
4. Acknowledge the GIPASS Assessment and Score Sheets when required by CM.

QUALITY CONTROL MEASURES FOR WELDING CONSUMABLES FOR STRUCTURAL STEELWORKS

PRE.C8.810.9 WELDING CONSUMABLES FOR STRUCTURAL STEELWORKS

1. The Contractor is to follow the following quality control measures on Site for the welding consumables to be used for temporary or permanent structural steelworks on Site of steel grade as stated in STW.M110 and shown in the working drawings:
    a. Centrally procure all welding consumables by the Contractor;
    b. Submit materials sample board for all types of welding consumables to be used on Site and at off-site fabrication yard if applicable;
    c. Submit the manufacturer's test certificates for each batch of welding consumables in accordance with STW.M715;
    d. Complete and submit report of the chemical analysis for the welding consumables in accordance with STW.T550 to STW.T590;
    e. Store the welding consumables in lockable storage. Welding consumables of different testing status shall be kept separately;
    f. Control the distributions of all welding consumables and record the distributions in a distribution record;
    g. Prepare a daily consumption record on the welding consumables, which shall include, but not be limited to, information such as:
        i. The quantities delivered to Site;
        ii. The approximate quantities used and wasted;
        iii. The quantities left;

iv. The approximate total quantities to be used based on the construction drawings or testing sample.

h. Keep on Site all distribution record form and daily consumption record for checking by the CM or his representatives;

i. Submit the distribution record form and the daily consumption record for discussion in monthly site meeting;

j. Conduct daily check to ensure the welding consumables are properly used by welders;

k. Stock a minimum quantity of tested welding consumables on Site which should be adequate for the anticipated consumption of next three weeks, or a longer period as is considered necessary for the Works by the CM;

l. Submit for Approval a colour code system for identification of welding consumables on Site:

i. For different batches, as defined in STW.T550, before any testing:

- Keep the welding consumables under wrapping during quarantine and label with adhesive tape of white, yellow, blue, grey colour or other specific colour, except green or red colour, by applying the adhesive tape to the package;
- Do not use the same colour code for different batches of welding consumables.

ii. For each batch of welding consumables with all test results (including the re-test results as required under the Specification) available, apply:

- Green colour to the packaging material and the tips of the welding consumables when the packaging material is removed where the welding consumables comply with the Specification;
- Red colour to the packaging material where the welding consumables do not comply with the Specification.

2. For off-site fabrication, follow the following quality control measures at the off-site fabrication yard for the welding consumables to be used for temporary or permanent structural steelworks on Site of steel grade as stated in STW.M110 and shown in the working drawings:

a. Submit the procurement record for all welding consumables to be used;

b. Submit materials sample board for all types of welding consumables to be used at the fabrication yard;

c. Submit the manufacturer's test certificates for each batch of welding consumables in accordance with STW.M715;

d. Complete and submit report of the chemical analysis for the welding consumables in accordance with STW.T550 to STW.T590;

e. Control the distributions of all welding consumables and record the distributions in a distribution record form;

f. Prepare a daily consumption record on the welding consumables, which shall include, but not be limited to, information such as:

i. The quantities delivered to Site;

ii. The approximate quantities used and wasted;

iii. The quantities left;

iv. The approximate total quantities to be used based on the construction drawings or testing sample.

g. Keep at the off-site fabrication yard all distribution record form and daily consumption record, for checking by the CM or his representatives;

h. Submit a quality assurance (QA) scheme for ensuring the compliance of materials and tests for the use of welding consumables at the off-site fabrication yard in accordance with STW.W1110.

APPENDIX PRE.C8/I

PRE.C8.APPEND1.A APPLICATION FORM FOR APPROVAL OF TESTING LABORATORY

Application for Approval of Testing Laboratory (Original) *Note 1

Contract No. : _____

Contract Title : _____

To Contract Manager,
(Attn:)

I apply for your approval of the commissioning of _____
(Name of testing laboratory)
that complies with PRE.C8.510 to carry out the following test(s):

Description of the test(s)	Relevant specification clauses

I confirm that our company and our sub-contractors have no affiliation with the proposed testing laboratory; and the test reports will be sent directly to you and to our company and sub-contractors at the same time.

Signature : _____

Name: _____

(BLOCK LETTER)
Post/Name of Company : _____

(with company chop)
Date : _____

Note This form consists of an original and a duplicate copy.
The original copy shall be submitted to the CM.
The duplicate cop shall be forwarded to CSE/DC for record.

DELETED

Application for Approval of Testing Laboratory (Duplicate) *Note 1

Contract No. : _____

Contract Title : _____

To Contract Manager,
(Attn:)

I apply for your approval of the commissioning of _____
(Name of testing laboratory)
that complies with PRE.C8.510 to carry out the following test(s):

Description of the test(s)	Relevant specification clauses

I confirm that our company and our sub-contractors have no affiliation with the proposed testing laboratory; and the test reports will be sent directly to you and to our company and sub-contractors at the same time.

Signature : _____

Name: _____

(BLOCK LETTER)
Post/Name of Company : _____

(with company chop)
Date : _____

Note This form consists of an original and a duplicate copy.
The original copy shall be submitted to the CM.
The duplicate cop shall be forwarded to CSE/DC for record.

PRE.C9 CONTRACTOR'S OBLIGATIONS

AUTHENTICITY OF INFORMATION

PRE.C9.005.N CONSENT TO THE EMPLOYER FOR VERIFICATION OF DOCUMENTS SUBMITTED BY THE CONTRACTOR

1. The Contractor shall give consent to the Employer to obtain from:

   a. any party who has been named in the Tender and/or documents submitted by the Contractor in the course of performance of the Contract;

   b. any issuing body of any test reports, certificates or documentary evidence mentioned or referred to in the Tender and/or documents submitted by the Contractor in the course of performance of the Contract; and

   c. any other parties such as banks, insurers, employers/clients/project managers/professionals of the projects/contracts listed in the submitted information and/or documents, professional bodies/institutions, universities or the like that have been referred to in the Tender and/or documents submitted by the Contractor in the course of performance of the Contract,

   all information which the Employer considers relevant for the enforcement and administration of the Contract, including but not limited to information to verify the legitimacy, completeness, authenticity and accuracy of any information included in the Tender and/or documents submitted by the Contractor in the course of performance of the Contract.

2. The consent specified in sub-clause (1) above shall be valid throughout the course of performance of the Contract. If any consent from any other person is required for the Employer to obtain any of the aforesaid information or document, the Contractor shall undertake to obtain such consent when required by the Employer. Further, upon request by the Employer or the CM, the Contractor shall provide a written authorization to the Employer if such written authorization is needed for the Employer to obtain information and/or document(s) from the person or issuing body referred to in sub-clauses (1)(a) to (1)(c) above.

3. The Contractor shall submit the names, qualifications, experience, documentary proof of the employment status and other required information of any members of his management team for approval of the CM in accordance with the Contract. The Contractor shall also submit to the Employer through the CM a signed declaration and consent by each member of his management team in the form set out in APPENDIX PRE.C9/XVIII to declare that the submitted information as to the qualifications, experience, employment status and other required information is true, accurate and complete, and to give consent to the Employer to obtain from and verify the authenticity of the submitted information with the relevant parties and to collect, use and input such information into the database of the Employer (if any) for the purposes of contract procurement and management of the Contract and any other contracts of the Employer. Should there be a replacement of any member of his management team, the Contractor shall propose a competent substitute with the qualifications and experience as specified in the Contract. The Contractor shall submit the name, qualifications, experience, documentary proof of the employment status and other required information of such substitute for approval of the CM and a signed declaration and consent by such substitute to the Employer through the CM in the same form set out in APPENDIX PRE.C9/XVIII.

4. Notwithstanding sub-clause (3) above, when required by the CM, the Contractor shall submit the name, qualifications, experience, documentary proof of the employment status and other required information of any person proposed in accordance with the Contract and a signed declaration and consent by such person to the Employer through the CM in the form set out in APPENDIX PRE.C9/XVIII.

USE OF SITE

PRE.C9.010.9 PURPOSE

Except if, and to the extent otherwise provided for in the Contract, the Site shall not be used for any purpose other than carrying out the Works.

PRE.C9.020.9 RESTRICTIONS ON ADVERTISING

No advertising notice boards of any kind are to be erected on the Site without prior Approval. The proposed advertising board design shall be submitted for Approval well in advance of the intended erection.

PRE.C9.030.9 RESTRICTIONS ON STOCKPILING

Areas inside the Site may be used as stockpile areas only with prior Approval.

PRE.C9.040.9 WORKERS

Do not allow workers to live on the Site with the exception of guards and watchmen.

PRE.C9.050.9 OCCUPANCY AND RENTAL OF PRIVATE LAND OF ECOLOGICAL VALUES

The Contractor shall not rent or occupy any private land falling within the designated areas listed below for any purposes arising out of or in connection with the Contract unless prior approval is obtained from the CM:

1. Existing country parks designated under the Country Parks Ordinance (Cap. 208);
2. Areas designated as Coastal Protection Area, Site of Special Scientific Interest, Green Belt, Conservation Area and Other Specified Uses (River Park) on statutory plans (i.e. Outline Zoning Plans and Development Permission Area Plans) under the Town Planning Ordinance (Cap. 131);
3. Restricted areas under the Wild Animals Protection Ordinance (Cap. 170);
4. Areas designated under the Marine Parks Ordinance (Cap. 476).

PRE.C9.082.9 MAINTENANCE WORKS PROCESS CONTROL

The procedures for the control of the Maintenance Works during the Maintenance Period, which, inter alia, meet the following requirements:

1. Documented work instructions are produced to cover the execution of Maintenance Works during the Maintenance Period and method statements are drawn up for the Maintenance Works to minimise nuisance to adjoining residents and the general public;
2. Monitoring and controlling of these Maintenance Works processes to ensure that Maintenance Works are carried out in accordance with the requirements of the Specification and approved method statements with the use of suitable equipment;
3. Recording and monitoring of the execution of those Maintenance Works which may affect the permanent works / structures.

SECURITY

PRE.C9.110.A SECURITY GUARDS

1. Employ security guards on the Site and on the Works, day and night;
2. At commencement of the Works, provide a minimum of ..... security guards at all times;
3. The CM may approve a lesser number of security guards when any Section of the Works has been completed, or increase the number as is considered necessary for the Works;
4. Provide each security guard with a walkie-talkie and make suitable arrangements for regular patrolling and reporting by security guards and for a key system check on each store;
5. Conduct sporadic site surveillance after working hours from the date for commencement of *the Works / Section(s) …… at frequency as agreed with the CM and maintain records of such surveillance for verification by the CM or his representatives upon request.

PRE.C9.120.9 ACCOMMODATION FOR SECURITY GUARDS

1. Provide secure huts or rooms for security guards, each fitted with a direct exchange line telephone, and an internally operated lock;
2. There shall be adequate illumination for the huts or rooms and all surrounding areas and site entrances.

PRE.C9.130.9 INTEGRITY OF SITE PERIMETER

1. All site hoardings and gantries shall be repaired and maintained in good condition for the duration of the Contract;
2. The number of entrances and exits to the Site shall be kept to a minimum or as specified;
3. All entrances and exits shall be provided with gates and all such gates shall be locked outside working hours.

PRE.C9.140.9 WAGE BOOKS

1. In addition to the requirements of GCC Clause 5.25, keep wage books for monitoring the payment of wages and MPF contribution paid by the Contractor and the sub-contractors of all tiers to all Site Personnel and identify each Site Personnel by the data as specified in PRE.C9.2550. The wage books shall give a full and up-to-date account of the payment of all wages and MPF contribution paid to all Site Personnel for the duration of the Contract, up to and including the month in which the operation of ACRS is terminated as stipulated in PRE.C9.2560. For Contracts with more than one Portion of the Site, the Contractor shall keep wage books for all Site Personnel of each particular Portion of the Site up to and including the month in which the operation of ACRS is terminated as stipulated in PRE.C9.2560, or up to an earlier date as otherwise agreed by CM, to be consisting of the following:
    a. A complete set of copy of the executed employment contracts of all Site Personnel on Site as required in PRE.C6.170;
    b. A complete set of signature specimens of all Site Personnel complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;
    c. A complete set of verified daily attendance records as required in PRE.C9.2510;

d. A complete set of copy of the schedules of wages and the respective records of transactions for payment of wages and MPF contribution as required in PRE.C6.170;

e. A complete set of copy of the written declaration that all wages of the Site Personnel have been paid and all MPF contributions have been made as required in PRE.C6.170.

2. Make wage books available on Site for inspection by the CM or LRO. Maintain and update an additional copy of wage books in the office of LRO for record;

3. All documents kept in the wage books shall be duly certified by the Contractor or the respective sub-contractors that they are the true copy of the original documents;

4. Provide information of daily wages on the daily returns submitted in accordance with PRE.C9.2220;

5. Keep wage books in a secure place as agreed by CM such as a room or cabinets with locking device during the whole contract period and after the date of terminating the operation of ACRS as stipulated in PRE.C9.2560, or up to an earlier date as otherwise agreed by CM. The respective keys shall only be held by the members of Contractor's management team. After at least 12 months from the date of terminating the operation of ACRS as stipulated in PRE.C9.2560 and with the consent of the CM, all the documents kept in the wage books including the additional copy in the office of LRO shall be destroyed and disposed properly without disclosing any information contained in them;

6. Provide cabinets with locking device to Nominated Sub-contractors for keeping their wage books;

7. The above requirements stipulated in sub-clauses (1) to (6) may be exempted subject to the compliance with all relevant criteria and procedures stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time or as Approved by the CM on individual case basis.

PRE.C9.170.A SITE SECURITY PLAN

1. Submit a Site Security Plan to the CM for information and comment at the following occasions:

   a. Within 14 days of the date of the Letter of Acceptance;

   b. Necessitated by revisions of programme in accordance with GCC Clauses 8.4 or 8.5 of the Conditions of Contract;

   c. When the Site Security Plan is revised by the Contractor.

2. The Site Security Plan comprises but is not restricted to the following:

   a. Policy Statement for security on the Site;

   b. Security staff organizational structure which shows:

      i. Duty list of the responsible officers;

      ii. Chain of responsibility;

      iii. Details of the resources allocated on the Site;

      iv. Emergency contact telephone numbers for security aspects of the Works.

   c. Means of compliance on the following aspects of Works at various stages of construction which are to be programmed into the programme or revised programme furnished pursuant to GCC Clauses 5.7, 8.4 and 8.5:

i. Proposed number, qualification and surveillance check on the performance of security guards;

ii. Control for the care of personal security and safety of all people on site;

iii. Control for the care and storage of any Constructional Plant, temporary buildings and materials and anything whatsoever on the Site or delivered to or placed on the Site in connection with or for the purpose of the Works or any Specialist Works;

iv. Control over hoardings, gantries, fencings, etc.;

v. Control of accessibility at Site entrance(s) and individual building blocks;

vi. Control of entry and exit of visitors and vehicles to and from the Site with records;

vii. Control over delivery and removal of materials, goods, equipment and plant with records;

viii. Control over unused materials, goods, plant and equipment;

ix. Control over storage of concrete cubes;

x. Adequacy of temporary lighting inside the buildings, within the Site and around the Site boundary especially during night time.

d. Procedures and records for security control and patrolling services on building blocks, storage areas for materials, goods, equipment and plant and the Site for the times / periods as follows:

i. At day and night time;

ii. At and within 6 months of the date for completion of each Section and the Works;

iii. For the period 45 days after the CM has certified completion of each Section and the Works pursuant to GCC Clause 5.12.

e. Emergency procedures in case of crime e.g. theft, burglary etc. or fire, including systems of reporting, recording and remedial measures;

f. Site security reports submitted at monthly site meetings to include, but not restricted to, the following information:

i. Site security measures implemented on the Site;

ii. Designated site security personnel for implementing and monitoring the plan;

iii. Cases of failure;

iv. Feedback from Nominated Sub-contractors, Suppliers or others.

g. Proposal for security training to the concerned personnel including Site Agent, General Foremen, and other concerned site staff;

h. Programme for reference to the local regional Crime Prevention Unit of the Hong Kong Police Force.

3. Accept full responsibility under the Contract. The obligation for site security is not relieved by:

a. The CM's consent to the Site Security Plan and any proposed revision or update;

b. The CM's rejection of the Site Security Plan and any proposed revision or update;

c. Implementation of the Site Security Plan.

4. Do not impose any obligation or responsibility on the Employer or the CM with regard to site security;

5. Hold regular meetings to review adequacy of Site Security Plan from time to time, and specifically in advance of each programmed work stage, to ensure compliance with specified requirements and continued adequacy of the Site Security Plan.

SAFETY

PRE.C9.205.E COMPLIANCE WITH SAFETY REGULATIONS AND CONTRACT REQUIREMENTS

In relation to the requirements of GCC Clause 5.11 and PRE.C6.070, comply with all current Regulations concerning safety on the Site in particular the Factories and Industrial Undertakings Regulations and the requirements specified in the Contract as follows:

1. Safety Officers:

   a. Employ Safety Officer(s) and Safety Supervisor(s) in accordance with the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, with specific detailed requirements as follows, and employ any other safety personnel in excess of the following as may be required by any enactments, regulations, by-laws or rules that may be in force at any time during the progress of the Works:

      i. The number of Safety Officer(s) to be employed shall depend on the total number of persons employed on Site as indicated below:

Total no. of persons employed on Site	No. of Safety Officer(s) required
Not more than 200	1
201 to 700	2
701 to 1200	3
1201 and above	4

      ii. The number of Safety Supervisor(s) to be employed shall depend on the total number of persons employed on Site and comply with the above said regulation;

      iii. The total number of persons employed on Site as per sub-clauses (a)(i) and (a)(ii) shall include the workforce of the Contractor, the Contractor's sub-contractors and Nominated Sub-contractors but shall exclude the workforce of those separate contractors employed directly by the Employer;

      iv. The Safety Officer(s) and Safety Supervisor(s) must be employed full time solely and designated for the Contract. The Safety Officer(s) shall be registered by the Commissioner for Labour under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations. The Safety Supervisor(s) shall be accredited under the Hong Kong Safety and Health Certification Scheme managed by the OSHC. Enhancement courses for Safety Supervisor(s) are conducted by the OSHC and CIC.

   b. Do not commence any construction work on the Site without the appointment of the required number of Safety Officer(s) and Safety Supervisor(s) unless expressly permitted by the CM in writing;

c. Before commencement of the Works and whenever there is a change in the appointment of Safety Officer(s) and/or Safety Supervisor(s), report to the CM a written confirmation that Safety Officer(s) and Safety Supervisor(s) are employed in accordance with the Contract. Such written confirmation shall append with the following documents:

   i. The name and a copy of the written notification of registration from the Commissioner of Labour for each Safety Officer;

   ii. A signed statement by each Safety Officer declaring that he is registered as a Safety Officer and he will advise the CM in writing immediately if he is no longer so registered;

   iii. Subject to sub-clause (1)(a)(iv) above, the name and a copy of the written certification of accreditation under the Hong Kong Safety and Health Certification Scheme for each Safety Supervisor;

   iv. Subject to sub-clause (1)(a)(iv) above, a signed statement by each Safety Supervisor declaring that he is accredited as a Safety Supervisor under the Hong Kong Safety and Health Certification Scheme and he will advise the CM in writing immediately if he is no longer so accredited.

d. The duties of Safety Supervisor shall be as stipulated in the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations;

e. The duties of the Safety Officer shall be solely directed towards safety and health matters. In addition to the duties stipulated in the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations, the Safety Officer's duties include:

   i. Site inspection:

      - Carry out comprehensive safety inspections on all activities on the Site including temporary works and scaffolding at weekly intervals. The safety inspection shall identify any unsafe operation or potential hazards;

      - The Safety Officer shall be clearly identified on the Site by wearing an armband or a safety helmet appropriately marked in Chinese and English;

      - The Contractor shall empower the Safety Officer to order any person working on the Site to suspend any unsafe operation or to take urgent action to make safe the Site or the Works or to disallow any practice which may infringe the Safety Plan or any statutory safety requirement;

      - Give prior notice to the CM of the date and time of the weekly inspection and allow the CM or his representatives to attend the inspection;

      - Prepare safety inspection reports.

   ii. Safety Plan:

      - Supervise and monitor implementation of the Safety Plan;

      - Ensure that sub-contractors and all persons working on the Site are made aware of and comply with the Safety Plan.

   iii. Accident / Incident report, investigation and follow-up actions:

      Carry out the duties relating to accident / incident report, investigation and follow up actions as specified in Safety Plan.

   iv. Training:

- Include in the Safety Plan or its monthly update the programme and the number of workers to receive training including site specific induction training, tool box talks and Silver Card training for the coming month;
- Conduct general induction training, site specific induction training as specified. Supervise the conduction of tool box talks specified;
- Identify those workers in the specified trades without valid Silver Card and coordinate their enrolment in requisite Silver Card training provided by CIC;
- At the end of each period of interim certificates report, report to the CM the actual number of workers trained as specified.

v. Site Safety Committee:

Arrange and coordinate Site Safety Committee.

vi. Risk Assessment Report:

- Prepare risk assessment reports for the following month and recommend measures to remove or minimize hazards;
- Adopt the methodology given at the leaflet Five Steps to Risk Assessment, the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work and the Guidance Notes on Prevention of Heat Stroke at Work issued by LD.

vii. Action on LD’s contravention notices:

- Attend to the notices issued by LD to the Contractor advising that safety related regulations are contravened, in particular:
  - Construction Site (Safety) Regulations;
  - Subsidiary regulations of the Factories and Industrial Undertakings Ordinance.
- Take all necessary actions to ensure full compliance with all statutory requirements;
- Report monthly to the CM the following LD's notices received:
  - Construction Site Inspection Report with category Part I or Part II contravention;
  - Improvement Notice;
  - Suspension Notice.

viii. Safety audit:

Implement the recommendations of the external Safety Audit Report.

ix. Safety Officer's report:

Compile and report the above duties to the CM at the monthly site meetings.

x. Safety diary:

- Maintain a safety diary which shall record all matters related to safety and health, including Safety Supervisors' reports, details of safety inspections and audits, accidents, dangerous occurrences, safety related incidents, etc.;

- Check to ensure that all unsafe situations are promptly rectified and the dates of their completion duly recorded in the safety diary;
- The safety diary shall be made available for inspection by the CM upon request and copy thereof shall be submitted to the CM upon request.

xi. Keep a register of the names, telephone numbers, addresses and qualifications of any competent persons and competent examiner as defined in the Construction Sites (Safety) Regulations, who has carried out duties on this Contract. Keep a register of the names of safety supervisors and their duties discharged as required under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations. Keep examination reports and certificates required by legislation or contract.

2. Safety Plan:

a. Prepare and submit to the CM 3 copies of a draft Safety Plan within 14 days of the date of the Letter of Acceptance. Arrange and hold an ad hoc meeting (or meetings if necessary) with the CM or his representatives to discuss the draft Safety Plan within 7 days from the submission of such plan. If the CM is of the opinion that the draft Safety Plan does not meet the requirements of the Contract, he can request for remedy of the deficiency. Comply with any such the CM's request prior to submitting 6 copies of the Safety Plan to the CM for endorsement within 35 days of the date of the Letter of Acceptance;

b. Update the Safety Plan at monthly intervals or when required by the CM so that the Safety Plan is at all times a comprehensive and contemporary statement of the Contractor's safety and health policies, procedures and requirements to achieve the safety and health obligations and responsibilities under the Contract. In the circumstance that there is no amendment of the Safety Plan in the monthly updating, submit explanation in writing with detail elaborations on why no amendment is required;

c. The CM may by notice in writing require the Contractor to supplement, revise or update the Safety Plan if he is of the opinion that the Safety Plan is insufficient or requires revision or modification in the interest of the safety, whether for the Works and / or the safety and health of persons on or adjacent to the Site or protection of any property on or adjacent to the Site or otherwise. Comply with the CM's requirements within 7 days of such notice;

d. Ensure the Safety Plan has incorporated the Nominated Sub-contractor's safety plan in respect of the Nominated Sub-contract Works. Request the Nominated Sub-contractor to prepare and submit a safety plan in respect of the Nominated Sub-contract Works within 14 days of the Letter of Acceptance of the Nominated Sub-contractor's tender for agreement and incorporation into the Safety Plan. Ensure consistency between the Safety Plan and the safety plan in respect of the Nominated Sub-contract Works. Submit the agreed safety plan in respect of the Nominated Sub-contract Works to the CM for endorsement. Revise and update the Safety Plan to incorporate the safety plan in respect of the Nominated Sub-contract Works endorsed by the CM when the Safety Plan is due to be revised or updated;

e. Request the Nominated Sub-contractor to revise or update the Safety Plan in respect of the Nominated Sub-contract Works by virtue of a revision or update of the Safety Plan pursuant to sub-clauses (2)(b) and 2(c) above. Ensure the revised or updated safety plan in respect of the Nominated Sub-contract Works is consistent with the Safety Plan and submit the revised or updated Safety Plan in respect of the Nominated Sub-contract Works to the CM for endorsement;

f. The CM's endorsement, comment or rejection of the Safety Plan, and of any proposed revision or update, and the implementation of the Safety Plan by the Contractor shall not relieve the Contractor from any obligations or responsibilities under the Contract or any statutory regulations;

g. The Safety Plan and subsequent monthly updated Safety Plan, if any, shall contain, without limitation, details of the following:

i. Company safety and health policy:

A safety and health policy is a written statement produced by the Contractor, signed by a senior member of the management board, in which it sets out its aims and objectives for securing safety and health and the means whereby the objectives can be met. It is the Contractor's statement of intent on matters of safety and health.

ii. Safety organisation:

The safety staff organisational structure including an organisation chart which shows the chain of responsibility and accountability from managing director, project manager, safety manager, site agent, safety officer and safety supervisors. Responsibilities and duties of these safety personnel shall be defined.

iii. Safety training:

- Provide all employees and others with adequate information, instruction and training on safety and health. Adopt the methodology given at the guide Five Steps to Information, Instruction and Training issued by LD. State in the safety and health policy the detail arrangements for providing safety and health training;
- The safety and health training shall include but not limited to the following:
  - General induction training;
  - Site specific induction training;
  - Tool box talks;
  - Silver Card training;
  - Lunchtime’s safety talk;

iv. In-house safety rules and regulations:

- Activities which are complex or inherently hazardous must be accompanied by:
  - Detailed working procedures to clearly identify the hazards and / or potential risks;
  - Clear steps to be taken to manage and to minimise the risks;
  - Operation procedures to ensure safety at work;
  - Provisions to ensure everyone involved is aware of the hazards and the safety precautionary measures to take.
- Strictly control access to particularly hazardous areas or operations. List the activities identified as demanding permits to work. The person identified by job title shall be responsible for the design / preparation of permits;

- A lock-off involves the physical isolation or locking-off to danger zones. The danger zones or operations shall be fenced off by barriers provided with warning notices to prevent unauthorized workers from entering the danger zones. Post a site layout plan indicating danger zones at conspicuous locations of the Site. The permit-to-work system shall cover the following high risk activities:
    - Work in confined spaces (Implement the permit-to-work system given at Appendix 1 of the CoP for Safety and Health at Work in Confined Spaces issued by LD. Follow the safety requirements for works in confined space related to underground drainage work as specified in PRE.C9.215);
    - Work in lift shaft;
    - Mobile crane, heavy machinery, piling rig and mobile elevating work platform operating or moving on the Site;
    - Hot work;
    - Lifting operation by tower cranes and mobile cranes, crawler cranes, or cranes alike or lifting operation by mechanical means (excluding lifting operation with load not exceeding 2.5 tonne within a distance of 2.5 metres from the edge of such crane);
    - Work with electrical hazard under Electricity (Wiring) Regulations;
    - Use of ladder for work above ground for work purpose.

v. Safety Committee as specified;

vi. Programme for inspection, thorough examination and testing of hazardous conditions:

- Provide a complaint management system, which may include a hotline phone number, a complaint management software, or both, to facilitate reporting, tracking and resolution of unsafe conditions or complaints by workers to a Contractor's superintendent. Post notices at conspicuous locations on the Site. Take follow-up action to deal with the reports received.
- Closely monitor the implementation of the safety and health statutory requirements, policies and procedures by effective arrangements including formal inspection, thorough examination and testing. This function must be allocated to suitably trained and experienced competent individuals. Reports (in the format prescribed by legislations if required) highlighting actions to be taken following an inspection shall be speedily prepared and issued to the appropriate superintendent and the CM;
- Inspections should include, but not limited to all:
    - Excavation, shafts, earthworks and tunnels;
    - Cofferdams and caissons, and suspected dangerous atmospheres;
    - Scaffolding;
    - Falsework;
    - Working platforms;

- Safety belts and anchorage systems (refer to the Guidance Notes on Classification and Use of Safety Belts and their Anchorage System issued by LD with respect to the information on some anchorage systems, the types, uses and specifications of safety belts under several national safety standards);
- Coverings for openings;
- Gangways and runs;
- Guard rails, barriers, toeboards and fences;
- Local exhaust;
- Pressure system and gas containers;
- Breathing apparatus, revival and other safety and rescue equipment;
- Electrical equipment and appliances;
- Fire fighting equipment;
- First-aid box provisions.

- Inspections, thorough examination and testing shall include, but not limited to:
  - Suspended working platforms;
  - Lifting appliances and lifting gear.

    (Refer to the Construction Sites (Safety) Regulations and the Guidance Notes on the Inspection, Thorough Examination and Testing of Suspended Working Platforms and the Guidance Notes on the Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by LD);
  - Tower cranes (including its anti-collision system), static and mobile cranes;
  - Material hoists and passenger lifts.

vii. Job hazard analysis:

- Carry out risk assessment to identify hazards in the workplace and assess the risk to employees and others who may be affected. Assessments shall be carried out by competent persons. When a risk assessment has indicated that a task poses a significant risk to safety and health, a written safe system of work shall be produced;
- A safe system of work must include not only procedures, equipment, materials and environment that are safe, but also safe workforce i.e. adequately trained, informed and supervised. Where appropriate, the safety system should also specify any checks to be made before the task is carried out;
- Refer to Form DCMP-F788 Generic (non-exhaustive) Checklist for High Risk Activities which gives examples of construction operations / activities requiring job hazard analysis. Contractor shall build up the list as appropriate and establish appropriate control measures / safe operation procedures. The DCMP-F788 is retrievable from the Question no. 5 of the Frequently Asked Questions (FAQ) of the Housing Authority Site Safety Website;

- Develop safe systems of work in a systematic manner, following the guidebook Safe Systems of Work issued by LD.

viii. Personal protection programme:

The type of personal protective equipment [PPE] to be worn in particular situations and any specific requirement related thereto, to be established as a result of a risk assessment which will be the first step towards ensuring compatibility between the risk and correct personal protective equipment. Develop procedures for PPE issue, maintenance and reporting defects.

ix. Accident / Incident report, investigation and follow-up actions:

- Report accidents and dangerous occurrence as defined in the Factories and Industrial Undertakings Regulations to LD in the prescribed Form 2 with Supplementary Information Sheet on Accidents on Construction Sites & Dangerous Occurrence Report Form;
- Copy the Supplementary Information Sheet, Dangerous Occurrence Report Form, Suspension Notice and Improvement Notice issued by the LD to the CM according to GCC Clause 5.21;
- Notify the CM immediately of all 'reportable accidents' as defined under the Factories and Industrial Undertakings Regulations and of the accidents / incidents to be reported in prescribed forms using the web through the Housing Authority Safety Alert Module and followed by submission of the completed documents to the CM under the accident / incident reporting procedures of the HD set out at the Housing Authority Site Safety Website (http://www.housingauthority.gov.hk/sitesafety) and comply with the procedures;
- Notify Site Staff immediately (i.e. within the day of the accident / incident) of accidents / incidents on the Site, including:
  - Serious accidents / incidents;
  - Reportable accidents, dangerous occurrence and near miss / incidents (if the accidents / incidents, though not serious by immediate effect, may have potentially serious consequence, such as those involving but not limited to falling from height, falling object, being struck by moving object, injury to head, profuse bleeding, injured person becoming unconscious, body of injured person pierced by foreign object, public safety etc.) on the Site;
  - Tree failure incidents resulting in of any of the following:
    - > Loss of human life;
    - > Major injury where the injured is admitted or to be admitted to hospital;
    - > Substantial damage to properties;
    - > Serious / complete blockage to main pedestrian / vehicular access;
    - > Death of person.
  - Any emergency situations as referred to in sub-clause (2)(g)(x).

- Inform the CM immediately whether the progress of construction works or the office operation of the Contractor and / or his sub-contractors are being affected or likely to be affected by the emergency situations as referred to in sub-clause (2)(g)(x).
- Provide statistics and analysis of accidents / incidents, investigate and ascertain the contributory factors and root causes, identify the trends and recommend means of prevention and improvement;
- The accident / incident investigation shall include, but not limited to, the following major items:
  - Causes of the sub-standard safety performance;
  - Potential deficiencies of the safety control system;
  - Areas of review and lessons learnt;
  - Recommendations to prevent recurrences;
  - Improvements to the safety control system to meet the Legislations and recommendations of the investigation report.
- Provide statics and trends of late report of accidents / incidents, later than the time prescribed under the relevant legislations and contract clauses; identify the causes and recommend means of improvement;
- Provide means to communicate accident / incident statistics information, recommendation to prevent recurrences and lessons learnt from previous accidents / incidents to all persons working on the Site.

x. Emergency preparedness:

- An emergency situation means a situation requiring emergency assistance of fire services / police / ambulance etc. It includes:
  - An accident which results in death or serious injury;
  - A fire breaking out which requires rescue crews from Fire Services Department to effect control;
  - A flood that causes or threatens life on the Site;
  - A leakage of dangerous goods or chemicals;
  - An accident of geotechnical concern such as landslip, rockfall, retaining wall failure, ground subsidence or land instability;
  - An outbreak of epidemic / infectious disease on the Site;
  - Any superintendent or worker of the Contractor or his sub-contractors on the Site who has been confirmed or suspected of contracting epidemic / infectious disease;
  - Any other accident / incident which creates a dangerous situation.
- Evacuation plans to be drawn for all areas. Call the hotline 999 and notify Site Staff immediately in case of emergency. Calling the local police station, fire services station and ambulance depot for police, fire services and ambulance can be accepted as an alternative to calling the hotline 999. The procedures are to be reviewed and revised periodically, especially when the work-site configuration is altered or changed in some way;

- Prepare emergency procedures for responding, monitoring and reporting on the following potential emergency situations:
  - Fire;
  - Accidents / Incidents;
  - Typhoons;
  - Heavy rainstorms, black rainstorms, floods;
  - Tree failures;
  - Working in confined space;
  - Leakage of chemicals or dangerous goods;
  - Damage of existing utilities;
  - Underground contamination;
  - Traffic incidents;
  - Announcement by the Government of any response level under the three-tier response levels, i.e. “Alert”, “Serious” and “Emergency” in the context of preparing for and responding to infectious disease of public health significance;
  - Outbreak of epidemic / infectious disease on the Site;
  - Any superintendent or worker of the contractor or his sub-contractors on the Site confirmed or suspected of contracting epidemic / infectious disease;
  - Any superintendent of the Contractor put under quarantine or medical surveillance for having close contact with infected personnel of epidemic / infectious disease and such superintendent has contacted with HA / HD officer or visited any HA / HD premises or sites;
  - Geotechnical concerns such as flood, landslip / rockfall, retaining wall failure, ground subsidence, or any land instability.
- Prepare contingency plans with detailed arrangements to be adopted to mitigate the effects of the above potential emergency situations on the Contractor’s organization and disruption to the progress of the Works. The contingency plans should aim at maintaining or resuming the progress of the Works as soon as possible whilst ensuring the safety and health of all personnel on the Site.

xi. Safety promotion:

The effort made by different sub-contractors or individuals to reduce accidents at work by the application of soundly based policies, procedures and disciplines to be recognised by the presentation of safety and health award. Adopt proactive attitude towards improving health and safety performance and / or the best related achievement in reducing number of accidents. The Site as a whole is encouraged to participate in the following designated safety and health campaigns:

- "Construction Safety Promotional Campaign", “Occupational Health Award” or “Hong Kong Occupational Safety and Health Award” led by OSHC;

- "Construction Industry Safety Award Scheme" led by the LD; or
- "Considerate Contractors Site Award Scheme" led by the Development Bureau and the CIC.

The Contractor is also encouraged to organize site-based safety and health awards and competitions to promote participation of his workers and teams in safety and health theme competitions during the contract period. The adjudicating team shall comprise the site management team, safety personnel and workers' representatives, and shall act openly and fairly in such events.

xii. Health assurance programme:

- The health of employees and others affected by the Contractor's activities must form an important part of the Contractor's safety and health policy. Work related health aspects, such as pre-employment and routine medical examination of employees engaged in specific jobs, shall be considered (refer to the Guidance Notes on Medical Examinations for Workers engaged in Hazardous Occupations in Industrial Undertakings issued by LD). Similarly, health related matters which may affect the workplace such as fumes or vapours from hazardous or toxic substances, pollution, noise, radiation etc., are to be reviewed;
- Health surveillance is to be used to detect adverse health effects at an early stage. Appropriate risk assessment to identify the circumstances in which health surveillance becomes necessary.

xiii. Health care plan:

Implement a health care plan for workers on the Site as specified under PRE.C9.960;

xiv. Evaluation, selection and control of sub-contractors:

The means by which to ensure sub-contractors of all levels including Nominated Sub-contractors and specialist sub-contractors comply with the Safety Plan and statutory requirements on safety and health;

xv. Process control programme:

Safety rules, regulations and working procedures covering all safety and health aspects, and in particular method statements and permit-to-work systems for identified high risk operations are to be addressed. Prepare pictorial or graphical presentation of safe working procedures and method statements of identified high risk operations for understanding by frontline personnel;

xvi. Non-smoking policy:

Mandate a non-smoking policy including the rules adopted by the Contractor with respect to prohibition of smoking on the Site. In the event that the Contractor does not fully prohibit smoking on the Site, include a site plan showing the number and sizes of the designated smoking areas and describe the associated requirements of provisions of fire fighting appliances and cleaning services in the policy.

h. Comply with the Safety Plan and ensure all Safety Officers, Safety Supervisors and all personnel who are in a position of authority among sub-contractors have access to the Safety Plan and made aware of their obligation to comply with the Safety Plan. Any Specialist Contractor and other entities (e.g. Utility Undertakings) working on the Site shall be provided with a copy of the Safety Plan and be required to comply with it, and report to the CM for any non-compliance on their part;

i. Provide all facilities, access and assistance to the CM to periodically check that the Safety Plan is being implemented properly and fully. If the CM is of the opinion that the Contactor fails to implement the Safety Plan properly and fully and the failure does or may adversely affect the safety, whether for the Works and / or the safety and health of persons on or adjacent to the Site, or protection of any property on or adjacent to the Site or otherwise, the CM shall notify the Contractor in writing of the failure. The Contractor shall take action to remedy the failure immediately. The CM may suspend the Works, or any part of it, until such time the failure has been rectified;

3. Housing Authority Safety Auditing System (HASAS):

a. Safety Auditor:

To be nominated centrally by the Safety and Health Unit of Housing Department using a random selection computing programme based on the list provided by OSHC after checking and confirmation of the following requirements by OSHC:

i. Must be from the OSHC's list of Accredited Safety Auditors immediately after the date of the Letter of Acceptance;

ii. Must have no current commercial dealings with the Contractor;

iii. Clear of any conflict of interest in exercising his role as safety auditor.

b. The Contractor may agree or reject such nomination with valid reason. If the nominee is rejected, re-nominate by the Safety and Health Unit of Housing Department using a random selection computing programme to repeat the selection process as in sub-clause (3)(a) above until an Accredited Safety Auditor is selected and appointed;

c. Once nomination is agreed:

i. The Accredited Safety Auditor shall conduct safety audit with the Contractor's representatives under the management of the OSHC once every 3 months;

ii. The CM may instruct the Accredited Safety Auditor to commence the Safety Audit at any time, but not later than the end of the third month from the notified date for commencement of the Works;

iii. Provide attendance of most senior site representative at each safety audit;

iv. Provide all necessary attendance for the safety audit including fully facilitating the inspection of the Site and the Works and all certificates, records and reports relating to safety and health matters, and fully cooperate with the Accredited Safety Auditor in the carrying out of the safety audit;

v. Report to the Accredited Safety Auditor innovative and functional safety installation or safety measures, application of Building Information Modelling for safety and application of Radio Frequency Identification for safety implemented for this Contract for onward payment assessment.

d. The Project Director / Heads of Projects of the Contractor shall sign an acknowledgement of receipt of the Safety Audit Report prepared by the Accredited Safety Auditor and submit to OSHC for record;

e. Implement the recommendations of the Accredited Safety Auditor within the time frame specified in the Safety Audit Report;

f. The Safety Officer shall report on the implementation of Accredited Safety Auditor's recommendations in the monthly site meeting;

g. Allow for all work undertaken in preparation for the safety audit or in the implementation of the Accredited Safety Auditor's recommendations. Neither shall entitle the Contractor to any extension of time for completion of the Works.

4. Green Card and Silver Card:

a. The Contractor, and any of his sub-contractors including Nominated Sub-contractors, shall provide and employ for the purposes of the Works such technical personnel and such skilled, semi-skilled and unskilled labourers who, upon their first appearance in the Site and throughout their working in the Site, are a holder of either a valid Green Card issued by an organisation or institution recognized by the LD or a valid Construction Workers Registration Card issued under the Construction Workers Registration Ordinance. The Green Card referred to in this sub-clause is a statutory identification document issued to a person by an organization or institution recognized by the LD upon completion of the training on Green Card;

b. The following trades shall be carried out by workers holding Silver Cards issued by the CIC upon their first appearance in the Site and throughout their working in the Site:

i. Painter and Decorator;

ii. Carpenter;

iii. Demolition Worker (Building);

iv. Plumber;

v. Bar Bender and Fixer;

vi. Plasterer and Tiler;

vii. Bamboo Scaffolder, Metal Scaffolder;

viii. Construction Materials Rigger;

ix. Rigger and Signaller;

x. Curtain Wall Installer;

xi. Tower Crane Worker (Erecting, Dismantling, Telescoping & Climbing);

xii. Concretor;

xiii. Tunnel Worker;

xiv. Lift Mechanic.

c. Arrange and release workers of the trades listed in sub-clauses (4)(b)(i) to (4)(b)(xiii) to attend Silver Card training or revalidation training. Bear the fees for the training courses and pay workers the wages which they would otherwise earn during that period of attending the training courses had the Contractor not released them to attend the training courses;

d. The Nominated Sub-contractor for lift installation shall arrange and release workers of the trade listed in sub-clause (4)(b)(xiv) to attend Silver Card training or revalidation training. The Nominated Sub-contractor for lift installation shall bear the fees for the training courses and pay workers the wages which they would otherwise earn during that period of attending the training courses had the Nominated Sub-contractor for lift installation not released the workers to attend the training courses;

e. Keep record of payment for the fees of training courses and, if applicable, payment of wages to workers who have attended Silver Card training, with workers' signed acknowledgement of receipt;

f. Keep record of card numbers, card holders' names and expiry dates of the cards, for the inspection by the CM. Ensure that the Green Cards or Silver Cards held by all workers are valid;

g. Submit to the CM a duly completed prescribed form (DCEI-F14) for the record of Silver Card holders for all workers engaged in the specified trades as listed in sub-clause(4)(b);

h. The Contractor shall ensure that all such personnel and workers shall at all times put on the appropriate Silver Card or Green Card or a valid Construction Workers Registration Card with a printed statement indicating that the holder has a valid Green Card and that such Green Card has not yet expired while they are within the Site. The CM shall, pursuant to GCC Clause 5.9(2), have the power to require the Contractor to remove forthwith any person employed by the Contractor, or by any of his sub-contractors from the Works who has not complied with the requirements prescribed by sub-clauses (4)(a) and (4)(b) above.

5. Induction Training, Tool box talks, lunchtime's safety talks and other training:

The training material shall cover critical items, namely working at height, housekeeping, materials handling, stacking and storing, prevention against falling objects, lifting operations, tower crane, mobile crane among other site activities in the form of audio-visual medium. The training will be subject to verification by safety auditor managed by OSHC.

a. Site specific induction training:

All persons employed on the Works or in connection with the Contract whether in the employment of the Contractor or his sub-contractor shall receive site specific induction training. The induction training shall cover contents to alert persons new to the Site to know specific hazards related to the Site or works nature and activities in operation, and necessary precautionary measures. This training should be carried out on the first working day of any such employee commencing work on the Site. Thereafter, he / she shall be given refresher training at intervals of about 6 months depending on the amount of changes to the site condition. The course shall be conducted by Safety Officers;

b. Tool box talks:

i. Provide tool box talks to workers once per week. The talks shall be attended by workers who are working on the Site and engaged in activities relevant to the topic of that training. The topics and contents of tool box talks shall be proposed by the Safety Officer having regard to the activities of the Site and the prevailing safety concern at that time;

ii. Tool box talks shall be conducted based on training kits published by the HKCA. If the proposed topic is not amongst one of those published by HKCA kits, the Contractor shall then develop training kits of comparable standard for approval by the CM;

iii. The Contractor's Safety Officer shall ensure that tool box talks are carried out by safety supervisors, foreman or gangers who have received training organised by the HKCA or other approved training organisations.

c. Lunchtime's safety talks:

i. Provide lunchtime's safety talks monthly to workers of at least 10% of daily average worker number of the corresponding month. The topics and contents of lunchtime's safety talks shall be proposed by the Safety Officer and contain but not limited to accident / incident review, findings of Safety PASS, findings of safety audit and surprise inspection by OSHC and findings of inspection by LD;

ii. The Contractor's Safety Officer shall ensure that lunchtime's safety talks are conducted by Safety Supervisors, foremen or gangers who have received training organised by HKCA or other approved training organisations, or by the training officers of trade associations or workers' unions which are member organisations of Housing Department Site Safety Subcommittee.

d. Arrange safety training of workers involved in unsafe act to let the workers concerned to review their unsafe act and learn the correct practice under the guidance of a safety representative (the ganger of the respective trade) within 7 working days of identification of unsafe act. The unsafe act may be identified by but not limited to the inspectors of Labour Department, surprise safety inspectors of OSHC, the accredited safety auditors during the safety audit, site inspecting officers of HD, the CM or his representatives and the site supervisory personnel of the Contractor;

e. Allow the CM or his representatives to attend any of the training courses viz. general induction training, site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act to verify that they are conducted according to specification;

f. Maintain attendance records on site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act the names of the trainers, names and trades of the persons receiving the training and their signatures; maintain electronic photo records taken during the training and talks that show the attendants attending such training and talks. These records shall be made available for the CM's inspection upon request by the CM;

g. The Contractor's Site Agent or Safety Officer shall certify the accuracy of attendance records on site specific induction training, tool box talks, lunchtime's safety talks and safety training of workers involved in unsafe act before they are submitted monthly to the CM;

h. Management and other staff, other than workers, employed on the Works or in connection with the Contract whether in the employment of the Contractor or his sub-contractors shall have received appropriate training on safety and health commensurate with their duties;

i. Maintain attendance records on the Site for all safety training conducted or arranged. These records shall include the topics and dates of the events, the names of trainers, names and trades of the persons receiving the training and their signature. Electronic means of keeping these records with print outs for submission will be acceptable subject to the approval of the CM. These records shall be made available for the CM's inspection upon request by the CM;

j. Unskilled labourers who are employed by the Contractor, or any of his sub-contractors, shall upon their first appearance on the Site have satisfactorily completed the training course "Basic Safety for Construction General Workers" organised by OSHC, otherwise arrange those unskilled labourers without having completed the above training to enrol in the above training course upon their first appearance on the Site. Acceptance of alternative training provided by other organisations is subject to verification by the CM that the alternative training is based on course contents of equivalent or higher standards than the aforesaid course of OSHC. Keep a record of the certificates, including the names of the certificate holders, the issue dates of the certificates and the relevant trade category for inspection by the CM, and report the status at the site meeting. Notwithstanding the above requirement, there is a grace period for arranging unskilled labourers to enrol in the above training course up to 31 December 2026 after which any unskilled labourer who has not yet satisfactorily completed the above training shall be arranged to enrol in the above training course upon their first appearance on the Site.

6. Site Safety Committee:

   a. Establish a Site Safety Committee which shall be responsible for ensuring the implementation of the Safety Plan, reviewing and monitoring the effectiveness of the safety and health measures taken and seeking the cooperation and commitment of staff at all levels;

   b. The Site Safety Committee shall be chaired by the Site Agent with members comprising the Contractor's project manager, Safety Officers, all Safety Supervisors, selected Safety Representatives and other staff of the Contractor or sub-contractors as may be considered necessary. It shall meet at least monthly discussing all matters relating to the implementation of the Safety Plan. The first meeting shall be held no later than 28 days from and including the date for commencement of the Works notified by the CM in accordance with GCC Clause 8.1. The Contractor may invite any other party such as the LD, Police or representatives of Utility Undertakings to attend the meeting and provide advice as necessary;

   c. Give advance notice of every Site Safety Committee meeting to the CM who will attend the meeting in person or nominate a representative to attend the meeting as an observer;

   d. The following items shall, amongst others, be reported and discussed at the Site Safety Committee meeting:

      i. Review of the Safety Plan, update risk assessment for the work scheduled at least for the next 2 months, review and establish safety and health provisions, safe working procedures and method statements, update the emergency and rescue procedure;

      ii. Update of the safety organisation chart and review of the adequacy of safety personnel;

      iii. Review of the safety performance of sub-contractors;

      iv. Any unsafe practices and conditions identified during safety inspections / audits and any follow up action;

      v. Advisory / warning or contravention notices and any Improvement / Suspension Notices received from LD;

      vi. Review of accident frequency rates and statistics of the Contractor and sub-contractors and identification of trends;

      vii. Details of the Contractor's accident and dangerous occurrence experience;

viii. Safety and health training undertaken in the previous month and the proposed training programme for the following month;

ix. Details of safety promotional activities;

x. Safety coordination among various sub-contractors working in close proximity to each other;

xi. Submission of forms GF527 and GF527A or other pertinent forms on the employment statistics of the Contract on a monthly basis as detailed in PRE.C9.2225;

xii. Compilation and submission to the Commissioner for Labour the Supplementary Information on Accidents on Construction Sites for the purpose of analysis in addition to the statutory forms and the requirements of GCC Clause 5.21;

xiii. Updated Safety Plan.

e. Prepare minutes of the Site Safety Committee meeting and copy it to the CM within 5 working days of the meeting.

7. Safe Working Cycle:

a. Practise Safe Working Cycle to improve and promote the safety and health of the Site. Safe Working Cycle should begin when there are workers working on the Site, and shall cease by the certified date of completion of the Works. The activities of Safe Working Cycle are classified into 3 categories. They are Daily Cycle, Weekly Cycle and Monthly Cycle. Details of each category of Safe Working Cycle are given below:

i. Daily Cycle:

- Pre-work Exercise and Safety (PES) meeting;
- Hazard Identification Activity (HIA) meeting;
- Pre-work Safety Checks;
- Safety inspection by Site Agent or his representatives;
- Guidance and supervision during work;
- Safety coordination meeting;
- Daily cleaning and tidying up of the Site;
- Checking of the Site after each day's work.

ii. Weekly Cycle:

- Weekly safety inspection by Site Agent and Safety Officer and the CM or his representatives;
- Weekly safety coordination meeting;
- Weekly overall cleaning and tidying up of the Site;
- Advance planning of the cleaning and tidying up, safety checks of the workplace, machineries and plant, before and after public holidays in the coming week(s). Site Agent and Safety Officer shall prepare a checklist of work making reference to the Handbook on Work Safety Immediately Before and After Public Holidays issued by OSHC and assign competent personnel for implementation and monitoring.

iii. Monthly Cycle:

- Site Safety Committee meeting and pre-meeting inspection.

b. The first 3 items under Daily Cycle described in sub-clause (7)(a)(i), namely, Pre-work Exercise and Safety (PES) meeting, Hazard Identification Activity (HIA) meeting and Pre-work Safety Checks, are collectively referred to as the "Pre-work Activities". Pre-work Activities are to be held for attendance by persons employed on the Works (excluding clerical and administrative staff in site office), irrespective of whether they are in the employment of the Contractor or sub-contractors. Detail requirements for the Pre-work Activities are:

   i. Arrange and hold Pre-work Exercise & Safety (PES) meeting of about 10 to 15 minutes for all persons employed on the Works. The PES meeting shall be led by the Site Agent or senior staff of site management of the Contractor, who has attended the training course on Safe Working Cycle of the OSHC or CIC. The PES meeting shall start with physical exercise, followed by a briefing to workers on the prevailing safety and health matters related to the Site, such as common hazards and control measures, safety precautions, specific safety concerns etc.;

   ii. Arrange and hold Hazard Identification Activity (HIA) meeting of about 10 minutes for the attendees immediately after the PES meeting. Alternatively, the HIA meetings can be held in small groups according to the trades, work teams or works areas set out by the Contractor for the Site. If so, the Contractor shall ensure that the assigned persons are competent to lead the HIA meetings. Persons who have attended one-day training course on HIA leadership provided by OSHC are considered competent to lead the HIA meetings. The issues discussed at the HIA meetings shall cover, but not limited to:

      - Implementation of the already devised safe systems of work for hazardous works to be carried out in accordance with the Safety Plan;
      - Hazards and control measures specific to the works or trades;
      - Special safety concerns;
      - Assurance of safety requirements and measures;
      - Reprimand of repeated irregularities and malpractice etc..

   iii. Arrange and hold Pre-work Safety Checks for the attendee immediately after the HIA meeting. The Pre-work Safety Checks shall be carried out by foremen, gangers, Safety Supervisors or Safety Representatives of the attendees according to the trades, work teams or works areas. The Pre-work Safety Checks shall include the checking of personal protective equipment worn by attendees before they start working on that day such as safety helmet, reflective vest, ear protectors, eye protectors, safety harness, safety footwear etc..

c. Pre-Work Activities are to be held daily, but in any case the frequency of Pre-work Activities for attendance by each person employed on the Works shall not be less than once a week. The Pre-work Activities shall be carried out prior to any work carried out by the persons attending the Pre-work Activities on that day;

d. Maintain attendance records of the workers participating in the Pre-Work Activities including their names and trades. Such attendance records are to be certified by Site Agent. Maintain electronic photo record showing the attendants during such activities. These records shall be made available for the CM's inspection upon request by the CM.

8. Safety Representatives:

   a. Appoint the ganger of each labour group or team working on the Site to act as Safety Representative. The Safety Representatives shall be clearly identified on the Site by wearing an armband or a safety helmet appropriately marked in Chinese and English;

   b. The Safety Representatives shall attend Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by the OSHC or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by the CIC. Acceptance of training provided by other organizations is subject to verification that the training is based on course contents of equivalent or above standards and the appointed superintendent has attained the associated qualification;

   c. In respect of underpinning safety management, the Safety Representative shall be responsible for ensuring that:

      i. The directives on safety and health matters from the Contractor, the Safety Officer, Safety Supervisors, Site Agent and Foremen are duly carried out;

      ii. Safety practices are adopted by the workers;

      iii. Protective clothing and equipment are used by the workers at all times on the Site.

   d. Ensure that the Safety Representatives and the workers on the Site under supervision of the Safety Representatives are aware of the roles and responsibilities of the Safety Representatives on safety and health matters.

9. Other Safety Requirement:

   In addition to any obligation under GCC Clause 5.11 or any similar obligations under any enactment or resolution, comply with the following requirements for temporary platform on the slope or berm of the slope:

   a. Do not erect temporary platform on the slope or on the berm of the slope, unless under exceptional circumstances, and approved by the CM. Under such circumstances, obtain approval of the CM, demonstrate compliance with the special precautions issued from time to time under Section 7(4) of the Factories and Industrial Undertakings Ordinance in all respects. Such Approval shall not relieve the Contractor from the responsibilities imposed by the Contract. The special precautions include, but are not limited to, the following:

      i. Commission a registered professional engineer, whose name is registered under the relevant statutes, to properly design every temporary platform on the slope or on the berm of the slope. Submit the name of the registered professional engineer to the CM for information.

         The plan shall contain all the specifications approved by such engineer. Keep plan available on the Site for inspection by the occupational safety officer of LD;

      ii. Construct every temporary platform on the slope or on the berm of the slope in accordance with the approved plan and under the supervision of a competent person. Keep record of the date of erection of each platform and the name of the person who supervised the work. Keep records available on the Site for inspection by the occupational safety officer of LD;

iii. Conduct risk assessment through a competent person within the meaning of the Factories and Industrial Undertakings Ordinance before work is commenced to dismantle a temporary platform on the slope or on the berm of the slope. The dismantling work shall be supervised by a competent person;

iv. Take all necessary steps to ensure that no material is thrown, tipped or shot down into a temporary platform on the slope or on the berm of the slope unless the platform has been designed for such purpose in sub-clause (9)(a)(i) above;

v. Remove materials accumulated on a temporary platform on the slope or on the berm of the slope regularly;

vi. Provide suitable fall arresting system used by workers while they are engaged in removing of any materials accumulated on a temporary platform on the slope or on the berm of the slope or in dismantling of the platform.

10. Surprise Safety Inspection Programme (SSIP):

a. Professional Safety Inspectors appointed by OSHC will conduct surprise safety inspection;

b. The surprise safety inspection may be conducted at any time after the date for commencement of the Works till the certified date of completion of the Works;

c. Surprise safety inspection shall be conducted to every discrete site. Site visit to every discrete site is required unless there is no significant active site works being carried out on a particular site or all the site works of a particular site have been certified complete;

d. Provide all necessary attendance for the surprise safety inspection including fully facilitating the inspection of the Site, the Works and all necessary supporting documents such as certificates, records and reports relating to safety and health matters, and fully cooperate with the Safety Inspector in the carrying out of the surprise safety inspection;

e. A Contractor's representative must accompany the Safety Inspector throughout the inspection;

f. The Contractor’s representative shall fill in the forms of the Record of Caring Opportunities (Form DCMP-F7135 and DCMP-F7136) and hand in the Form DCMP-F7135 to the CM or his representatives and submit the Form DCMP-F7136 to the Safety and Health Unit;

g. The Contractor's representative shall acknowledge the result of the inspection by signing in the presence of Site Staff and submit a copy of signed report to the CM and another copy to OSHC for record;

h. Rectify the non-conformance items recorded by the Safety Inspector; and

i. The Site Agent shall report the results of surprise safety inspection, implementation of the Safety Inspector’s recommendations, caring actions taken for the involved employees/workers and supervisors, and the respective follow up rectification actions for non-conformance items in the monthly site meeting.

11. Comply with the requirements of the Construction Sites (Safety) Regulations, and adopt the practices and / or measures in respect of first aid facilities and first aiders recommended in the latest edition of the Reference Materials on Construction Site Welfare Health and Safety Measures issued by CIC. First aid room / area shall be provided on the Site and fitted with:

a. sufficient first aid supplies and equipment for transporting the injured persons, including but not limited to stretchers;

b. First aid kits, up to the standard required by the Occupational Safety and Health Ordinance (Cap. 509) and the Factories and Industrial Undertakings Ordinance (Cap. 59).

12. Work Safe Behaviour Programme:

a. Use a work safe behaviour programme with reference to the guidebook "Implementing The Work Safe Behaviour (WSB) Programme" issued by the OSHC. Persons who have completed 12-hour train-the-trainer course for work safe behaviour and safety climate index survey offered by OSHC are considered competent to deliver internal training of WSB observers. The course duration of the internal training of WSB observers should be at least 3 hours;

b. Identify the major high risk activities to the Site Staff for comment according to the construction cycle and review on a half-yearly basis;

c. Based on the major high risk activities identified, create and develop relevant work safe behaviour checklists and conduct observations with observed data analysed for behaviour interventions. Templates of the work safe behaviour checklists can be downloaded from the Housing Authority Site Safety Website for reference;

d. Analyse the work safe behaviour result and prepare the WSB report;

e. Develop and implement an action plan according to the analysed result;

f. Submit the work safe behaviour report, action plan and the excel file of raw data base to the Safety and Health Unit of Housing Department for record within 6 months after the certified date of completion of the Works.

PRE.C9.210.9 GENERAL REQUIREMENTS

1. Be responsible for the safety of all workers and other persons entering or in the Works and, to the Approval of the CM, take measures necessary to ensure their safety;

2. In particular such measures shall include:

a. Provision of apparatus for dealing with casualties due to fire, gas and electric shock including stretchers and first aid equipment and personnel trained in their use;

b. Safe supporting for all excavations;

c. Safe control of water including provision of ample standby generating and pumping plant;

d. Provision and maintenance of safe, sound mechanical equipment, each item of plant having an up-to-date testing certificate where applicable;

e. Provision of good and safe access to all parts of the Site.

PRE.C9.211.N PROHIBITION OF IMPOSING ADMINISTRATIVE CHARGES FOR REPORTING OF SITE ACCIDENTS AND ELIMINATION OF UNDER-REPORTING OF SITE ACCIDENTS

1. The Contractor shall not impose charges of any form on any sub-contractor, or deduct any amount from the payment to which any sub-contractor is entitled, for reporting accidents and processing any claims for compensation under the Employees' Compensation Ordinance (Cap. 282) on behalf of the sub-contractor. For the avoidance of doubt, sub-contractor in this clause means all types of sub-contractors, irrespective of tiers.

2. The Contractor shall ensure that the following sub-contract provisions in sub-clauses (2)(a) to (2)(e) ("Mandatory Sub-contract Provisions for Prohibition of Imposing Administrative Charges for Reporting of Site Accidents and Elimination of Under-reporting of Site Accidents") are included *mutatis mutandis* in all sub-contracts entered into with his sub-contractors. The Contractor shall, if necessary, within a reasonable time enter into a supplemental agreement with his sub-contractors to comply with the requirements in this sub-clause. The following sub-contract provisions in sub-clauses (2)(a) to (2)(e) shall also be incorporated *mutatis mutandis* into sub-contracts at any tiers under the Contract:

   a. In these Mandatory Sub-contract Provisions for Prohibition of Imposing Administrative Charges for Reporting of Site Accidents and Elimination of Under-reporting of Site Accidents, the following words and expressions shall have the meanings hereby assigned to them except when the context otherwise requires:

      "Employer" means the Hong Kong Housing Authority;

      "Contract Manager" means the Contract Manager for the Contract;

      "Contract" means the main contract (Contract No. _____) made between the Employer and the Contractor;

      "Contractor" means the contractor who has entered into the Contract with the Employer and entered into the Sub-contract with the Sub-contractor; *[Note: Replace the words "the Sub-contract with the Sub-contractor" with "a sub-contract with a sub-contractor at the first tier of the same chain of sub-contracting in connection with this Sub-contract" for the second or lower tiers sub-contracts]*

      "Sub-contract" means this agreement;

      "Sub-contractor" means the party who entered into this Sub-contract with the Contractor; *[Note: Replace the words "the Contractor" with "the Higher-tier-sub-contractor" for the second or lower tiers sub-contracts]*

      "sub-contractors" means all types of sub-contractors of the Sub-contractor, irrespective of tiers;

      "Higher-tier-sub-contractor" means the party who entered into a sub-contract at higher tier than this Sub-contract with another party and entered into this Sub-contract with the Sub-contractor; *[Note: Adopt this definition for the second or lower tiers sub-contracts only]*

   b. The Sub-contractor shall not impose charges in any form on any sub-contractor, or deduct any amount from the payment to which any sub-contractor is entitled, for reporting any accidents and processing any claims for compensation under the Employees' Compensation Ordinance (Cap. 282) on behalf of the sub-contractor;

   c. Where injury by accident arising out of and in the course of the employment is caused to any person employed by the Sub-contractor or sub-contractors on the Works or in connection with the Contract, the Sub-contractor shall, without delay, report the matter to the Contractor *[Note: Add "via the Higher-tier-sub-contractor" for the second or lower tiers sub-contracts]* for notifying the Commissioner for Labour in such form and manner as required by the law and for reporting to the Contract Manager. This provision shall apply irrespective of whether the person claims for compensation;

d. Upon request by the Contractor *[Note: Add "or the Higher-tier-sub-contractor" for the second or lower tiers sub-contracts],* the Sub-contractor shall provide the original documents of the sub-contracts to the Contractor *[Note: Replace "the Contractor" with "the Higher-tier-sub-contractor" for the second or lower tiers sub-contracts]* who is authorized to provide the same to the Contract Manager *[Note: Add "and the Contractor" for the second or lower tiers sub-contracts]* for inspection;

e. The compliance of these Mandatory Sub-contract Provisions for Prohibition of Imposing Administrative Charges for Reporting of Site Accidents and Elimination of Under-reporting of Site Accidents by the Sub-contractor is entirely without prejudice to and does not relieve the Sub-contractor from any of his obligations or responsibilities under this Sub-contract, the Factories and Industrial Undertakings Ordinance (Cap. 59), the Occupational Safety and Health Ordinance (Cap. 509) and the Employees' Compensation Ordinance (Cap. 282), and all their subsidiary legislation.

3. The Contractor shall make necessary arrangements to ensure that all sub-contractors report all accidents on the Site involving their employees via their upper tier sub-contractors (if applicable) to the Contractor without delay. Such arrangement shall be incorporated in the Safety Plan and Sub-contractors Management Plan required under the Contract.

4. The compliance of this clause by the Contractor is entirely without prejudice to and does not relieve the Contractor from any of his obligations or responsibilities under the Contract, the Factories and Industrial Undertakings Ordinance (Cap. 59), the Occupational Safety and Health Ordinance (Cap. 509) and the Employees' Compensation Ordinance (Cap. 282), and all their subsidiary legislation.

PRE.C9.215.N SAFETY IN CONFINED SPACE RELATED TO UNDERGROUND DRAINAGE WORK

Further to PRE.C9.205, comply with the particular requirements as follows:

1. For works in confined space in connection with or in the vicinity of underground pipework, drainage / sewage manholes / chambers or structures alike, the following additional requirements shall apply:

   a. Appoint the person-in-charge (e.g. foreman or ganger) of the confined space works and the person-in-charge shall ensure that -

      i. detailed working procedures and safety precautions are drawn up for the work being carried out;

      ii. all workers are provided with adequate training and information on the personal hygiene and health precautions, the use of personal protective equipment etc;

      iii. equipment is provided in sufficient quantities and readily available in serviceable condition at the scene for immediate use so that the working procedures and safety precautions can be followed;

      iv. the working procedures and safety precautions are correctly carried out;

      v. a designated competent person is appointed to carry out risk assessment of the working environment and the works to be carried out in the confined space and make recommendations on measures to be taken in relation to safety and health of workers when work is to be undertaken, and he shall not be the certified worker in the same confined space operation;

      vi. no workers enter or work in the confined space other than certified workers;

vii. he shall not act as the Contractor's representative on confined space works or designated competent person in the same shift of confined space works concurrently;

viii. he shall attend the Site at the commencement of the confined space works and shall not leave the Site until all personnel entering the confined space have left that space and return to the open atmosphere;

ix. he shall not enter the confined space to carry out any work thereat throughout the period of discharging the duties as the person-in-charge for the confined space works;

x. arrange the responsible designated competent person to closely monitor the health and safety of all personnel staying in the confined space;

b. Designate a competent person for the confined space works and the designated competent person shall –

i Attend the Site and shall not leave the Site until all persons entering the confined space have left that space and return to the open atmosphere;

ii. Have sufficient knowledge and experience in supervising the work in confined space appointed by the Contractor and accepted by the CM;

iii. Carry out risk assessment of the work environment and the works to be carried out in the confined space and make recommendations on measures to be taken in relation to safety and health of workers when work is to be undertaken in compliance with the Factories and Industrial Undertakings (Confined Spaces) Regulations;

iv. Not enter the confined space throughout the period of discharging the duties as designated competent person in that operation. Should his/her entry into confined space be required, he/she shall designate a competent standby person, who holds a valid Certificate for Certified Worker, to station outside the confined space throughout the duration of his/her absence outside the confined space to perform the duties of the standby person mentioned in the CoP for Safety and Health at Work in Confined Spaces issued by LD. The designated competent person's entry is limited to ad-hoc (not full time) inspection, checking, verification or assessment of the condition in confined space and he/she shall hold a valid Certificate for Certified Worker. A separate risk assessment (not compiled by the designated competent person intending to enter confined space) and permit-to-work shall be prepared prior to the designated competent person's entry;

v. Not act as the person-in-charge or specified responsible person for confined space works in the same shift;

c. Specify the responsible person for confined space works (e.g. site agent or project manager) and the specified responsible person shall -

i. be responsible for endorsing the risk assessment and issue / void the permit-to-work in the confined space;

ii. determine the continuation / suspension / resuming of confined space operation at the onset of / during / after adverse weather conditions and / or the lowering of adverse weather warning signals;

iii. attend the Site and shall ensure all persons entering the confined space have left that space and returned to the open atmosphere;

iv. not enter the confined space throughout the period of discharging the duties as "specified responsible person for confined space";

v. not act as the person-in-charge or designated competent person in the same shift;

d. Arrange the standby person to –

i. keep in touch with the personnel staying in the confined space via two-way communication device at reasonable intervals, normally not more than every 2 minutes (direct calling / shouting is NOT encouraged and the Contractor is required to explore and formulate more effective two-way communication device before the commencement of confined space operation);

ii. continuously monitor the worker entering a confined space via direct line of sight or CCTV visual display panel when the direct line of sight between the standby person and the worker entering the confined space is blocked;

iii. ensure the lifelines are holding firmly on the man-lifting tripod, or other approved lifting equipment, pay out and reel in the lifelines as required, so that at all times the lifeline can be used in an emergency;

iv. in the event of a warning being received that working environment is likely to become dangerous, or if they suspect danger themselves, instruct all personnel staying in the confined space to return to the open atmosphere immediately;

v. hold a valid Certificate for Certified Worker and to be responsible for the lookout for signs of danger including sudden increase in flow, heavy rain falling in the area or upstream, and signs of hot or peculiar smelling discharges;

vi. ensure all confined space including manholes etc. required for ventilation are kept open;

vii. prohibit smoking and ensure that no naked lights, fires and internal combustion engine (e,g. diesel generator set) are located near to the confined space openings;

viii. avoid acting as the person-in-charge, the specified responsible person or designated competent person;

ix. avoid entering the confined space thereat throughout the period of discharging the duties as "standby person" in the same shift of confined space operation.

e. Station a Safety Officer or the designated competent person qualified under the Factories and Industries Undertakings (Confined Spaces) Regulation at the site during the execution of work inside the confined space. The Safety Officer or the designated competent person shall not leave the Site until all persons entering the confined space have left the confined space and returned to the open atmosphere;

f. Implement a permit-to-work system;

g. Notify the CM two full working days in advance of any proposed work in confined space in writing. The Contractor shall also notify the CM the proposed time of commencement for the confined space works. In case of emergency situations where the 2-day advance notification requirement cannot be met, the Contractor shall obtain verbal consent from the CM prior to the commencement of any confined space works. The verbal consent shall be recorded in writing by the CM before noon on the next working day following the granting of verbal consent;

h. Avoid man-entry to sewers or drains with a diameter not greater than 900mm or equivalent. For CCTV survey, avid man-entry to sewers or drains with a diameter not larger than 1300mm or equivalent. Where man-entry cannot be avoided under anomalous circumstances, obtain prior approval from the CM. The Contractor's attention is drawn to that approval from the CM would not normally be given for man-entry to carry out opening of lateral connections inside a lined pipeline due to lack of robotic cutting machine / equipment or the like;

i. Avoid work to proceed in a confined space located in industrial areas unless the persons working therein are wearing suitable breathing apparatus of approved type;

j. Set up CCTV cameras at manhole or end of pipeline for real-time monitoring of the conditions of the workers staying in the confined space where the direct line of sight between the standby person stationed at the entrance of a confined space and the person entering a confined space is impossible;

k. Take video throughout the whole work duration, including entry to and exit from the confined space. Submit electronic copy of the videos to the CM within two working days for record purpose;

l. Conduct regular rescue drill on confined space works at an interval of not more than six months or a more frequent interval when considered necessary by the risk assessment;

m. Ensure that all persons entering or staying in manholes, sewers, drains and other confined space should-

   i. Hold a valid Certificate for Certified Worker;

   ii. Wear adequate protective clothing and safety harness with lifeline;

   iii. Keep in touch with the standby persons and obey any instructions given by them;

   iv. Carry a gas detector with them and perform continuous gas monitoring throughout the period of stay;

   v. Wear an audio-visual dead-man type personal alarm maintaining in active operating mode throughout his / her stay in that space, and capable of emitting signals that can alert the standby person stationed at the entrance of that space;

   vi. Wear spark-proof / explosion-proof two-way telecommunication equipment to enable communication with the standby person stationed at the entrance of a confined space;

   vii. Place safety chains etc. in manholes where facilities are provided for them, in particular, downstream of the area being worked;

   viii. Avoid stirring up silt and check frequently for gas when this is unavoidable;

ix. Be on the lookout for signs of danger including sudden increase in flow, signs of hot or peculiar smelling discharges, signs of gas shown by the gas detector equipment, and tiredness, faintness and headaches;

x. Return to the open atmosphere immediately when the working environment become dangerous or weather condition become worsen;

xi. Observe procedures implemented by the person-in-charge of the confined space operation;

xii. Observe instructions and advice from the designated competent person and have already attended relevant safety training course for confined space operation;

xiii. Make full and proper use of, and forthwith report to the person-in-charge of the confined space operation any fault or defect in, any safety equipment or emergency facilities provided.

n. Arrange Confined Space Safety Training:

i. All workers having the qualification of a competent person under Factories and Industrial Undertakings (Confined Spaces) Regulation and involved in the works in confined space in connection with or in the vicinity of underground pipework, drainage or sewage manholes or chambers, or structure alike shall complete the 1-day Confined Space Safety Training Course for Competent Persons Engaged in DSD's Works provided by the CIC or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

ii. All workers having the qualification of a certified worker under Factories and Industrial Undertakings (Confined Spaces) Regulation and involved in the works in confined space in connection with or in the vicinity of underground pipework, drainage or sewage manholes or chambers, or structure alike shall complete the 1-day Confined Space Safety Training Course for Certified Workers Engaged in DSD's Works provided by the CIC or equivalent training provided by other organisations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

iii. Workers having both the qualifications of a competent person and certified worker under Factories and Industrial Undertakings (Confined Spaces) Regulation shall be taken as workers having the qualification of a competent person only for the purpose of the above sub-clauses (i) and (ii);

iv. Safety Officers having the qualification of competent persons under Factories and Industrial Undertaking (Confined Spaces) Regulation and performing the duties of competent person in carrying out confined space works in connection with or in the vicinity of underground pipework, drainage or sewage manholes or chambers, or structure alike shall be taken as workers having the qualification of a competent person for the purpose of the above sub-clause (i) and shall comply with the training requirement.

PRE.C9.230.9 PROVISION OF SAFETY REGULATIONS

Keep on Site a copy of the 'Construction Sites (Safety) Regulations 1997' and a copy of the booklet 'A Guide to the Construction Site (Safety) Regulations' which shall be available for the reference of the CM.

PRE.C9.235.9 SAFETY POSTERS

Obtain posters, in both English and Chinese, drawing attention to safety on Site and display prominently upon all structures or temporary huts on the Site throughout the duration of the Contract and remove on completion. These posters are obtainable from LD, OSHC and CIC.

PRE.C9.240.9 SAFETY TRAINING

The Contractor shall ensure that all his employees are fully conversant with the emergency and rescue procedures and regulations and shall ensure that any employee committing a serious breach of such regulations shall be dismissed instantly and shall not be re-employed.

PREC9.241.N INSPECTION AND CERTIFICATION OF OVERHAUL OF MAJOR CONSTRUCTION PLANT ON SITE

1. The major construction plant on Site covered under this Specification include but not limited to the following:
    a. Mobile cranes (excluding crawler cranes);
    b. Truck-mounted cranes;
    c. Crawler cranes (rented);
    d. Crawler cranes (self-owned);
2. Mobile crane (excluding crawler crane) and truck-mounted crane are defined as follows:
    a. A mobile crane (excluding crawler crane) is a crane mounted on a wheeled chassis for travel as shown in Fig. 1b and 1d on page 14 of the Code of Practice for Safe Use of Mobile Cranes published by the Labour Department;
    b. A truck-mounted crane is a loader crane (consisting of a column, a base and a boom system) mounted on a truck or lorry as shown in Fig. 1c (irrespective of the position of mounting of the crane) on page 14 of the Code of Practice for Safe Use of Mobile Cranes published by the Labour Department.
3. Comply with all statutory requirements in relation to the use of the major construction plant on Site. Compliance with this Specification clause does not by itself confer any immunity from legal obligations;
4. Submit a schedule of inspection, examination, testing and maintenance for the major construction plant on Site to the CM in accordance with the manufacturer's recommendation or to suit the actual plant conditions, whichever is more frequent, to ensure that the construction plant is adequately provided and in safe and serviceable conditions. Submit also a schedule of plant deployment and removal. Update such schedules on a quarterly basis during the whole duration of the works until the date of certified completion of the Works. Submit any updated schedules within one month from the start of each quarter;
5. Appoint a responsible person or persons to perform inspection during and after the erection or re-erection or alteration of the major construction plant on Site. The responsible person or persons shall have adequate training and experience to ensure that the major construction plant under checking are in safe and serviceable conditions;

6. The responsible person or persons shall look out for any signs of material defect in the components of the major construction plant such as fatigue crack or corrosion crack during his inspection. Carry out Non-destructive Test (NDT) to further assess the integrity of those components in question. Any part with damage or defects found shall be repaired or replaced in accordance with the manufacturer's recommendations;

7. Keep on Site all records of inspection, examination, testing, maintenance and breakdown of the major construction plant in a form to the satisfaction of the CM for checking by the CM or his representatives on monthly basis;

8. In addition to the requirements in sub-clauses (3) to (7), overhaul the following major construction plant and provide Certificates of Overhaul which shall be certified and signed by a "Competent Examiner" (CE) as defined under Cap. 59I Construction Sites (Safety) Regulations, Cap. 59J Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations at the overhaul ages as defined in the following table:

Major construction plant	Overhaul ages (years)			Ages beyond which the plant is not allowed to be on Site (years)
	1st Overhaul	2nd Overhaul	3rd Overhaul	
1. Mobile cranes (excluding crawler cranes)	12	20	26	30
2. Truck-mounted cranes	10	20	26	30
3. Crawler cranes (rented)	15	25	30	35
4. Crawler cranes (self-owned)	20	30	35	40
Any overhaul, regular maintenance, etc. required by the manufacturers should also be met **in addition to** any overhaul requirements above "Overhaul age" means the age at or beyond which overhaul maintenance is required at least in accordance with the specified overhaul procedures including the Checklists of Critical Parts for Overhaul Maintenance of the respective types of major construction plant as specified in Appendix PRE.C9/XVII before the plant is put into use on Site again. "Overhaul maintenance" means an overall inspection, examination, repair, renewal and maintenance on critical parts and main components of a plant to be carried out in a depot with good engineering practice throughout by maintenance technicians and plant engineers to ensure that the critical parts and main components of the plant conform to the manufacturers' specifications and reinstate in a fully serviceable condition. "Serviceable condition" means the state of a plant that is fit for use with due regard to the manufacturers' specifications and the relevant national or international standards.				

   a. The age of the major construction plant shall be clearly indicated on the plant itself and in the manufacturers' documents, such that it can be verifiable by the CM on Site. The age of renewed / rebuilt plant shall be defined by the age of the oldest part of the plant as declared by the manufacturer and certified by the AS;

   b. Provide evidence of the eligibility of the CE responsible for certifying the overhaul at the time of certification;

c. The Certificate of Overhaul of the respective types of major construction plant on Site at Appendix PRE.C9/XVI shall be used, indicating the following:

i. The CE has verified and confirms the age of plant based on the manufacturer's records;

ii. The CE has inspected and confirms that overhaul has been done in accordance with the Checklists of Critical Parts for Overhaul Maintenance for the respective types of major construction plant in Appendix PRE.C9/XVII where applicable;

iii. The CE has recorded any deviation from the requirements in the checklist with full substantiation;

iv. The CE confirms that the plant is in a safe working condition.

d. The Checklists of Critical Parts for Overhaul Maintenance at Appendix PRE.C9/XVII for the respective types of major construction plant is not exhaustive and compliance with which shall not relieve the Contractor from his responsibility and liability under the Contract. NDT in the Checklists of Critical Parts for Overhaul Maintenance refers to such inspection and tests to be carried out by persons specifically qualified to conduct NDT. When both English and Chinese are presented, English takes precedence over Chinese in the Checklists of Critical Parts for Overhaul Maintenance.

9. Provide Certificates of Overhaul for all major construction plant on Site in accordance with sub-clause (8). The age of any major construction plant on Site must at all times within the Contract period be less than or equal to the age due for the next immediate overhaul or the respective ages beyond which the plant is not allowed to be on Site, whichever is lower. Ensure compliance with the overhaul requirements herein throughout the service period of all major construction plant on Site by measures including forecasting the service periods and deploying plant of appropriate ages when first installed;

10. The overhaul ages for the respective major construction plant as referred in sub-clause (8) are defined by the critical parts of the plant or the whole plant itself as tabulated below:

Major construction plant	Definition of overhaul age
Mobile cranes (excluding crawler cranes)	Age of mobile crane itself
Truck-mounted cranes	Age of the crane itself only, not the truck on which the crane is mounted
Crawler cranes (rented and self-owned)	Age of crawler crane itself

11. Notwithstanding the requirements in sub-clause (8), the following apply to truck-mounted cranes:

a. The overhaul requirements herein for truck-mounted cranes apply to the cranes only but not to the trucks on which the cranes are mounted;

b. Provide Certificates of Overhaul for the cranes mounted on all trucks on Site in accordance sub-clause (8) herein;

c. Prohibit the operation of the cranes mounted on any trucks on Site in case Certificates of Overhaul are not provided for the cranes mounted thereon. In such cases, provide and operate all necessary alternative lifting appliances to perform offloading / uploading from and onto such trucks;

d. Plan ahead for delivery of goods, materials, etc. to ensure the use of trucks for which Certificates of Overhaul is provided for the cranes mounted thereon.

12. "Self-owned" plant mentioned above shall mean plant owned by the Contractor or by the Contractor's parent, sister or subsidiary company for the exclusive use of the Contractor. In case the Contractor sublets part of the Works to a sub-contractor and this sub-contractor is on the appropriate Category of Housing Authority List of Piling Contractors, then "self-owned" plant shall be extended to cover also plant owned by this sub-contractor or by the sub-contractor's parent, sister or subsidiary company for the exclusive use of the sub-contractor. "Rented" plant mentioned above shall mean plant that are not considered as "self-owned" plant;

13. Bear all the additional time and costs arising from compliance with the requirements in sub-clauses (1) to (12) above.

PRE.C9.245.9 CARING OF NEW WORKERS

Provide caring programme for new workers, making reference to the practices recommended by the Guidelines on The Implementation of “P” and “N” Caring Programme issued by CIC, including but not limited to the following:

1. Probationers (workers who newly join the construction industry or with relevant job experience of less than 6 months):
   a. Provide identification with "P" labels;
   b. Assign mentors (with a ratio of 1 mentor to not more than 4 probationers) who possess good experience on the Site to take care of the Probationers and provide guidance on site safety with a caring period not less than 3 months;
   c. Provide a safety orientation programme covering the essential safety aspects related to the Site, guidance for work and arrangement for familiarization of the Site;
   d. Subject to the mentor being satisfied with the Probationer's safety performance, remove identification label from safety helmet after the 3 months' caring period.
2. Newcomers (workers with relevant job experience of more than 6 months but newly arrive at the Site):
   a. Provide identification with "N" labels;
   b. The display of "N" labels shall not be less than 2 weeks;
   c. Provide a safety orientation programme covering the essential safety aspects related to the Site, guidance for work and arrangement for familiarization of the Site.
3. Requirements of labels for Probationers and Newcomers:
   a. Each label shall be adhered on a conspicuous part of a safety helmet;
   b. The size of label shall not be less than 50 mm (L) x 50 mm (H);
   c. The name and telephone number of the mentor shall be shown on the label;
   d. The date on which the worker joined the Site shall be shown on the label.

PRE.C9.250.D SAFETY OF CRANES, HOISTS ETC.

1. In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of tower crane operation as recommended in the latest edition of the CoP for Safe Use of Tower Cranes, CoP for Safe Use of Mobile Cranes issued by LD and the Guidelines on Safety of Tower Cranes issued by CIC. Examine critically the practices and / or measures as recommended in the said CoP and Guidelines, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said CoP and Guidelines may be proposed for the CM's approval before implementation. The following highlights of the crucial practices and / or measures, albeit not exhaustive, are extracted from the said CoP:
    a. Develop a checklist for checking Form 1, 3, 5, 6 & 7 and critical parts of the mobile crane, anchorage and supporting structure before operation of mobile cranes. The checklist should cover but not limited to outriggers, jib, oil hoses, hook, safety latch, control lever, automatic safe load indicator, emergency control button, cut-off device, etc.;
    b. Enforce close site supervision of mobile crane operations;
    c. Specify qualification and experience of competent person, mobile crane operators, slingers, signallers, inspection and maintenance technicians etc. for mobile crane operations, inspections and maintenance;
    d. Comply with the legal requirements prescribed under the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations for inspections, thorough examination and testing of mobile cranes. Practical guidance on the compliance with the said Regulations is available at the Guidance Notes on Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by LD.
2. Comply with the following measures in lifting operations:
    a. Conduct a trial of the lifting operation of precast concrete pipes and large metal components, as recommended by risk assessment, when the load is lifted not more than 300-500mm off the level where it is originally placed and ensure the load is securely rigged before the load is further lifted;
    b. Ensure all workers to leave the danger zone of lifting operation before the load being lifted is started to be lifted above 300-500mm off the level where it is originally placed;
    c. Work within the safe working load with due considerations on various specific working conditions;
    d. Tie all materials safely and securely;
    e. Take due care to avoid falling objects;
    f. Not to work outside the Site boundary unless obtained the CM’s prior approval;
    g. Provide Site Personnel to assist the slinger to carry out his work within the lifting zone;

h. Mobile cranes having outriggers shall be fully extended, securely held at the extended position, securely levelled and supported before commencing operations. Yellow triangular markings with lateral sides of each at least 75 mm in length shall be marked or painted on the front and rear sides of each outrigger beam to indicate the fully extended position. For use of mobile cranes with safe working load of 70 tonnes or more, conduct firm ground loading capacity testing using a firm ground tester. In assessing the applied bearing pressure, the crane suppliers must be consulted to obtain the load distribution diagram. An average value of bearing pressure cannot be assumed because the maximum pressure will exceed this average value. As lifting is a temporary operation, the absolute magnitude of settlement under the test load is not the prime concern. Measure the trend of settlement using a dial gauge. As long as the ground reaches a plateau in settlement and does not settle further at the test load, the ground is considered firm enough for the lifting operation. The firm ground tester is a designated truck equipped with a set of hydraulic jack and measurement devices (for load and settlement). The hydraulic jack is fixed with a float having a plan size of 316mmx316mm, giving a contact area of about $0.1m^2$. The testing mechanism is like that of plate loading tests. The kentledge is provided by the self-weight of the truck and the concrete blocks it carries. Once activated for testing, the load in the hydraulic jack can be read from the Force Indicator (unit in tonne). Obtain the specific ground bearing capacity using the conversion of 1 tonne shown in the Force Indicator to 100kPa.

3. Provide interlocking devices or other measures to secure the safety latches of crane hooks. Cranes which are rented and are not expected to be used on Site for more than six months are not subject to this requirement. Provide interlocking devices or other measures to secure the safety latches of crane hooks. The safety latches shall only be released manually, so as to prevent slipping of lifting gear out of the hooks. Submit details to the CM for approval. Refer to drawing no. REF/SS/ID/SK-01 in Appendix U to this Specification for reference only;

4. Display a current valid test and examination certificate for all lifting equipment. The certificate shall be in Forms 1, 2, 3 and 5 of the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations where appropriate and duly signed by the competent person (for Form 1 only) and the competent examiner respectively;

5. Develop a checklist for checking Form 1, 3, 5, 6 & 7 and critical parts of the mobile crane, anchorage and supporting structure before operation of mobile cranes;

6. Provide close site supervision of mobile crane operations. Ensure all workers to leave the danger zone of lifting operation before the commencement of lifting operation, but the crane operator is an exception if it is not feasible to have remote control of mobile crane by the crane operator;

7. Engage or arrange through Contractor's sub-contractor(s) the engagement of the following personnel full time on Site during the operation of mobile crane (except the personnel under sub-clauses (7)(a) and (7)(f) who need to be on Site for the carrying out of the duties in accordance with the said CoP):

    a. Competent Examiner:

        i. The competent examiner shall be a registered professional engineer registered under the Engineers Registration Ordinance within the discipline of Mechanical Engineering or Marine & Naval Architecture or a relevant discipline specified by the Commissioner for Labour.

    b. Crane Operator:

        i. The crane operator shall possess relevant qualification, experience and competency as specified in the said CoP.

c. Slinger (Construction Materials Rigger):

i. The slinger shall possess relevant qualification, experience and competency as specified in the said CoP.

d. Signaller:

i. The signaller shall possess Silver Card of Slinger (Construction Materials Rigger) and have completed Signalman for Hoisting Operations at Construction Sites Course, or possess Silver Card of Rigger and Signaller, relevant qualification, experience and competency as specified in the said CoP;

ii. The role of signaller can be taken up by a slinger possessing relevant qualification and experience in carrying out the duties as specified in sub-clause (7)(d)(i) above;

iii. The safety training courses for Silver Card of Slinger (Construction Materials Rigger), Signalman for Hoisting Operations at Construction Sites Course and Silver Card of Rigger and Signaller are provided by the CIC. Acceptance of training provided by other organisations is subject to verification by the CM that the training is based on course contents of equivalent or higher standards and the appointed signaller has attained the associated qualification. A signaller having completed relevant training and already working in the industry by end 2017 is exempted.

e. Responsible Person:

i. The responsible person shall possess relevant training, experience and competency in respect of discharging duties for the proper implementation of the safe system of work and the permit-to-work system as specified in the said CoP.

f. Competent Person:

i. The competent person shall possess adequate training, experience and competency as specified in the said CoP.

g. Lifting Supervisor:

i. The lifting supervisor shall possess certificate for lifting safety supervisors provided by CIC;

ii. The lifting supervisor shall have a minimum of four-year experience in lifting operation;

iii. The lifting supervisor shall monitor and supervise the lifting process involving crane operations.

8. Ensure all the personnel as specified in sub-clauses (7)(a) to (7)(f), the Safety Supervision Personnel as per PRE.C9.205 shall carry out their respective duties on Site in accordance with the said CoP;

9. Submit particulars of all the personnel as specified in sub-clauses (7)(a) to (7)(f), the Safety Supervision Personnel as per PRE.C9.205, including their names and qualifications, to the CM for approval before their engagement in the Contract.

PRE.C9.260.B SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF OPERATIVES AND SITE SUPERVISORY STAFF

1. Safety helmet: provide each of the operatives and site supervisory staff with safety helmet conforming to the following requirements, and ensure that each of them wears the safety helmet on the Site:
    a. Comply with the latest guidance notes on the selection, use and maintenance of safety helmets issued by LD;
    b. With ventilation vents and wear the Y-type chin strap as prerequisite and with sunshade accessories such as brim or neck protector where appropriate;
    c. The Y-type chin strap shall be supplied by the same manufacturer of the safety helmet used and have a clear identification label, the manufacturer name, model number, and a proof that the safety helmet with the chin strap comply with BS EN397 or other international or national standards recognized by Labour Department. If the manufacturer of safety helmet does not produce Y-type chin strap, then the manufacturer of safety helmet shall produce test certificate and test report issued by a BSI / CSA / or an approved third party accredited laboratory for compatible Y-type chin straps to demonstrate compliance with BS EN397;
    d. Replacement cycle shall not be more than 2 years from date of manufacture unless the manufacturers of safety helmet can provide proof such as BSI test certificate and test report to substantiate a longer life span of their helmets.
2. Clothing and footwear: provide each of the operatives (other than casual workers who are expected to work on the Site for not more than an aggregate total of 7 working days throughout the duration of the Contract) and site supervisory staff with the following items and ensure that each of them wears them on the Site:
    a. Anti-heat stress uniform comprising polo shirt in short sleeves or long sleeves, cool sleeves and trousers to suit the weather;
    b. Reflective vest (for operatives and site supervisory staff involved in lifting operation, roadworks outside Site and controlling vehicular traffic except the tower crane operator);
    c. Wind breaker (to suit the weather);
    d. Sunglasses of normal type or sunglasses of specific types suitable for putting over spectacles;
    e. Safety boots shall comply with ASTM F2413, EN 20345 or equivalent standard (except for bamboo scaffolders, plasterers and tilers).
3. The clothing provided shall be in compliance with specified requirements as follows:
    a. The Contractor shall procure the anti-heat stress uniform designed by the Hong Kong Polytechnic University through Construction Industry Council (CIC) or sign a sub-licence with CIC for procuring the uniform from other supplier / manufacturer based on the design of Hong Kong Polytechnic University as shown in the Drawing No. CIC-SK-01 and CIC-SK-02 in Appendix C to this Specification. The polo shirt shall be made with Coolmax fabric (100% polyester) with minimum weight of 140 grams per square meter (gsm) or other fabric meeting the requirement of anti-heat stress uniform design laid down by CIC. Trousers shall be made with fabric comprising 60% cotton and 40% polyester with minimum weight of 180 gsm or other fabric meeting the requirement of anti-heat stress uniform design laid down by CIC. The yellow standard uniform previously developed / promoted by CIC can also be accepted. For avoidance of doubt, since the yellow standard uniform does not comprise trousers, the Contractor shall ensure that workers wear the trousers of either anti-heat stress uniform or corporate uniform;

b. Washable retroreflective strips in silver colour with mesh shall be incorporated onto the anti-heat stress uniform and wind breakers. The specification of the retroreflective strips shall comply with EN20471 class 2;

c. Reflective vests shall conform to Drawing No. RJ-SK-01 in Appendix C to this Specification and the following:

i. High visibility background material with colour complying EN 20471 of specified colour fluorescent yellow, fluorescent orange-red or fluorescent red with minimum area of 0.5 square metre, mesh knitted;

ii. Retroreflective strips:

- 50 mm in silver grey with fabric backing, conforming to photometric performance requirements as mentioned in EN20471 class 2;
- Be durable and can still comply with EN20471 class 2 after washing for a minimum of 25 cycles;
- The supplier shall submit test reports on retroreflective materials for demonstrating compliance with the following requirements under EN20471 class 2: photometric performance (initial), abrasion, flexing, folding at cold temperatures, exposure to temperature variations, washing and influence of rainfall.

d. Wind breaker shall be imprinted with a logo of the construction industry;

e. The fabric for summer clothing should preferably be of light colour and be thin and absorbent to minimise heat absorption and enhance heat and perspiration dissipation.

4. Eye and ear protection: ensure that

a. Operatives of grinding machines and cutting wheels wear goggles;

b. Operatives chiselling or drilling rock or concrete wear goggles;

c. Welders use visors;

d. Operatives of percussion tools wear ear mufflers;

e. Operatives handling corrosives wear goggles;

f. Operatives using hand held cartridge-operated tools wear goggles and ear mufflers;

g. Operatives of digging operations wear goggles;

h. Operatives working under direct sunshine wear sunglasses. The sunglasses provided shall comply with EN 166 or equivalent standard.

5. Provide and maintain machine guards to dangerous parts of machines. Size of openings in fixed guards shall comply with the 3rd Schedule of the Factories and Industrial Undertakings (Guarding and Operation of Machinery) Regulations;

6. Ensure that operatives using spray paint or similar materials wear suitable protective respirators;

7. Provide operatives with relevant information, instructions, training and supervision, to ensure operatives understand the cause of using and how to use properly the personal protective clothing and equipment;

8. Certain categories / types of personal protective clothing and equipment shall conform to the models and specifications recognised by LD under relevant legislations. Other categories / types not prescribed by LD shall conform to current international and national standards;

9. The sunglasses provided shall comply with EN166 or equivalent standard;
10. Keep the safety equipment stipulated in sub-clause (1) to (4) above in good and hygienic conditions;
11. When working in drains and sewers, adequate safety equipment shall be provided and maintained to the satisfaction of the CM;
12. When working in sewers, drains and other confined spaces, safety precautions shall comply with the Factories and Industrial Undertakings (Confined Spaces) Regulations. The major provisions of these Regulations are contained in the current edition of the document "A Brief Guide to the Factories and Industrial Undertakings (Confined Spaces) Regulation" issued by LD;
13. When work is being carried out over water, adequate life saving equipment shall be provided and maintained, all to the satisfaction of the CM;
14. Provision of appropriate fall arresting devices such as waist tool belts and tool straps securely attached to the wrist so that handheld tools are handled securely by workers to avoid the hazard of falling of tools from height. The Contractor shall consider and safeguard against the risk of falling heavy portable power tools when it is still connected to the user's body by tool strap. The straps shall comply with ANSI 121-2018 or equivalent standard;
15. Protection for hands: ensure, albeit not exhaustive, that an operative wears -
    a. protective cotton gloves to facilitate better grip of objects by absorbing sweat when handling sharp edges and corners;
    b. fire retardant leather gloves during gas welding;
    c. cut-resistant gloves during cutting or handling metal trunkings;
    d. chemical-proof gloves with high mechanical strength when handling chemicals;
    e. plastic gloves when handling corrosives;
    f. heat insulating gloves when handling hot objects;
    g. leather gloves when handling steel reinforcement or sharp objects;
    h. electric insulating gloves when carrying out electrical works and electric welding;
    i. anti-shock gloves when operating vibrating machines;
    j. anti-slip gloves to facilitate better grip of bamboo sticks when dismantling bamboo scaffolds.

PRE.C9.270.A SAFETY EQUIPMENT AND CLOTHING FOR PERSONAL PROTECTION OF THE CM, HIS REPRESENTATIVES AND VISITORS

1. Provide sufficient safety helmets complying with the latest guidance notes on the selection, use and maintenance of safety helmets issued by LD with ventilation vents and Y-type chin straps as prerequisite and with sunshade accessories such as brim or neck protector where appropriate, protective and waterproof clothing, safety harness and lines, reflective vests, safety rubber boots, safety leather boots with shoe insoles, replacements for worn-out shoe insoles, breathing respirators (of Approved proprietary type), ear mufflers, protective glasses, sunglasses of normal types as well as specific types suitable for putting over spectacles of the users, torches and the like where appropriate for the use of the CM, his representatives, and authorised persons visiting the Site;
2. Replacement cycle of safety helmets shall not be more than 2 years from date of manufacture;

3. The reflective vests provided shall conform to the following with reference to drawing no. RJ-SK-01 in Appendix C to this Specification:
    a. Background material: fluorescent orange-red, mesh knitted;
    b. Retroreflective strips:
        i. 50 mm in silver grey with fabric backing, conforming to photometric performance requirements as mentioned in EN471-2003 (Class 2);
        ii. Be durable and can still comply with the requirement in sub-clause 3(b)(i) after washing for a minimum of 25 cycles;
        iii. The supplier shall submit test reports on retroreflective materials for demonstrating compliance with the following requirements under EN471-2003 (Class 2): photometric performance (initial), abrasion, flexing, folding at cold temperatures, exposure to temperature variations, washing and influence of rainfall.
4. The sunglasses provided shall comply with EN 166 or equivalent standard;
5. Keep the safety equipment stipulated in sub-clause (1) above in good and hygienic conditions.

PRE.C9.280.B DELIVERY OF MATERIALS BY VEHICLES TO SITE

1. Suitable types of vehicles shall be used with respect to the loads to be transported;
2. Only vehicles designed for the loadings to be transported in compliance with the requirements stipulated in the Code of Practice for the Loading of Vehicles issued by the Transport Department shall be allowed to enter into the Site;
3. The following safety measures shall be taken for loading / unloading of vehicles:
    a. Planning:
        i. Conduct risk assessment of lifting operations by the safety officer or a competent person to identify hazards and risk control measures beforehand;
        ii. Prepare statement with substantiation for the extent of danger zone to be fenced off in relation to loading and unloading of vehicles;
        iii. Provide appropriate and adequate warning signs, guards, fences or barriers around danger zone to prevent unauthorized entry.
    b. Crane Operators and Personnel:
        i. Maintain a list of lorry-mounted crane / operators employed by the Contractor and his sub-contractors of all tiers for handling loading and unloading operations on the Site. All operators shall be trained as both qualified riggers & signallers and worker(s) assisting in unloading material from the vehicle on the Site shall be trained in lifting operation;
        ii. Provide a lifting supervisor to monitor and supervise the whole lifting process on the site in accordance with the lifting plan. The lifting supervisor shall possess certificate for lifting safety supervisors provided by CIC. The lifting supervisor shall have a minimum of four-year experience in lifting operation.
    c. Operation:
        i. Park the vehicle on a level ground as far as possible before loading / unloading. If a level site condition is not available, adjust the vehicle to be level with outriggers fully stretched to rest on pads for stability;

ii. Stretch the outriggers of the lorry-mounted crane fully to rest on pads laid on solid ground.

d. Handling Load:

i. If there is a risk of the load falling down from the vehicle, secure and keep the load to be unloaded from the vehicle in a position by a device or method such as a crane before the strap / chain fastening the load is unfastened;

ii. When the load is higher than the sideboard of the vehicle, provide lateral barriers which may take the form of a metal frame mounted on the vehicle to restrain the position of the load;

iii. When the load comprises layers stacked over one another, add devices between the layers to secure them altogether to avoid risk of sliding;

iv. Tie all loads on the vehicle securely to the vehicle to prevent undue movement during transportation.

PRE.C9.290.C PLATFORMS FOR WORKING AT DIFFERENT HEIGHTS

1. Provide the following equipment for working involving a possible fall of:
   a. 2 meters or more: working platform with guard-rails, toe boards and a fall arresting system as warranted after conducting risk assessment;
   b. Less than 2 meters but more than 900mm:
      i. Light-duty working platform such as hop-up platform or step platform with guard-rails, and provide toe-boards when the working platform or step platform is used near a building edge or floor opening to avoid risk of falling object from height;
      ii. A fall arresting system as warranted after conducting risk assessment for working at a height of 1350mm - 2000mm.
   c. Less than or equal to 900mm: hop-up platform or step platform with or without guard-rails;
   d. A height under abnormal circumstances where use of working platform, hop-up platform or step platform is not reasonably practicable: alternative proposal incorporating a fall arresting system after conducting risk assessment.
2. Ensure that the following safety measures are fulfilled:
   a. the right type of light-duty working platform is used for the job;
   b. the workers who use the light-duty working platforms have been provided with adequate information, instruction, training and supervision;
   c. the workers are fully aware of the risks and control measures;
   d. follow a safe system of work (including a pre-use check) so as to use the platform safely;
   e. the workers are not allowed to work on the access steps of a light-duty working platform;
   f. the fall arresting system shall comprise a full body harness with double hook lanyard to allow a user to stay linked to at least a rigid anchor point. The anchor point shall be planned in advance, installed and tested.
3. Guard-rails shall be situated at 450mm - 600mm and 900mm - 1150mm high from the platform and form a barrier to prevent the worker standing on the platform from falling down;

4. Toe boards shall be not less than 200mm high;
5. Locking device shall be provided to movable working platforms to ensure that the platforms are stable when in use;
6. Step ladders, straight ladders and extension ladders are used purely as a means of access and egress to working platforms;
7. Portable ladders provided shall comply with the safety requirements of at least one of the following standards (the latest version):
    a. BS EN131-7 for portable ladders and mobile ladders with platforms including hop-up platform and step platform, timber, metal and glass fibre reinforced plastic ladder;
    b. EATS 13/1 for glass fibre reinforced plastic ladder;
    c. BS EN14183 for step stools; or
    d. Other international standards approved by the CM.
8. Prevent injuries of manual handling of ladders of varying sizes for providing access to working platforms of a reverse circulation drill to suit different heights of the working platforms. An example of safety measure(s) includes the extendable and adjustable ladder. Submit detail drawings of the extendable and adjustable ladders for the CM's approval. Refer to drawing no. REF/SS/EL/SK-01 to REF/SS/EL/SK-04 in Appendix U to this Specification for reference only.
9. Implement a visual and audio alarm system for monitoring the clamping device of reverse circulation drill. Refer to drawing no. REF/SS/CD/SK-01 to REF/SS/CD/SK-03 in Appendix U to this Specification for reference only.
10. Provide extendable reinforcement cage working platform when the platform is used for fabricating different size of reinforcement cage. Submit detail drawings of the extendable reinforcement cage working platform for the CM's approval. Refer to drawing no. REF/SS/WP/SK-01 in Appendix U to this Specification for reference only.
11. A safe system of work shall be developed and implemented for using a mobile elevating work platform (MEWP). The planning of the operation shall include but not limit to the selection, provision and use of a suitable MEWP. Refer to "Guidance Notes on Safe Use of Power-operated Elevating Work Platforms" issued by Labour Department on selection;
12. When a risk of contact with an obstacle in the use of MEWP is identified by the risk assessment, the Contractor shall consider the need of smart device as secondary guarding device (SGD) for protecting the operator from the risk of entrapment. The SGD shall be one of the SSSS component following the requirements in PRE.C9.294 (wireless communication technologies). The Contractor shall maintain a register to monitor whether all MEWPs on Site are fitted with SGD and the register shall be included in the monthly safety report. Provide the SGD with the following consideration:
    a. If the SGD is not an integral part of the original MEWP from the manufacturer, then the Contractor, who intends to fit SGD as an attachment to existing MEWP shall be liable for the adaptation, addition, modification and safe operation of a MEWP with SGD;

b. The smart device shall be an anti-collision sensor fitted at a MEWP for detecting any obstacles around and above the MEWP. When the distance between any operator or worker on the MEWP and any obstacle around or above the MEWP becomes less than 500mm or other distance as pre-determined by the risk assessment, the device is to trigger a warning siren with a minimum of 70 dB noise level and a flashing red light to alert the operator and workers on the MEWP. When the distance between any operator or worker on the MEWP becomes less than the distance as pre-determined by the risk assessment, which poses an imminent danger, the smart device could automatically carry out a function of stopping the MEWP operation at emergency. All warning signal shall be automatically turned off when the MEWP operator resume the plant operation and address the warning signals. The device shall have a minimum battery life of two working days per charge under continuous operation and a lighting display showing its battery is in normal operation mode. All warning signals and the status of the smart device during operation shall be automatically transmitted to a CMP for record where the data transmitted shall be digitalised signal in chronological sequence and marked with the time and date and be available for integration by Open Application Programming Interface (API) format. Conduct all necessary maintenance, repair and / or replacement of smart device within 24 hours upon reporting of any device abnormality, malfunction or damage of the smart device;

c. Display warning notices at prominent location of all MEWPs on Site to alert all operators and workers to the potential hazards on using MEWPs such as the hazard of entrapment;

d. The SGD shall only be retracted or collapsed when:

i. The MEWP is at stationary status;

ii. The presence of SGD will render works to be carried out not practicable;

iii. Other types of safety precautionary measures are in place to completely eliminate the risk of entrapment of any operator or workers on MEWP;

iv. The retract and collapse of SGD shall be done under supervision of a Safety Supervisor / Safety Officer;

13. All workers on a MEWP shall have attended the training course provided by the supplier of the MEWP on the use of the respective type of MEWP. When a trained worker is newly employed for operating a MEWP, the Contractor shall verify the adequacy of the training and relevant experience of such trained worker for the use of respective type of MEWP. Provide the trained workers with all necessary information, instructions, training and supervision regarding the safety of work at heights. Prepare emergency procedures for accidents / incidents arising from or in connection with the use of MEWP. Assign worker(s) to receive the same training so that there is always a trained worker available on Site during the operation of the respective type of MEWP to operate the control set at ground or chassis level of the MEWP to lower the platform of MEWP in an emergency. Maintain the training record of the workers using MEWP provided by the supplier of MEWP on Site for inspection by the CM;

14. The Contractor shall use the permit-to-work system to conduct checking of implementation of all necessary safety precautionary measures for the use of MEWP. Use of MEWP on Site shall be permitted only after the issue of a permit-to-work certification by the Contractor. These certificates shall be made available for inspection upon request by CM;

15. Arrange gangers who will have workers to work on MEWP and foremen to complete the Mobile Elevating Work Platforms Operator Safety Training provided by the OSHC or equivalent training by other organisations. The gangers or foremen who have received training in the said course shall provide talks to workers who are required to operate MEWP. Maintain the record of talks to the workers using MEWP provided by gangers or foremen on Site for inspection by the CM.

PRE.C9.291.9 SAFETY OF REINFORCEMENT BAR BENDING MACHINES

Apply the following safety measure(s) to machines for small reinforcement bars or stirrups (Y16 or below), to avoid striking and trapping by the moving parts of machines or the bending reinforcement bars. Submit details of the safety measure(s) for the CM's approval. Examples include the following and refer to drawing no. REF/SS/BM/SK-01 in Appendix U to this Specification for reference only.

1. Install an interlocking guarding to the rotating part and a timer switch to isolate power supply automatically after a time interval set according to risk assessment conducted by Safety Officer, if the guarding is not closed properly;
2. Install an angle indicator on the top to visually indicate the angle set for the current operation.

PRE.C9.292.9 INSTALLATIONS TO REDUCE RISK OF MANUAL HANDLING AND WORKING AT HEIGHT

Provide installations, or safety measures, to reduce risk of manual handling and working at height. Include, but not limited to, the following implementation:

1. Prevent injuries of wheelbarrow users by providing two-wheel wheelbarrow with braking system. Prohibit the use of single-wheel wheelbarrow. Refer to drawing no. REF/SS/WB/SK-01 in Appendix U to this Specification for reference only;
2. Provide safety measures to reduce manual lifting of hand-held pneumatic breaker for works. Refer to drawing no. REF/SS/BR/SK-01 in Appendix U to this Specification for reference only;
3. Adopt safety measure by mechanical means, certified by Quality Control Engineer as stipulated in PRE.C6.060 as necessary, to eliminate releasing shackle for H-pile and sheet pile at height manually and prohibit the use of man-cage. Use double lock remote release shackle or other measures to achieve the purpose. Refer to drawing no. REF/SS/DL/SK-01 in Appendix U to this Specification for reference only.
4. Provide safety measure(s) by mechanical means, certified by Qualified Engineer as stipulated in PRE.C6.060 as necessary, to reduce manual lifting of the reinforcement bars during fabrication of large diameter bored piles. Submit details to the CM for approval. Refer to drawing no. REF/SS/TF/SK-01 in Appendix U to this Specification for reference only.
5. Provide bridging chains on the four corners of the steel frame housing generator set to avoid rigging at height. Refer to drawing nos. REF/SS/BC/SK-01 to REF/SS/BC/SK/03 in Appendix U to this Specification for reference only.
6. Provide power-assisted trolley or wheelbarrow with "Dead Man's Switch" and lift dump for carrying heavy load exceeding 50kg. Refer to drawing no. REF/SS/PT/SK-01 in Appendix U to this Specification for reference only.
7. Provide fencing barrier clamp or similar means as a gripping hand tool to lift, carry and / or move big panels. Refer to drawing no. REF/SS/FB/SK-01 in Appendix U to this Specification for reference only.

PRE.C9.293.C SAFETY OF ELECTRIC PORTABLE TOOLS

1. Ensure the use of cordless electric portable tools by operatives, including: circular saws for cutting wood or metal, reciprocating saws, angle grinders, rotary hammers, combination hammers for drilling and chiselling in concrete, impact drivers and impact wrenches, demolition hammers, masonry cutters and jig saws. Prohibit the use of the above tools that are with cords;
2. Inspection records that verify the cordless electric portable tools are in safe and serviceable conditions shall be kept on Site for checking by representatives of the CM. Verification record shall be either:
    a. annual certificates issued by the original manufacturer; or
    b. quarterly records certified by Registered Electrical Worker.
3. Arrange centralised charging facilities to ensure safe use of electricity. Provide at the place of centralised charging facility with at least one 6 kg dry chemical powder (automatic type) fire extinguisher, or its equivalent, and at least one fire detector which will trigger audio and visual alarm with alert to the site office in case of a fire;
4. Ensure that the angle grinders are provided with the following features:

    An auxiliary handle; double-action switch to prevent accidental start-up and stop the grinder when released; electronic brake to stop the wheel in 3 seconds or less; and kick back detection to shut down the grinder automatically when rotation of wheel is suddenly forced to stop;
5. Use low spark tools (cold-cut tools) instead of tools fitted with abrasive wheels.

PRE.C9.294.D WIRELESS COMMUNICATION TECHNOLOGIES

1. Implement efficient and effective smart site safety system (SSSS) with aid of wireless communication technologies incorporated with facial recognition system, artificial intelligence system, Radio Frequency Identification (RFID), infra-red, Internet of Things (IoT) or Ultra wideband (UWB), Long Range (LoRa), etc. for authenticating authorised operation of mobile plant or equipment, controlling access, alerting to unsafe acts or conditions, and checking data of personnel, plant and equipment, tools and materials and monitoring health condition of workers and frontline personnel. The operation and collection of data of SSSS shall comply with the Personal Data (Privacy) Ordinance (Cap.486). Ensure that the SSSS shall have 99.9% uptime during working hours and at other time when the Contractor is working or other time as advised by the CM. Refer to drawing nos. REF/SS/WT/SK-01 to SK-04 in Appendix U to this Specification for reference only. The Contractor shall provide the SSSS for use by all his sub-contractors free of charge;
2. Submit implementation plan of the SSSS to the CM within 14 days from the notified date for commencement of the Works for approval by the CM. The implementation plan shall include:
    a. A general description on overall SSSS setup, including site telecommunication networking, list of individual SSSS components as specified in sub-clause (1), implementation and operation schedule and a management plan with designated personnel other than safety personnel for SSSS general implementation and maintenance;
    b. Site telecommunication network proposal as specified in sub-clause (6) for supporting SSSS implementation;
    c. Details of all computer hardware and software and the associated furniture for SSSS;
    d. Proposal for each SSSS component to be implemented:

i. The proposal for each SSSS component specified;

ii. Each SSSS component proposal shall include, but not limited to the following:

- Actual body vital sign data shall not be displayed on the platform for privacy protection;
- Details on the corresponding SSSS component performance specifications;
- A location plan for the corresponding SSSS devices and sensors setup during the progress of the Works, and the arrangement of video cameras where SSSS components include video cameras;
- Specification of computer system, including all associated hardware and software supporting the Centralised Management Platform as specified in sub-clause 15(a);
- The format, report and presentation details of the dashboard for the Centralised Management Platform;
- Details, layout and furniture for housing the Centralised Management Platform inside the site office;
- Action plan on Site Personnel's required actions and responses to SSSS components generated alarm / alert or identified unsafe acts / conditions which shall include details on immediate / follow-up actions required, recommend response time, designate responsible supervising personnel and establish procedures to record all incidents triggered by SSSS components;
- Details on the emergency support services provision for the SSSS components where necessary, which shall also include an alternative monitoring back-up plan for each of the SSSS components in case where malfunctioning of any of the SSSS component cannot be rectified in a short period of time.

3. Review and update the implementation plan on SSSS monthly according to the prevailing site condition. The review of implementation plan on SSSS shall be one of the agenda items of the Site Safety Committee meetings. Unless agreed by the CM, deliver and implement all components of SSSS within 1 month from the date of acceptance of the first implementation plan on SSSS. Deliver and implement any additional components on SSSS as stated in the updated implementation plan on SSSS within 1 month from the date of acceptance of the updated implementation plan on SSSS concerned. Within 5 days of delivery of any component, the Contractor shall arrange the components of SSSS to be installed and tested for demonstrating that the SSSS components are in good working order to the satisfaction of the CM;

4. Ensure uninterrupted operation of all SSSS components installed until the certified date of completion of the Works or for such shorter or longer period as directed by the CM. The SSSS and all its components shall be able to operate automatically 24 hours per day and 7 days per week. The Contractor shall be responsible for:

   a. The cost of servicing, repair and maintenance of all SSSS components as well as the computer hardware and software;

   b. The cost of supplying all consumables of all SSSS components and training of all Site Personnel for SSSS;

c. The cost for replacement of worn out or defective parts of all SSSS components, and computer hardware and software;

d. Providing the respective replacement for the period of breakdown in the event of a breakdown of any SSSS components, or computer hardware or software.

5. Implement appropriate security controls and measures to protect the confidentiality, integrity and availability of all data and information obtained, stored, processed or transmitted for the implementation and delivery of SSSS. Review monthly the adequacy of the security control and protection measures. Brief all Site Personnel on the collection of data for SSSS;

6. Provide site telecommunication network which shall support mobile communication with adequate data transmission speed, capacity, coverage, connectivity, stability and cybersecurity to ensure that the real-time data transmission, including any video / audio signals, from any automation / remote sensing devices to their targeted operators / receivers / monitors / data storage devices for efficient implementation of the proposed SSSS components is uninterrupted, reliable and effective. Due consideration on the flexibility and adjustability of the network system with respect to changes in construction work and site progress shall be given in the selection of the telecommunication network;

7. Adopt more than one telecommunication network systems available in the market, including but not limited to Wi-Fi, broadband network, 4G/5G network, Bluetooth, LoRa, Ultra wideband etc., to suit each of the proposed SSSS components and with respect to the progress of the Works. Ensure the accessibility and compatibility among multiple network systems with the corresponding SSSS components and that there shall not be any signal interference between different network systems adopted. Provide all necessary power supply and all associated infrastructures (including hardware and software) for the site telecommunication network;

8. Ensure that any proposed SSSS component that issues automated warning, alarm or alert in the process shall achieve and maintain an adequate accuracy. In any case, no less than 90% in detecting conditions for triggering alert / warning signal shall be maintained on routine operation during the progress of the Works. Ensure that each time when the automated warning system activates, a signal shall be automatically transmitted to a Centralised Management Platform for record, review and data analysis. The warning trigger record shall include but not limited to the involved Site Personnel and machinery identification, the date, time and duration of the warning triggered etc. Review and analyse all the records and submit a summarized report monthly to the CM. Where SSSS components include video cameras, the camera shall have a protective casing. The video cameras resolution shall not be less than 1920(H) x 1080(V) pixels with at least 5X optical zoom and shall be able to continuously transmit wireless encrypted live-streamed video signal to a Centralised Management Platform for recording, viewing and monitoring by the Contractor and the CM;

9. Where interim modification / adjustment to the operating SSSS components are proposed, the corresponding modification / adjustment shall be undertaken with minimum interruption to normal SSSS components operation. Submit the corresponding modification / adjustment proposal to the CM for acceptance before implementation;

10. Provide all necessary power supply for the operation of all SSSS components. Conduct all necessary system maintenance, repair and / or replacement of any SSSS component / unit within 24 hours upon reporting of any system abnormality, malfunction or damage to ensure normal operation of the SSSS components;

11. Ensure that all audio, video, image and data transmitted from SSSS components shall be:

a. Digitalised signal in chronological sequence and marked with the time and date of the signal transmission and be available for integration by Open Application Programming Interface (API) format;

b. Live-streamed to a Centralised Management Platform for storage, viewing and analysis by personnel authorized by the Contractor.

Allow the CM to access the stored audio, video, image and data upon request. All audio, video, image and data shall be encrypted. Maintain all APIs during system upgrade or maintenance and keep copy of the API library documents after launching of SSSS and major system upgrades;

12. Assign competent personnel with relevant knowledge, experience and training to check and ascertain the proper functioning of the SSSS components, such as correct alarm triggering, real-time transmission and receiving of warning / alert signal between devices and concerned workers, supervisors and stations etc., before commencement of works on each day. Any irregularity observed during daily checks shall be recorded and rectified before conducting any related work activities. The daily check records with the irregularity and rectification records shall be kept on the Site for inspection by the CM upon request;

13. Provide appropriate training to Site Personnel involved in the use of SSSS components to ensure they are familiar with the concerned SSSS components operation before the commencement of the Works;

14. Submit monthly report on implementation of SSSS components on Site to the CM in advance of the monthly Site Safety Committee meeting for record. The monthly report shall include, but not limited to, updates on Site SSSS components setup, operation, malfunction, interruption and modification, etc. The report shall also include a summary of all SSSS components triggered incidents, including false alarm, with details of the incidents, the actions taken and the response time, the consequence of incidents and the follow up actions, and the site monitoring and analysis report on the unsafe practices / behaviours detected on Site and the warning signals / alerts issued and associated measures retrieved from the Centralised Management Platform as specified in sub-clause 15(a);

15. The SSSS shall include, but not limited to, the following implementation:

    a. Centralised Management Platform

        i. Provide and operate a Centralised Management Platform (CMP) to respond, manage and record signals / alerts received from all SSSS components implemented on the Site. The CMP shall be run in automatic mode. The CMP shall be compatible and able to work with the BIM model of the Contract in case one is provided. A trained superintendent of the Contractor shall be assigned to oversee the operation of the CMP during working hour of the Site and promptly attend to the alerts / signals for taking immediate actions to address the alerts / signals or emergency situations;

        ii. Ensure uninterrupted operation of the CMP upon setting up with the necessary backup and support in terms of equipment, device, power supply, data storage, telecommunication connection, maintenance and repair personnel and emergency support;

iii. Develop a CMP dashboard that can display video, audio, image and data transmitted from different SSSS components on corresponding CMP monitors and ensure the various signals will not interfere with one another or become corrupt. The CMP shall have the capacity to control, monitor, manage and maintain simultaneous operation of all SSSS components under a single platform. The CMP shall also be designed to display various warning signals from different SSSS components with highlighted pop-up notification display on corresponding CMP monitors. Such pop-up notifications shall include details of warning and necessary follow up actions. The CMP shall allow concurrent access by not less than 30 users;

iv. The CMP shall support real-time distributed event data streaming for large volume and high speed data handling. It shall support real-time video streaming from the safety monitoring system using artificial intelligence;

v. Develop a CMP dashboard with a unique website link based on signals collected from SSSS. Provide all necessary training for designated Contractor's superintendent on operating the CMP and on the procedures to handle received warning signal and any emergency situation;

vi. Provide the access policy of the CMP for acceptance by the CM before the delivery of the CMP. The access policy of the CMP shall cover, but not limited to user accounts control, access for system support personnel and procedures for management of users account created;

vii. Establish a rational and logical filing system for automatic storage of all data, video, audio and images received from SSSS components, with a storage duration of at least 3 months. Ensure that the computer system supporting the CMP has adequate processing power and storage space for storing all data, video, audio and images received from SSSS components. The servers for CMP for storing video, audio, image and data transmitted from different SSSS components shall be hosted at site office or externally in data centre or cloud-based system. Archive all captured data for each construction site quarterly. When requested by the CM or his representatives, the Contractor shall store the data into removable storage media (e.g. USB thumb-drive, DVD-RW, etc) in construction site office or make the archived data available at FTP server for downloading by the CM or his representatives;

viii. The CMP and its server shall be fully accessible via a web-browser by a desktop computer / laptop computer with secured internet connection (Hypertext Transfer Protocols) without physical or geographical limitation. No other software or licenses shall be needed to access CMP;

ix. For CMP servers hosted at site office, it shall be protected and separated from other systems by firewall (e.g. trusted zone, demilitarized (DM) zone, etc.) and / or virtual private network (VPN). Ensure the hosting environment meets the requirements of data confidentiality, system integrity, system availability / accessibility, and data privacy aspect as agreed with the CM;

x. For CMP servers hosted in data centre or cloud-based system, the Contractor shall ensure that the selected hosting solution is configured, deployed and managed to meet the requirements of data confidentiality, system integrity, system availability / accessibility and data privacy aspects and is in compliance with globally recognised industrial security standard, e.g. Telecommunications Industry Association (TIA)-942 certified Tier 3 data centre and International Organization for Standardization (ISO)/ International Electrotechnical Commission (IEC) 27001. Provide an up-to-date independent auditor report for achieving international recognised certification, e.g. ISO/IEC 20000 or ISO/IEC 27017 to demonstrate the cloud service provider has the required capability in security and risk management;

xi. Secure connection of at least 256-bit Secret Sockets Layer (SSL) shall be used for any network communication, transaction and data feed;

xii. Implement measures and conduct IT security audits to ensure the security of CMP is in accordance with Chapter IX of the Security Regulations, the Baseline IT Security Policy promulgated by the Office of the Government Chief Information Officer (OGCIO) and the derived Employer's IT Security Policy. Also implement appropriate arrangements for preventing unauthorised access to CMP and its data.

b. Authenticating authorised operation of plant and equipment

For authenticating authorised operation of plant and equipment, implement a digitalised system on mobile plant (including mobile elevating work platforms, forklift trucks, bobcats, excavators, mobile cranes) and a system with RFID and face recognition technology or equivalent for material hoists to allow operation by authorised operators only; and prohibit unauthorised duplication of operation keys;

c. Controlling access to hazardous areas:

i. Implement an automated access control and warning system to prevent unauthorised opening of locked cover, doorway and barrier to hazardous areas within the Site which shall include but not limit to the following:

- Entrance to confined space;
- Storage yard of precast concrete elements;
- Lift shaft opening;
- Material hoist landing gate;
- Floor opening equal to or larger than 500mm x 500mm;
- Electrical distribution board cabinet.

ii. The access control and warning system shall include an electronic lock and key system for locking accesses to hazardous areas in the Site. The electronic lock shall only be openable by authorised electronic key with key owner's identity electronically embedded in the key. Review and renew all electronic locks access authority periodically or as necessary and maintain an updated register of all electronic keys issued with the corresponding authority for opening the designated electronic locks. Prohibit unauthorised duplication of electronic keys;

iii. When an unauthorized person attempts to open the electronic lock by using an outdated key or by force, the system shall immediately issue a warning siren with a minimum of 70 dB noise level and flashing red light and the siren can only be turned off when the electronic lock is re-engaged or by an authorized electronic key. Furthermore, every time a warning siren is triggered, an automatically generated alert message shall be sent to the mobile devices of the Site Agent, General Foreman, Safety Officers, Safety Supervisor, Competent Person for confined space, lifting supervisor and registered electrical worker by means of short message service (SMS) or in-app pop-up notification for immediate actions to check the corresponding electronic lock being tampered with and recorded at the CMP for the Contractor's actions where necessary. The alert message shall include location of electronic lock being tampered with the date and time of the incident and the electronic key identification number.

d. Alerting against unsafe acts or conditions:

i. Tower crane lifting zone

- Implement an automated warning system on tower cranes to alert tower crane operator and any personnel encroaching upon the tower crane loading / unloading danger zone to the risk of being hit by the moving load under the crane hook. The automated warning system shall include an adequate number of sensors installed on or around the tower crane to ensure full coverage of all loading / unloading areas danger zone at all floor levels involved. The loading / unloading danger zones of the tower crane operation shall be determined by the Safety Officer according to risk assessment but in no case shall the extent of the danger zone be less than 7m radius from the crane hook. The minimum clearance between the load being lifted and the loading / unloading area activating the automatic warning system shall be determined by the Safety Officer according to risk assessment but in no case be less than 3m from the crane hook;

- When clearance between the load and the loading / unloading area is less than the minimum clearance for system activation and any one of the sensors detect person encroaching upon the danger zone, a warning light signal shall flash on the plant operating dashboard and an automated warning message shall be delivered via speaker or headphone to the tower crane operator to stop all crane motion. At the same time, siren speaker attached to the crane hook shall automatically turn on with flashing red light and continuous alarm at a minimum of 100 dB to warn away any encroachment of the danger zone. All warning signal shall be automatically turned off when the encroaching person has left the danger zone, the plant operator stopped the plant operation and the workers or Site Personnel concerned addressed the warning signals / alerts. An alert message shall be generated to the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification and be recorded at the CMP for follow up actions. The alert message shall include the date and time of the encroachment upon the lifting danger zone and the video clip capturing 15 seconds before the encroachment of loading / unloading danger zone until 10 seconds after the encroaching person has left the loading / unloading danger zone.

ii. Mobile plant danger zone

- Implement an automated warning system on mobile plant (including but not limited to forklift trucks, bobcats, mobile cranes and loadshifting machines covering bulldozer, loader, excavator, truck, lorry, compactor, dumper, grader, locomotive and scraper) to alert the mobile plant operator and any personnel who enters mobile plant danger zone to the risk of being hit by the plant moving components. The automated warning system shall include an adequate number of sensors installed on the mobile plant chassis and moving components to ensure full 360^0 coverage around the mobile plant danger zone. The danger zones of the mobile plant operation shall be determined by the Safety Officer according to risk assessment but in no case shall the extent of the danger zone be less than 2m from any part of the mobile plant;

- When any one of the sensors detect a person encroaching upon the mobile plant danger zone, a warning light signal shall flash on the plant operating dashboard and an automated warning message shall be delivered via speaker or headphone to the plant operator to stop all plant operation. At the same time, siren speaker attached to the top of the mobile plant shall automatically turn on with flashing red light and continuous alarm at a minimum of 100 dB to warn away any encroachment of the mobile plant danger zone. All warning signal shall be automatically turned off when the encroaching person has left the plant danger zone, the plant operator stopped the plant operation and the workers or Site Personnel concerned addressed the warning signals / alerts. An alert message shall be generated to the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification and be recorded at the CMP for follow-up actions. The alert message shall include the date and time of the person encroached upon the danger zone of the mobile plant and the video clip capturing the person 15 seconds before the encroachment of the danger zone until 10 seconds after the encroaching person has left the plant danger zone;

iii. Implement a visual and audio alarm system at Site entrance / exit to alert drivers and security guards to stop a mobile plant from entering or leaving the Site when the mobile plant exceeds the height limit of haul road of the Site or the height limit of vehicles regulated by the Transport Department, whichever is the lower;

iv. Implement an automated warning system with adequate number of sensors installed on the safety harness for detection of proper wearing of safety harness which is fixed to a proper anchorage point or fall arrestor of lifeline for workers working at height. The automated warning system shall immediately issue a warning signal with a minimum of 70 dB to the workers working at height when an unsafe act or condition is detected. Furthermore, every time when a warning signal is triggered, an automatically generated alert message shall be sent to the mobile device of the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Block Foreman by means of SMS or in-app pop-up notification for immediate actions. The automatically generated alert message shall also be sent and recorded at the CMP for follow-up actions;

v. Implement an artificial intelligence (AI) system with internet protocol (IP) cameras and video recording system for collecting videos of all uncovered areas of the Site, working floors and facades of buildings for real-time monitoring of the Site conditions. All IP cameras, sensors and related video recordings shall be managed by the CMP. The proposed AI detection and video analytics shall pass an accuracy test with a testing dataset.

- Conduct a live test with the pre-built AI engine modules to achieve an accuracy of AI detection of at least 80% (true positive) for each type of unsafe acts or conditions required. The testing dataset comprises not less than 10,000 images and it shall be split into half between image data with and without the proposed detecting object (or event) in those images;
- In the first four weeks after deployment of AI detection on the Site, provide the CM or his representatives with weekly AI improvement plan (with re-training and other proposed methodology) to achieve the required accuracy of AI detection;
- From the fifth week to the twelfth week after the deployment of AI detection on the Site, the Contractor shall provide the CM or his representatives with bi-weekly AI improvement plan (with re-training and other proposed methodology) to achieve the required accuracy of AI detection;
- From the fourth months after the deployment of AI detection on the Site to the date of certified completion of the Works or for such shorter or longer period as directed by the CM, provide the CM or his representatives with monthly AI improvement plan (with re-training and other proposed methodology) to achieve the required accuracy of AI detection;
- Improve and maintain the required AI detection accuracy of at least 90% on average, covering all types of unsafe acts or conditions required to be detected at all times after 4 weeks from the deployment of AI detection on the Site till the date of certified completion of the Works or for such shorter or longer period as directed by the CM;
- Provide a total of two on-site technical training courses (4 hours for each course) for implementing the site monitoring system using AI. The details are as follows:
    - The content of each course shall cover aspects of data acquisition, processing and detection analysis for different types of unsafe acts and conditions relevant to the AI engine modules required at different construction activities;
    - The trainer shall possess extensive knowledge and practical experience in deploying IP cameras for surveillance and analysing data collected from site videos by appropriate AI engine modules;
    - The training course shall be conducted within 2 weeks from the date after deployment of AI detection on the Site;
    - The content of each course, the experience and qualifications of the trainer shall be accepted by the CM prior to commencement of the training course.

- By using the AI system, videos shall be recorded and analysed in real-time by AI engine modules designed to detect, identify and classify different types of unsafe acts and conditions, including but not limited to the following:
    - Unauthorized access to restricted zones, danger zones, lifting zones or vehicular routes (detection zones and alerts should be configurable);
    - Workers near site vehicles or plant;
    - Potential collisions between workers and site vehicles or plant;
    - Outriggers of mobile crane not being fully stretched;
    - Workers and other personnel not wearing the required personal protective equipment, including safety helmet and reflective vest in lifting zone and safety helmet on the Site;
    - Heights of lifting in excess of the authorized limits;
    - Workers working at height either without wearing safety harness and fixed to a proper anchorage point of lifeline, or without a proper working platform;
    - Monitoring of fatigue, distraction, inattentive behaviours of operators of crawler cranes during operation of the cranes.
- The AI engine shall be able to detect multiple physical events at the same time. The AI system shall allow restricted zones, danger zones and lifting zones to be defined on the screen either by the user or by recognition of a series of plastic barriers placed on the Site;
- When any unsafe act or condition is detected, siren speaker attached to the top of the mobile plant concerned and / or at the incident location concerned shall automatically turn on with flashing red light and continuous alarm at a minimum of 100 dB. All warning signal shall be automatically turned off when the encroaching person has left the danger zone, the plant operator stopped the plant operation and the workers or Site Personnel concerned addressed the warning signals / alerts. In addition, every time a warning siren is triggered, an automatically generated alert message shall be sent to the mobile devices of the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification for immediate actions. The automatically generated alert message shall also be sent and stored in the CMP. All the sound / light signals / alerts mentioned in this sub-clause shall be triggered within 1 second after any unsafe act or condition is detected;
- The duration of the recorded videos for unsafe acts or conditions shall be 1 minute before and 1 minute after the identified unsafe acts or conditions. The videos shall be captured and stored for future analysis;
- The videos, data, warning alerts / signals and response times collected by the AI system shall be live-streamed to the CMP for viewing. All videos or image data shall be encrypted. The display format at the CMP shall be accepted by the CM;

- Record the response time of the follow-up actions triggered by each warning signal / alert and furnish a summary report to the CM, which covers the period from the warning signal / alert triggered to the close of the case. A drill shall be conducted by the Contractor once every 6 months to test the effectiveness of the AI system.

e. Tracking system for information of personnel, plant and equipment:

Implement a digitalised system for real-time online tracking of information of personnel, plant and equipment on the Site by mobile device. The Site Agent, General Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor shall be able to retrieve such information instantly from the CMP by an electronic mobile device. Set up and update computerised data base regularly. The mobile device shall display an alert message if the corresponding personnel, plant or equipment has an outdated certification or is overdue for examination or renewal of certificate and automatically generate an alert message to the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification and record at the CMP for follow up actions. The alert message shall include details of the date and time of scanning, digital identification number, status and record of the personnel, plant or equipment:

i. Major construction plant, (including mobile crane, truck-mounted crane, crawler crane, oscillator and rotator) – for the plant checking and updating of the information of the plant including, but not limited to, its type, permit number, owner, model number, serial number / owner's mark, manufacture date, Certificate of Overhaul, photo of the plant for confirmation, list of authorized operators, valid records of test, examination, checking, maintenance and risk assessment;

ii. Workers - for checking and updating of their information, including but not limited to, their names, employers (i.e. the Contractor or sub-contractors that they belong to), their registered trade through reading the data in Construction Workers Registration Cards issued under Construction Workers Registration Ordinance (CWRO), plus records of training attended and safety performance;

iii. Plant and equipment, which involve safe working load, periodic testing and examination under legislation or contractual provision - for checking the data by smart tag and mobile applications, such as safe working load, latest examination date, relevant information of the plant and equipment, capturing the images of the subject or by inputting key words.

f. Smart monitoring devices for workers and Contractor's superintendent

i. Based on the result of risk assessment, provide workers and Contractor's superintendent in need with smart monitoring devices or other equivalent wearable monitoring devices including but not limited to smart wristband and / or smart helmet;

ii. The smart monitoring devices or other equivalent wearable monitoring devices shall include, but not limited to, the following functions:

- Capable of both outdoor and indoor location tracking and visualisation of location in the CMP, and recording of workers and Contractor's superintendent in different areas and time of working. The location data shall be stored in the CMP;

- Real-time detection of any standstill and sending alerts to the CMP; SMS or in-app pop-up notification shall be generated and recorded at the database platform for follow up actions. The period of standstill criteria shall be adjustable;
- Real-time detection of body temperature and heart beat rate and sending alerts to the CMP when the threshold is exceeded. SMS or in-app pop-up notification shall be generated and recorded at the database platform for follow up actions. The threshold of body temperature and heart beat rate shall be adjustable;
- Actual body vital sign data shall not be displayed on the platform for privacy protection;
- Allowing both battery and wireless charging modes and shall have a minimum battery life of 30 hours per charge under continuous operation;
- Wireless connection to cellular, WiFi, NBIoT and/or LoRa networks, or equivalent;
- Warning of entry to restricted area: only authorized workers and Contractor's superintendent could enter the restricted area and any unauthorized entry shall trigger alerts to workers, Site Agent, General Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification;
- Capable of broadcasting up to at least 3 voice messages with continuous light flashing function to alert workers and Contractor's superintendent of various weather conditions, including but not limited to heat stress at work, rainstorm and tropical cyclone warnings.

g. Confined space monitoring system

i. Implement a confined space monitoring system to monitor the locations on the Site which are defined as confined spaces under the Factories and Industrial Undertakings (Confined Spaces) Regulation (Cap. 59AE) and considered necessary to have this confined space monitoring system by the risk assessment. The Confined Space Monitoring System shall fulfil the following functions:

- Real-time site worker counting and location tracking inside confined spaces;
- Confined space environment monitoring including oxygen level, temperature, PM2.5 level, carbon monoxide, carbon dioxide, hydrogen sulphide and methane level, combustible gas;
- Real-time alert if any monitoring parameter exceeds the pre-determined safety levels as mentioned in the Code of Practice on Safety and Health at Work in Confined Spaces issued by Labour Department or any anomaly of workers' conditions is detected.

ii. All sensors and related warning signals / alerts shall be managed by the CMP;

iii. The warning alerts / signals and response times collected by the confined space monitoring system shall be automatically transferred to the CMP for viewing. All warning alerts / signals shall be encrypted. The display format at the CMP shall be accepted by the CM.

h. Digitalised permit-to-work system

Implement a digitalised permit-to-work system to facilitate online real-time application, issuance and tracking of permit-to-work / permit to move and operate. The Site Agent, General Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor can access the system using a mobile device to display real-time information on the corresponding permit-to-work / permit to move and operate status. The mobile device shall also display an alert message if the corresponding permit-to-work / permit to move and operate has expired and automatically generate an alert message to the Site Agent, General Foreman, Safety Officer, Safety Supervisor, Competent Person for confined space and lifting supervisor by means of SMS or in-app pop-up notification and record at a CMP for follow up actions. The alert message shall include details of the permit-to-work / permit to move and operate, date and time of alert message. The activities to be covered under the digitalised permit-to-work system shall at least cover the high risk activities specified in PRE.C9.205 sub-clause (2)(g)(iv);

i. Virtual reality (VR) for safety training

i. Adopt virtual reality for safety training to simulate the site environment and operation;

ii. Provide VR safety training to workers as a part of the tool box talks. The VR training shall be attended by workers who are working on the Site and engaged in activities relevant to the topic of that training. The topics and contents of VR training shall be proposed by the Safety Officer having regard to the activities of the Site and the prevailing safety concern at that time. In providing the VR safety training, first priority should be given to the topics related to lifting operation, working at height, use of suspended working platform, erection / alteration / dismantling of bamboo scaffolds and / or truss-out bamboo scaffolds, electrical supply system, heavy machinery operation and working in confined spaces. The VR training kits can be those prepared by the Development Bureau, CIC, HKCA or equivalent.

PRE.C9.295.9 TEMPORARY STAIRCASES

When permanent staircases are unavailable and the level difference is not less than 600mm, provide a secure temporary staircase or other safe means of access. The temporary staircase provided shall have top railings at a height of 900 mm to 1100 mm and middle railings at a height of 450 mm to 500 mm. The riser and the tread shall not be more than 175mm and less than 250mm respectively whereas the sum of two times the riser plus the tread shall not be less than 600mm.

PRE.C9.298.9 LOCKOUT AND TAGOUT PROCEDURES FOR ELECTRICAL WORKS

1. Implement "lockout and tagout" procedures on Site when conducting electrical works to keep workers safe from electrical hazard;
2. Isolate and lock out any electrical system and / or equipment from its power source with an assigned lock by a designated individual using a unique key;
3. Each designated individual must place his individual lock and tag on the power source. Use a multi-pad lock if more than one designated individual is required to work on the same equipment/same outgoing circuit on Site;
4. Verify the power supply of the electrical system and / or equipment has been disconnected by using a voltage indicator;

5. Fasten a tag securely at the isolator with a clear and easy to understand prominent warning notice;
6. The name of each designated registered electrical worker shall appear on the tag which shall be signed with date and time;
7. Implement permit-to-work system according to the requirements stipulated in CoP for the Electricity (Wiring) Regulations issued by EMSD.

HEALTH

PRE.C9.300.9 PROVISION OF AUTOMATED EXTERNAL DEFIBRILLATOR (AED)

1. Provide an automated external defibrillator (AED) for resuscitation at the site office with trained personnel to operate the machine.
2. The AED shall provide the following functions:
   a. Fully automatic or semi-automatic operation to provide basic life support;
   b. Provided with non-polarised and self-adhesive defibrillation pads;
   c. Providing Cantonese voice prompts as well as traditional Chinese display to guide the operator on the use of AED and Cardio Pulmonary Resuscitation;
   d. Meeting AAMI DF80 and American Heart Association recommendations;
   e. Battery level indicator;
   f. Recording the rescue event data and patient analysis decisions;
   g. Complying with the relevant safety and health standard set by the Electrical and Mechanical Services Department and Department of Health.
3. The operator of the AED shall have attained the training course or revalidation training on use of AED organised by the Occupational Safety & Health Council or the Hong Kong St. John Ambulance or equivalent training provided by other organisations subject to verification that the equivalent training is based on course contents of equivalent or higher standard.

PRE.C9.305.X DELETED

FIRE PRECAUTIONS

PRE.C9.310.9 FIRE REGULATIONS

Comply with all regulations to prevent loss or damage from fire with particular regard to the following clauses in this sub-section.

PRE.C9.320.9 STREET FIRE HYDRANTS

Ensure that any existing street fire hydrants are not obstructed by hoardings etc.

PRE.C9.330.9 DANGEROUS GOODS STORE

1. Comply with all relevant regulations to prevent the occurrence of fire or damage from fire;
2. Post notices in Chinese and English characters.

PRE.C9.340.9 PORTABLE FIRE FIGHTING APPLIANCES

Provide and properly maintain a sufficient number of portable fire fighting appliances.

PRE.C9.350.9 PROHIBITING SMOKING ON SITE

1. Prohibit smoking on Site except in the designated smoking areas;
2. Provide the designated smoking areas with suitable fire-fighting appliances and clean the designated smoking areas daily;
3. Do not designate the following areas as a designated smoking area on Site:
    a. Any area where there is a risk of fire due to the use, intended use or storage of flammable liquid, mixture containing flammable liquid or substances/materials;
    b. Any area where naked lights are prohibited.

PRE.C9.360.N SCREEN FOR WELDING AND FLAME CUTTING

1. Provide and erect fire retardant screen to prevent spread of sparks generated from the welding or flame cutting operation onto other areas;
2. Provide fire-fighting appliances in connection with carrying out welding or flame cutting operation.

GENERAL NUISANCE

PRE.C9.410.9 AVOIDANCE OF NUISANCE

1. Carry out the Works in such a manner as to cause the minimum inconvenience and annoyance to adjoining residents and the general public;
2. Undertake environmental protection measures to reduce the environmental impacts arising from the execution of the Works. Arrange the method of working to minimise the effects on the air, noise, water quality as well as nuisance of waste within and outside the Site, on transport routes and at the loading, dredging and dumping areas;
3. Be responsible for any claims which may arise from such inconvenience.

PRE.C9.420.9 COMPLIANCE WITH REGULATIONS

1. Observe and comply with relevant environmental protection and pollution control ordinances which shall include but not be limited to the following:
    a. Air Pollution Control Ordinance (Cap 311);
    b. Waste Disposal Ordinance (Cap 354);
    c. Water Pollution Control Ordinance (Cap 358);
    d. Noise Control Ordinance (Cap 400);
    e. Dumping at Sea Ordinance (Cap 446);
    f. Environmental Impact Assessment Ordinance (Cap 499);
    g. Factories and Industrial Undertakings Ordinance (Cap 59);
    h. Buildings Ordinance (Cap 123);
    i. Buildings Ordinance (Application to New Territories) Ordinance (Cap 121);
    j. Public Health and Municipal Services Ordinance (Cap 132);
    k. Public Cleansing and Prevention of Nuisances (Regional Council) By-Laws (Cap 132);

l. Public Cleansing and Prevention of Nuisances (Urban Council) By-Laws (Cap 132);

m. Summary Offences Ordinance (Cap 228);

n. Merchant Shipping (Oil Pollution) (Hong Kong) Order 1975;

o. Waste Disposal (Chemical Waste) (General) Regulation;

p. Air Pollution Control (Open Burning) Regulation;

q. Air Pollution Control (Construction Dust) Regulation;

r. Air Pollution Control (Furnaces Ovens and Chimneys) Installation and Alteration Regulation;

s. Air Pollution Control (Smoke) Regulation;

t. Air Pollution Control (Volatile Organic Compounds) Regulation.

2. Design, construct, operate and maintain pollution control measures to ensure compliance with the contract provisions as well as the environmental ordinances and their regulations. Conduct compliance monitoring following a programme as agreed with the CM, and submit the monitoring results to the CM;

3. Make due allowance in the rates and in the programme for the carrying out of the Works in compliance with the environmental protection control requirements under the Contract.

PRE.C9.430.A BONFIRE RESTRICTIONS

Do not light bonfires on Site for the burning of debris, or of any other matter, arising out of the execution of the Works, or from any other source.

PRE.C9.440.9 AIR POLLUTION REGULATIONS

1. Observe and comply with the Air Pollution Control Ordinance and its subsidiary regulations, particularly the Air Pollution Control (Open Burning) Regulation, Air Pollution Control (Construction Dust) Regulation, Air Pollution Control (Smoke) Regulation and Air Pollution Control (Volatile Organic Compounds) Regulation;

2. For materials under the control of the Air Pollution Control (Volatile Organic Compounds) Regulation, submit written confirmation of the following from suppliers or manufacturers:

   a. The types of regulated coatings/paints and their VOC content;

   b. The VOC contents of the coatings/paints complied with the Air Pollution Control (Volatile Organic Compounds) Regulation.

PRE.C9.450.9 POLLUTION BY VEHICLES

1. Construction vehicles must be well maintained so that they will not generate excessive exhaust fumes or noise;

2. Drivers shall be instructed to drive slowly so as to keep traffic noise to a minimum;

3. Upon the Instruction of the CM, cease to employ any vehicles or drivers that are considered not meeting the above requirements.

PRE.C9.460.A WATER POLLUTION

1. Observe and comply with the Water Pollution Control Ordinance (WPCO) and the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters and any additions or amendments thereto during the continuance of the Works;

2. Obtain a WPCO Licence from Environmental Protection Department (EPD) before discharging any waste water from the Site and comply with all terms and conditions stipulated in the Licence including the installation of a continuous flow measuring device as stipulated therein. Submit a copy of valid WPCO Licence to the CM for record as soon as it has been issued by EPD. Prepare and submit monthly record for the daily flow rate of the waste water discharged from Site (reference proforma at PRE.C9.APPEND5) to the CM for inspection;

3. Carry out the Works in such a manner as to minimise adverse impacts on the water quality during execution of the Works. In particular, arrange the method of working to minimise the effects on the water quality within and outside the Site, on the transport routes and at the loading, dredging and dumping areas. Observe strictly the water pollution and monitoring requirements during reclamation and seawall construction as specified in the Contract;

4. Follow the practices, and be responsible for the design, construction, operation and maintenance of all the mitigation measures as specified in the Professional Persons Environmental Consultative Committee Practice Note (ProPECC PN) 2/24 "Construction Site Drainage" issued by the Director of Environmental Protection, or any additions or amendments thereto during continuance of the Works. Submit the design of the mitigation measures to the CM for approval.

DISPOSAL OF CONSTRUCTION AND DEMOLITION (C&D) MATERIALS

PRE.C9.470.A DISPOSAL OF INERT C&D MATERIALS

1. Subject to sub-clause (1) above on alternative disposal ground, the public fill reception facility as designated by CEDD is ..... and the corresponding acceptance criteria are as follows:

   a. ……;

   b. ……

2. Allow for adoption of other public fill reception facilities that may be subsequently designated by CEDD due to reasons such as closure of the designated public fill reception facility by CEDD. Bear all additional time and cost incurred due to switching to the alternative designated disposal facility;

3. Implement a Trip Ticket system (TTS) as specified in PRE.C9.490;

4. Unless separate Approval is obtained, disposal of inert C&D materials from the Site shall not commence before the Environmental Management Plan required in PRE.C9.2420 is endorsed by the CM;

5. If no public fill reception facility is available, as confirmed by the PFC, submit a disposal plan for inert C&D materials for the CM's agreement. The disposal plan shall include information as specified in sub-clauses (1)(a) to (1)(f) of PRE.C9.500.

PRE.C9.480.A DISPOSAL OF NON-INERT C&D MATERIALS

1. Non-inert C&D materials refer to the portion of the C&D materials other than the inert portion. In order to make use of non-inert C&D materials generated by the Site, make best endeavours to identify recycling facilities or other construction sites as alternative disposal grounds where such materials can be used. Obtain Approval for such a site which has been identified as an alternative disposal ground in accordance with PRE.C9.500. If there is no such a site as an alternative disposal ground, dispose of non-inert C&D materials as specified in sub-clauses (2) and (4) below;

2. Subject to sub-clause (1) above on alternative disposal ground, dispose of non-inert C&D materials at the landfill or outlying islands transfer facility as designated by PEPO(FM) of EPD and to comply with their acceptance criteria;

3. Subject to sub-clause (1) above on alternative disposal ground, the landfill or outlying islands transfer facility as designated by EPD is ..... and the corresponding acceptance criteria are as follows:

   a. …….;

   b. ……..

4. Allow for adoption of other landfills or outlying islands transfer facilities that may be subsequently designated by EPD due to reasons such as closure of the designated landfill or outlying islands transfer facility by EPD. Bear all additional time and cost incurred due to switching to the alternative designated disposal facility;

5. Implement a Trip Ticket System (TTS) as specified in PRE.C9.490;

6. Unless separate Approval is obtained, disposal of non-inert C&D materials from the Site shall not commence before the Environmental Management Plan required in PRE.C9.2420 is approved by the CM;

7. If no landfill or outlying islands transfer facility is available, as confirmed by EPD, submit a disposal plan for non-inert C&D materials for the CM's agreement. The disposal plan shall include information as specified in sub-clauses (1)(a) to (1)(f) of PRE.C9.500.

PRE.C9.490.9 TRIP TICKET SYSTEM FOR DISPOSAL OF C&D MATERIALS AT PUBLIC FILL RECEPTION FACILITIES/LANDFILLS/OUTLYING ISLANDS TRANSFER FACILITIES

1. Provide the account number of the billing account for disposal of construction waste under the Waste Disposal (Designated Waste Disposal Facility) Regulation (Cap. 354L) for overall monitoring of the Trip Ticket System;

2. Maintain a daily record of disposal of C&D materials from the Site including CHIT numbers, vehicle registration numbers, approximate volume, C&D materials type, designated disposal ground, departure time from the Site, actual disposal ground and arrival time at disposal ground, using the Daily Record Summary (DRS) at Appendix PRE.C9/II;

3. Submit the duly completed Part 1 of the DRS in duplicate before departure of the dump truck;

4. When leaving the Site, each and every vehicle transporting C&D materials including both the inert and non-inert portion, must bear a CHIT. The CHIT shall be duly completed;

5. Carry the CHIT on board the vehicle at all times throughout the vehicular trip to the designated disposal ground as stipulated in the CHIT;

6. For each vehicular trip after disposal of C&D materials, obtain a Transaction Record Slip and a stamped return of the CHIT from the operator of the designated disposal facility;

7. Check the information recorded in the DRS against available information including the Contractor's own records and data from EPD's web-site, then complete Part 2 of the DRS form and submit it to the CM within 1 working day after the records are posted at the EPD's web-site;

8. Where an irregularity is observed or where requested by the CM under special circumstances (e.g. a CHIT has been issued but there is no disposal record at the disposal ground), submit to the CM within 5 working days after the recorded date of disposal the supporting evidence such as duly stamped CHIT and/or the Transaction Record Slip (where relevant) to confirm proper completion of the delivery trip(s) in question, or within 2 working days after the CM has requested for such evidence, whichever is later;
9. All C&D materials shall become the property of the Contractor when they are removed from the Site.

PRE.C9.493.A TRIP TICKET SYSTEM FOR DISPOSAL OF C&D MATERIALS AT DISPOSAL FACILITIES OTHER THAN PUBLIC FILL RECEPTION FACILITIES/LANDFILLS/OUTLYING ISLANDS TRANSFER FACILITIES

1. Maintain a daily record of disposal of C&D materials from the Site including Disposal Delivery Form (DDF) numbers, vehicle registration numbers, approximate volume, C&D materials type, Approved alternative disposal ground, departure time from the Site, actual disposal ground and arrival time at disposal ground, using the Daily Record Summary (DRS) at Appendix PRE.C9/II;
2. Submit the duly completed Part 1 of the DRS in duplicate before departure of the dump truck;
3. When leaving the Site, each and every vehicle transporting C&D materials including both the inert and non-inert portion, must bear a DDF. A sample of the DDF is at Appendix PRE.C9/IV. The DDF shall be duly completed and authorized by the CM or his representatives;
4. Carry the DDF on board the vehicle at all times throughout the vehicular trip to the Approved alternative disposal ground as stipulated in the DDF;
5. For each vehicular trip after disposal of C&D materials, ensure that the DDF is signed off by a competent person as agreed by the CM at the Approved alternative disposal ground to confirm completion of each trip. Keep a copy of the DDF for inspection by the CM upon request. Complete Part 2 of the DRS form and submit it to the CM within 3 working days after the date of disposal;
6. Where an irregularity is observed or where requested by the CM under special circumstances (e.g. a DDF has been issued but there is no disposal record at the Approved alternative disposal ground), submit to the CM within 5 working days after the recorded date of disposal the supporting evidence such as the signed off DDF to confirm proper completion of the delivery trip(s) in question, or within 2 working days after the CM has requested for such evidence, whichever is later;
7. All C&D materials shall become the property of the Contractor when they are removed from the Site.

PRE.C9.495.9 SITE VIDEO RECORDING SYSTEM

1. Provide, operate and maintain, including all necessary cables, wirings, lightings and other accessories, a video recording system, at each vehicular exit with gate(s), with the following essential features to record all trucks leaving the Site:
    a. The video cameras used in the system shall be suitable for external use, protected from adverse weather and of high resolution, lowlight and colour type;
    b. Power backup shall be provided to cater for accidental breakdown of the power supply to the system;
    c. Videos captured by the system shall be recorded continuously without break unless agreed by the CM;

d. Videos shall be captured in a format acceptable to CM;

e. Registration number of each dump truck leaving the Site shall be captured by the system;

f. Loading conditions of dump trucks including empty trucks shall be captured by the system prior to opening of the gate.

2. Securely protect the video cameras from being damaged or blocked;

3. Design and construct all necessary temporary works, including any supporting frames and protections, for mounting the video cameras and their accessories;

4. Provide the software and hardware for capturing the vehicle registration number, the time and date, and the loading condition of each dump truck including empty truck leaving the Site, and for the CM's immediate viewing and taking of photograph of the trucks, and for viewing the recorded videos and photographs. Keep the videos record for at least 60 days and the photographs until such time as agreed by the CM;

5. Post sufficient notices at conspicuous positions to notify the workers, drivers and staff about the purpose of the video recording system (i.e. all collected personal information/data will be used by the CM to monitor the loading conditions of trucks with C&D materials leaving the Site only and will not be released/issued to irrelevant persons/parties without the permission of the persons/parties being monitored) in accordance with data protection principles set out in the Personal Data (Privacy) Ordinance.

PRE.C9.498.9 MECHANICAL COVER SYSTEM FOR DUMP TRUCK FOR TRANSPORTING CONSTRUCTION AND DEMOLITION (C&D) MATERIALS

1. Use dump truck with mechanical cover system satisfying the requirements specified in either sub-clauses (7) to (10) below;

2. Ensure all dump trucks, which are goods vehicles fitted with a dump bed and of gross vehicle weight equal to or over 16 tonnes for transportation of C&D materials, are installed with a mechanical cover system, which is in good service condition to cover the dump bed;

3. Dump truck may not be allowed to enter the Site if sub-clauses (2) and (7) to (10) of this clause have not been complied with;

4. Clean all dust or debris on top of the mechanical cover so as not to obstruct its operation;

5. Loaded dump truck may be required to unload its contents on Site before leaving the Site if the dump bed and the cover of the dump truck do not comply with the requirements specified in sub-clauses (2), (4) and (7) to (10) of this clause after loading;

6. The Approval of the CM for a loaded dump truck leaving the Site shall not relieve the Contractor's obligation to comply with the relevant legislation. The Employer shall not be liable for any loss or damage sustained by the Contractor arising from or in connection with any offence committed by the Contractor or the dump truck drivers or dump truck owners in relation to the transportation of the C&D materials from the Site;

7. The mechanical cover system of a dump truck shall comply with the following requirements:

a. The cover shall be made of durable material and constructed with suitable components;

b. The mechanical cover system shall be effective in preventing dust emission from the dump bed of the truck;

c. The system shall be able to withstand strong winds under normal circumstances;

d. The system shall be power-operated inside the driving cabin and backup with manual operation outside;

e. When the dump bed is covered by the mechanical cover, any gap between the cover and the dump bed shall not exceed 25 mm wide and shall be sealed up tightly with suitable materials as far as practicable;

f. The mechanical cover system shall be installed with the following control devices to ensure its safe operation:

i. The mechanical cover shall be operated only when the dump truck has been stopped and the hand brake is engaged;

ii. A warning system consisting of flashing amber lights and audible alarm shall be activated automatically when the mechanical cover is being operated inside the driving cabin;

iii. The warning system shall be visible and audible from both inside (by an indicator light associated with alarm system or the like) and outside of the driving cabin;

iv. An locking system shall be provided to prevent accidental opening of the mechanical cover, if applicable;

v. The associated electrical equipment shall comply with the commonly adopted safety standard.

8. The gross vehicle weight and maximum dimensions of the dump truck after installation of a mechanical cover system shall comply with the relevant legislation and such dump truck shall pass the annual inspection and examination by the Transport Department. Submit supporting evidence to the CM to prove that such annual inspection and examination has passed;

9. Unless otherwise Approved by the CM, the mechanical cover system of a dump truck shall be certified by a Registered Professional Engineer in the Mechanical Engineering Discipline under the Engineers Registration Ordinance that the system complies with the requirements as specified in sub-clauses (2), (7) and (8) above. The certification must include a certified true photograph of the mechanical cover in a closed configuration;

10. Dump trucks installed with a mechanical cover system and have been registered under the "Pay for Safety Scheme" or "Pay for Safety and Environment Scheme" of the CEDD are deemed to comply with the requirement of sub-clause (9) above;

11. Vehicles other than 'dump trucks' carrying dusty materials from the Site may use means other than mechanical covers to cover the dusty materials, provided that the requirements stipulated in sub-clause (3) of PRE.C9.720 are complied with.

PRE.C9.500.A ALTERNATIVE DISPOSAL GROUNDS

1. Make best endeavours to identify recycling facilities or construction sites other than the designated public fill reception facilities/landfills/outlying islands transfer facilities, or other public fill reception facilities/landfills/outlying islands transfer facilities as may be required by CEDD/EPD, which can be used as an alternative disposal ground. Obtain Approval for adoption of such a site as an alternative disposal ground. In support of the request for such Approval, submit a disposal plan for the CM's agreement. The disposal plan shall include:

a. A detailed description of the alternative disposal ground, including location, lot number (where appropriate), location plan and photographs of the proposed alternative disposal ground showing the surrounding environment and land use;

b. Where the alternative disposal ground is a private construction site, a letter from each of the relevant authorities, such as Agriculture, Fisheries and Conservation Department, Lands Department and Planning Department, providing comment on suitability of the site under their respective purview, and a letter from the Authorized Person (as defined under the Buildings Ordinance) of the private construction site to confirm that:

i. The C&D materials for use in the development are acceptable;

ii. The land/pond filling in the proposed alternative disposal ground and the use of land so formed by the C&D materials is in conformity with the statutory Outline Zoning Plan and lease conditions;

iii. The CM or his representatives are allowed to enter the alternative disposal ground to conduct inspections where necessary.

c. Where the alternative disposal ground is a private recycling facility, it shall be on the recyclers' list for C&D materials recognized by EPD, as well as a letter from the recycling facility operator to confirm that the CM's staff are allowed to enter the recycling facility to conduct inspections where necessary;

d. Where the alternative disposal ground is a construction site of Government (other than a government contract quarry) including those of Housing Authority, or MTRCL, a written consent from the contract/project manager of the alternative disposal ground to use the C&D materials generated from the Site;

e. Where the alternative disposal ground is a government contract quarry, a written consent from the Mines Division of CEDD to import the C&D materials generated from the Site;

f. The estimated quantity and type of C&D materials to be used/processed in the alternative disposal ground and the approximate delivery programme, together with the name, post and specimen signature of the competent person to sign the Disposal Delivery Form (DDF).

2. Dispose of C&D materials at Approved alternative disposal ground. Disposal of C&D materials at private land or a private construction site which is not administered by an Authorized Person (as defined under the Buildings Ordinance) is prohibited;

3. Bear all additional time and cost incurred due to the Approval or disapproval by the CM on the Contractor's request for alternative disposal ground.

PRE.C9.510.A REMOVAL OF C&D MATERIALS FROM UNAUTHORIZED DISPOSAL GROUND

1. Where C&D materials from the Site have been dumped at a place other than that designated under the Contract or as Approved, undertake the following remedial action and bear all associated time and cost:

a. Remove the dumped C&D materials from the unauthorised disposal ground to a disposal ground designated under the Contract or as Approved;

b. Reinstate the unauthorized disposal ground to the condition as before dumping of the C&D materials or a condition considered satisfactory by the relevant Government authorities as required under the relevant legislation where appropriate.

2. Where the unauthorised disposal ground is private property, obtain the landowner's consent before removal of the dumped C&D materials.

PREVENTION OF MOSQUITO BREEDING

PRE.C9.610.9 DISPLAY OF POSTERS

Provide and display prominently upon all structures or temporary huts on the Site throughout the construction period and remove on completion, posters, in both English and Chinese, drawing attention to the dangers of allowing the breeding of mosquitoes. These posters may be obtained free of charge from the Food and Environmental Hygiene Department, Health Education Exhibition and Resource Centre of the Government of the Hong Kong Special Administrative Region.

PRE.C9.620.9 REMOVAL AND TREATMENT OF STANDING WATER

Prevent or remove standing water from disused tyres, uneven floors, pits or any other water receptacle location. Dispose of the water through a petrol interceptor and not directly into the stormwater drainage system. Where removal of water is not possible, treat any standing water on the Site with an Approved oil at least once per week.

PRE.C9.630.9 TREATMENT OF WATER RECEPTACLES

Store, cover or treat all items on the Site, including Constructional Plant, capable of retaining water to prevent the collection of water in them.

PRE.C9.640.9 DISPOSAL OF WATER RECEPTACLES

Provide throughout the construction period, an Approved central collection point on the Site for depositing of all empty cans, oil drums, packings and other receptacles capable of holding water and for the regular collection and removal of such articles from the Site.

PRE.C9.650.A PESTICIDES AND LARVICIDES

Only pesticides and larvicides that have been registered in Hong Kong shall be used. To protect environmental and human impacts, pesticides and larvicides must be used in accordance with the manufacturers' instructions. For enquiries on the procurement and use of pesticides, contact the Agricultural, Fisheries and Conservation Department.

CONTROL OF DUST AND DEBRIS

PRE.C9.710.A DUST CONTROL GENERALLY

1. Undertake at all times to prevent dust nuisance and smoke as a result of activities on the Site;
2. In the process of material handling, any material which has the potential to create dust shall be treated with water or wetting agent sprays. Obtain prior approval of the Director of Water Supplies for any proposal to use a dust suppression chemical in the immediate vicinity of water storage or gathering grounds of the Water Supplies Department;
3. Frequently clean and water the Site to minimize the fugitive dust emissions. Ensure that there will be adequate water supply/storage for dust suppressions. If dust extraction and filtering device is used for dust control, clear the dust collector when it is full;
4. Devise, arrange methods of working and carrying out the works in such a manner so as to minimize dust impacts on the surrounding environment, and provide experienced personnel with suitable training to ensure that these methods are implemented;

5. Before the commencement of any work, the CM may require the methods of working, plant, equipment and air pollution control system to be used on the Site to be made available for inspection and approval to ensure that they are suitable for the Contract;
6. Portable electric dust control equipment used on Site shall be cordless to improve the working environment and reduce risk of accidents.

PRE.C9.720.9 VEHICLE PREPARATIONS

1. Restrict all motorised vehicles to a maximum speed of 8 km per hour and confine haulage and delivered vehicle to designed roadways inside the Site. These roadways shall be paved with concrete, bituminous materials or hardcores to the satisfaction of the CM;
2. All trucks for delivery of concrete are to be effectively washed down after loading and prior to leaving the Site. Concrete waste material must not enter any drains. Water recycling should be practised as far as practicable to minimize water use;
3. Without prejudice to the generality of GCC Clause 5.23, any vehicle with an open load compartment used for transferring dusty materials off Site shall have properly fitted side boards and tailboards. Dusty materials shall not be loaded to a level higher than the side boards and tailboards, and shall be covered by a suitable tarpaulin (or any other impervious covering material as Approved by the Contract Manager) in good condition before the vehicle leaves the Site. The tarpaulin or Approved covering material shall be properly secured and extended at least 300 mm over the edges of the side boards and tailboards and properly secured and maintained throughout the journey to the off-loading destination;
4. For the purpose of sub-clauses (3) and (4), "dusty materials" include cement, earth, pulverized fuel ash, aggregates, silt, stone fines, sand, debris, saw dust and wooden chips, etc.;
5. Loads of filling material shall be dampened with water and properly covered with tarpaulins or Approved covering material;
6. Dump trucks for transporting C&D materials shall be installed with a mechanical cover system as specified in clause PRE.C9.498;
7. Employ sufficient labourers to clear the roads and footways along the public roads regularly of any debris deposited by vehicles leaving the Site. Do not flush or hose down the deposited soil or debris into the public road drains;
8. When wheel washing bay is provided at the site exit, the sand and silt in the wash water shall be settled out before discharging into the site drainage system. The section of the site road between the wheel washing bay and the public road should be paved with concrete, bituminous materials or hardcores to the satisfaction of the CM to reduce tracking of soil and prevent surface run-off from entering the public road drains;
9. No vehicle or engine driven movable equipment shall have its exhaust directed towards the ground.

PRE.C9.730.9 STOCKPILING

1. Materials handling and storage areas shall be levelled, well-drained and maintained hard-standing ground to facilitate cleansing and minimize dust generation. In addition, water sprays shall be provided and used both to dampen stored materials and when receiving raw material;
2. Stockpiles of materials which have the potential to create dust shall be either:
   a. Enclosed on three sides, with walls extending above the pile and 2 m beyond the front of the pile;

b. Covered entirely by impervious sheeting; or

c. Sprayed with water or a dust suppression chemical so as to maintain the entire surface wet.

PRE.C9.740.9 AIR SAMPLERS

1. Monitor the ambient dust concentration level by sampling at specified locations and frequency to the satisfaction of the CM. Provide and operate to the satisfaction of the CM sufficient numbers of high volume air samplers, PM10 air samplers and associated equipment and shelters in accordance with the USA standard Title 40, Code of Federal Regulations, Chapter 1 (Part 50) Appendix K (for TSP) and Appendix J (for RSP);
2. Carried out sampling 1 day in every 6 days at 6 sampling points within and along the site boundary for such periods and in a manner as Instructed by the CM;
3. The samplers, equipment and shelters shall be constructed so as to be transferable between sampling points to enable monitoring of "dust in air" levels at any sampling point required by the CM;
4. Provide all necessary protection fences and the like at sampling points;
5. Testing and analysis of sampled materials shall be carried out by an Approved laboratory.

PRE.C9.750.9 DUST SUPPRESSION EQUIPMENT

The Contractor shall, at his own cost and to the satisfaction of the CM, install effective dust suppression equipment and take such measures as may be necessary to ensure that the concentration of air-borne dust at any location within the Site shall not exceed 5 milligrams per cubic metre, at standard temperature (25°C) and pressure (1.0 bar) at any time and that at the Site boundary and any nearby residential area the concentration of air-borne dust shall not exceed 0.5 milligrams per cubic metre, at standard temperature (25°C) and pressure (1.0 bar) averaged over one hour, or 0.15 milligrams per cubic metre, at standard temperature (25 ° C) and pressure (1.0 bar) averaged over 24 hours.

PRE.C9.760.9 RESTRICTION ON CONCRETE BATCHING AND ROCK CRUSHING PLANTS ON SITE

The operations of concrete batching and rock crushing plants within the Site are not allowed.

CONTROL OF NOISE

PRE.C9.810.9 GENERAL CARE

Carry out the Works in such a manner as to minimize noise impacts on the surrounding environment during execution of the Works.

PRE.C9.820.9 NOISE CONTROL REGULATIONS

Comply with and observe the Noise Control Ordinance and its subsidiary regulations in force in Hong Kong.

PRE.C9.830.9 CONSTRUCTION NOISE PERMIT

When necessary, apply as soon as possible for a Construction Noise Permit under the Noise Control Ordinance, display the permit as required and copy to the CM. Ensure compliance with any term or condition in the Construction Noise Permit. The Contractor is to note that neither the Employer nor its employees can influence the issue or terms or conditions of a Construction Noise Permit.

PRE.C9.840.9 SOUND LEVEL METER

Provide an Approved integrating sound level meter to IEC 651:1979 (Type 1) and 804:1985 (Type 1) with calibrator and printer (including consumables), for the exclusive use of the CM at all times. Maintain also the meter, calibrator and printer in proper working order and provide a substitute when they are out of order or otherwise not available.

PRE.C9.850.A ADDITIONAL REQUIREMENTS

In addition to the requirements imposed by the Noise Control Ordinance, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday (including Sundays), the following requirements shall also be complied with:

1. The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction works alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 75 dB(A);
2. The noise level measured at 1 m from the most affected external facade of the nearby schools from the construction works alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 70 dB(A) [65 dB(A) during school examination periods]. Liaise with the schools and/or the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the Contract;
3. Should the limits stated in the above sub-clauses (1) and (2) be exceeded, stop the construction operation(s) causing the excesses and do not recommence until appropriate measures acceptable to the CM that are necessary for compliance have been taken;
4. Measures that are to be taken to protect adjacent schools and other adjacent noise sensitive receivers, if necessary, shall include, but not be limited to, adequate noise barriers. The barriers shall be of substantial construction and designed to reduce transmission of noise (simple plywood hoarding will not be sufficient). The barriers shall be surmounted with baffle boxes designed to reduce transmission of noise. The barriers shall be designed to BS 5228:Part 1:1984. The location and details of the barriers shall be submitted to the CM for approval before works commence adjacent to schools and other noise sensitive receivers;
5. Adopt, where necessary, the use of quiet construction equipment (QCE) and/or shall employ the quietest practicable working methods when carrying out demolition works, and/or road opening works during restricted hours;
6. The Contractor shall bear the associated cost and time implications arising from any stoppage or reduction in output resulting from compliance with this clause.

PRE.C9.855.N CONSTRUCTION NOISE MANAGEMENT PLAN (CNMP)

1. Submit Construction Noise Management Plan (CNMP) for the CM's agreement no later than one month after the date of the Letter of Acceptance. A CNMP shall contain but not limited to the following information:

a. Construction works programme and construction methodology;

b. Powered mechanical equipment (PME) list for the construction work;

c. Quantitative construction noise impact assessment;

d. List of noise mitigation measures to be adopted;

e. Evaluation of technical constraints, if any, that will hinder the use of quieter construction methods and equipment as recorded in the assessment in sub-clause (c), and possible measures or techniques to overcome the constraints;

f. Implementation schedule listing out the mitigation measures, the implementation party, location and timing of implementation.

2. Verify if there should be any change to the construction noise mitigation measures and / or plant inventory recommended in the CNMP / updated CNMP, subsequent to its agreement by the CM, during the progress of the Works. If there is to be such change, submit an updated CNMP to the CM, no later than one month before the implementation of any of such change, for his further agreement;

3. Implement fully all mitigation measures recommended or changed, and other requirements specified in the CNMP / updated CNMP upon CM's agreement;

4. Prepare the CNMP / updated CNMP by a Certified Noise Modelling Professional as recognized by the Hong Kong Institute of Qualified Environmental Professionals Limited or a Member of Hong Kong Institution of Engineers (Environmental Discipline) or equivalent;

5. Adopt the following general noise mitigation practices as far as possible unless there are genuine insurmountable technical constraints which hinder their use as identified under sub-clause (1)(e):

a. Use Quality Powered Mechanical Equipment (QPME) recognized by the Environmental Protection Department (EPD) as far as practicable. Details of QPME can be found at EPD's website (https://www.epd.gov.hk/epd/english/environmentinhk/noise/qpme/index.html). Where a QPME is used, the plant shall be registered with EPD, and a valid label issued by EPD from such registration shall be affixed on the plant at all times and kept legible. To facilitate monitoring and control, establish a register to record all QPME used on the Site;

b. Use of quieter construction methods as far as practicable listed at the EPD's website (https://www.epd.gov.hk/epd/misc/construction_noise/contents/index.php/en/home2/quieter-construction-methods.html).

6. Deploy on Site an Environmental Manager as stated in PRE.C9.1903 to oversee the implementation of the CNMP / updated CNMP.

PRE.C9.860.9 METHODS OF OPERATION

Devise and arrange methods of working to minimize noise impacts, and provide experienced personnel with suitable training to ensure that these methods are implemented.

PRE.C9.870.9 APPROVAL OF METHODS OF OPERATION

Before the commencement of any work, the CM may require the methods of working, equipment and sound-reducing measures intended to be used on the Site to be made available for inspection and Approval to ensure that they are suitable for the Contract.

PRE.C9.880.9 SOUND REDUCTION EQUIPMENT

Ensure that all plant and equipment to be used on the Site are properly maintained in good operating condition and noisy construction activities shall be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means, to avoid disturbance to any nearby noise sensitive receivers.

PRE.C9.890.9 APPROVED EXCEPTIONS

Notwithstanding the requirements and limitations set out in PRE.C9.850 above, and subject to the compliance with PRE.C9.810, PRE.C9.860 and PRE.C9.880, the CM may, upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any durations provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the Noise Control Ordinance in any respect.

PRE.C9.900.9 RESTRICTED USE OF EXCAVATOR MOUNTED BREAKERS

The use of excavator mounted breakers within 125 m from any nearby noise sensitive receivers shall be minimized.

PRE.C9.910.9 NOISE SENSITIVE RECEIVERS

For the purposes of the above clauses, any domestic premises, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing arts centre or office building shall be considered to be a noise sensitive receiver.

PRE.C9.920.9 RESTRICTED USE OF ROCK DRILLING EQUIPMENT

Rock drilling equipment shall be quiet drilling rigs with a sound power level not exceeding 100 dB(A). Conventional pneumatically driven drilling rigs are specifically prohibited.

PRE.C9.930.9 BLASTING RESTRICTIONS

1. Observe blasting restrictions due to the presence of the construction works or completed works by others in Sections .....;
2. Blasting shall not be carried out during 7 p.m. to 7 a.m. and any time on a general holiday, including Sunday, to avoid noise impact at sensitive hours.

PRE.C9.940.9 HAND-HELD BREAKERS AND PORTABLE AIR COMPRESSORS

Hand-held breakers and portable air compressors shall comply with Noise Control (Hand Held Percussion Breakers) Regulations and Noise Control (Air Compressors) Regulations and shall be fitted with Noise Emission Labels when operated.

PRE.C9.950.9 GENERATORS FOR SUPPLY OF TEMPORARY ELECTRICITY TO SITE

1. Provide generators which shall meet with all relevant requirements under the European Union or Japanese system and be certified by an approved body appointed by a member State of the European Union under the European Council Directive 2000/14/EC, or designated as Low Noise Emission Construction Equipment by the Ministry of Land, Infrastructure and Transport of Japan (MLIT), or equivalent or better standards, with the result that the generators are qualified with the Quality Powered Mechanical Equipment (QPME) label;

2. Affix the generators for site's temporary electricity supply with valid QPME labels to facilitate inspection by CM's representatives;
3. Provide hangers for hanging cables of the generators. Refer to drawing no. REF/SS/CH/SK-01 in Appendix U to this Specification for reference only.

PRE.C9.960.A HEALTH CARE PLAN

1. The health care plan is one of the sections of the Safety Plan as per PRE.C9.205, where specifies the time of its submission to the CM and the frequency of its updating;
2. The health care plan shall comprise the following:
   a. Health check programme for workers on Site on worker's volunteer basis;
   b. Medical Examination for workers as required under relevant legislations for specific trades of workers. Details of the requirements of the statutory medical examinations are given at Appendix I of the Guidance Notes on Medical Examinations for Workers engaged in Hazardous Occupations in Industrial Undertakings issued by LD;
   c. Recommended medical examinations for certain trades of construction workers given at Appendix II of the Guidance Notes mentioned at sub-clause (2)(b);
   d. Risk assessment and the preventive measures for working under inclement weather conditions as per PRE.C9.1110;
   e. Risk assessment and the caring measures for the prevention of heat stroke as per PRE.C9.1260;
   f. Risk assessment and the caring measures for working in cold weather as per PRE.C9.1270;
   g. Information to the workers on Site about the substances they work with and train them about the risks to their health and the proper way to use any control measures provided;
   h. Health promotion for the well-being of workers on Site;
   i. Provide a self-checking health station with an automatic arm-through blood pressure machine, and a body mass index (BMI) height and weight machine at the Site office to facilitate the body check by workers on their own. Put up a message near the station about the indication of ranges of blood pressure and BMI readings with reference to the information of the World Health Organisation or Department of Health, and healthy diet and life style to prevent cardio-cerebrovascular disease. Provide assistance to the workers to operate the machines as necessary. Maintain record of usage of health station by workers such as log book or photo record.
3. Execute the health care plan throughout the duration of the Contract.

PRE.C9.965.A REST AREAS FOR WORKERS

1. Provide sheltered rest area(s) close to the workplace for all workers employed on the Works or in connection with the Contract. The area(s) shall be furnished with drinking facilities, hand washing facilities, chairs, tables, lighting and power, and good mechanical ventilation. The rest area(s) shall be in adequate number taking into account the number workers and their locations on Site;
2. Maintain the rest area(s) in clean, tidy and functional condition for use of workers throughout the duration of the Contract.

CLEANLINESS

PRE.C9.1010.9 DISPOSAL OF RUBBISH

Further to the requirements of the Conditions of Contract remove all rubbish whether from domestic or other sources, debris, cement bags, disused formwork, etc. as they accumulate on the Site and at the end of each working day. Carry out a general tidying up at the end of each week. The area is to be clean by sweeping and flushing with water as necessary so that the Site is kept constantly clean and tidy during the progress of the Contract.

PRE.C9.1020.9 HEALTH AND SANITATION

Maintain the Site and all working areas in a sanitary condition and in all matters of health and sanitation shall comply with the requirements of Food and Environmental Hygiene Department or other Government bodies.

PRE.C9.1030.9 MAINTAINING CLEARANCE OF DRAINAGE CHANNELS

Ensure that existing drainage channels and drains in and adjacent to the Site do not as a result of the Works become partially or totally blocked by any material from any source.

PRE.C9.1040.9 MAINTAINING CLEARANCE OF RIGHTS OF WAY

1. Take every precaution to prevent earth, rock or debris from depositing on public or private rights of way as a result of site operations including any deposits arising from the movement of plant or vehicles. In the event of any earth, rock or debris from construction works being deposited on public or private rights of way, remove immediately all such earth, rock or debris and restore the affected rights of way to their original state to the satisfaction of the CM;
2. In the event of any spoil or debris from construction works being deposited on adjacent land or seabed or any silt washed down to any area, remove immediately all such spoil, debris or material and silt and restore the affected land or seabed and areas to their natural state to the satisfaction of the CM.

PRE.C9.1050.9 WHEEL CLEANING FACILITY

1. All points of egress from the Site onto public roads shall be equipped with a wheel cleaning facility with an automatic high pressure water jet and wheel-wash trough;
2. The facility shall be supervised by the Contractor's personnel at all times when in use, to ensure that no vehicles leaving the Site deposit earth, mud, debris, dust, and the like on the roads;
3. The water in the wheel cleaner shall be changed at frequent intervals, and sediments shall be removed regularly;
4. Submit proposals for Approval prior to construction of the facility;
5. The wheel washing facility shall be ready for use prior to the commencement of earthworks excavation activity on the Site;
6. Provide a hard-surfaced road between the wheel washing facility and the public road;
7. If, despite the above, any vehicle should be found to be depositing any form of dirt on the public road then at the discretion of the CM, the Contractor may not be permitted to use that vehicle on the Works.

PROTECTION

PRE.C9.1110.A PROTECTION FROM WEATHER

1. In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working under inclement weather conditions as recommended in the latest edition of the CoP in Times of Adverse Weather and "Extreme Conditions" issued by LD and the Guide on Safety at Work in Times of Inclement Weather jointly issued by LD and OSHC. Examine critically the practices and / or measures as recommended in the said CoP and Guide, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said CoP and Guide may be proposed for the CM's approval before implementation. The following highlights of the crucial practices and / or measures, albeit not exhaustive, are extracted from the said CoP and Guide:
    a. Conduct risk assessment on working under inclement weather conditions, identify and analyse the hazards;
    b. Establish practical safety measures and emergency plans with documented procedures on communication of weather information, warning system, traffic arrangement, work arrangement, use of appropriate personal protective equipment, evacuation route, safe shelters, first aid facilities and back up services etc.;
    c. Formulate training programme with regular drills for all emergency situations to all site personnel to become knowledgeable to all hazards, and all necessary precautions to take under inclement weather conditions;
    d. Resume work after the occurrence of inclement weather conditions only after a thorough examination and completion of all necessary repairs to ensure the safe working condition of lifting appliances, scaffolds, suspended working platforms, electrical installations and other plant.
2. Appoint an emergency standby team as per PRE.C9.1230 to monitor changes in weather conditions and take appropriate actions as per sub-clause (1);
3. Follow the advice and practical guidelines on work arrangements in times of typhoons and rainstorms as given at the said CoP, taking into account the applicability and suitability to the Works on account of actual site conditions and the specific safety hazards of the Works;
4. Protect carefully from injury by rain, heat or inclement weather all work which may be adversely affected thereby. In addition to the applicable clauses in these preliminaries the Contractor's attention is drawn to appropriate clauses in other Worksections of this Specification;
5. Take all precautionary measures to prevent nuisance, danger, damage or accident due to rain and wind (including the effects of erosion, silting, accumulation of sediment and / or debris, flooding, landslips, mudflows etc.). In particular such precautions shall include, but shall not be limited, to the following clauses in this Section.

PRE.C9.1120.9 WORK RESTRICTIONS

1. All works shall be carried out in the dry, unless otherwise authorised by the CM;
2. Work shall not be carried out in weather conditions which may adversely affect the work unless protection by methods agreed by the CM is provided. Permanent work, including materials for permanent work, shall be protected by methods agreed by the CM from exposure to weather conditions which may affect the work or materials.

PRE.C9.1130.9 MONITORING WEATHER FORECASTS

The Contractor shall monitor weather forecasts from the Hong Kong Observatory and shall ensure that he is aware of heavy rain warnings, thunderstorm warnings and the hoisting of typhoon signals; when such warnings are announced, precautions shall be taken and any necessary arrangements made.

PRE.C9.1140.9 MONITORING WATER LEVEL MEASURING DEVICES

Monitor water-level measuring devices, in accordance with the requirements of the CM.

PRE.C9.1150.9 WATER DISPERSAL

1. Arrange for the rapid dispersal of water which enters the Works from any source;
2. When practicable the water shall be discharged into the permanent drainage system, providing adequate means for trapping silt are provided before discharging into the permanent systems;
3. Excavated areas shall be kept well-drained and free from standing water;
4. Construct, operate and maintain all temporary dams, watercourses and other works of all kinds (including pumping, horizontal drains and well-point dewatering) that may be necessary to exclude water from the Works while construction is in progress. Such Temporary Works shall not be removed without the Approval of the CM;
5. Notwithstanding any Approval by the CM of the Contractor's arrangement for the exclusion of water, the Contractor shall be responsible for the sufficiency thereof and for keeping the Works safe at all times;
6. In this matter take account of PRE.C9.1520;
7. The Contractor is to accept and deal with overflow/wash out from the existing service reservoirs, storm water drainage, surface run-off, foul sewerage and any other liquid discharged from the construction works or completed works by others in Sections .....

PRE.C9.1160.A DISCHARGES GENERATED FROM SITE ACTIVITIES

1. Contain within the Site all surface runoff generated from foundation works, dust control and vehicle washing etc. Re-circulate and re-use as far as practicable the surface runoff for housekeeping operations such as dust-control and wheel-washing as detailed in PRE.C9.710 and PRE.C9.1050 respectively. Install waste-water recycling facilities to the satisfaction of the CM that meets the following:
    a. Waste-water shall be properly treated to meet discharge standards (other than that for foul sewers discharge) as stipulated in the WPCO Licence issued by EPD before re-use for dust-control and wheel-washing;
    b. Warning signs shall be displayed prominently upon all temporary storage tanks, drawing attention to the dangers of allowing breeding of mosquitoes;
    c. Proper and adequate drainage facilities shall be provided to discharge excess treated effluent.
2. Maintain the waste-water recycling facilities up to the end of the contract as far as practicable. Obtain the CM’s approval prior to removal of the waste-water recycling facilities;

3. Do not discharge directly or indirectly or cause or permit or suffer to be discharged into any public sewer, stormwater drain, channel, stream-course or sea any trade effluent or foul or contaminated water or cooling or hot water without the prior written consent of the CM in consultation with the Director of Environmental Protection and Director of Water Supplies, who may as a condition of granting his consent require the Contractor to provide, operate and maintain at the Contractor's own expense to the satisfaction of the CM suitable works for the treatment and disposal of such trade effluent or foul or contaminated or cooling or hot water. Submit the design of such treatment works to the CM for approval not less than one month before the commencement of the relevant works;
4. If any office, site canteen or toilet facilities is erected, foul water effluent shall be directed to a foul sewer or to a sewage treatment and disposal facility either directly or indirectly by means of pumping or other means approved by the CM.

PRE.C9.1170.A REUSE OF WATER FROM BORING AND DRILLING

Water used in ground boring and drilling for ground investigation or rock/soil anchoring shall as far as practicable be re-circulated after sedimentation. When there is a need for final disposal, the waste water shall be discharged into site drainage system via silt removal facilities.

PRE.C9.1180.9 REUSE AND DISPOSAL OF BENTONITE SLURRY

1. Bentonite slurry used in diaphragm wall and bored-pile construction shall be reused as far as practicable. If the disposal of a certain residual quantity cannot be avoided, the used slurry may be disposed of at designated marine dumping area subject to obtaining a marine dumping permit from EPD;
2. Disposal of used bentonite slurry into public drainage system, if intended, shall be treated to meet the discharge standards as stipulated in the WPCO Licence issued by EPD.

PRE.C9.1190.9 TEMPORARY DRAINAGE SYSTEMS

1. Where possible drainage systems shall be constructed from the lowest point upwards;
2. The permanent cut-off channels at the top of all slopes shall be constructed before the commencement of earthworks in accordance with the Drawings. The cut-off channels shall be connected into the existing watercourses which flow across the Site;
3. Design all temporary drainage in accordance with the requirements of PRE.C11.060;
4. Temporary sumps and traps shall be constructed to prevent sediment and/or debris from entering existing drains.

PRE.C9.1200.9 REMOVAL OF SEDIMENT/DEBRIS

1. In accordance with the requirements of GCC Clause 5.7 furnish, for the CM's information, particulars of the arrangements for ensuring that materials from the earthworks do not wash into the drainage system;
2. Any sediment and/or debris that accumulates in any catchpit, manhole, sump, trap, drain, drainage channel or watercourse whether temporary, existing or newly constructed, within the Site, shall be removed on at least a monthly basis, or as directed by the CM;
3. Notwithstanding the above requirements, any sediment and/or debris, that accumulates in such a way that it could, in the opinion of the CM, cause nuisance, danger, damage or accident, shall be removed immediately to the satisfaction of the CM;

4. Also, notwithstanding the above requirements, any water, sediment and/or debris, that accumulates in any property, structure, installation and service within or in the vicinity of the Site as a result of the Works shall be removed immediately to the satisfaction of the CM.

PRE.C9.1210.9 METHOD OF WORKING

1. A method of working shall be adopted to minimize erosion;
2. Excavations on or at the top of slopes, which cannot be drained other than by pumping, shall not remain open for prolonged periods;
3. Construction materials or excavated material shall not be stockpiled where they could erode or cause a landslip or mud flow.

PRE.C9.1220.9 REINSTATING DAMAGE WORKS

The Contractor's attention is drawn to GCC Clause 5.12. Should any damage to the Works occur due to inclement weather or the effects of inclement weather the Contractor shall carry out such repairs and reinstatement as are deemed necessary by the CM at the expense of the Contractor.

PRE.C9.1230.9 EMERGENCY COMMUNICATION AND STANDBY TEAM

1. Provide emergency communication and standby team for the execution of any emergency work on Site warranted necessary by the Contractor for the safety of the Works and/or the public, in accordance with the following:
   a. Within one week from the notified date for commencement of the Works establish an emergency contact telephone number and submit the said telephone number to the CM;
   b. The emergency contact telephone is to be manned, at all times during which the Rainstorm Red Warning or the Rainstorm Black Warning is issued, or the Tropical Cyclone Warning Signal No 3 or above is hoisted, by a competent English-speaking person. All information received to be immediately conveyed to the Contractor;
   c. The emergency standby team comprising suitable staff, labour and plant is to be available at all times during which the said Signal, including Rainstorm Black/Red Warning, is hoisted. The standby team to be sufficient in size for any emergency work required to be carried out on Site. In the event that the standby team is not stationed at the Site, ensure that the team can be mobilized within the shortest possible time.
2. The provision of the emergency contact telephone number and the emergency standby team shall in no way relieve the Contractor of his obligations, responsibilities and liabilities under the Contract.

PRE.C9.1260.B PROTECTION OF WORKERS FROM HEAT STROKE

In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working in hot weather as recommended in the latest edition of the Guidelines on Site Safety Measures for Working in Hot Weather issued by CIC, the Guidance Notes on Prevention of Heat Stroke at Work and the leaflet on Prevention of Heat Stroke at Work in a Hot Environment issued by LD. Examine critically the practices and / or measures as recommended in the said Guidelines, the Guidance Notes and leaflet, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guidelines, the Guidance Notes and leaflet may be proposed for the CM's approval before implementation. The following highlights the crucial practices and / or measures, albeit not exhaustive, extracted from the said Guidelines, Guidance Notes, leaflet and measures required:

1. In relation to PRE.C6.070, ensure that a safe system of work including the risk assessment and the caring measures for prevention of heat stroke are incorporated in the Safety Plan;
2. Make reference to the said Guidelines issued by CIC and the Guidance Notes issued by LD for the purpose of conducting the risk assessment as per sub-clause (1); review and adopt as appropriate in the light of applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works;
3. Set up sunshade to block away sunlight at exposed work areas and provide good mechanical ventilation as far as reasonably practicable;
4. Ventilate the workplace by means of fans / blowers / chillers or any other form as appropriate;
5. Where working in enclosed area with poor ventilation, in addition to the provision at sub-clause (4), exhaust the hot air by exhaust pipes or other suitable measures;
6. Keep heat-generating machinery (e.g. diesel air compressors or generators) away from workers or use insulating materials to minimize heat dissipation as far as reasonably practicable;
7. Use mechanical aids for execution of works where appropriate to minimise workers' physical exertion;
8. Establish administration control measures with trained supervisors to take heed of hot weather report and if necessary, to reschedule outdoor work or to arrange job rotation or suitable rest breaks to avoid prolonged working in hot environment;
9. Assign a lower workload or shorter working duration as a start to the workers new to a hot environment, with the workload increased gradually over a number of days to help them acclimatize to the hot environment;
10. Avoid assigning workers who may have difficulties in coping with heat to work under hot environment. Consider the advice of their attending doctors if necessary;
11. Arrange rest periods to reduce the duration of exposure to the hot environment to let the workers cool down in accordance with the risk assessment conducted in sub-clause (2) above;
12. Provide relevant training and site safety information to supervisors and workers in understanding the potential risks for working in hot environment inclusive of the knowledge in recognizing symptoms of heat-related disorders, the precautionary measures and the emergency response actions etc.;
13. Provide sheltered rest areas as per PRE.C9.965 with cooling aids and cool potable water close to the workplace;

14. In addition to sub-clause (13), provide easily accessible drinking points with cool potable water for all workers employed on the Works or in connection with the Contract;

15. Encourage workers to take plenty of water or other appropriate beverages to replenish the fluid and electrolytes lost through sweating;

16. Prohibit consumption of alcoholic drinks;

17. Pursuant to PRE.C9.260, encourage workers to wear proper clothing and safety helmet in light colour, wide brim and with ventilation vents to suit the weather. Provide sun protection arm sleeves (upon request by workers and not required for workers with long sleeves clothing). The sun protection arm sleeves shall be made of thin and vapour permeable fabric allowing effective sweat evaporation and having a ultraviolet protection factor of at least 50;

18. Provide misting machines and regularly change the water in water tank of misting machine for hygiene;

19. Provide air-conditioners or cooling facilities in the cabins of plant where the operator is likely to be exposed to high temperature;

20. Subject to measures recommended in risk assessment, monitor periodically the body temperature of workers working under direct sunshine during the very hot weather warning issued by the Hong Kong Observatory. The frequency of measurement required shall be recommended in the risk assessment. For the mode of measurement, the reading may be taken manually and recorded in paper format. Alternatively, artificial intelligence body temperature measuring device with recording function may be used for monitoring the temperature of workers.

PRE.C9.1270.9 PROTECTION OF WORKERS WORKING IN COLD WEATHER

In addition to any obligation under GCC Clause 5.11 or similar obligations under any enactment or Regulation, adopt the practices and / or measures in respect of working in cold weather as recommended in the Health Guide for Working during the Cold Weather issued by LD. Examine critically the practices and / or measures as recommended in the said Guide, especially their applicability and suitability to the Works on account of the actual site conditions and the specific safety hazards of the Works. Alternative practices and / or measures which should not be inferior to those recommended in the said Guide may be proposed for the CM's approval before implementation:

1. In relation to PRE.C6.070, ensure that the risks of working in cold weather to the workers and the caring measures are incorporated in the Safety Plan;

2. Take heed of weather report. Inform workers of the necessary safety and health precautions to take and remind workers to wear appropriate warm clothing at work;

3. Reschedule outdoor work or work in remote areas to warmer periods in daytime where practicable;

4. Make arrangements for work shifts to rotate from outdoor to indoor or sheltered work sites where practicable;

5. Provide hot drinking water or other beverages for all workers employed on the Works or in connection with the Contract;

6. Provide workers working alone in remote areas with effective communication or other suitable measures for calling for assistance in case of emergency.

PROTECTION AND PRESERVATION OF EXISTING TREES AND SHRUBS

PRE.C9.1310.B PROTECTION GENERALLY

Option 1

There are no existing trees or shrubs on the Site, adjoining or outside the Site boundary which are to be retained and protected.

Option 2

Preserve and protect the existing trees and shrubs on the Site, and trees and shrubs adjoining or outside the Site boundary which are being or will be affected by the Works, and conduct yard waste treatment and management in accordance with PRE.C9.1312 to PRE.C9.1380 and Worksection EXT18. The Contractor shall:

1. Carry out a survey to confirm if there are any trees on the Site, and trees adjoining or outside the Site boundary which may be affected by the Works, but are not recorded on the Drawings. Identify them and report the survey result to the CM within 28 days from the notified date for commencement of the Works;

Option A

2. Preserve and protect all existing trees which are on the Site, adjoining or outside the Site boundary as shown on Drawing No(s). ……... in Appendix B to this Specification. Where there are any trees on the Site, and trees adjoining or outside the Site boundary which are being or will be affected by the Works, but are not recorded on the Drawing(s), preserve and protect them in accordance with PRE.C9.1312 to PRE.C9.1380 and as directed by the CM including liaising with the owner / maintenance agents of the trees and / or relevant Government departments / authority if necessary;

Option B

2. Carry out all necessary preservation and protection works to the trees and shrubs on the Site, and the trees and shrubs adjoining or outside the Site boundary which are being or will be affected by the carrying out of the Works including liaising with the owner / maintenance agents of the trees and / or relevant Government departments / authority in accordance with PRE.C9.1312 to PRE.C9.1380 and as directed by the CM. The existing tree(s) and shrub(s) known to be in the vicinity of the Site are as shown on the drawing no(s). …….. in Appendix U to this Specification for reference only. All information as shown on the said drawing(s) is given in good faith without guarantee of its correctness. No responsibility will be taken for its accuracy or sufficiency by the Employer and no claims for costs, time or whatsoever will be entertained on account of any errors, discrepancies, omissions, insufficiency of the said information;

3. Carry out all necessary tree surgery and pruning works for existing trees adjoining or outside the Site boundary with canopies or branches encroached into or trespassed on the Site. Provide method statement for the tree surgery and pruning works, coordinate, liaise and seek advice and / or approval from the owner / maintenance agents of the trees and / or relevant Government departments / authority prior to the commencement of the tree survey and pruning works;

4. Where it is found necessary to remove, either by felling or by transplanting, any trees not recorded on the Drawings, the Contractor shall:

    a. Report to the CM the necessity of such tree removal works;

b. Engage a Registered Landscape Architect or competent person approved by the CM to prepare the tree removal application and to obtain approval of such application. The application shall include a detailed tree survey and the justification(s) for the proposed removal of each tree, with substantiation and necessary details such as site formation plan and architectural or engineering drawings in the format agreed by the CM;

c. Fell or transplant the tree(s) only after obtaining the CM's approval of the tree removal, which shall normally be given only after approval of the tree removal application by the owner / maintenance agents of the trees and / or relevant Government departments / authority.

5. Provide sufficient site supervising personnel to supervise the tree surgery and pruning works, preservation and protection work for the existing trees and shrubs as referred to in sub-clauses (1) to (4) above, paying particular attention to site safety;

6. Comply with Worksection EXT18 for proper treatment of felled trees and yard waste recycling. The Qualified Arborist (QAr) shall manage and supervise the entire workflow of the implementation of the yard waste treatment and management exercise;

7. Carry out all safety precautions which are necessary for the protection of the public and minimize any inconvenience to the public in connection with or resulting from the carrying out of the tree removal, tree surgery and pruning works, preservation and protection work for the existing trees and shrubs;

8. Indemnify and keep indemnified the Employer against all losses and claims for injury or damage to any person or property including the trees and whatsoever caused to or by the trees in association with the carrying out of the works for the trees, shrubs and other vegetation and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

PRE.C9.1312.B DEFINITIONS

1. "Tree" means a plant with diameter at breast height measuring 95 mm or more. Including plants growing on retaining structures;

2. "Old and Valuable Tree" (hereinafter referred to as OVT) means any tree included in the Register of Old and Valuable Trees established by the Government and published in Development Bureau's website at https://ovt.greening.gov.hk or the Tree Register posted on the Government's website at https://treeregister.greening.gov.hk;

3. "Diameter at breast height (DBH)" means the diameter of the trunk of the plant measured at a height of 1.3m above ground level;

4. "Tree crown spread" means the diameter of the tree crown defined by the outermost branches of the tree;

5. "Tree height" means the height from ground level to the top of the tree;

6. "Dripline" of a tree means the imaginary vertical plumb line that extends downward from the tips of the outermost tree branches and intersects the ground;

7. "Tree protection zone" for OVT (Tree No. shown on Drawings) means the zone encompassing the tree along its dripline and extending vertically to 2 m upward beyond the top of the tree and 2 m downward beyond the ground level at the trunk base of the tree. For an OVT growing on a retaining structure / wall / rock surface, the tree protection zone should encompass the body of the tree itself and 2 m above the tree crown, as well as the vertical and horizontal surfaces of the retaining structure / wall / rock surface covered by the tree roots together with the space up to 2 m behind those surfaces;

8. "Tree protection zone" for non-OVT (tree other than OVT) means an area within the perimeter that is defined by the dripline of the tree. For a non-OVT growing on a retaining structure / wall / rock surface, the tree protection zone should encompass the body of the tree itself, and the vertical and horizontal surfaces of the retaining structure / wall covered by the tree roots;
9. "Preserved tree" means an existing tree, including OVT, not earmarked to be felled, which may be a tree to be retained at its existing location, a tree at its existing location prior to transplanting, or a tree transplanted within the Site;
10. "Arboricultural work" means any work related to the cultivation and care of trees for any purpose other than timber production, including but not limiting to planting, replanting, transplanting, tree surgery work and control of pest and disease;
11. "Aftercare to Old and Valuable Trees" means the regular monitoring and other operations specified to be performed for Old and Valuable Tree (Tree No. shown on Drawings) during the period stated in the Contract for such regular monitoring and other operations.

PRE.C9.1313.X DELETED

PRE.C9.1314.A SPECIALIST CONTRACTOR

Engage a specialist contractor in accordance with the following:

1. Unless otherwise agreed by the CM, select such specialist contractor from the prevailing "Housing Authority List of Soft Landscape Contractors Groups 1 or 2" and the approved listed contractors in the appropriate category in the Works Branch Development Bureau List of Approved Suppliers of Materials and Specialist Contractors for Public Works;
2. Enter into a written sub-contract with the specialist contractor to carry out the arboricultural work to trees within and adjoining the Site, including but not limited to planting, replanting, transplanting, conduct tree risk assessment, tree surgery work and control of pest and disease;
3. Provided that without the written consent of the CM, do not enter into a written sub-contract with a specialist contractor on the prevailing "Housing Authority List of Soft Landscape Contractors Groups 1 or 2", who is then restricted from tendering in respect of the works in that category;
4. At least seven (7) days prior to entering into a written sub-contract with the specialist contractor, submit details of the specialist contractor to the CM for checking of compliance with sub-clauses (1) to (3) above.

PRE.C9.1315.A COMPETENT MEMBER OF SITE SUPERVISORY STAFF TO OVERSEE TREE WORKS

1. Assign a competent member of the site supervisory staff to oversee and supervise tree works related to horticultural operations and preservation of trees on the Site, adjoining or outside the Site boundary, including but not limited to planting, transplanting, tree surgery work and control of pest and disease affecting the preserved and protected trees;
2. The assigned competent member shall comply with the following requirements:
    a. Be working full-time on the Site, but not necessarily working solely on trees;
    b. Have attended relevant training on the subject organised by the training institutes (such as Construction Industry Council), or similar courses as considered appropriate by the CM.

3. Within 28 days from the date of the Letter of Acceptance, submit to the CM for approval particulars of the assigned competent member (including his name, experience and position) together with a copy of the certificate issued by the training institute confirming his satisfactory completion of the relevant course.

PRE.C9.1316.A PRESERVATION AND PROTECTION OF EXISTING TREES AND VEGETATION GENERALLY

Unless otherwise directed or agreed by the CM, comply with the following requirements:

1. Protect all existing trees, palms, bamboos and shrubs as shown on Drawing No(s). ……. and / or as required in accordance with PRE.C9.1310;
2. Protect the branch structure, crown and root zone and any overhanging vegetation;
3. Protect and preserve all existing trees and shrubs including any surrounding curbs / dwarf walls except those Instructed to be removed;
4. Be fully acquainted with the location, size, canopy shape, and spread of the existing vegetation shown on the Drawing(s) to the extent that the location of existing trees may affect the programming, method or sequencing, and access to the Works;
5. Identify each tree, palm and bamboo shown on the Drawing(s) that is designated to be retained, transplanted or removed by affixing differently coloured labels (tree identification card) printed with the number shown on Drawing No(s). …… as follows:
    a. Conduct initial tree survey to identify trees that are not recorded under the Contract and their treatment is yet to be instructed by the CM;
    b. Submit the survey record to the CM within 28 days of the notified date for commencement of the Works;
    c. Secure the tree identification card by carefully tying with plastic string and avoid damage to the trunk or bark in accordance with Worksection EXT11;
    d. Provide additional tree identification card(s) or marking to identify the OVT;
    e. Comply with the following in providing the tree identification cards or marking systems:
        i. Tree identification cards shall be made of durable materials that are non-injurious to the trees, placed at a position visible but not easily accessible to the public, and attached in such a manner that allows for the growth of the trees and does not injure the trees;
        ii. Provide Radio Frequency Identification (RFID) label tags as specified in APC.A010, attach to the back of the tree identification cards and secure to all trees included in the Tree Inventory Records;
        iii. The tree identification card or marking systems and the on-site status identification of trees, palms and bamboos shall be agreed by the CM and installed prior to the commencement of site clearance, demolition, earth moving, construction of permanent, or other temporary works, and any other site operations which may affect the trees, palms and bamboos;
        iv. Reinstate or replace where necessary the tree identification card or marking systems for the preserved trees, and remove these tree identification card or marking systems from the Site upon completion of the Works or earlier if so directed by the CM;
        v. Provide photographic record in accordance with EXT11.W060.

f. Liaise and coordinate with other relevant Government departments and Utility Undertakings for the protection and preservation of existing trees, including OVT, adjoining or outside the Site boundary and carry out any necessary measures. The QAr is responsible for preparing the additional tree removal application, obtaining prior approval of the CM, and submission of the tree removal application to relevant Government departments or appropriate authority.

6. Ensure that the QAr shall carry out the following duties in relation to the existing preserved trees, including OVT, on the Site, adjoining or outside the Site boundary as shown on Drawing No(s). ……. and as required in accordance with PRE.C9.1310:

a. Conduct an initial survey of the existing preserved trees, including OVT, and an initial site survey and initial soil tests of the tree protection zone(s) of the existing preserved trees, including OVT, and submit a report on the same comprising the details and within the time frames. The report shall be in the form of an A4-sized, bound document with a report cover indicating the Contract number, Contract title, and date of the report and shall be signed by the QAr. The format of the report shall be agreed by the CM prior to its submission;

b. Prepare the Tree Inventory Records with the use of RFID readers and mobile devices as specified in APC.A010 or as instructed by the CM for all existing preserved trees on the Site, adjoining or outside the Site boundary. All Tree Inventory Records shall be uploaded to the computerised tree inventory and management system, i.e. the Enterprise Tree Management System (ETrMS), the web and mobile application (Apps) of which to be provided by the Employer. The format of Tree Inventory Record should be in accordance with APC.A010;

c. Prepare monitoring reports on the existing preserved trees, including OVT, and submit each monitoring report comprising the details and within the time frames as stipulated in EXT11.W062. Report the progress of yard waste management and update the attributes of tree inventory records in sub-clause (b) in accordance with the changes in tree conditions;

d. Conduct a final survey of the existing preserved trees, including OVT, a final site survey and final soil tests of the tree protection zone(s) of the existing preserved trees, including OVT, and submit a report on the same comprising the details and within the time frames as stipulated in EXT11.W062;

e. Provide arboricultural advice in the preparation of method statements and any reports on repair of damage, supervise arboricultural work, and provide on-site advice in relation to site control within the tree protection zone and at its adjacent areas, for the preservation and protection measures for the existing preserved trees, including OVT, as stipulated in the Contract;

f. Manage and conduct the entire workflow of the yard waste treatment and management plan in accordance with PRE.C9.1310 and Worksection EXT18 or as instructed by the CM. Submit records of the yard waste treatment and management exercise in accordance with EXT18.W040;

g. Carry out any other services or duties specified in the Contract.

PRE.C9.1320.A PROGRAMMING OF PROTECTION WORKS

Allow fully in the programme the effects of preservation and protection of existing trees, the method of operation and construction, and the vehicular access for the Works:

1. Exercise utmost care to avoid damage to all vegetation which is required to be protected throughout the progress of the Works;

2. Complete protection works before any site clearance, demolition, earth moving, construction of permanent, or other temporary works, and any other site operations that are to be carried out in the vicinity of any vegetation to be retained, and allow inspection of the protective works by the CM;
3. Make allowance for any required tree surgery or transplanting operations to be carried out by the Employer's Specialist Contractor during works in the vicinity of the vegetation to be retained, including construction of any hoardings and gantries.

PRE.C9.1330.A EXISTING PROTECTIVE FENCING

Where indicated on the Drawings or as Instructed, accept responsibility for protective fencing erected by others for a previous contract. Replace damaged parts as necessary to ensure effective use.

PRE.C9.1340.A PROTECTIVE BAMBOO FENCING

Where indicated on the Drawings or as Instructed, surround existing preserved trees and shrubs around the perimeter of the crown with a 1500 mm high ±50 mm bamboo fence, comprising:

1. 2500 mm long ±50 mm, 30 mm x 30 mm x 5 mm thick galvanized mild steel angle posts driven into the ground at 1500 mm centres ±50 mm and fitted with protective caps with;
2. Top, middle and bottom rails of 70 mm diameter ±5 mm bamboo poles;
3. 1500 mm long ±50 mm 50 mm diameter ±5 mm bamboo vertical poles at 120 mm centres ±5 mm;
4. All firmly fixed with rot proof twine or wire.

PRE.C9.1350.A PROTECTIVE CHAIN LINK FENCING

Where indicated on the Drawings or as Instructed, surround existing preserved trees and shrubs around the perimeter of the crown with chain link fencing to BS 1722:Part 1:1986:

1. Fence type: GLS 180 (Table 1 of BS 1722:1986);
2. Height above ground: 1800 mm ±50 mm;
3. Materials:
    a. Zinc coated chain link, 1800 mm wide roll, 50 mm mesh size, 3 mm nominal wire diameter;
    b. Zinc coated mild steel line wire, 3.55 mm nominal wire diameter;
    c. Rolled mild steel angle iron posts and struts in accordance with Table 4 of BS 1722:1986:
        i. Intermediate posts:

            2600 mm long ±50 mm

            45 x 45 x 5 mm section
        ii. Straining posts:

            2600 mm long ±50 mm

            60 x 60 x 6 mm section
        iii. Struts:

            2000 mm long ±50 mm

45 x 45 x 5 mm section

4. Erection:

   In accordance with Section 3 of BS 1722:Part 1:1986 drive posts or set in concrete as necessary to obtain firm base.

PRE.C9.1360.A ALIGNMENT OF PROTECTIVE FENCING

Where indicated on the Drawings or as Instructed, align the protective fencing along the outer limit of the canopy ("drip line") of all trees and palms to be retained, to protect from damage.

PRE.C9.1362.A PROTECTION FROM CHANGE IN GROUND LEVEL

1. Unless explicitly required in the Contract, do not change the existing ground levels within the tree protection zones of the preserved trees without the prior approval of the CM;
2. Where it is necessary for the completion of the Works to reduce the existing ground level around a preserved tree which will result in a lowering of the existing ground level within the tree protection zone, comply with the following requirements:
   a. Construct a retaining wall as shown on Drawing No. ……. install tree supporting devices as shown on Drawing No. …… or similar measures as agreed by the CM to accommodate the reduction in the existing ground level around the tree;
   b. Before commencing the construction of the measures to accommodate reduction in the ground level pursuant to sub-clause (2)(a) above, submit method statements including construction details for the measures for the CM's approval;
   c. Commence the construction of the measures only after obtaining CM's approval for the method statements;
   d. Follow the requirements stipulated in PRE.C9.1363, regarding excavation and cutting of tree roots;
   e. Maintain balanced moisture content in the tree and in the soil after construction of the measures, by carrying out necessary precautionary measures such as crown thinning, watering and mulching.
3. Where it is necessary for the completion of the Works to raise the existing ground level around a preserved tree which will result in a rise in the existing ground level within the tree protection zone, comply with the following requirements:
   a. Construct a dry well and soil aeration system as shown on Drawing No. …… or similar measures as agreed by the CM to accommodate minor to moderate rise of up to 300 mm in the existing ground level around the tree;
   b. Construct a dry well and soil aeration system as shown on Drawing No. ……. or similar measures as agreed by the CM to accommodate major rise of more than 300 mm in the existing ground level around the tree;
   c. Before commencing the construction of the measures to accommodate rise in the ground level pursuant to sub-clauses (3)(a) and (3)(b) above, submit method statements including construction details for the measures for the CM's approval;
   d. Commence the construction of the measures only after obtaining CM's approval for the method statements.

PRE.C9.1363.B PROTECTION FROM EXCAVATION INCLUDING TRENCHING

1. Unless explicitly required in the Contract, do not carry out excavation within the tree protection zones of the preserved trees without the prior approval of the CM;

2. For the Approved excavation work within the tree protection zones, comply with the following requirements:
    a. Obtain agreement from the CM to the detailed locations and extent of the excavations before commencing any excavation work;
    b. Carry out the following before commencing any cutting work to the aerial roots or underground roots of the preserved trees:
        i. Determine the locations of the major roots and the bulk of their absorbing roots so as to keep the cutting of tree roots to a minimum and to preserve the tap roots, sinker roots and support roots of the trees in any circumstances;
        ii. Obtain agreement from the CM to the extent of root cutting on the Site;
        iii. Where the stability of the trees is likely to be jeopardised, comply with the requirements stipulated in PRE.C9.1365.
    c. Submit to the CM the photographic records showing the condition of the affected trees and the agreed extent of excavations and root cuttings as marked on the Site prior to commencement of the excavation work and root cutting work. Thereafter, submit photographic records showing the condition of the affected trees and the progress of the excavation work and root cutting work at weekly intervals until backfilling of the excavations is complete;
    d. Excavate the service trench on the paved side of the tree if one exists;
    e. Pile the excavated materials outside the tree protection zones to reduce soil compaction;
    f. Carry out the excavations carefully so as not to damage the bark and root collars of the preserved trees;
    g. Maintain balanced moisture content in the trees and in the soil after backfilling of the excavations by carrying out necessary precautionary measures;
    h. Move the temporary protective fencing stipulated in PRE.C9.1330 to PRE.C9.1350 to the edge of the intended excavation area, between the excavation area and the rest of the tree protection zone, during the duration of excavation work, and move back the same to its original location after backfilling.
3. Where the Approved excavation works within the tree protection zone will involve cutting of the roots of the preserved trees, take the following precautions:
    a. Carry out excavation by using only hand-held tools such as hoe and spade, but not mechanical diggers or bulldozers in any circumstances;
    b. Whenever roots are encountered and before root cutting is carried out, fork away soil from the roots carefully by using hand-held tools up to the edge along which root cutting is required;
    c. Carry out root cutting carefully by using sterilised hand-held pruning tools, and prune roots greater than 25 mm in diameter carefully so as not to result in shattered and frayed roots;
    d. Cut back cleanly with sharp tools to undamaged tissue of any roots damaged during excavation and treat it with an Approved fungicidal dressing prior to backfilling;
    e. Prevent all cut and exposed roots from drying out during excavation by adopting the following measures until backfilling, unless otherwise agreed by the CM:
        i. Wrap the tap roots, sinker roots, support roots, and roots with diameter exceeding 50 mm, which shall not be cut with hessian, straw or other porous absorbent fabric once they are exposed;

ii. Hang thick hessian or other porous absorbent fabric from top of the cut surface over the exposed roots and soil immediately after root cutting;

iii. Mist the hessian or fabric in a frequency that keeps the roots and the soil at the cut surface moist all the time.

f. Remove immediately before backfilling the hessian, straw or other porous absorbent fabric stipulated in sub-clause (3)(e)(i) above and the hessian or fabric stipulated in sub-clause (3)(e)(ii) above;

g. Backfill excavations with soil mix incorporated with slow release fertiliser at a rate of 500g/m³ or at a rate as directed by the CM to a level not higher than the original soil level at the root collar.

4. Based on the result of sub-clauses (2)(b)(i) & (2)(b)(ii) above, if in the opinion of the CM that the trenching works within the tree protection zone will involve cutting of a significant part of the roots of the preserved trees, adopt tunnelling in lieu of trench excavation in the following manner and as shown on Drawing No……. close to the tree trunk on one side:

a. Excavate a trench as narrow as possible directly towards the tree along a radius to not closer than 1.0 m from the trunk or where roots larger than 25 mm in diameter are encountered, whichever distance is farther away from the trunk;

b. Tunnel straight beneath the tree at a depth of not less than 750 mm and in a way to avoid damaging any tap root, sinker roots or support roots;

c. Exit on the opposite side along another radius;

d. Sleeve the service where it passes beneath the tree to reduce the risk of damage to the service and facilitate future servicing and repair;

e. Hand-dug tunnelling shall comply with the latest Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department.

The following terms used in the Guidance Notes shall be construed as follows for the purpose of the Specification:

Term used in the Guidance Notes	Terms in the Specification
the proprietor	Direct Contractor
project engineer	Qualified Engineer
contractor	Contractor

PRE.C9.1364.A PROTECTION FROM DRILLING

1. Unless explicitly required in the Contract, do not carry out drilling such as soil nailing and drilling for bore holes, rock bolts or dowels, within the tree protection zones of the preserved trees without the prior approval of the CM;

2. For the Approved drilling work within the tree protection zones, comply with the following requirements:

a. Obtain agreement from the CM to the detailed locations and extent of the drill holes before commencing any drilling work, bearing in mind that the drill holes shall be located in such a way that the structures to be placed into the drill holes, including the surface elements of the structures such as soil nail heads, are at a minimum distance of 500 mm from the trunks of the preserved trees unless otherwise agreed by the CM in exceptional circumstances;

b. Carry out the following before commencing any cutting work to the aerial roots or underground roots of the preserved trees:

i. Determine the locations of their major roots and the bulk of their absorbing roots so as to keep the cutting of tree roots to a minimum and to preserve the tap roots, sinker roots and support roots of the trees in any circumstances;

ii. Obtain agreement from the CM to the extent of root cutting on the Site;

iii. Where the stability of the trees is likely to be jeopardised, comply with the requirements stipulated in PRE.C9.1365.

c. Carry out the drilling work carefully so as not to damage the branches, foliage, trunk, bark and root collars of the preserved trees when gaining access for supporting, mobilising, positioning and operating the drilling rig;

d. Maintain balanced moisture content in the trees and in the soil after the drilling work by carrying out necessary precautionary measures such as crown thinning, watering and mulching.

3. Take the following precautions when carrying out drilling work that involves cutting of the roots of the preserved trees:

a. Carry out the drilling work and root cutting work carefully;

b. Prune roots greater than 25 mm in diameter carefully in order to prevent the roots from shattering and fraying;

c. Cut back cleanly with sharp tools to undamaged tissue of any roots damaged during drilling and treat it with an Approved fungicidal dressing.

PRE.C9.1365.A PROTECTION FROM INSTABILITY

1. Where the Works involve cutting of any major roots or other major parts of the preserved trees or any other works that may jeopardise the stability of the preserved trees, comply with the following:

a. Install all necessary physical support for the preserved trees to ensure their stability;

b. Pay particular attention to the stability of the OVT and all other preserved trees that grow on retaining structures in order to prevent the trees from being dislodged from their positions as a result of inadequate support.

2. Comply with the following in installing the physical support measures for the preserved trees:

a. Before commencing the installation of the physical support, submit method statements for the support measures to the CM for approval;

b. Commence the installation of the physical support only after obtaining CM's approval for the method statements;

c. Install the physical support securely prior to commencement of the root cutting, tree pruning or any other works that may affect the stability of the trees;

d. Securely found the physical support in footings independent of existing walls or building structures or in other supporting systems as appropriate, without interfering with other works, other existing features, and the preserved trees;

e. Where the affected tree is an OVT or any other tree that grows on a retaining structure, make a detailed assessment to estimate the weight of the tree and to identify the best position of supporting the tree in relation to its overall spread and centre of gravity. The method statements for the support measures in respect of the OVT or other trees that grow on retaining structures shall include the following information:

i. Details of the form of construction and where requested by the CM structural design calculation for the support measures, demonstrating the bearing capacity of each element;

ii. Details of the foundation of the support measures, demonstrating that the support measures shall not interfere with other works, other existing features, and the preserved trees and, in the case of the tree growing on a retaining structure, shall not affect the stability of the retaining structure;

iii. Means of securing the tree to the structure of the support measures, including detail design of how cups and ties are adjusted to the form of the tree;

iv. Method of fabrication and erection on the Site.

f. Remove the physical support for the preserved trees from the Site upon completion of the Works, or earlier if so directed by the CM. Do not remove or relocate the physical support for the trees without the prior agreement of the CM.

PRE.C9.1370.B PRESERVATION AND TREATMENT / REPLACEMENT OF EXISTING TREES AND SHRUBS

As Worksection EXT11.

PRE.C9.1380.N TREE INVENTORY REPORT

1. No later than 28 days from the notified date for commencement of the Works, provide written Tree Inventory Report and Tree Topographic Survey with information of all existing trees, palms, conifers and bamboos as indicated in the drawings and schedules as shown on Drawing No(s). …… and trees identified from the survey as specified in PRE.C9.1310 for the CM's approval. In particular, attention is drawn to the following requirements:

   a. Provide tree information including location stored in Geographic Information System (GIS) digital files, dimensions including trunk girth at 1.3m above ground level, crown spread, overall height, current conditions of tree such as form and health, and tree identification number to trees, palms and conifers as indicated on Drawing No(s). …… and trees identified from the survey as specified in PRE.C9.1310;

   b. Install tree identification card with RFID label tag attached at the back to individual tree, palm or conifer with the tree identification (ID) number based on the tree layout plan and the survey result as specified in PRE.C9.1310. The tree identification card and the RFID label tag should bear the project name / code and the number of individual tree. Format of the tree identification card and the numbering system are given in APC.A010 to be approved by the CM. Consult the CM for the exact project code;

   c. Take and complete the Tree Inventory Record for each tree, palm or conifer in accordance with APC.A010, with a photo showing the whole tree, palm or conifer;

   d. Simultaneously, provide Tree Topographical Survey for all existing and identified trees, palms and conifers which are tagged according to sub-clause (1)(b) above. The requirements of Tree Topographic Survey are detailed in the "Technical Specification of Tree and Planting Area Survey" provided by the CM;

e. The undertaking of Tree Topographic Survey shall be supervised by a Land Surveyor. The Land Surveyor shall be competent and experienced and shall possess a diploma / higher certificate in land surveying or a higher diploma in geomatics from a Hong Kong technical institute / polytechnic or university; or an associate membership of the Hong Kong Institute of Surveyors in the Land Surveying Division; or equivalent qualification appropriate to the nature of the survey work required for the Contract, plus a minimum of 2 years of relevant experience in engineering surveying.

TREE RISK ASSESSMENT AND INSPECTION AFTER INCLEMENT WEATHER

PRE.C9.1410.A TREE RISK ASSESSMENT AND ARBORICULTURAL WORKS

Provide the following services in relation to tree risk assessment and arboricultural works:

1. Carry out tree risk assessment for the trees as shown on Drawing No(s). ..... in Appendix B to this Specification and those other trees as designated by the CM through on-the-ground or aerial inspections as approved by the CM;
2. Tree risk assessments shall include but without limitation to the following:
   a. assessment in accordance with the latest version of the Guidelines For Tree Risk Assessment and Management Arrangement as issued by the Greening, Landscape and Tree Management Section (GLTMS) of the DEVB posted at website:

      http://www.greening.gov.hk/en/home/index.html

   b. assessment on internal decay of the main trunk and other locations being considered with structural defects;
   c. conditions of installations, if any, such as cable, bracing road and propping structure so as to identify any visual damage and other irregularities.
3. Submit tree risk assessment reports, using Form 1 and / or Form 2 as appropriate, with recommendations of arboricultural works for risk abatement to the CM, details and format of the report have to be approved by the CM;
4. Adopt the use of RFID readers and mobile devices, as specified in APC.A010, or as instructed by the CM, for conducting tree risk assessment and uploading tree data and assessment reports to the ETrMS;
5. Carry out and complete the arboricultural works as recommended in the assessment reports and approved by the CM, and keep records of supervision and work done;
6. Provide one Qualified Arborist ("QAr") to carry out tree risk assessment, preparation and presentation of assessment reports, supervise the execution of the arboricultural works recommended in the assessment reports and approved by the CM including preparation of records on supervision and work done.

PRE.C9.1420.B TIMING FOR CARRYING OUT OF TREE RISK ASSESSMENT AND ARBORICULTURAL WORK

1. Carry out and complete tree risk assessment and the related arboricultural work as approved by and to the satisfaction of the CM during the course of the Contract as described below:

Length of the service period	……. months
Covering period	From (Date) ……. to (Date) …….

2. In general, each tree as identified in PRE.C9.1410 or instructed by the CM shall be subject to tree risk assessment by QAr within each twelve (12) months period commencing from the notified date for commencement of the Works with the exact date to be instructed by the CM; in any case no two assessments shall be separated by more than twelve (12) months within the duration of Contract;
3. Carry out additional tree risk assessments as instructed by the CM on trees which are subject to emergency situations including but not limited to failure of major branches or trunk, blooming of fungal fruiting bodies, accident causing tree injury, acute pest problem and other situation causing imminent danger;
4. Use Tree Risk Assessment Form 1, Form 2, and / or Tree Failure Report Form as appropriate, or as directed by the CM to conduct the above tree risk assessment exercise.

PRE.C9.1430.B QUALIFICATION AND EXPERIENCE REQUIREMENTS OF THE QUALIFIED ARBORIST

1. Each QAr must have registered as "Arborist" and maintained a valid registration status under the Registration Scheme for Tree Management Personnel (RSTMP) of Development Bureau (DEVB) during the progress of the Works;

2. Within seven (7) days of the date of the Letter of Acceptance, nominate a candidate to be the QAr according to sub-clause (1) above for the approval of the CM. In case the employment of the QAr with the Contractor is terminated or his registration status under the RSTMP of DEVB has changed i.e. suspended or terminated for whatever reasons, the Contractor shall further provide another QAr in accordance with sub-clause (1) above within fourteen (14) days of the termination or change of registration status.

PRE.C9.1440.A PRACTICE ON TREE RISK ASSESSMENT AND MANAGEMENT

1. Practice and Procedures on Tree Risk Assessment and Management (TRAM)
   a. The QAr shall use proper equipment such as wood decay detection equipment and drilling resistance measuring equipment, for checking internal decay and take photos for major defects or irregularities spotted;
   b. The QAr shall not cause any unnecessary damage to any tree parts or excessive soil compaction during assessment;
   c. The Contractor shall provide all necessary equipment and machineries for assessments to be conducted by the QAr;
   d. The Contractor shall cordon-off the Site during the aerial inspection and make all arrangements for site cordon-off or road closure, if necessary;
   e. The Contractor shall ensure that all their staff and the QAr are provided with and properly used all appropriate equipment and measures in carrying and assisting in carrying out of assessments;
   f. The Contractor shall also take every safety precaution to avoid injury to its staff, the QAr, the general public and to avoid damage to property of others during tree assessments.
2. Tree risk Assessment Report
   a. The QAr shall complete and sign a full comprehensive assessment report for each tree as shown on Drawing No(s). ……, using Form 1 or Form 2 as instructed and provided by the CM from time to time, which shall include but not be limited to the following:
      i. General information of the tree(s);
      ii. Observations;
      iii. Views on risk caused by defects with justifications;
      iv Recommended measures for risk abatement which shall, without limitation, include:
         - A proposal of arboricultural works for risk abatement to each tree assessed. The proposal shall have taken into account avoidance of permanent blockage of vehicular or pedestrian traffic;
         - Annotated plans, photos, sketches, or drawings for clear indication in the proposal in respect of the following pruning works or installations may be provided in the report to illustrate or elaborate the recommended measures:

	Pruning/ Installation	Required details
i	Crown Reduction	Overall crown reduction: recommended percentage; or Selected branch reduction: location of major limbs (direct connection to the trunk), position of the cut and percentage of reduction.
ii	Crown thinning	Location of major limbs (if any) to be removed and position of the cut.
iii	Crown lifting	Location of major limbs (if any) to be removed and position of the cut.
iv	Cabling	Exact location of each limb involved. Position of each cable and its connection points on approximate position of related limbs. Submit fixing details / shop drawings of cable and end-connection between the limb and the cable for CM's approval. Exact location and the limb position of another tree if involved in cabling.
v	Bracing	Exact location of each limb involved. Position of each bracing rod, its passing through angle and the approximate installation position of related limbs. Submit fixing details / shop drawings of bracing rod for CM's approval.
vi	Guying	Exact location of each limb involved. Position of each cable and its connection point on approximate position of related limb and that of the ground /other surface. Submit fixing details / shop drawings of cable and end-connection between the limb for CM's approval. Proposed specification of the ground support.
vii	Propping	Exact location of each limb involved. Position of each prop and its connection point on approximate position of related limb and that of the ground /other surface. Submit detail design of the propping structure and fixing details / shop drawings of the prop and its foundation for CM's approval. The connection details between the prop and the main trunk or the limb, and between the prop and the ground /other surface.

- As regards to chemical treatment for nutrition problem or pests and diseases, a proposal of the specific chemicals to be used together with potential chemical suppliers, application method and schedule.

v. Attachments for witnessing the content of the report ……..

3. Presentation of proposal:

    a. After submission of the tree risk assessment report to the CM, using either Form 1 or Form 2, the QAr shall present the proposals as and when called upon to do so by the CM. The QAr shall, if necessary, revise the recommendations by incorporating further detailed elaboration as required by and up to the satisfaction of the CM. The amended proposals shall be re-submitted to the CM by one week.

PRE.C9.1450.A INSPECTION AFTER INCLEMENT WEATHER

Ensure the QAr shall carry out inspection on trees as shown on Drawing No(s). …….. in Appendix B to this Specification and those instructed by the CM and submit preliminary tree damage report to the CM within 48 hours after cessation of all Typhoon Signals at No.8 or above or cancellation of Black Rainstorm Warning Signal. The inspections shall focus on the damage, the stability and potential hazard. The preliminary tree damage report shall include number of tree fallen, uprooted and / or with trunk and / or branches broken, the tree identification number and the species. For cases where tree damages are identified, the QAr shall also submit recommendations for any arboricultural remedial works within one week after cessation of all Typhoon Signals at No. 8 or above or cancellation of Black Rainstorm Warning Signal for Contractor's submission to the CM for approval, and supervise the execution of the arboricultural works as approved by the CM.

PRE.C9.1460.C ARBORICULTURAL WORKS IN RELATION TO TREE RISK ASSESSMENT AND INSPECTION AFTER INCLEMENT WEATHER AS APPROVED BY THE CM

1. Schedule for Work Completion

    All arboricultural works in relation to tree risk assessment and inspection after inclement weather as approved by the CM shall be completed within the time limit as instructed by and to the satisfaction of the CM.

2. Pruning

    a. Pruning including crown cleaning, crown lifting, crown thinning and crown reduction shall comply with any one of the following standards (the latest version):

        i. American National Standard for Tree Care Operations (ANSI A300 (Part 1)) – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning); or

        ii. British Standard for Tree Work (BS 3998:2010); or

        iii. Other international standards approved by the CM.

    b. As regards emergency pruning against imminent danger, prior verbal consent should be obtained by the QAr from the CM;

    c. The Contractor shall provide all necessary equipment and machineries including chainsaws, rigging ropes, lifting platform for carrying out and completion of the pruning works;

    d. The QAr shall arrange for secure lowering of cut limbs to avoid causing injury to person and damage to property when free falling onto the ground;

    e. The pruning operation shall not cause damage to the nearby planting or structure. All cut branches carrying diseases or insects have to be bagged in a recyclable polythene bag and properly disposed to avoid contamination.

3. Cabling, Bracing and Guying

a. Cabling, bracing and guying shall comply with any one of the following standards (the latest version):

i. American National Standard for Tree Care Operations (ANSI A300 (Part 3)) – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Support Systems a. Cabling, Bracing, and Guying); or

ii. British Standard for Tree Work (BS 3998:2010); or

iii. Other international standards approved by the CM.

b. In case the CM approve to connect a cable to another tree or object, the Contractor shall ensure the proper preparation of anchorage and the connection of cable;

c. The Contractor shall provide all necessary equipment to facilitate the cabling, bracing and guying work as approved by the CM and comply with all safety requirements;

d. The CM may direct the removal by the Contractor of any equipment which is considered to be unsafe and unfit for the cabling, bracing and guying work. The Contractor shall bear all associated costs and the extra time required in relation to such removals.

4. Tree Removal

a. Do not remove any tree without the confirmation of the CM that tree felling approval has been obtained from relevant Government departments;

b. Rigging and removal of trees shall comply with any one of the following standards (the latest version):

i. American National Standard for Arboricultural Operations (ANSI Z133) – Safety Requirements; or

ii. British Standard for Tree Work (BS 3998:2010); or

iii. Other international standards approved by the CM.

c. Provide all necessary equipment and machineries including chainsaws, rigging ropes, lifting platform for removal of trees;

d. Ensure that the QAr has arranged for secure lowering of cut limbs and stumps to avoid causing injury to person and damage to property;

e. Clear away the remaining stump and removal of tree debris, cut pieces of limbs and refuse generated from the tree removal work;

f. Manage and conduct the entire workflow of the yard waste treatment and management plan in accordance with PRE.C9.1310 and Worksection EXT18 or as instructed by the CM;

g. Prepare a Tree Failure Report as required by the CM.

5. Application of Fertilizers and Pesticides

a. Provide and apply fertilizers and pesticides in accordance with the recommendation approved by the CM;

b. Application of fertilizers shall comply with any one of the following standards (the latest version):

i. American National Standard for Tree Care Operations (ANSI A300 (Part 2)) – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Fertilization); or

ii. British Standard for Tree Work (BS 3998:2010); or

iii. Other recommendations or international standards approved by the CM.

c. Where chemical method is engaged for pest and disease control, only Approved equipment and chemicals shall be used, and could only be carried out by trained personnel. Pesticides could only be applied by trained personnel who possessed all relevant licence under statutory requirements. Detail records (including but not be limited to name of the pesticide, its formulation, registration number, time and location of application, the particulars of the applicator) shall be submitted to the CM for information prior to each operation;

d. No application of pesticides shall be carried out unless with the prior approval of the CM on the time and location of application so as to reduce the disturbance to the public to the minimum; No chemical pest control shall be conducted unless under suitable weather condition and with safety measures implemented. The Contractor shall ensure that the Site is suitably cordoned off and warning notice is displayed to keep off people and animals when chemical is applied. Warning notices should be put up at prominent positions of the Site after each operation of pest control chemical has been applied;

e. The Contractor shall ensure that all personnel in carrying out pesticide application is equipped with and wear the proper protective clothing and working gears during each operation;

f. The Contractor shall ensure that all pesticides to be used shall be in compliance with the Pesticides Ordinance (Cap. 133), amended by the Pesticides (Amendment) Ordinance 2013, and approved by the CM before use and application of pesticide shall be performed in accordance with the manufacturer's recommendations;

g. The Contractor shall dispose of any unwanted pesticides in accordance with the requirements laid down in the Waste Disposal Ordinance (Cap. 354).

6. Work Record

Records on arboricultural works on each tree shall be signed by the QAr, the format of such records shall be as approved by the CM.

7. Safety Requirements

a. The Contractor shall provide proper climbing equipment and protective clothing for its QAr and at all times ensure that all workers shall wear safety boots, goggles, protective clothing and reflective safety vests of a conspicuous colour;

b. The Contractor shall ensure that all workers involve in tree climbing must have registered as “Tree Climber” and maintained a valid registration status under the RSTMP of DEVB when carrying out the works;

c. The Contractor shall ensure that all workers undertaking tree pruning works involving the use of chainsaw must have registered as “Chainsaw Operator” and maintained a valid registration status under the RSTMP of DEVB when carrying out the works;

d. The Contractor shall remind all personnel working on highway structures (including footbridges, non-expressway bridges and bridge columns) that they have a statutory duty to take reasonable care of their own health and safety as well as that of others their actions or omissions at work may affect. The hazards associated with personnel working on highway structures shall include working at height, falling objects and traffic accidents. All personnel working on highway structures shall wear reflective belts, safety belts, safety harnesses or lifelines as appropriate which should be connected to stable anchorage points;

e. The Contractor shall carry out safety precautions to prevent injury to persons and damage to property as against its workers and the general public. The Contractor shall fulfil the safety requirements of at least one of the following standards (the latest version):

   i. American National Standard for Arboricultural Operations (ANSI Z133) – Safety Requirements; or

   ii. British Standard for Tree Work (BS 3998:2010); or

   iii. Other international standards approved by the CM.

f. Before commencing tree pruning or climbing works, the Contractor shall ensure that there is no overhead high voltage cable near the working area and that pruning operation will not cause damage to the nearby planting or structure. Safety measures must be taken to ensure the safety of the public. The Contractor shall ensure that neither unrelated person nor animal stays nearby during operation and coordinate with relevant authorities regarding any special pruning equipment and / or lighting requirements which may interrupt traffic. Warning signs shall be put up to keep public away from the pruning operation;

g. The Contractor shall ensure that all chainsaws or other machineries used have fulfilled the statutory safety requirements;

h. The CM may direct the removal by the Contractor of any equipment which is considered to be unsafe and unfit for arboricultural works, and the Contractor shall bear all associated costs and the extra time required in relation to such removals;

i. The Contractor shall ensure arboricultural works are carried out in compliance with the Occupational Safety and Health Ordinance (Cap. 509) and its regulations.

8. Collection and Disposal of Refuse

   a. The Contractor shall be responsible for the picking up and removal of tree debris, cut pieces of wood, refuse generated from tree assessment / inspection and arboricultural works. The Contractor shall also clear away all debris or refuse, such as joss sticks, incensed idols, construction debris, etc. within the dripline;

   b. The Contractor shall provide recyclable polythene bags and transport the refuse collected to the controlled tips at its own cost using wheeled handcarts or any other appropriate equipment in properly covered containers;

   c. No damage should be caused to the planting in the working sites when carrying out cleansing duties by the Contractor;

   d. The Contractor shall strictly prohibit its employees or agents from sweeping or dumping the refuses onto the adjoining pavements, surface channels or gullies, or other area or sites at which refuse dumping is not allowed.

9. Work Arrangement along Carriageways

   a. The Contractor shall at its own expense make all arrangements for road closure so as to carry out tree assessment / inspection and arboricultural works;

   b. Where lane closure is necessary, the Contractor shall liaise with lane closure sub-contractor from approved list of the Highways Department and obtain the necessary approvals from Commissioner for Transport, the Commissioner of Police, the Director of Highways and any other relevant authority for temporary traffic arrangements. The Contractor shall ensure that its workers shall strictly follow the requirements for temporary traffic arrangements as stipulated in the latest version of Code of Practice for the Lighting, Signing and Guarding of Road Works issued by the Highways Department;

c. The Contractor shall also comply with any other conditions and restrictions imposed by the Commissioner for Transport, the Commissioner of Police and the Director of Highways.

PRESERVATION AND MAINTENANCE OF EXISTING FEATURES

PRE.C9.1510.9 AMENITIES TO BE PRESERVED

Cause the least possible interference with existing amenities, whether natural or man-made.

PRE.C9.1520.9 PROTECTION OF EXISTING ROADS, BUILDINGS AND OTHER STRUCTURES

1. Take all necessary precautions to protect roads, buildings and any other structures, services under or above ground adjacent to or within the Site from the effect of vibration, settlement, undermining or other earth movements, and any such monitoring measures as specified in the Contract or as may be Instructed by the CM;
2. Should the effects of ground movements be detected in any adjacent roads, buildings or other structures, modify methods of construction as Instructed by the CM and any additional expense incurred is deemed to be included in the respective items in the Bill of Quantities;
3. Should ground movements cause any damage to any adjacent roads, buildings or other structures, be responsible for the cost of repairing any such damage.

PRE.C9.1530.9 RESTRICTIONS ON USE OF HIGHWAYS

1. For the purpose of this clause, all public roads shall be regarded as highways;
2. Do not make use of public or private rights of way for depositing or storing plant or materials, other than such plant, materials, tools and instruments as shall from time to time be required for immediate use on the various sections of the Works. Place plant, materials and temporary works in such a way as to cause minimum interference with the use of any right of way by the public and maintain those parts of the right of way not temporarily occupied by the Works in a clean, passable and safe state at all times;
3. Use of the surfaced roads leading to the Site shall be limited to tyred vehicular traffic only; tracked vehicles shall not be allowed to run on these roads. The Contractor shall be held responsible for any damage whatsoever caused by construction vehicles and make good immediately any such damage at his own expense.

PRE.C9.1540.9 EXISTING PIEZOMETERS

There are a number of existing piezometers within the Site as indicated on Drawing No. ..... Take all necessary protective measures, such as the erection of protective fencing, to prevent these piezometers from being damaged until the piezometers are removed for the earthworks. Monitor these piezometers in accordance with clause ..... The Contractor is required to give at least 24 hours advance notice to the CM of his intention of removing the existing piezometers.

PRE.C9.1550.9 REMOVAL OF TREES, PIPES, CABLES, ETC.

If any trees, utility services or other obstructions are required to be removed during the progress of the Works and are not otherwise specifically catered for in the Contract, draw the CM's attention to them and the CM shall arrange for their removal by the Contractor or otherwise.

PRE.C9.1560.9 REINSTATEMENT OF THE SITE

On completion of the Works, all areas outside the limit of construction works shall be restored to their original condition and ground contours unless the CM shall direct otherwise.

PRE.C9.1570.A PROTECTION OF NATURAL STREAMS/RIVERS

1. Isolate the Site, such as by placing of sandbags, to prevent adverse impacts on the stream water qualities of natural streams/rivers in the proximity. Take protective measures to ensure that no pollution or siltation occurs to the water gathering grounds of the Site;
2. Locate and properly cover temporary storage of construction materials (e.g. equipment, filling materials, chemicals, fuel etc.) away from natural streams/rivers;
3. Cover up and properly dispose of construction debris as soon as possible to avoid being washed into natural streams/rivers;
4. Locate discharge outlets of wastewater away from natural streams/rivers;
5. Obtain the CM's approval prior to carrying out of any works which may cause disturbance to the natural bottom and existing flow in the river or removal of any existing vegetation alongside the riverbanks;
6. When disturbance to riverbed and/or existing vegetation alongside the riverbanks is unavoidable, reinstate all disturbed areas with suitable methods upon completions of works. Submit remedial proposal for the CM's approval and bear the cost of all associated works and the extra time involved;
7. Attend to issues on water pollution, discharges generated from site activities, temporary drainage systems and diversion of streams or drains specified in PRE.C9.460, PRE.C9.1160, PRE.C9.1190 and PRE.C11.060.

PRESERVATION AND MAINTENANCE OF EXISTING UTILITY AND OTHER SERVICES

PRE.C9.1610.A LIAISON WITH STATUTORY AUTHORITIES

Liaise with the Utility Undertakings including Water Supplies Department (WSD), Highways Department, Fire Services Department (FSD), Transport Department, Electrical and Mechanical Services Department and Drainage Services Department (DSD) and other relevant departments/parties as advised by the CM from time to time for the removal, alteration and diversion of all utilities, water mains, junction boxes, drainage pipes, traffic light cables, street lighting, road signs and the like during the construction period. Follow the latest version of Transport Department's Guidelines on Handling of Traffic Installations During Road Works.

PRE.C9.1620.9 DUTY OF CARE

Exercise the greatest care during the progress of work to avoid damage to or interface with any utility or other services, and ensure that no damage shall be done during excavation or any other work on the Site.

PRE.C9.1630.A PRELIMINARY INVESTIGATIONS

1. Requirements for detecting underground utilities before excavation:

a. Within 7 days from the date of the Letter of Acceptance, submit to the CM for approval the brand and model of an underground services detection equipment to be used for investigating the locations and depths of underground utilities as required under sub-clause (1)(b) below. The underground services detection equipment proposed must be suitable for the purpose of locating underground utilities which may normally be encountered in the execution of the Works;

b. Before any excavation including excavation for trial pits, use an Approved underground services detection equipment to locate underground utilities. The underground services detection equipment shall be operated and the results shall be analysed by a person who has the necessary expertise to undertake the detection and analysis;

c. Take notice of the limitation of using any method of detecting underground services by non-destructive means. Neither the Employer nor the CM shall be responsible whatsoever for any unsuitability of the Approved underground services detection equipment or for the failure of detecting any underground services accurately.

2. Before excavations are carried out near utility services by means of mechanical plant, carry out full and adequate preliminary investigations to locate utility services by means of hand-dug trial holes;

3. Should any cables, ducts and or cover tiles be exposed, the respective Utility Undertakings should be contacted to determine if all the services have been located;

4. The ducts and cover tiles should only be removed directly by the Utility Undertakings concerned;

5. Bear the cost of all investigations arising from the requirements of this clause.

PRE.C9.1640.9 LOCATION OF UTILITY SERVICES

1. Details and extent of existing services and installations, and future services and installations likely to be carried out by the Utility Undertaking are prepared from the information provided by the Utility Undertaking and are shown on the Drawings;

2. No warranty either expressed or implied can be given for the accuracy of the information provided;

3. Neither the Housing Authority nor its agents accept any responsibility whatsoever for the accuracy of the Drawings or for the information contained thereon and the Contractor shall be deemed to have made such further enquires and investigation as are required for his own information.

PRE.C9.1650.A IDENTIFICATION OF SERVICES

1. After the utility services or drains have been located, request the concerned Utility Undertakings or Government departments to inspect and identify the services or drains by giving at least 3 days notice;

2. Carry out and complete such enquiries and investigations immediately after the notified date for commencement of the Works;

3. Existing services that are known to be within the Site are referred to in PRE.C3.110 and are to be maintained throughout the period of the Contract unless shown on the drawings to be sealed, removed or abandoned.

PRE.C9.1660.9 ALTERATIONS TO SERVICES

Where alterations to services are necessitated by the Works, no adjacent work will be commenced until the alterations have been made.

PRE.C9.1670.9 SAFE KEEPING OF EQUIPMENT

1. Be responsible for the safe keeping and protection of any controllers, cables or other equipment connected with traffic light installations within the Site;
2. The installation, maintenance, removal and resiting of permanent traffic light installations will be arranged by the Housing Authority.

PRE.C9.1680.9 MAINTENANCE OF DRAINAGE SYSTEM

Be responsible for adequately maintaining the existing drainage system at all times including removal of solids in sand traps, manholes and stream beds. (See also PRE.C9.1150 to PRE.C9.1200 inclusive).

PRE.C9.1690.9 RESPONSIBILITY FOR DAMAGE TO SERVICES

1. Be responsible for any such damage caused by the Contractor or his agents directly or arising indirectly from anything done or omitted to be done;
2. Should damage occur, report it to the CM immediately and shall contact the appropriate Utility Undertaking to arrange for any remedial work necessary to be carried out in a manner approved by the CM;
3. Carry out all temporary works necessary to adequately support and protect such services;
4. Bear all costs associated with damage caused to the services.

PRE.C9.1700.9 EXCAVATION BY HAND

If, in the CM's opinion, damage may be caused by the operation of mechanical plant over or adjacent to any utility services, the Contractor shall be required to excavate by hand in their vicinity. The rates in the contract shall include for such hand excavations.

CONTRACTOR'S SUPERINTENDENCE

PRE.C9.1810.9 GENERALLY

Provide the services of the superintendents listed in PRE.C6.060 in pursuance of GCC Clause 5.8(1) and as specified in the following clauses in this sub-section. Safety training requirements of respective superintendents are specified in the clause PRE.C9.1980.

PRE.C9.1820.9 AUTHORISED REPRESENTATIVE

1. Duties:

   The Authorised Representative shall be vested with adequate authority to receive and carry out the directions and instructions of the CM. He shall be an English-speaking representative who shall be in full time attendance on the Contract. To underpin implementation of the safety plan, the Authorised Representative is at duty to assist in promoting the safety and health of personnel employed on Site, which shall include but are not limited to:

   a. Supervise the observance of safety standards by the workers;
   b. Carry out daily safety inspection;
   c. Promote safety-at-work in carrying out work on Site;
   d. Attend Site Safety Committee meetings;
   e. Conduct tool-box talks as necessary.

2. Qualifications:

   The Contractor's Authorised Representative shall be a Member of one or more of the following or otherwise suitably qualified to the satisfaction of the CM:

   a. The Institution of Civil Engineers (UK);

   b. The Institution of Structural Engineers (UK);

   c. The Institution of Professional Engineers (New Zealand);

   d. The Hong Kong Institution of Engineers.

PRE.C9.1830.A LAND SURVEYORS

1. Duties:

   Provide the services of a Land Surveyor full time on Site for setting out the works. He shall be authorised to receive from the CM all survey data relevant to the Contract.

2. Qualifications:

   The Land Surveyor shall be competent and experienced and shall possess a diploma / higher certificate in land surveying or a higher diploma in geomatics from a Hong Kong technical institute / polytechnic or university; or an associate membership of the Hong Kong Institute of Surveyors in the Land Surveying Division; or equivalent qualification appropriate to the nature of the survey work required for the Contract, plus a minimum of 2 years of relevant experience in engineering surveying.

3. Facilities:

   Ensure that all necessary equipment and labour for setting out is available when required.

PRE.C9.1840.A ENGINEERING GEOLOGIST(S)

1. Duties:

   Provide the services of ..... No. Engineering Geologist(s) full time on Site whose duties shall include:

   a. Preparing geological logs of drillholes, exploratory pits, excavation faces of caissons and rock and soil faces; keeping photographic records of same; preparing geological sections and reports to the CM, as directed by the CM;

   b. Monitoring behaviour of rock and soil slopes by means of geotechnical instrumentation; collection and presentation of data to the CM, as directed by the CM;

   c. Observing and recording the geological characteristics of the excavated material, all as directed by the CM;

   d. Monitoring behaviour of groundwater on the Site by observing and recording surface flows, piezometers, and flows from any raking drains; collection and presentation of data to the CM, as directed by the CM;

   e. Observation and recording of rock mass characteristics by means of discontinuity surveys; selection of samples for testing; rock and soil slope stability and stabilisation works analyses; presentation of data and reports to the CM as directed by the CM;

   f. Design and sketch stabilisation works using personal computers and Approved computer software, as directed by the CM;

   g. Collection and analysis of data relating to effects of blasting procedures on condition of rock berms and faces and report to the CM, as directed by the CM;

h. Ensuring adequate field supervision and procedural correctness of rock and soil slope protection and stabilisation works, as directed by the CM. Assessing the stability of boulders and recommending the types of stabilisation works to the CM;

i. Liaising with the CM on all aspects of the engineering geology and geotechnical works;

j. Certifying the accuracy, correctness, and completeness, of all geotechnical information supplied to the CM by the Contractor;

k. Keeping a detailed record of all aspects of the geotechnical works carried out on Site and reporting to the CM weekly.

2. Qualifications:

The Engineering Geologists shall be competent, English speaking, with a degree from a Hong Kong or British University or Government-approved equivalent in civil engineering, engineering geology, geotechnical engineering, or applied geology, with at least four years geotechnical field experience in Hong Kong.

3. Facilities:

a. Provide all necessary labour, technical assistance, draughting assistance and equipment to the Engineering Geologist to allow him to carry out the above work;

b. Because of the technical nature of this supervision and the necessity to work closely with the CM's Geotechnical Engineer, the Engineering Geologist shall be accommodated in the CM's site office.

PRE.C9.1850.A BLASTING CONTROL ENGINEER

1. Duties:

Provide the services of a Blasting Control Engineer full time on Site during rock excavation operations. The Blasting Control Engineer's duties shall include:

a. Preparing a Blasting Assessment for comment by the Geotechnical Engineering Office before commencement of any rock blasting works;

b. Notifying the CM of the Contractor's blasting proposals in accordance with the appropriate clauses in Worksection EAR2 and certifying in writing to the Contractor's Representative that all such requirements have been complied with prior to each blast. This certification shall be copied to the CM at least one hour before each blast;

c. Acting as an intermediary with the Mines Division, Civil Engineering Development Department;

d. Advising the Contractor on and vetting the techniques for Controlled blasting, such as pre-splitting, smooth blasting, etc., with particular reference to the preservation of high quality rockslope faces and the minimizing of necessary protection works;

e. Advising on all aspects of blasting safety and in particular prevention of flying rock;

f. Monitoring effects of blasting on adjacent property and recommending improvements to the blasting techniques used where necessary.

Compliance with this sub-clause shall not relieve the Contractor of his general obligations regarding blasting elsewhere in the Specification.

2. Qualifications:

The Blasting Control Engineer shall be competent, English-speaking, from an Approved independent agency, and shall be qualified to the satisfaction of the CM and experienced in Bulk and Controlled blasting.

PRE.C9.1860.9 INDEPENDENT DIVING SPECIALIST

1. Duties:

   Provide the services of an independent Diving Specialist. He shall be full-time on Site during the seawall construction and ..... He shall inspect all underwater works and the jointing of the precast box culvert units including taking colour submarine photographs and preparing inspection reports to the CM, as directed by the CM.

2. Qualifications:

   The independent Diving Specialist shall be suitably qualified to the satisfaction of the CM.

3. Facilities:

   Provide all necessary equipment including a submarine camera, safety equipment, underwater communication system and a surface decompression chamber where necessary to the independent Diving Specialist to allow him to carry out the above works. Provide qualified operators and these persons shall standby during diving operations.

PRE.C9.1870.9 INDEPENDENT ENVIRONMENTAL CONSULTANT

Provide the services of an independent environmental consultant to conduct the water quality monitoring works as specified in Worksection MAR. Provide also all works boats, labour and other resources to the independent environmental consultant necessary to carry out the above works.

PRE.C9.1880.A QUALITY CONTROL ENGINEER

1. Duties:

   The Contractor shall provide the full time services of a Quality Control Engineer. The Quality Control Engineer's duties are:

   a. To ensure that all the material and tests comply with the Specification and Drawings;

   b. To inspect work and to certify that it is in accordance with the Specification and Drawings before seeking the CM’s Approval to covering up under GCC Clause 7.3(2);

   c. To endorse all delivery vouchers, testing instructions and analysis of testing results.

      The Quality Control Engineer's endorsement under sub-clause (1)(c) above should state that the materials delivered and constructed and/or testing and/or analysis of testing results conform with the Specification and Drawings.

   d. To play the role of competent engineer under the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department;

2. Qualifications:

   a. The Quality Control Engineer shall be competent, English-speaking and qualified in accordance with the following requirements and appropriately experienced to carry out the duties specified in the Contract;

b. The Quality Control Engineer, shall have a minimum of ..... years' working experience on construction sites of which ..... years must be spent in ..... construction works, and hold one of the following qualifications:

i. MICE or MHKIE; or

ii. A degree/higher diploma in civil or structural engineering from a Hong Kong or British University or Government recognised tertiary educational institution.

c. The Quality Control Engineer shall possess the following qualifications and experience:

i. Registered Professional Engineer under the Engineers Registration Ordinance in the Geotechnical or Civil discipline (and also in the Structural discipline if structural works are required) plus at least 5 years of relevant experience in site investigation, design and construction of trenchless or underground excavation works.

PRE.C9.1881.N COMPETENT PERSON FOR HAND-DUG TUNNELLING WORK

1. The qualifications and experience of the competent person shall be as follows:

a. Safety officer registered under the Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations; or

b. A person certified by Labour Department as competent to prepare risk assessment reports;

c. Possessing at least one year's relevant experience, after obtaining the registration or certificate from Labour Department, in assessing risk to the safety and health of workers working in confined space;

2. The competent person shall carry out the responsibility stipulated in the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department.

PRE.C9.1882.N INDEPENDENT CHECKING ENGINEER FOR HAND-DUG TUNNELLING WORK

1. The qualifications and experience of the Independent Checking Engineer (ICE) shall be as follows:

a. Registered Professional Engineer under the Engineers Registration Ordinance in the Geotechnical or Civil discipline (and also in the Structural discipline if structural works are required) plus at least 5 years of relevant experience in site investigation, design and construction of trenchless or underground excavation works;

2. The ICE shall carry out the responsibility stipulated in the Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department;

3. The ICE shall possess the experience stipulated in EAR1.D010 and shall carry out the responsibility detailed in EAR1.D050.

PRE.C9.1890.A COMPACTION CONTROL ENGINEER

1. Duties: Be full-time on Site during fill slope construction works and:

a. Supervise and control the quality of all slope filling and compaction works to ensure their compliance with the requirements of the contract;

b. Supervise all testing associated with the filling and compaction works;

c. Prepare the monthly reports, covering assessment, "as-built" plans and sections and testing records specified in EAR1.W2410.

2. Qualifications

The Compaction Control Engineer shall:

a. Be a Member of either The Hong Kong Institution of Engineers (Civil or Geotechnical Engineering Discipline) or The Institution of Civil Engineers (UK); or

b. Hold a degree or higher diploma in civil engineering from a Hong Kong or British University or other Government recognised tertiary educational institution, plus a minimum of four years' relevant experience in civil or geotechnical engineering works.

PRE.C9.1900.9 REGISTERED STRUCTURAL ENGINEER (RSE)

1. Duties: to design, supervise and control all temporary works for earthworks, excavation, dewatering and any specified design and built items. Details are given in Worksection EAR1. Design Section;
2. Qualifications: Registered with the Building Authority as a Registered Structural Engineer and has relevant experiences to the satisfaction of the CM;
3. The RSE shall utilise standard forms (EPS-F3 and EPS-F4 in APPENDIX PRE.C9/III to this Worksection) when submitting all items requiring his certification;
4. Where off-site fabrication of structural steelwork is proposed by the Contractor, the Registered Structural Engineer shall carry out the responsibility detailed in STW.W1130.

PRE.C9.1902.9 REGISTERED GEOTECHNICAL ENGINEER (RGE)

1. Duties: to prepare and sign the geotechnical report and supporting documentation to support the Contractor's submissions made by the Design Certifying Consultant/Registered Structural Engineer for the following works;
   a. Excavation and Lateral Support Works as stated in EAR1.D030;
   b. Foundation works as stated in the Worksection PIL;
   c. Demolition works as stated in the Worksection DEM.
2. Qualifications: Registered with the Building Authority as a Registered Geotechnical Engineer and has relevant experiences to the satisfaction of the CM;
3. The RGE shall utilise standard forms (EPS-F3 and EPS-F4 in APPENDIX PRE.C9/III to this Worksection) when submitting all items requiring his certification;
4. The RGE shall verify that the conditions on Site are consistent with assumptions made in the geotechnical report and supporting documentation prepared by him;
5. The division of responsibilities between RSE and RGE shall be in accordance with PNAP APP-141.

PRE.C9.1903.B ENVIRONMENTAL MANAGER (EM)

1. Appoint a person as the EM working on Site to provide professional advice to the Contractor and overseeing all Environmental Management and Site Hygiene matters of the Works and include but not limited to the following duties:
   a. Prepare, implement and update the Environmental Management Plan;

b. Advise on measures to be taken to comply with legislative and contractual obligations under environmental protection, waste management and site hygiene and implement such measures;

c. Liaise on all matters relating to environmental and site hygiene monitoring;

d. Conduct periodic inspections of the Site for identifying potential hazards to the environment and deficiencies in site hygiene, and recommend corrective actions as necessary;

e. Attend to enforcement actions taken by the Environmental Protection Department, Food and Environmental Hygiene Department, and other enforcing departments on matters relating to site environment and hygiene;

f. Attend to public complaints and coordinate remedial actions;

g. Oversee all the environmental performance on the Site and ensure that any polluting or potentially polluting situation is promptly rectified;

h. Organize and attend Environmental Management and Site Hygiene meetings;

i. Compile monthly environmental report for submission to the CM at least five working days before such meetings;

j. Advise on the implementation of an environmental management system; waste disposal, trip ticketing and other enhancement measures;

k. Arrange and provide environmental training including site specific induction training and toolbox talks for all Site Personnel, and to organize environmental promotional activities;

l. Prepare the documentation to support the Contractor's submissions under the Housing Authority's incentive schemes in respect of environmental and site hygiene items;

m. Monitor the maintenance of cleanliness and tidiness on Site;

n. Oversee the proper maintenance of amenity facilities by dedicated workers stated in clause PRE.C9.2440 on the Site;

o. Oversee the implementation of the Construction Noise Management Plan (CNMP) / updated CNMP stated in PRE.C9.855.

Option 1

2. The minimum qualification of the EM or the person providing the services of an EM under sub-clause (1) above shall be as follows:

a. Degree in Environmental Discipline (Environmental Science, Environmental Engineering, Environmental Studies or Environmental Management); or

b. Degree in construction related discipline and having satisfactorily completed a certificate course in environmental management by a local or overseas tertiary education institute; or

c. A corporate member of the Hong Kong Institution of Engineers (HKIE) in Environmental Discipline or equivalent; or

d. A full member of the Hong Kong Chartered Institute of Water and Environmental Management; or

e. A professional member of the Hong Kong Institute of Qualified Environmental Professionals; or

f. A corporate member of a professional institution other than those as mentioned in (c) to (e) above and EITHER having at least 3 years working experience in construction / project management with environmental management content OR in possession of a diploma or above in environmental studies or environmental engineering awarded by a local or overseas tertiary educational institution.

Option 2

2. The minimum qualification of the EM or the person providing the services of an EM under sub-clause (1) above shall be as follows:

   a. A corporate member of the Hong Kong Institution of Engineers (HKIE) in Environmental Discipline or equivalent; or

   b. A full member of the Hong Kong Chartered Institute of Water and Environmental Management; or

   c. A professional member of the Hong Kong Institute of Qualified Environmental Professionals; or

   d. A corporate member of a professional institution other than those as mentioned in (a) to (c) above and EITHER having at least 3 years working experience in construction / project management with environmental management content OR in possession of a diploma or above in environmental studies or environmental engineering awarded by a local or overseas tertiary educational institution.

PRE.C9.1904.9 ENVIRONMENTAL SUPERVISOR (ES)

1. Appoint an ES working full time on Site to assist EM on the inspection, supervision and monitoring of the environmental and hygiene performance of the Works. The ES's duties include but not limited to the following:

   a. Assist the EM in carrying out his duties;

   b. Carry out routine inspections of the Site for identifying potential hazards to the environment and deficiencies in site hygiene, report findings with recommendations for corrective actions; and ensure that follow-up action is taken promptly to rectify defects;

   c. Supervise and monitor all the environmental performance on the Site; check and ensure that any polluting or potentially polluting situation is promptly rectified;

   d. Advise EM on the up-keeping of environmental performance and hygiene standards of the Site;

   e. Supervise and promote the execution of environmental protection and hygiene works by the workers on the Site;

   f. Organize site-based environmental protection and hygiene promotion awards and promotional activities as prescribed under the Integrated Pay for Safety, Environment and Hygiene (IPSEHS); and

   g. Supervise the dedicated workers stated in clause PRE.C9.2440 in the proper maintenance of amenity facilities on the Site.

2. The qualification and experience of ES shall be as follows:

   a. A person in possession of a higher diploma or a higher certificate in construction related discipline or environmental studies or environmental engineering awarded by a local or overseas tertiary educational institution, plus 3 years' working experience with a minimum of one year in working experience in environmental related work; or

b. A person in possession of a higher diploma or a higher certificate in construction related discipline and has satisfactorily completed the "Environmental Protection Course for Environmental Supervisors" organized by CIC, IVE or equivalent.

PRE.C9.1905.9 CONTRACTOR'S LABOUR OFFICER (CLO)

1. The qualifications and experience of the CLO shall be as follows:
   a. Completed Secondary 5 or equivalent; and
   b. Well versed in Hong Kong Employment Ordinance & relevant labour legislation; and
   c. Good command of both oral and written English and Chinese; and
   d. Good knowledge and experience of the operation and practices of the construction industry is preferable; and
   e. Good computer knowledge preferably with past experience on the operation of a computerized smart-card system; and
   f. 2 years' full-time working experience on personnel management or human resources related duties; or Post-secondary qualification in Human Resources or Personnel Management is preferable.
2. Within 7 days from the notified date for commencement of the Works, the Contractor shall nominate at least ..... numbers of Contractor's Labour Officer (CLO) for CM's approval. The nominated CLO(s) when approved shall work on-site and responsible for monitoring the payment of wages and MPF contributions. The CLO(s) shall provide all necessary assistance to the Labour Relations Officer in the monitoring process and in the handling of complaints on arrears of wages and MPF contributions raised by any Site Personnel;
3. The provision of CLO shall be maintained for the duration of the Contract and at least 2 months after the month in which the operation of ACRS is terminated as stipulated in PRE.C9.2560, and within the period the Contractor is required to keep the wage books as stipulated in PRE.C9.140;
4. The CM shall have the power to withdraw his approval of the CLO at any time. If such approval shall be withdrawn the Contractor shall, after receiving notice in writing of such withdrawal, remove the CLO from the Site forthwith and shall replace him by another CLO approved by the CM.

PRE.C9.1910.9 CONTRACTOR'S EMPLOYEES

1. The Contractor and his subcontractors shall comply with the Construction Workers Registration Ordinance (Cap. 583), in particular with respect to the requirements that only registered skilled / semi-skilled workers are employed to carry out construction works of those designated trade divisions set out in the Ordinance unless under the conditions specified in the Ordinance which exempt the above requirements;
2. Further to GCC Clause 5.9(1), the following qualified workers shall have acquired the respective qualifications:
   a. “Skilled Worker” is a registered skilled worker or registered skilled worker (provisional) as respectively defined in section 2(1) of the Construction Workers Registration Ordinance (Cap. 583);
   b. “Semi-skilled Worker” is a registered semi-skilled worker or registered semi-skilled worker (provisional) as respectively defined in section 2(1) of the Construction Workers Registration Ordinance (Cap 583).

3. For complying with GCC Clause 5.9(1)(c), the Contractor or his subcontractors shall employ the minimum number of Skilled and Semi-skilled Workers calculated in accordance with the stated percentages of the total workforce on Site at any time in each of the following specified trade divisions. For the purpose of this sub-clause, the term "total workforce" means the total number of workers of the relevant trade division but excluding Workers under Instruction as provided for under sub-clause (4) below, workers working across designated trade divisions pursuant to section 3A of the Construction Workers Registration Ordinance (Cap. 583) and workers carrying out exempted construction work pursuant to section 63A of the Construction Workers Registration Ordinance (Cap. 583):

Trade division	Requirement of combined percentage for Skilled and Semi-skilled Workers	Max. permissible percentage of Semi-skilled Workers
Waterproofing Worker (C301)	100%	0%
Bamboo Scaffolder (C303)	100%	15%
Bar Bender and Fixer (C304)	100%	15%
Bricklayer (C305)	100%	15%
Carpenter (Formwork)(C307)	100%	15%
Concretor (C309)	100%	15%
Construction Plant Mechanic (C310)	100%	15%
Drainlayer (C314)	100%	15%
General Welder (C318)	100%	15%
Ground Investigation Operator / Driller / Borer (C320)	100%	0%
Joiner (C322)	100%	15%
Leveller (C323)	100%	15%
Marble Worker (C324)	100%	15%
Metal Scaffolder (C327)	100%	15%
Metal Worker (C328)	100%	15%
Painter and Decorator (C329)	100%	15%
Piling Operative (C330)	100%	0%
Pipelayer (C331)	100%	0%*
Plant and Equipment Operator (Piling) (C335)	100%	0%
Plasterer (C337)	100%	15%
Plumber (C338)	100%	15%
Tiler (C347)	100%	15%
Window Frame Installer (C350)	100%	15%

* Semi-skilled worker is not available in this trade division.

4. The Contractor and his subcontractors shall follow the latest "Guidelines on Arrangement of Instruction and Supervision and Code of Practice for Reasonable Measures of Instruction and Supervision" published by CIC and implement reasonable measures regarding the arrangement for workers not registered under the relevant trade division (i.e. "Workers under Instruction") to carry out construction work of such trade division under instruction and supervision pursuant to section 4 of the Construction Workers Registration Ordinance (Cap. 583);
5. Complete a return for workers for each trade division prescribed under sub-clause (3) above, giving details of the personal particulars of each of such workers employed, and deliver it together with the returns submitted by the Nominated Sub-contractors to the CM in accordance with GCC Clause 5.25(3):
    a. Obtain the format of the return from the CM;
    b. The return is to be completed in respect of:
        i. The workers which include Skilled Workers, Semi-skilled Workers, Workers under Instruction, workers working across designated trade divisions and workers carrying out exempted construction work for each trade division employed on the fifteenth (15) day of each month, or in the event of the fifteenth (15) day being a General Holiday on the working day immediately following the General Holiday;
        ii. The average number of workers which include Skilled Workers, Semi-skilled Workers, Workers under Instruction, workers working across designated trade divisions and workers carrying out exempted construction work for each trade division per day employed in the preceding week.

PRE.C9.1920.9 GENERAL FOREMAN

1. Appoint a General Foreman constantly on Site who must have a minimum of 7 years site experience of which four years must have been spent in relevant piling works as a site supervisory staff;
2. Part of the duties of the General Foreman are to assist in promoting the safety and health of personnel employed on Site which shall include but are not limited to:
    a. Supervise the observance of safety standards by the workers;
    b. Carry out daily safety inspection;
    c. Promote safety-at-work in carrying out work on Site;
    d. Attend Site Safety Committee meetings;
    e. Conduct tool-box talks as necessary.
3. The General Foreman shall have attended and completed the Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by the Occupational Safety and Health Council or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by the Construction Industry Council. Acceptance of training provided by other organizations is subject to verification that the training is based on course contents of equivalent or above standards and the appointed superintendent has attained the associated qualification;
4. Submit for Approval within seven days from the notified date for commencement for the Works, the name(s), qualifications and experience of general foreman.

PRE.C9.1930.9 AUTHORIZED SIGNATORY (AS)

1. The qualification and experience of the AS shall be as required under the Buildings Ordinance, in particular, the requirement stated in the Practice Note for Registered Contractors (PNRC) No. 38, the CoPSS, and other relevant PNRCs issued by the BD;
2. The AS shall carry out the duties in the SP stated in clause PRE.C9.2010 and other relevant requirements.

PRE.C9.1950.9 DESIGN CERTIFYING CONSULTANT

1. Select a consultant on the Architectural and Associated Consultants Selection Board's (AACSB) List of Structural Engineering Consultants for CM's approval as the Design Certifying Consultant;
2. Duties: to certify all layouts, details and calculations submitted to the CM. The submissions must be signed by a Director of the Design Certifying Consultant, who must be a Registered Structural Engineer registered with the Building Authority;
3. The Design Certifying Consultant shall utilise standard forms (EPS-F3 and EPS-F4 in APPENDIX PRE.C9/III to this Worksection) when submitting all items requiring his certification.

PRE.C9.1965.9 TECHNICALLY COMPETENT PERSONS (TCP) FOR SP

1. Appoint one or more TCP of the grade and with qualification and relevant experience specified in the TMSP and CoPSS for various types of works as required under the SP, to carry out the duties as specified in the SP;
2. Subject to the CM's approval, one TCP may be assigned to cover the duties and responsibilities of more than one role provided that:
   a. The TCP who is appointed satisfies the requirements of the highest grade of TCP specified;
   b. The TCP undertakes inspections at a frequency not less than the frequency derived in accordance with the documents stated in sub-clause (1) above.
3. Notify the CM immediately if there is any subsequent change of the TCP during the course of services.

PRE.C9.1970.9 TECHNICAL DIRECTOR (TD)

1. The qualification and experience of the TD shall be as required under the Buildings Ordinance, in particular, the requirements stated in the PNRC No. 38, and other relevant PNRCs issued by the BD;
2. The TD shall be authorized by the Contractor to:
   a. Have access to plant and resources;
   b. Provide technical and financial support for the execution of the Works; and;
   c. Make decisions for the company and supervise the AS and other personnel.
3. The TD should not be the same person as the AS in PRE.C9.1930.

PRE.C9.1980.A MANDATORY SAFETY TRAINING FOR APPOINTED SUPERINTENDENTS

1. Appointed superintendents, namely, Authorised Representative, Quality Control Engineer (QCE), Blast Control Engineer, Authorized Signatory (AS), Technically Competent Person (TCP) Grade T4 to T5 for SP and Environmental Manager (EM) shall have attained the following mandatory safety training qualification:

a. Safety Training Course for Site Management Staff (nominal course duration 27 hours) provided by the Construction Industry Council or Occupational Safety & Health Council or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

b. Those appointed superintendents having completed a Safety Training Course for Site Management Staff Certificate provided by the CIC or the OSHC or equivalent training organization for 5 years or above shall complete the Safety Training Refresher Course for Site Management Staff (nominal course duration 7 hours) provided by the CIC or the Safety Training Course for Site Management Staff (Refresher) (nominal course duration 7 hours) by the OSHC or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard.

2. Superintendents can be exempted from certain modules of the Safety Training Course for Site Management Staff by fulfilling the exemption criteria laid down by the Construction Industry Council or Occupational Safety & Health Council;

3. Appointed superintendents, namely, Technically Competent Person (TCP) Grade T1 to T3 for SP and Environmental Supervisor (ES) shall have attained the following mandatory safety training qualification:

a. Safety and Health for Supervisors (Construction) Course (nominal course duration 43 hours) provided by the Occupational Safety and Health Council or Construction Safety Supervisor Course (nominal course duration 43 hours) provided by the Construction Industry Council or equivalent training provided by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard;

b. Those appointed superintendents having completed the mandatory safety training for 4 years or above shall complete the Enhancement Course for Construction Safety Supervisors (nominal course duration 12 hours) provided by CIC or the Enhancement Course for Safety Supervisors (Construction) (nominal course duration 12 hours) by the OSHC or equivalent training by other organizations subject to verification that the equivalent training is based on course contents of equivalent or higher standard.

4. The appointed superintendents as per in sub-clauses (1) and (3) above who have attained or once attain the stipulated training qualification shall participate and give advice in Induction Training and Tool Box Talks to enrich the knowledge of personnel of particular trades.

SITE ORGANISATION AND SUPERVISION PLAN

PRE.C9.2010.9 SUBMISSIONS OF ORGANISATION CHART AND SP

1. Submit to the CM for approval within seven days from the notified date for commencement of the Works, and re-submit any change for the CM's further approval, the following:

a. Site organisation chart including the names of the project director, the Contractor's superintendents as required in PRE.C9 and safety officer;

b. Names of sub-contractors for foundation works, if any, including the names of the project directors, Authorized Signatory, Technical Director, TCPs and site representatives of sub-contractors;

c. Written declaration together with supporting documents (e.g. employment contract, bank payroll record, MPF contribution record) stating that the Contractor's Management Team and the Contractor's superintendents as required in PRE.C6.060 and other personnel as shown on the site organisation chart are directly employed by the Contractor. The employment terms for the Contractor's Management Team and the Contractor's superintendents shall include a "consent to disclosure" clause in accordance with the data protection principles set out under the Personal Data (Privacy) Ordinance (Cap. 486). Personal data (e.g. HKID number, salary amount) within the supporting documents can be blanked out or covered up when submitted by the Contractor.

2. Submit a SP for Site Formation Works to the CM at least 22 days before the commencement of the Site Formation Works as follows:

   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;

   b. Complete and submit Form ICU 206 for the SP.

3. Submit a SP for the foundation works to the CM at least 22 days before commencement of the foundation works:

   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;

   b. The supervision provided by the RSC(F) shall cover all stages of works stated in the above documents, including those works required to be carried out by the RSC(GIFW) as stated in PIL1.G460 & PRE.C2.110;

   c. Complete and submit Form ICU 206 for the SP.

4. Submit a SP for ELSW to the CM at least 22 days before the commencement of the ELSW as follows:

   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;

   b. Complete and submit Form ICU 206 for the SP.

5. Submit a SP for GIFW to the CM at least 22 days before the commencement of the GIFW as follows:

   a. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;

   b. Complete and submit Form ICU 206 for the SP.

PRE.C9.2020.9 PROBITY AND CODE OF ETHICS

1. The Contractor shall submit to the CM a company code of ethics and associated code of conduct similar to the probity and integrity requirements in the "Sample Company Code of Ethics for Hong Kong Housing Authority Contractors" and "Sample Code of Conduct for Directors and Staff Members of Hong Kong Housing Authority Contractors / Service Providers" in APPENDIX PRE.C9/VII to this Worksection;

2. The Contractor shall uphold its company code of ethics and associated code of conduct and shall also ensure its employees, sub-contractors, suppliers and agents to comply with the same probity and integrity requirements as stated in the company code of ethics and code of conduct in execution of the Works.

SITE ADMINISTRATION

PRE.C9.2110.9 NORMAL WORKING HOURS

Normal working hours of the Contract shall be the period between 08.00 and 17.00 of the same day. The CM shall be informed in advance when the Contractor intends to carry out work outside normal working hours and no such work shall be carried out without Approval.

PRE.C9.2120.9 NOTIFICATION OF OPERATIONS

1. The site inspection system for the Works shall be in accordance with the sub-clauses (2) to (5) below except for mainlaying works which should be as Worksection WSP;
2. Further to GCC Clause 7.3, the Works will be subjected to a formalized system of written application for inspection and approval. The format of the proforma to be used is to be proposed by the Contractor for the Approval of the CM;
3. Further to any other notification required under the Contract, submit to the CM a written application for inspection and Approval at least 24 hours, or longer if so instructed, before any works are to be covered up or put out of view. In the case of weekend working the Contractor must give notice to the CM at the latest 12 o'clock noon on the previous Thursday with regard to works which he intends to carry out on the following Saturday or Sunday. Forty-eight hours notice, or other such period as agreed by the CM, shall be given where it is intended to carry out work immediately following a General Holiday;
4. Notwithstanding the requirements of sub-clause (3) above the CM shall at his absolute discretion have the right to withhold permission for the Contractor to carry out certain works after 12 o'clock noon on Saturdays, and on General Holidays;
5. In addition to the above, submit to the CM at the end of each day (and on Friday for each weekend) a detailed list of the work to be carried out the next day. This shall include exact locations, nature of each operation, and time when the work is to be carried out to enable CM's staff to attend for the purpose of examining such work;
6. Should any work not be examined as a result of the Contractor failing to take action in accordance with sub-clauses (3), (4) and (5) above, then it will be treated as having been done without the Approval required by GCC Clause 7.3.

PRE.C9.2130.9 ESTIMATED LABOUR AND PLANT RESOURCES

1. The estimated monthly labour and plant resources for the whole contract period shall be submitted with the programme submitted under GCC Clause 5.7;
2. Within two months from the notified date for commencement of the Works, submit to the CM a forecast of all the estimated monthly interim statements to be submitted by the Contractors pursuant to GCC Clause 14.1(1);
3. The forecast of the estimated monthly interim statements shall be based upon the Contractor's programme submitted in accordance with GCC Clause 5.7.

PRE.C9.2140.9 MONTHLY PROGRESS REPORTS

1. Furnish to the CM written progress reports at monthly intervals at the end of each Contract month;
2. The monthly progress reports shall be submitted in duplicate and shall include a schedule of the labour and plant resources employed during the previous month;

3. The monthly reports shall be related to the programme provided according to PRE.C6.050 and shall also include a schedule of those activities carried out in the previous month and those activities to be carried out in the following three months showing actual or forecast start and finish times, total and free float and variance against the programme for all activities;
4. Critical activities shall be clearly marked and any critical activities which have not started or finished on time shall be noted;
5. The monthly progress reports shall include revised bar charts and a revised network whenever the logic of the network is changed;
6. The Contractor shall indicate what steps he proposes to make to recover any time lost.

PRE.C9.2150.9 FORMS FOR CONTRACTOR'S MONTHLY INTERIM STATEMENTS

Monthly statements pursuant to GCC Clause 14.1(2) shall be submitted in the manner set out in Appendix ..... on forms to be provided by the Contractor. Such forms shall be printed or duplicated to the Approval of the CM as soon as practicable after the order to commence the Works has been given. Each statement shall be submitted to the CM through his representative, interim statements being in 3 copies and the final statement being in 4 copies.

PRE.C9.2160.9 PROGRESS PHOTOGRAPHS

1. Provide colour record progress photographs taken from the same vantage points at monthly intervals or as directed by the CM. Such photographs shall be sufficient in number and location to record the progress of the Works and one proof copy of each shall be supplied to the CM to allow him to select the photographs which in his opinion provide the best record;
2. Provide two prints of not less than 250 mm x 200 mm in size of each selected photograph in Approved hard cover ring-file type albums with clear plastic sleeves to accommodate the prints and provide the soft copy of such photographs. A label shall be provided for each photograph in the album clearly indicating the project title, the date the photograph is taken and the part of the works it shows. Prints of the selected photographs shall be signed and dated by the Contractor and the CM and these together with such soft copy and the albums shall become the property of the Housing Authority;
3. One set of photographs shall be taken to comprise 36 No. photographs selected by the CM and shall consist of three prints and the soft copy of each of such photographs;
4. Notwithstanding the above, additional progress photographs shall be provided by the Contractor of any part of the Works when considered necessary as directed by the CM. The cost of these photographs is covered in the Bills of Quantities;
5. Provide the progress photographs and corresponding soft copy to the CM not later than 2 weeks after filming;
6. The Contractor shall ensure that the soft copy or prints in his possession are not used by him or other parties without the CM's written permission and shall also ensure that all photography on the Site is authorised by the CM;
7. Upon completion of the Works, provide two sets of aerial photographs showing all the completed works. One set of these photographs shall comprise 36 No. of photographs selected by the CM and shall consist of three 8R size mounted prints and the soft copy each of such photographs.

PRE.C9.2170.9 STEEL BAR REINFORCEMENT RECORD PHOTOGRAPHS

Provide a photographic record comprising 3R or other Approved size colour prints of each stockpile of mild steel bars placed in each and every location in the Site. Such photographs shall be taken and furnished immediately to the CM twice daily at 9:00 a.m. and 6:00 p.m. for every stockpile of mild steel bars from the same vantage points for each stockpile or as directed by the CM.

PRE.C9.2180.9 DOCUMENTATION FOR STEEL BAR REINFORCEMENT

Submit to the CM the mill certificates and delivery receipts for each consignment of reinforcement. The mill certificates shall be certified by the supplier and the weighing certificates and the delivery receipts shall be certified by the Contractor.

PRE.C9.2190.9 PUBLICITY

Refer all requests from the press or from other media for information concerning the Works or the progress thereof directly to the CM.

PRE.C9.2200.9 GOVERNMENT PLANT

1. Be responsible for the protection, watching, lighting and safe custody of any Government equipment being used on the Works;
2. When Government equipment is hired to the Contractor, the Contractor will be required to enter into a formal agreement setting out the conditions of hire. The Contractor shall be responsible for the collection and transportation of the equipment from the place of issue to the Site and vice versa at his own expense;
3. Housing Authority and Government do not accept liability for any loss or damage caused or alleged to be caused to the Contractor, in the event of breakdown or non-availability of the equipment, due to unforeseen circumstances.

PRE.C9.2210.9 MATERIALS SUPPLIED BY HOUSING AUTHORITY

1. Materials supplied by Housing Authority from Government Supplies Department shall be supplied at ledger cost plus 20% in accordance with Stores Regulation 302 unless specifically provided for otherwise in the Contract;
2.
    a. Any materials so supplied shall be delivered to the Contractor either at ship, godown, Government stores or quarries on presentation of a requisition signed by the CM;
    b. The Contractor must satisfy himself at the time of taking delivery that all the stores stated in the requisition are handed over to him and that each article is in good condition;
    c. No claim for compensation after they have been removed from the ship, godown or stores can be entertained;
    d. Remove the whole of the articles to the Works and house them to the satisfaction of the CM in a proper store until such time as they are required for use in the Works.
3. The Contractor shall be held responsible for all stores issued to him by the CM and shall make good any damage or losses to the same, the value of such damage or loss being assessed by the CM and deducted from the Contract Manager's certificates for payment to the Contractor;
4. The cost of transport and storage of all such stores will be included in the appropriate rates in the Contract;

5. Where materials supplied by Housing Authority are delivered in crates or containers, dispose of such crates or containers as directed by the CM;

6. The Contractor shall prepare a schedule, in accordance with GCC Clause 5.7, of his programme for the estimated timing of taking delivery of materials to be supplied by the Housing Authority. The schedule shall be submitted to the CM within four weeks from the notified date for commencement of the Works.

PRE.C9.2220.A LABOUR RETURNS

1. Further to GCC Clause 5.25, enter daily, on a form provided by the CM, information in respect of labour employed on Site for the Works. Provide information for each of the separate classes of labour, including daily wages, and in accordance with any requirements of the CM and the Census and Statistics Department of the Government of Hong Kong Special Administrative Region. Three copies of the form shall be prepared and two completed forms shall be submitted to the CM. The remaining copy shall be retained by the Contractor;

2. For the purpose of completing the labour return, the individual trades shown in the left hand column below shall be considered as being equivalent to those appearing on the corresponding lines in the right hand column:

Trade	Equivalent Trade
Office Attendant	Labourer (unskilled) male or female
Watchman	Labourer (unskilled) male
Working Ganger	As an ordinary worker in the trade in which he is ganging, or failing this as a lorry driver
Survey Labourer	Contractor's Labourer (male)
Turf-layer	Contractor's Labourer (male)
Bitumen Macadam/Asphaltic Concrete Layer	Contractor's Labourer (male)
Shot-firer	Plasterer
Lorry Checker	Labourer (unskilled) male
Motor Driver (car/Van)	Truck Driver
Survey Leveller	Plumber
Welder	Painter
Coxswain, Barge Engineer	Truck Driver
Dredger crew, Barge Crew	Diver's Linesman

3. No requests from the Contractor for alterations in these equivalent trades will be entertained. Trades of supervisory staff shall not be considered.

PRE.C9.2225.N RETURN OF SITE LABOUR DEPLOYMENT AND EMPLOYMENT TO CENSUS AND STATISTICS DEPARTMENT

1. Submit the following site labour deployment/employment returns using prescribed forms to the CM for onward submission to Census and Statistics Department:

   a. Monthly Return of Site Labour Deployment and Wage Rates for Construction Works (Form GF527);

   b. Monthly Return on Construction Site Employment (Form GF527A);

   c. Quarterly Return on Employment Survey.

PRE.C9.2230.A CALIBRATION OF EQUIPMENT

1. Be responsible for the calibration of the equipment used for the Contract against the appropriate national standards upon commencement of the Works and the calibration will repeat at an interval as specified in PRE.C9.2240;
2. Ensure that the equipment are capable of the accuracy and precision necessary to carry out the inspection, measuring and test;
3. The calibration shall be carried out at the Contractor's own expense;
4. Each item of equipment shall be attached with an identification label and a calibration status label;
5. Calibration Certificates shall be provided as required;
6. Records of calibration results shall also be available at all times for inspection when requested by the CM;
7. Equipment items that are not calibrated at the required interval or found to be inaccurate after calibration shall not be allowed to be used in this Contract.

PRE.C9.2240.A EQUIPMENT CALIBRATION SCHEDULE

Description	Calibration Certificate upon Commencement of the Works	Calibration Interval
Total Station	Required	1 year
E.D.M.	Required	1 year
Level	Required	Two-peg test before use
Theodolite	Required	1 year
Levelling staff	Not required	1 year
Steel measuring tape	Required	1 year
Steel measuring tape, pocket size	Not required	1 year
Linen measuring tape	Not required	6 months
Steel carpenter level	Not required	Reversible test before use
Echo-sounder	Required	Bar-check before use, and annually by external agent.
Minimum/maximum thermometer	Not required	6 months
Sound level meter	Required	1 year, plus sound level calibrator check before and after use
Moisture tester	Required	6 months
Galvanizing check meter	Required	1 year
Vibration meter	Required	1 year

PRE.C9.2250.X DELETED

PRE.C9.2260.9 ENVIRONMENTAL PERMIT

1. Further to GCC Clause 5.23, conform in all respects with the conditions of the Environmental Permit, a copy of which is reproduced in Appendix ….....;
2. For the purpose of this Contract, the "Environmental Permit" means any environmental permit issued by the Director of Environmental Protection in respect of the Works or project which the Works form a part thereof under the Environmental Impact Assessment Ordinance (Cap. 499) including any variation of the environmental permit;
3. Be responsible for displaying a copy of the most updated Environmental Permit at the locations as stipulated under the Environmental Permit or as directed by the CM;
4. It is unnecessary for the Contractor to apply for and hold an Environmental Permit since he may rely on the Environmental Permit obtained by the Employer. Should for any reason the Contractor choose to apply for and hold an Environmental Permit he shall do so at his own risk and cost and it shall not form the basis of any claim for extension of time.

PRE.C9.2270.9 CONFIRMATION OF VERBAL INSTRUCTION (CVI)

1. In accordance with Clause 4.2(4) of the GCC, the Contractor shall give adequate notice in writing to the CM of any other Drawings or Specification that may be required for the execution of the Works. CVI is an interim measure for the CM and the Contractor to confirm construction details usually minor in nature, which have to be determined promptly for immediate resolution of construction problems encountered, in order not to affect the progress of works;
2. The Contractor shall use the standard template for CVI in APPENDIX PRE.C9/VIII when submitting CVI;
3. Any variation to the Works arising from the information in CVI shall be separately covered by written instruction by the CM with variation drawings incorporating changes confirmed by the CM;
4. If CVI involves abortive works, the Contractor shall use the standard template for Abortive Works Record Sheet in APPENDIX PRE.C9/IX for recording the abortive works and submit for the CM's checking;
5. CVI is not a notice of claims for extension of time or additional expenditure under the Contract and no time or cost claim shall be implied under CVI. Any such claim shall be submitted separately in accordance with the Contract provisions;
6. The Contractor shall use the standard template for CVI Summary Table for Monthly Site Meetings in APPENDIX PRE.C9/X to report the status of CVI in the site meeting;
7. Unless otherwise approved by the CM, the CVI, Abortive Works Record Sheet and CVI Summary Table for Monthly Site Meetings submitted by the Contractor shall be in accordance with the standard templates in APPENDIX PRE.C9/VIII, IX and X.

PRE.C9.2280.C DEVELOPMENT AND CONSTRUCTION SITE MOBILE SYSTEM (DCSMS)

1. The Development and Construction Site Mobile System (DCSMS) shall be adopted from a date within one month after the notified date for commencement of the Works to the date of six months after the date of certified completion of the Works. The Contractor shall login the DCSMS system with his HOMES accounts and use the following mobile application (App) and/or web application (Web), if applicable, of the DCSMS:

a. Safety Alert App and Web for reporting and recording accidents / incidents, and followed by submission of the completed documents to the CM;

b. Site Operation Module Web for agreement of Site Diary as referred to in GCC Clause 5.25(2), and submission of Contractor's Daily Report as stipulated in GCC Clause 5.25(3) and Monthly Labour Return as stipulated in sub-clause (1)(a) of PRE.C9.2225.

2. Ensure the availability of computer systems and/or mobile devices, if applicable, that connect to and login the DCSMS, and bear all costs for the computer systems, mobile devices and the connection of the computer systems and the mobile devices to DCSMS through web browser (internet connection). The mobile devices and computer systems shall fulfil the minimum requirements as specified in sub-clauses (3) and (4) below respectively;

3. The minimum requirements of the mobile devices to access DCSMS are tabled as follows:

a. Operating System	Android 6.0 or above Non-rooted
b. Screen Size	5.0 – 6.0 inches
c. Display	Resolution (pixel): 1920 x 1080 – 2560 x 1440 Capacitive and Multi-touch
d. Dimension	Height <= 6.5 inches Width <= 3.2 inches Thickness <= 0.4 inches
e. Weight	200 g or below
f. CPU	CPU core: 4 - 8 Frequency: 1.6 – 2.45 GHz
g. Memory (RAM)	3 – 6 GB
h. Memory (Storage: ROM)	32 – 64 GB
i. Primary Camera	Image Resolution: 12M – 16M pixel Features: Autofocus, Flash
j. Network	Cellular Network: 4G LTE 1800 / 2300 / 2600 UMTS 850 / 900 / 2100 GSM 900 / 1800 Wi-Fi: 802.11 b/g/n/ac or more Bluetooth: 4.0 or above
k. Tracking / Positioning	A-GPS
l. Battery	Can serve > 10 hrs (3G Talk time) Spare battery for battery detachable smartphone or External battery pack as required
m. Accessories	With protection case With Anti-glare Screen Protector

4. The minimum requirements of the computer systems to access DCSMS are tabled as follows:

a. CPU	Intel Core i5-650 3.20GHz or above
b. Memory	4 GB RAM or above
c. Hard disk	500 MB or above free space
d. Operation System	Microsoft Windows 7 or above
e. Browser	Microsoft Internet Explorer 11 or above

CONSTRUCTION WASTE MANAGEMENT

PRE.C9.2310.9 CONSTRUCTION WASTE MANAGEMENT - GENERAL

1. In executing the works, generate the minimum quantity of waste possible;
2. Of the inevitable waste that is generated, sort, salvage for re-use, or recycle on or off Site as much of the material as possible;
3. Minimize the disposal of waste material in landfills.

PRE.C9.2320.9 SPECIAL WASTE MANAGEMENT RESPONSIBILITIES

Be responsible for the following:

1. To ensure that all relevant legislation and the Contractor’s duty of care is complied with throughout the duration of the Contract;
2. To minimize waste:
   a. Adopt measures to ensure the proper planning of the Works;
   b. Avoid over ordering of materials;
   c. Avoid cross contamination of materials, either for use in the Works or for reuse or recycling;
   d. Minimize the use of timber in temporary work;
   e. Optimize the use of reusable metal formwork, falsework, trench supports and the like;
   f. Maximize the use of inert excavated material within the Site.
3. To coordinate waste management on Site, keep accurate records on waste movement on and off Site;
4. To ensure that all containers and storage areas are properly labelled;
5. To obtain a list of potential buyers or collectors of materials to be re-used or recycled;
6. Whenever possible (except when new materials are expressly specified), ensure re-use or recycling of material already on Site before it is carted away or new materials are imported;
7. To investigate potential re-use and recycling opportunities.

PRE.C9.2330.9 PACKAGING MATERIAL

Unwrap materials only when they are needed. Separate and store packaging material immediately after unwrapping. Return packaging materials to the supplier or his agent as stated in the Waste Management Plan. Where this is not possible, arrange for collection of the material by a recycling company. Such material may only be disposed of at landfill when it is demonstrated that recycling facilities are either not available, impractical or cost effective.

PRE.C9.2340.A ON-SITE SORTING OF C&D MATERIAL

1. Sort all C&D material arising from or in connection with the Works to recover the inert portion and other re-usable or recyclable material prior to disposal off-site. Unless otherwise stated in the Specification, all surplus C&D material shall become the property of the Contractor when it is removed from the Site;
2. Devise a system to sort C&D material on-site including the identification of the source of generation, estimated quantity, arrangement for on-site sorting and/or collection, sorting methodology, temporary storage areas, frequency of collection by the recovery/recycling contractors where specified in the Contract or frequency of removal off the Site;
3. All inert C&D material shall be sorted into:
    a. Hard rocks and large broken concrete reusable on the Site or disposable at a designated location as advised by CEDD;
    b. Metals;
    c. Paper and plastics;
    d. Reusable or recyclable material other than materials listed in sub-clauses (3)(a), (3)(b) and (3)(c);
    e. Chemical wastes and containers;
    f. Materials suitable for disposal at public fill reception facilities, sorting facilities and landfills/outlying islands transfer facilities.
4. Segregate inert C&D material that is suitable for recycling for aggregates to be used in concrete, sub-base or concrete based products for delivery to a designated recycling facility where specified;
5. Packaging material (cardboard, paper, plastics, foam etc.) shall be properly sorted, segregated and stockpiled in a protected area to prevent contamination.

PRE.C9.2350.9 REMOVAL OF WASTE MATERIALS

1. Stack waste materials neatly, and remove from Site as soon as is practical after completion of each operation and before next trade commences all material that will not be reused or recycled;
2. Avoid obstruction where more than one trade is operating simultaneously;
3. Do not permit accumulated waste material piles to exceed 2000 mm generally;
4. Provide necessary receptacles to store waste tidily prior to removal from Site.

PRE.C9.2360.9 WASTE REDUCTION TARGETS

1. To facilitate assessment of waste management measures, the following minimum performance targets shall be adopted:
    a. The sorting targets described or specified in Clause PRE.C9.2340;
    b. 100% recovery of inert portion of excavated material and demolition debris from demolition works;
    c. 100% recovery for metallic waste;
    d. 100% recovery for non contaminated paper and cardboard.
2. Other targets set for this Contract are as follows:

    ……

3. The Contractor may set higher recovery targets providing that such targets are realistic and achievable. The Contractor may add targets for other C&D waste material that may be applicable to the Contract.

ENVIRONMENTAL MANAGEMENT PLAN

PRE.C9.2410.A ENVIRONMENTAL MANAGEMENT RESPONSIBILITIES

1. For the duration of the Contract, instruct workers, oversee, and document the results of the Environmental Management Plan described hereafter. Be responsible and ensure that all Nominated Subcontractors, Specialist Contractors, Utility Undertakings and employees are aware of aims of and the contents of the Environmental Management Plan;
2. Ensure that all relevant legislations and the Contractor's duty of care are complied with throughout the duration of the Contract.

PRE.C9.2415.9 SUBMISSION AND UPDATING OF ENVIRONMENTAL MANAGEMENT PLAN

1. Further to GCC Clauses 5.28 and 5.31, prepare and submit to the CM within 21 days of the date of the Letter of Acceptance 3 copies of draft Environmental Management Plan (EMP) containing the information specified or required under PRE.C9.2420. Arrange and hold an ad hoc meeting (or meetings if necessary) with the CM or his representatives to discuss the draft EMP within 7 days from the submission of such plan. If the CM is of the opinion that the draft EMP does not meet the requirements of the Contract, he can request for remedy of the deficiency. Comply with any such CM's request prior to submitting six copies of the EMP to the CM for endorsement within 35 days of the date of the Letter of Acceptance;
2. Throughout the duration of the Contract and any extended contract period, update the EMP at monthly intervals or when circumstances deem necessary or when required by the CM so that it is at all times a comprehensive and contemporary statement of the policies, procedures and requirements to achieve the environmental management, waste management and site hygiene obligations and responsibilities under the Contract;
3. The CM may by notice in writing require the Contractor to supplement, revise or update the EMP if he is of the opinions that the EMP is insufficient or requires revision of modification in the interest of the environmental management, waste management and site hygiene, whether for the Site or adjacent to the Site or otherwise. Comply with such CM's notice within 7 days of such notice;
4. Ensure the EMP has incorporated the Nominated Sub-contractor's environmental management plan in respect of the Nominated Sub-contract Works. Request the Nominated Sub-contractor to prepare and submit an environmental management plan in respect of the Nominated Sub-contract Works within 14 days of the letter of acceptance of the Nominated Sub-contractor's tender for agreement and incorporation into the EMP. Ensure consistency between the EMP and the environmental management plan in respect of the Nominated Sub-contract Works. Submit the agreed environmental management plan in respect of the Nominated Sub-contract Works to the CM for endorsement. Revise and update the EMP to incorporate the environmental management plan in respect of the Nominated Sub-contract Works endorsed by the CM when the EMP is due to be revised or updated;

5. Request the Nominated Sub-contractor to revise or update the environmental management plan in respect of the Nominated Sub-contract Works by virtue of a revision or update of the EMP pursuant to sub-clauses (2) and (3) above. Ensure the revised or updated environmental management plan in respect of the Nominated Sub-contract Works is consistent with the EMP and submit the revised or updated environmental management plan in respect of the Nominated Sub-contract Works to the CM for endorsement;
6. Submit and present the EMP to the Environmental and Site Hygiene Management Meetings;
7. CM's endorsement, comment or rejection of the EMP and of any proposed revision or update, and the implementation of the EMP by the Contractor shall not relieve the Contractor from any obligations or responsibilities under the Contract or any statutory regulations;
8. Appoint on a full time basis on Site a person to oversee the implementation of the EMP. Comply and ensure all personnel who are responsible for the environmental management, waste management and site hygiene and who are in a position of authority among sub-contractors have access to the EMP. Any Specialist Contractor and other entities (e.g. public utilities) working on the Site shall also be provided with a copy of the EMP and be required to comply with it, report to the CM any non-compliance on their part;
9. Provide all facilities, access and assistance to the CM to periodically check that the EMP is being implemented properly and fully. If the CM is of the opinion that the Contractor fails to implement properly and fully the EMP and the failure does or may adversely affect the environmental management, waste management and site hygiene, whether for the Site or adjacent to the Site or otherwise, the CM will notify the Contractor in writing of the failure. Take action to remedy the failure immediately.

PRE.C9.2420.A ENVIRONMENTAL MANAGEMENT PLAN (EMP)

All Environmental Management Plan (EMP) and draft EMP shall be signed by the Contractor's Managing Director or his Representative before submission. The EMP shall be subdivided into the following sections containing:

1. General environmental management of the Contract:
    a. A signed environmental and site hygiene policy statement committing the Contractor to environmental protection for the project;
    b. A Contractor's staff organization chart with duties, responsibilities and accountability defined. Identify the name and position of the person to oversee the implementation of the EMP. The person shall work full time on-site. Also appoint a senior staff member, designated person(s) and experience person(s) for the implementation of the Trip Ticket System (TTS) in pursuance of PRE.C9.470 and PRE.C9.480;
    c. Staff awareness and training proposals for Contractors' and Sub-contractors' staff with auditable records of trained persons;
    d. Environmental impacts, targets and mitigation objectives to minimize impacts;
    e. Records containing licences, permits, trip ticket records, complaints and record of corrective actions where non-compliance has been identified;
    f. A list on environmental regulations and descriptions on methodology (including testing) to ensure compliance.
2. Waste Management Plan to reduce and minimize the generation of C&D materials in the execution of the Works stating:

a. An analysis of waste likely to be generated from work processes with types of waste identified and quantified with list of each material proposed to be salvaged, and re-used or recycled with quantities. The data shall be included in the Waste Flow Table at Appendix PRE.C9/I. The Waste Flow Table shall be reviewed and if necessary revised monthly;

b. A statement of measures taken to reduce, salvage, re-use and recycle waste materials on and off Site;

c. A description of the methods of sorting, segregation, labelling, storing, protecting and disposing of all the various types of waste materials generated. The materials shall be listed in the Waste Flow Table. Various materials may include but are not limited to:

   i. Inert C&D materials generated from the Works;

   ii. Inert C&D materials to be re-used in the Works;

   iii. C&D materials to be re-used in other projects (including reclamations) or at Contractor's nominated Approved outlets;

   iv. Inert C&D materials suitable for recycling into aggregates for concrete or sub-base to be disposed of at an Approved location;

   v. Inert C&D materials to be disposed of at a public fill reception facility;

   vi. Steel and other metals (including reinforcement bars) for collection by recycling contractors;

   vii. Paper and cardboard for collection by recycling contractors;

   viii. Plastics (i.e. plastic bottles, containers, sheets, foam);

   ix. A list of hazardous wastes (oils, paints and chemicals) together with details of the method of storage and proposals for collection and disposal arrangements by specialist disposal company;

   x. General refuse to be disposed of at a landfill or outlying islands transfer facility.

d. The location, layout and details of designated sorting and storage areas. Describe necessary adaptations as the works progress;

e. A method statement of how the Site will be kept clean with debris minimized;

f. Details to minimize the use of timber in temporary works construction;

g. Control measures to ensure that the sorted recyclable materials such as metal, paper, plastics and milled bituminous materials etc. are delivered to a proper recycling outlet for processing;

h. For materials delivered to Site, a statement that reusable and recyclable packaging materials and pallets will be re-used, recycled or returned to the supplier. Identify those suppliers who will not accept the return of pallets and reusable and recyclable packaging materials;

i. The Waste Management Plan may be revised from time to time to incorporate Nominated Sub-contractors and other party's requirements as and when they are appointed;

j. A Waste Disposal Record.

3. Site Management Plan for implementation of the TTS. Submit the Site Management Plan for the CM's Approval within 45 days of the date of the Letter of Acceptance. If the CM is of the opinion by notice in writing that the Site Management Plan does not meet the requirements of this clause, revise the Plan and resubmit for the CM's Approval within 7 days of the notice. Review the Site Management Plan on a monthly basis at the Site Safety and Environmental Management Committee meeting with discussion items as detailed in sub-clause (3)(i) below. Submit any updated version of the Plan for the CM's Approval. The Plan shall include the following details:

    a. Names of the designated or alternative disposal grounds identified;

    b. A site organization chart showing the manpower resources and duties of each staff member in the implementation of the TTS. The following requirements shall be met:

        i. Appoint a senior staff member with at least two years experience in site management to be fully responsible for implementing and overseeing the operation of the TTS;

        ii. Appoint designated person(s) to fill in and sign Part 1 of the Daily Record Summary (DRS) properly before departure of the trucks. A sample of the DRS is given at Appendix PRE.C9.APPEND2;

        iii. Appoint experienced person(s) to man each exit from the Site to ensure that every truck carrying C&D materials leaving the Site bears a duly completed CHIT or Disposal Delivery Form (DDF). Such appointed person(s) shall record the CHIT/DDF number, the vehicle registration number and the departure time of every truck leaving the Site with C&D material.

    c. A monthly programme for disposal of C&D materials off the Site, and indicate the estimated quantities, types of the C&D materials and corresponding disposal grounds. Update the programme and submit to the CM by the fifteenth (15) day of each month, or in the event of the fifteenth (15) day being a General Holiday the working day immediately following the General Holiday, or a later date as agreed by the CM;

    d. Site procedures to ensure that each truckload of C&D materials leaving the Site will bear a duly completed CHIT/DDF and that Part 1 of the DRS has been filled in and signed properly before departure of the truck;

    e. Recording system with comprehensive register to ensure timely retrieval of the CHIT/DDF issued and Transaction Record Slip from the disposal grounds, and make it available for inspection by the CM upon request or where irregularities are observed;

    f. Surveillance system within the Site and at any alternative disposal grounds to check that the disposal activities comply with the requirements specified;

    g. Control measures to prevent any unauthorized disposal of C&D materials, where trucks need to exit and re-enter the Site for delivery of C&D materials generated;

    h. For site formation contract, a video recording system as specified in PRE.C9.495;

    i. The following items shall be included in the agenda for discussion at every Site Safety and Environmental Management Committee meeting, or other established channels for performance monitoring as agreed by the CM:

        i. Review the Site Management Plan and implementation of the TTS, and identify areas for improvement;

ii. Audit the quantity of C&D materials removed from the Site (based on the DRS and survey records) against the quantities of C&D materials delivered to the disposal ground designated in the Contract (e.g. based on the EPD's web-site) or against the quantities of C&D materials delivered to the Approved alternative disposal ground;

iii. Review incidents of non-compliance and discuss the necessary follow-up actions;

iv. Monitor the follow-up action on defects and deficiencies identified.

4. Air Quality

a. Measures and methods to control dust and debris on and off Site;

b. Measures to monitor and report air quality conditions on Site;

c. Use of B5 diesel or Euro V diesel / Ultra-low-sulphur diesel:

i. All Constructional Plant powered by diesel fuel, whether they belong to the Contractor or his sub-contractors, shall only be replenished with B5 diesel when working on Site;

ii. The B5 diesel shall be Euro V diesel containing a fatty acid methyl ester content of 5%, as determined in accordance with the document published by the European Committee for Standardization commonly known as EN 14078:2003. The Euro V diesel shall be light diesel oil complying with the specifications set out in Chapter 311L Schedule I – Air Pollution Control (Motor Vehicle Fuel) Regulation of the Laws of Hong Kong, all applicable legislation in Hong Kong and the requirements of all relevant regulatory authorities in Hong Kong which are in effect on the date that the B5 diesel is supplied;

iii. Notwithstanding sub-clause 4(c)(i) above, should there be a supply shortage or other difficulties in delivering of B5 diesel to Site, the Contractor or his sub-contractors may propose with justification for the CM's Approval for the use of Euro V diesel / Ultra-low-sulphur diesel (ULSD) instead of B5 diesel. ULSD is defined as diesel fuel containing not more than 0.005% by weight of sulphur;

iv. The Contractor shall maintain a summary record of all the delivery notes of B5 diesel or Euro V diesel / ULSD delivered to Site, including those ordered by his sub-contractors, together with the details of consumption of such fuel by the individual Constructional Plant on Site and the date of arrival and departure of the Constructional Plant to and from the Site. The Contractor shall utilise the standard proforma in APPENDIX PRE.C9/VI;

v. All records of fuel deliveries shall be supported by the original delivery notes of the oil companies. All records and delivery notes shall be kept on Site and ready for inspection by the CM upon request.

5. Noise Control

a. Acquisition of noise permits;

b. Types of noise reduction equipments to be used and their applications;

c. Details of noise restrictions affecting the Contract;

d. Descriptions of noise mitigation measures.

6. Protection and Damage Mitigation

a. Mitigation methods to prevent soil erosion, wash down or slope collapse and any method to carry out reinstatement work;

b. Methods of protecting the existing trees, shrubs and other vegetation including protecting fencing provided by others;

c. Maintenance of roads and footpaths;

d. Methods to protect adjoining properties, roads, paving, and boundary structures;

e. Methods to deal with chemical spillage.

7. Water Pollution Control and Conservation

a. Measures to conserve water and record water consumption;

b. Methods of minimizing water consumption including wastewater recycling;

c. Methods to avoid contamination and blockage of drains and sewers and comply with the Water Pollution Control Ordinance;

d. Method to prevent flooding and blocking of site drainage system;

e. Listing and description of necessary permits, approvals to be obtained and complied with;

f. Details of necessary drainage diversions and temporary drainage systems.

8. Tropical Hardwoods

A description of proposed alternatives to tropical hardwood which will meet the same performance standards in the construction of all temporary works including site accommodation, storage sheds, covered walkways, hoardings, screens, signboards excavation supports and formwork and falsework. Tropical hardwoods are not permitted to be used in temporary works without the Approval of the CM.

9. Site cleanliness, tidiness and hygiene

a. Description of a proposed system to maintain cleanliness and tidiness of the Site including details of means to protect materials locations of stockpiles and on-site sorting and disposal areas;

b. Measures to remove and prevent standing water and prevent mosquito breeding;

c. Assign a specific number of dedicated workers for maintenance of site hygiene and amenities provisions on Site which are subject to the IPSEHS as referred to in PRE.C9.1903 and PRE.C9.1904. If required, provide the identity of such workers for verification by the CM or his representatives.

10. Emergency Procedures

Identify whether any environmental emergency could occur on Site such as typhoons and rainstorms and formulate emergency procedures to deal with such situations;

11. Environment and site hygiene promotion

a. The effort made by different sub-contractors or individuals to maintain cleanliness and tidiness of the Site, to reduce and minimize the generation of waste at work and to protect materials locations of stockpiles and on-site sorting and disposal areas by the application of soundly based policies, procedures and disciplines to be recognised by the presentation of environmental protection awards. Adopt proactive attitude towards improving environmental management and site hygiene performance and to promote workers' awareness on environmental protection and site hygiene. The Site as a whole is encouraged to participate in the following designated environmental protection awards:

i. "The Hong Kong Awards for Environmental Excellence" [Environmental Labels (Wastewise or Energywise); Green Innovations; or Sectoral Awards] organized by the Environmental Campaign Committee with EPD; or

ii. "Considerate Contractors Site Award Scheme" (Outstanding Environmental Management and Performance Award) organized by the Development Bureau and the Construction Industry Council.

b. The Contractor is also encouraged to organize site-based awards and competitions to promote participation of his workers and teams in environmental protection and site hygiene theme competitions during the contract period. The adjudicating team shall comprise the site management team, environmental protection personnel and workers' representatives, and shall act openly and fairly in such events.

PRE.C9.2430.9 DISTRIBUTION OF AND COMPLIANCE WITH THE ENVIRONMENTAL MANAGEMENT PLAN

After CM's endorsement to the EMP, distribute copies of same to the CM, Nominated Sub-contractors and all specialist contractors and suppliers. Ensure compliance with the EMP and all relevant statutory regulations.

PRE.C9.2435.9 ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE

Throughout the duration of the Contract carry out to the satisfaction of the CM all environmental protection/management and site hygiene measures including the discharge of duties as specified in the Environmental and Site Hygiene Checklist shown below:

Environmental and Site Hygiene Issues -Site Management	Spec. PRE.C	Checking Frequency	Compliance
Noise Control			
Air Quality			
Removal of Water			
Construction Waste Management			
Protection			
Site Cleanliness and Hygiene			

PRE.C9.2440.A ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE PERFORMANCE MONITORING AND REPORTING

Throughout the duration of the Contract:

1. Carry out environmental inspections to review, monitor and report monthly to the CM (or when so directed by the CM) on the effectiveness of the implementation of the EMP;
2. Report monthly to the CM for the following received from Environmental Protection Department (EPD) or Food and Environmental Hygiene Department (FEHD):
    a. Warning letters or offences notifications;
    b. Convictions during the period under any environmental and site hygiene regulations or legislation;
    c. Abatement Notice.
3. Take all necessary follow-up actions to ensure that any defects or deficiencies are made good and;
4. Conduct monthly Environmental and Site Hygiene Management Meetings or when directed by the CM, submit minutes of the meetings to the CM for verification. The CM may also attend or nominate a representative to attend the meetings. Meetings shall cover the following:
    a. Environmental and site hygiene matters, including implementation of the Trip-ticket System as appropriate, arising from the Contractor's obligations in executing the Works;
    b. The review on incidents of non-compliance with the EMP;
    c. Discussion and monitoring of the necessary follow-up action on defects and deficiencies;
    d. Areas for improvement.
5. Report monthly to the CM for the following:
    a. Particulars of workers specially trained and deployed to attend to site hygiene and amenities provisions during the day and have assisted in the tidying up of trade waste at the end of a working day;
    b. Date-marked photos of site amenities conditions before and after tidying up of loose ends on Site;
    c. Photographic evidence in chronological order of such maintenance work.

PRE.C9.2460.A PROVISION OF ENVIRONMENT AND HYGIENE TRAINING

1. Arrange for all skilled workers employed on the Works or in connection with the Contract whether in the employment of the Contractor or his sub-contractors, to attend training on all aspects of environmental management organized by training institutions and/or the Environmental Protection Department (EPD);
2. Set out the level, frequency and estimated staff numbers to attend such training and state the same in the EMP;

3. Develop and provide site specific induction training and tool box talks on all appropriate aspects of environmental protection and site hygiene to promote workers' awareness on environmental management and state the same in EMP, such training and tool box talks are to be carried out by suitably qualified supervisors or foremen, site specific induction training and tool box talks may be conducted as part of the site safety training regime;
4. At the end of each period of interim certificate, report to the CM the actual number of workers trained as specified and submit Contractor's certified attendance records;
5. A full statement of the Contractors training proposals shall be stated in the EMP.

PRE.C9.2470.D PAYMENT FOR PRE-DETERMINED AMOUNTS FOR SITE SAFETY, ENVIRONMENTAL MANAGEMENT AND SITE HYGIENE

1. The payment for the "environmental management and site hygiene performance" item in the Bills of Quantities shall be subject to the Contractor's average score (A) of the items as specified in the checklist stipulated in PRE.C9.2435 and this average score (A) is worked out by the CM or his representatives as follows:
   a. Items of environmental management and site hygiene performance as specified in PRE.C9.2435 are subject to assessment at the frequency specified therein;
   b. The calculation of the average score (A) only applies to valuation of the items under environmental management and site hygiene performance as specified in PRE.C9.2435. The average score (A) for each monthly valuation shall be derived from the results of the assessment as follows:

$$(A) = \frac{A1 + A2 + A3 + A4 + A5 + A6}{6}$$

whereas

$$A1 = \frac{\text{Total No. of Items of Compliance under Noise Control}}{\text{Total No. of Items of Inspection under Noise Control}}$$

$$A2 = \frac{\text{Total No. of Items of Compliance under Air Quality}}{\text{Total No. of Items of Inspection under Air Quality}}$$

$$A3 = \frac{\text{Total No. of Items of Compliance under Removal of Water}}{\text{Total No. of Items of Inspection under Removal of Water}}$$

$$A4 = \frac{\text{Total No. of Items of Compliance under Construction Waste Management}}{\text{Total No. of Items of Inspection under Construction Waste Management}}$$

$$A5 = \frac{\text{Total No. of Items of Compliance under Protection}}{\text{Total No. of Items of Inspection under Protection}}$$

$$A6 = \frac{\text{Total No. of Items of Compliance under Site Cleanliness \& Hygiene}}{\text{Total No. of Items of Inspection under Site Cleanliness \& Hygiene}}$$

Total number of items of compliance is referring to the number of compliance achieved for the respective item under the respective group for the checking made according to the checking frequency specified in the checklist stipulated in PRE.C9.2435 for a monthly valuation period.

Total number of items of inspection is referring to the number of inspection for the respective item under the respective group for the checking made according to the checking frequency specified in the checklist stipulated in PRE.C9.2435 for a monthly valuation period.

   c. Criteria for payment are as follows:

i. If the score of any element (A1 to A6) is below 85%, no payment for the environmental management and site hygiene monitoring performance item incorporated in the Bills of Quantities shall be made for that month;

ii. If the scores of each of the elements (A1 to A6) is 85% or above and the Contractor's average score (A) is within the range of 85% to less than 90%, payment for that month in respect of environmental management and site hygiene performance shall be valued at the pre-determined rate included in the Bill of Quantities multiplied by 0.7;

iii. If the scores of each of the elements (A1 to A6) is 85% or above and the Contractor's average score (A) is 90% or above, payment for that month in respect of the environmental management and site hygiene performance shall be valued at the pre-determined rate included in the Bill of Quantities multiplied by 1.0.

2. The assessment of payment for the "Silver Card compliance" item in the Bills of Quantities shall be subject to the principles as given below:

a. The status of each category of workers of specified trades listed in PRE.C9.205 (4)(b) is subject to assessment on a monthly basis based on the records of the date of record checking as designated by the CM (hereinunder referred to as the 'designated date of record checking') for a month;

b. The payment for the "Silver Card compliance" item in the Bills of Quantities shall be subject to the Contractor's score (R). The score (R) for a monthly valuation shall be derived as follows:

$$(R) = P / Q$$

expressed as a percentage rounded to one decimal place

where $P = P1 + P2$

and $Q = Q1 + Q2 – Q3$

with each parameter defined in sub-clauses (2)(c) to (2)(g) below.

c. P1 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') who are on Site and in possession of valid Silver Cards on the designated date of record checking of the month;

d. P2 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') with all of the following attributes:

i. The worker was verified to be on Site on the designated date of record checking of a previous month;

ii. The worker did not possess a valid Silver Card on the designated date of record checking of a previous month but the worker had enrolled in a Silver Card training course / re-validation course run by the CIC;

iii. The worker is not on Site on the designated date of record checking of the month;

iv. The designated date of record checking of the month is more than 90 calendar days from the date of the worker's first appearance on Site;

v. The worker had not been counted under the parameter Q2 in any designated date of record checking of any previous months;

vi. The worker has successfully obtained a valid Silver Card as required on or before the designated date of record checking of the month.

e. Q1 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') on Site on the designated date of record checking of the month;

f. Q2 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') with all of the following attributes:

i. The worker was verified to be on Site on the designated date of record checking of a previous month;

ii. The worker did not possess a valid Silver Card on the designated date of record checking of a previous month but the worker had enrolled in a Silver Card training course / re-validation course run by the CIC;

iii. The worker is not on Site on the designated date of record checking of the month;

iv. The designated date of record checking of the month is more than 90 calendar days from the date of the worker's first appearance on Site;

v. The worker had not been counted under this parameter Q2 in any designated date of record checking of any previous months.

g. Q3 denotes the number of workers of the specified trades (except for the trade of 'Lift Mechanic') with all of the following attributes:

i. The worker is on Site on the designated date of record checking of the month;

ii. The worker does not possess a valid Silver Card but has enrolled in a Silver Card training course / re-validation course run by the CIC;

iii. The designated date of record checking of the month is not more than 90 calendar days from the date of the worker's first appearance on Site.

h. For the avoidance of doubt, the 'date of the worker's first appearance on Site' as referred to in sub-clause (2)(d) to (2)(g) above shall be the day on which the worker first enters into the Site to carry out the work of the specified trades and is regardless of whether or not the worker has left the Site and is returning to work again on the specified trades;

i. The score (R) shall be worked out by the Contractor in accordance with sub-clause (2)(b) above when completing the prescribed form (DCEI-F14) and is subject to verification by the CM or his representatives;

j. Criteria for payment for the 'Silver Card Compliance' item are as follows:

i. Where score (R) turns out to be 0/0 for the designated date of record checking of the month, no payment shall be made for the month in which the designated date of record checking falls;

ii. Where score (R) is a percentage other than 0/0 for the designated date of record checking of the month, then payment for the month in which the designated date of record checking falls shall be valued at the pre-determined rate against this item multiplied by this score (R).

3. The assessment for payment of the items for "Safety Audit performance indicators" in the Bills of Quantities shall be subject to the principles as given below:

a. Verified percentage scores for Part A "Safety Management", Part B "Safety Audit Checklist" and verified individual percentage score for designated critical items (collectively referred to as "Verified Safety Audit Percentage Score") are obtained from each safety audit conducted under the Housing Authority Safety Auditing System (HASAS) as specified in PRE.C9.205. Those scores shall be verified by the OSHC and confirmed by the CM for official record and payment purpose;

b. The criteria for payment assessment in respect of "Safety Audit performance indicator (overall score)" are as follows:

   i. If the verified percentage scores for either Part A or Part B of a safety audit are below 70%, no payment shall be valued and made for this item in respect of that safety audit;

   ii. If the verified percentage scores for both Part A and Part B of a safety audit are each equal to or above 70% but with either one or both of them below 80%, payment for this item in respect of that safety audit shall be valued by multiplying the pre-determined rate of this item as included in the Bill of Quantities with 0.7;

   iii. If the verified percentage scores for both Part A and Part B of a safety audit are equal to or above 80%, payment for this item in respect of that safety audit shall be valued by multiplying the pre-determined rate of this item as included in the Bill of Quantities with 1.0.

c. Payment assessment in respect of "Safety Audit performance indicators (scores for critical items)" shall take into account the following:

   i. The verified individual percentage score for designated critical items of the Verified Safety Audit Percentage Scores;

   ii. The apportioned percentages for the respective designated critical items as shown in the table below.

Designated critical items	Element / Subsection and reference in safety audit	Apportioned percentage %
Job hazard analysis	Key element 7	25
Housekeeping	Subsection 14.1.4	15
Prevention against falling objects	Subsection 14.1.5	25
Lifting	Lifting operation (subsection 14.2.3)	25
	Tower crane (subsection 14.4.1)	
	Mobile crane (subsection 14.4.2)	
Electrical supply system	Subsection 14.3.2	10
	Total of apportioned percentages =	100

   Note: The apportioned percentage for each designated critical item shall be referred to as "effective apportioned percentage" when being applied for payment assessment.

d. The criteria for payment assessment in respect of "Safety Audit performance indicators (scores for critical items)"are as follows:

i. If the verified percentage score for a designated critical item (in the table in sub-clause (3)(c) above) of a safety audit is below 70%, no payment shall be valued and made for that critical item in respect of that safety audit;

ii. If the verified percentage score of a designated critical item is equal to or above 70% and below 75% the corresponding apportioned percentage as included in the table in sub-clause (3)(c) above multiplied by 0.7 shall become the “payable effective apportioned percentage” for that designated critical item for payment assessment in respect of that safety audit;

iii. If the verified percentage score of a designated critical item of a safety audit is equal to or above 75% the corresponding apportioned percentage as included in the table in sub-clause (3)(c) above multiplied by 1.0 shall become the “payable effective apportioned percentage” for that designated critical item for payment assessment in respect of that safety audit;

iv. Payment for this item "Safety Audit performance indicators (scores for critical items)" in respect of a safety audit shall be valued by multiplying the pre-determined rate of this item as included in the Bill of Quantities or schedule of rates with the sum of the “payable effective apportioned percentage” of the critical items in the table in sub-clause (3)(c) above in respect of that safety audit;

v. For the avoidance of doubt, 0.7 and 1.0 of the corresponding apportioned percentage for the critical item of "lifting" as included in the table in sub-clause (c) above shall only become the “payable effective apportioned percentage” applicable for payment assessment in respect of a safety audit if each of the sub-items available for assessment (namely, subsection 14.2.3, 14.4.1 and 14.4.2) has acquired a verified individual percentage score of 70% or above but below 75% and not less than 75% in that safety audit respectively. However, if any one of these sub-items available for assessment has acquired a verified individual percentage score of below 70%, no "payable effective apportioned percentage" for the whole critical item of "lifting" shall be applicable for payment assessment in respect of that safety audit.

4. The assessment for payment of the item of "Control of Temporary Works" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

   a. The Contractor has submitted quarterly record of satisfactory certification of temporary works by independent checking engineer in respect of temporary works that is specified in PRE.C6.145 and PRE.C9.1882;

   b. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

5. The assessment for payment of the items of "Smart Site Safety System" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

   a. The Contractor has implemented smart site safety measures specified in PRE.C9.294 to match with the site progress.

6. The assessment for payment of the items of "Regulatory Compliance Indicator - yearly record check", "Regulatory Compliance Indicator - residual period record check at completion" and "Regulatory Compliance Indicator – final record check" items in the Bills of Quantities shall be subject to the principles as given below:

Option 1

a. Payment for the item of "Regulatory Compliance Indicator - final record check" shall be valued by multiplying the pre-determined rate of the item as included in the Bill of Quantities with 1.0 in respect of the record check if the Contractor has confirmed in writing that none of the following is received from the Labour Department (LD) within the assessment period:

   i. One or more letters received subsequent to LD's inspection advising category Part 1 contravention particularly against Construction Site (Safety) Regulations or subsidiary regulations of the Factories and Industrial Undertakings Ordinance;

   ii. Five or more letters received subsequent to LD's inspection advising category Part II contravention particularly against Construction Site (Safety) Regulations or subsidiary regulations of the Factories and Industrial Undertakings Ordinance;

   iii. Suspension Notice.

b. For the purpose of establishing the Contractor's entitlement to payment for the item of "Regulatory Compliance Indicator - final record check", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities shall be carried out by the CM or his representatives;

c. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

Option 2

a. Payment for the items of "Regulatory Compliance Indicator - yearly record check" and "Regulatory Compliance Indicator - residual period record check at completion" shall be valued by multiplying the pre-determined rate of the respective item as included in the Bill of Quantities with 1.0 in respect of the record check if the Contractor has confirmed in writing that none of the following is received from the Labour Department (LD) within the respective assessment period:

   i. One or more letters received subsequent to LD's inspection advising category Part 1 contravention particularly against Construction Site (Safety) Regulations or subsidiary regulations of the Factories and Industrial Undertakings Ordinance;

   ii. Five or more letters received subsequent to LD's inspection advising category Part II contravention particularly against Construction Site (Safety) Regulations or subsidiary regulations of the Factories and Industrial Undertakings Ordinance;

   iii. Suspension Notice.

b. For the purpose of establishing the Contractor's entitlement to payment for the item of "Regulatory Compliance Indicator - yearly record check", an assessment shall be carried out by the CM or his representatives at the end of each full 12-month period commencing from the notified date for commencement of the Works. However, no assessment (and hence no payment) shall be made for any full 12-month period which ends on a date beyond the contract /extended contract period as defined in Bill of Quantities;

c. For the avoidance of doubt, the remeasured quantity in adjustment of account for items of "Regulatory Compliance Indicator - yearly record check" shall not exceed the quantity as stated in the Bill of Quantities;

d. For the purpose of establishing the Contractor's entitlement to payment for the item of "Regulatory Compliance Indicator - residual period record check at completion", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities shall be carried out by the CM or CM or his representatives. The assessment period shall be from the first day after the last assessed period of "yearly record check" in sub-clause (6)(b) above up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

7. The assessment for payment of the items of "Accident indicator - yearly record check" and "Accident indicator - final record check at completion" items in the Bills of Quantities shall be subject to the principles as given below:

Option 1

a. Payment for the item of "Accident Indicator - final record check at completion" shall be valued by multiplying the pre-determined rate of the item as included in the Bill of Quantities with 1.0 in respect of the record check if the Contractor has achieved the following results within the assessment period:

i. No fatal accident;

ii. Annualized accumulative accident rate not more than 8 per 1,000 workers.

b. The annualized accumulative reportable accident occurrence rate per 1000 workers (AR) is derived from the following formula with the cut-off date applicable to all variables (i.e. D, N and W) being set at the last date of a quarter of the calendar year, i.e. 31st March, 30th June, 30th September or 31st December, immediately preceding the quarter in which the last date of the assessment period of the record check falls:

$$AR = \frac{N}{W} \times 1000 \times \frac{365}{D}$$

Where

N = Accumulative number of reportable site accidents as defined in the Factories and Industrial Undertakings Ordinance up to the cut-off date. A "reportable accident" shall refer to an accident arising from industrial activities leading to death(s) or injuries which have incurred incapacity of the person injured for more than 3 days.

W = Average daily number of workers on site reported on Labour Return Form GF527 plus number of site management staff collated by CTO site staff starting from the notified date for commencement of the Works up to the cut-off date.

D = Number of calendar days from the notified date for commencement of the Works up to the cut-off date.

c. For the purpose of establishing the Contractor's entitlement to payment for the item of "Accident indicator - final record check at completion", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities shall be carried out by the CM or his representatives;

d. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Section of the Works) issued by the CM under GCC Clause 8.7.

Option 2

a. Payment for the items of "Accident indicator - yearly record check" and "Accident indicator - final record check at completion" shall be valued by multiplying the pre-determined rate of the respective item as included in the Bill of Quantities with 1.0 in respect of the record check if the Contractor has achieved the following results within the assessment period:

   i. No fatal accident;

   ii. Annualized accumulative accident rate not more than 8 per 1,000 workers.

b. The annualized accumulative reportable accident occurrence rate per 1000 workers (AR) is derived from the following formula with the cut-off date applicable to all variables (i.e. D, N and W) being set at the last date of a quarter of the calendar year, i.e. 31st March, 30th June, 30th September or 31st December, immediately preceding the quarter in which the last date of the assessment period of the record check falls:

$$AR = \frac{N}{W} \times 1000 \times \frac{365}{D}$$

   Where

   N = Accumulative number of reportable site accidents as defined in the Factories and Industrial Undertakings Ordinance up to the cut-off date. A "reportable accident" shall refer to an accident arising from industrial activities leading to death(s) or injuries which have incurred incapacity of the person injured for more than 3 days.

   W = Average daily number of workers on site reported on Labour Return Form GF527 plus number of site management staff collated by CTO site staff starting from the notified date for commencement of the Works up to the cut-off date.

   D = Number of calendar days from the notified date for commencement of the Works up to the cut-off date.

c. For establishment of the Contractor's entitlement to payment for the item of "Accident indicator - yearly record check", an assessment shall be carried out by the CM or his representatives at the end of each full 12-month period commencing from the notified date for commencement of the Works. However, no assessment (and hence no payment) shall be made for any full 12-month period which ends on a date beyond the contract/extended contract period as defined in Bill of Quantities or schedule of rates;

d. For the avoidance of doubt, the remeasured quantity in adjustment of account for item of "Accident indicator - yearly record check" is subject to the capping limit which is equal to the quantity as stated in the Bill of Quantities. Therefore, in case where the remeasured quantity is larger than the quantity as stated in the Bill of Quantities, the respective quantity stated in the Bill of Quantities shall be taken as the remeasured quantity for adjustment of account;

e. For the purpose of establishing the Contractor's entitlement to payment for the item of "Accident indicator - final record check at completion", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities shall be carried out by the CM or his representatives. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Section of the Works) issued by the CM under GCC Clause 8.7.

8. The assessment of payment of the item "Reporting of Accident and Incident" in the Bills of Quantities or schedule of rates shall be subject to the principles as given below:

   a. The Contractor shall report accidents and incidents, if any, timely to Labour Department under the Factories and Industrial Undertakings Regulations and to the CM according to the accident / incident reporting procedures set out at the Housing Authority Site Safety Website;

   b. Full payment at the pre-determined rate shall be assessed if there is no accident or incident for reporting or the total number of late reporting of accidents and incidents is not more than 3 up to the certified date of completion of the Works (or where phased completion of Sections is specified in the Contract, up to the last certified date of completion stated amongst the different certificates of completion for the Sections);

   c. For more than 3 cases of late reporting, full payment at the pre-determined rate shall be assessed if the project team is convinced that the late reporting is beyond the Contractor’s reasonable control such that the total number of accidents and incidents with late reporting after deducting those cases beyond the Contractor’s reasonable control is not more than 3. Otherwise, no payment for this item "Reporting of Accident and Incident" shall be made.

9. The assessment for payment of the item "Recognition of innovative and functional safety installation or safety measures" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

   a. The Contractor has implemented innovative and functional safety installation or safety measures, including but not limited to innovation in construction technology, application of Building Information Modelling (BIM) or Radio Frequency Identification (RFID) technology etc. for safety, to enhance site safety and health management in terms of hazard analysis, risk assessment, safety training, etc., which shall be new concepts subject to OSHC's assessment under HASAS/HALENSAS and such safety installation, or safety measures are not implemented to comply with legal or contractual requirement, not common practices in the construction industry nor proprietary products procured from the market;

   b. The Contractor shall submit the relevant detailed specification and design drawings to the accredited safety auditor for vetting. The innovative and functional safety installation or safety measures has been verified/supported by the OSHC through safety audit and explicitly stated in the Safety Audit reports;

   c. The CM has verified the implementation merits and checked the sufficiency of the relevant detailed specification and design drawings to his satisfaction.

10. The assessment for payment of the items of "Compliance with regulations related to Environmental Protection and Site Hygiene - yearly record check", "Compliance with regulations related to Environmental Protection and Site Hygiene - residual period record check at completion" and "Compliance with regulations related to Environmental Protection and Site Hygiene - final record check" items in the Bills of Quantities shall be subject to the principles as given below:

Option 1

a. Payment for the item of "Compliance with regulations related to Environmental Protection and Site Hygiene - final record check" in respect of an assessment period shall be valued by multiplying the pre-determined rate of the item as included in the Bill of Quantities with 1.0 in respect of the record check if none of the following criteria in respect of environmental and site hygiene legislation and regulations are received from the Environmental Protection Department (EPD) or the Food and Environmental Hygiene Department (FEHD) during the assessment period:

   i. One or more warning letters received from the Contract Manager subsequent to inspections;

   ii. One or more warning letters received from EPD or FEHD;

   iii. One or more convictions under any environmental and site hygiene regulations or legislation;

   iv. Abatement Notice.

   Provided that where the criteria under sub-clauses (10)(a)(i) to (iv) above are satisfied but there are one or more offence notifications received from EPD or FEHD during any assessment period for which any conviction under any environmental and site hygiene regulations or legislations is yet to be confirmed by EPD or FEHD at the time when the payment assessment is being carried out, payment for this item shall be valued with the quantity provisionally set at zero and which will be adjusted to 1.0 upon confirmation from EPD or FEHD that there is no conviction;

b. For the purpose of establishing the Contractor's entitlement to payment for the item "Environmental Protection and Site Hygiene - final record check", a one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities shall be carried out by the CM or his representatives;

c. The assessment period shall be from the notified date for commencement of the Works up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

Option 2

a. Payment for the items of "Compliance with regulations related to Environmental Protection and Site Hygiene - yearly record check" and "Compliance with regulations related to Environmental Protection and Site Hygiene - residual period record check at completion" shall be valued by multiplying the pre-determined rate of the respective item included in the Bill of Quantities with 1.0 in respect of the record check if none of the following in respect of environmental and site hygiene legislation and regulations are received from the Environmental Protection Department (EPD) or the Food and Environmental Hygiene Department (FEHD) during the assessment period:

   i. One or more warning letters received from the Contract Manager subsequent to inspections;

   ii. One or more warning letters received from EPD or FEHD;

   iii. One or more convictions under any environmental and site hygiene regulations or legislation;

   iv. Abatement Notice.

Provided that where the criteria under sub-clauses (10)(a)(i) to (iv) above are satisfied but there are one or more offence notifications received from EPD or FEHD during any assessment period for which any conviction under any environmental and site hygiene regulations or legislations is yet to be confirmed by EPD or FEHD at the time when the payment assessment is being carried out, payment for this item shall be valued with the quantity provisionally set at zero and which will be adjusted to 1.0 upon confirmation from EPD or FEHD that there is no conviction;

b. For the purpose of establishing the Contractor's entitlement to payment for the items of "Compliance with regulations related Environmental Protection and Site Hygiene - yearly record check", an assessment shall be carried out by the CM or his representatives at the end of each full 12-month period commencing from the notified date for commencement of the Works. However, no assessment (and hence no payment) shall be made for any full 12-month period which ends on a date beyond the contract / extended contract period as defined in Bill of Quantities or schedule of rates;

c. For the avoidance of doubt, the remeasured quantity in adjustment of account for item of "Compliance with regulations related to Environmental Protection and Site Hygiene - yearly record check" is subject to the capping limit which is equal to the quantity as stated in the Bill of Quantities. Therefore, in case where the remeasured quantity is larger than the quantity as stated in the Bill of Quantities, the respective quantity stated in the Bill of Quantities shall be taken as the remeasured quantity for adjustment of account;

d. For the purpose of establishing the Contractor's entitlement to payment for the item of "Compliance with regulations related Environmental Protection and Site Hygiene - residual period record check at completion", an one-off assessment irrespective of any extended contract period as defined in the Bill of Quantities shall be carried out by the CM or his representatives. The assessment period shall be from the first day after the last assessed period of "yearly record check" in sub-clause (10)(b) above up to and including the certified date of completion of the Works (or where phased completion of Sections is specified, the last certified date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7.

11. The assessment for payment of the "Recognition of innovation in environmental management and site hygiene measures" item in the Bills of Quantities shall be subject to the principles as given below:

    a. The Contractor has implemented innovative and functional environmental protection installation and site hygiene measures which shall be new concepts and such measures are not implemented to comply with legal or contractual requirement, not common practices in the construction industry nor proprietary products procured from the market;

    b. The measures have been supported by an independent vetting panel; and

    c. The CM has verified the implementation merits to his satisfaction.

12. The assessment for payment of the items for "Surprise Safety Inspection Programme performance indicators" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

    a. Total score and activity scores are obtained from each inspection conducted under the Surprise Safety Inspection Programme (SSIP) as specified in PRE.C9.205. These scores shall be verified by the OSHC and confirmed by the CM for official record and payment purpose;

    b. The criteria for payment assessment in respect of Surprise Safety Inspection Programme performance indicators (total score) are as follows:

i. If the total score or any activity score is below 70%, no payment shall be valued and made for this item in respect of that inspection;

ii. If the total score and all activity scores are equal to or above 70% but either the total score or any activity score is below 80%, payment for this item in respect of that inspection shall be valued by multiplying the pre-determined rate of this item as included in the Bill of Quantities or schedule of rates with 0.7;

iii. If the total score and all activity scores are equal to or above 80%, payment for this item in respect of that inspection shall be valued by multiplying the pre-determined rate of this item as included in the Bill of Quantities or schedule of rates with 1.0.

c. The criteria for payment assessment in respect of Surprise Safety Inspection performance indicators (activity scores) are as follows:

The apportioned percentage for each activity item is included in the table below.

Item	**Designated Critical Items**	**Apportioned percentage %**
1	Working at height	20
2	Prevention against falling objects	20
3	Housekeeping	20
4	Lifting operations	20
5	Electrical supply system	20

Note: The apportioned percentage for each designated critical item shall be referred to as "effective apportioned percentage" when being applied for payment assessment.

i. If the activity score of a designated critical item of an inspection is below 70%, no payment shall be valued and made for that critical item in respect of that inspection; or

ii. If the activity score of a designated critical item of an inspection is equal to or above 70% and below 80%, the corresponding apportioned percentage as included in the above table shall become an "effective apportioned percentage" for payment assessment in respect of that inspection. Payment for this item in respect of this designated critical item of that inspection shall be valued by multiplying the pre-determined rate of the item as included in the Bill of Quantities or schedule of rates with 0.7 of the 'effective apportioned percentage" of the designated critical item; or

iii. If the activity score of a designated critical item of an inspection is equal to or above 80%, the corresponding apportioned percentage as included in the above table shall become an "effective apportioned percentage" for payment assessment in respect of that inspection. Payment for this item in respect of this designated critical item of that inspection shall be valued by multiplying the pre-determined rate of the item included in the Bill of Quantities or schedule of rates with 1.0 of the "effective apportioned percentage" of the designated critical item.

13. The assessment of payment of the item "Contribution to Safety Campaigns" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

a. The Contractor shall be entitled to payment for entry to one of the following safety campaigns:

i. Construction Safety Promotional Campaign organised by the OSHC;

ii. Occupational Health Award organised by the OSHC;

iii. Hong Kong Occupational Safety and Health Award organised by the OSHC;

iv. Construction Industry Safety Award Scheme organised by the Labour Department; or

v. Considerate Contractors Site Award Scheme organised by the Development Bureau with the Construction Industry Council.

vi. One contract can only allow a maximum of 5 such one-off payments.

b. The Contractor shall also be entitled to payment for winning a prize (any of the Gold, Silver, Bronze or Meritorious prize) in the above campaigns. The Contractor shall only be entitled to a maximum of 5 one-off payments for winning open competitions;

c. The Contractor shall also be entitled to a maximum of 3 one-off payments for organising site-based safety awards.

14. The assessment of payment of the item "Contribution to Environmental Protection Awards" in the Bill of Quantities or schedule of rates shall be subject to the principles as given below:

a. The Contractor shall be entitled to payment for entry to one of the following:

i. Environmental Labels (Wastewise or Energywise) organised by the Environmental Campaign Committee (ECC) with Environmental Protection Department (EPD);

ii. Green Innovations organised by ECC and EPD;

iii. Sectoral Awards of The Hong Kong Awards for Environmental Excellence organised by ECC and EPD; or

iv. Outstanding Environmental Management and Performance Award of the Considerate Contractors Site Award Scheme organised by the Development Bureau with the Construction Industry Council.

v. One contract can only allow a maximum of 3 such one-off payments.

b. The Contractor shall only be entitled to a maximum of 2 one-off payments for organising site-based environmental awards.

SITE ACCESS CONTROL OF PERSONNEL

PRE.C9.2510.9 SITE ACCESS CONTROL AND RECORDING SYSTEM

Provide and operate an Access Control and Recording System (ACRS) to record and verify the information of all personnel (including Site Personnel, Self-employed Workers, Specialist Contractors' workers and visitors) entering and leaving the Site as specified in PRE.C9.2512 to PRE.C9.2560 and as per the requirements stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time:

1. Operate the ACRS within two weeks from the notified date for commencement of the Works;

2. After the ACRS is put into operation, issue smart cards to all personnel for identification;

3. Subject to sub-clause 2 above, do not allow any personnel without a smart card to work on the Site;
4. Compile a register for all issued smart cards with detail information of the card holders and submit it to the CM for records at regular intervals as confirmed by the CM. Both hard and soft copies of the register shall comply with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;
5. Compile and maintain daily attendance records of all personnel working on the Site and site access record of all visitors and keep a verified copy in the wage books as required in PRE.C9.140 as per the timeframe confirmed by the CM or his representatives;
6. Compile and maintain schedules of wages and MPF contribution as required in PRE.C6.170 and PRE.C9.140;
7. Compile and print record forms of Silver Card Holders working on Site by respective trades on dates designated by the CM. The record form shall be in the format similar to the Record Form (DCEI-F14) and fields to be entered shall enable the information required in sub-clause (2) of PRE.C6.210 to be retrieved. The Record Form (DCEI-F14) can be obtained from the CM upon request in writing;
8. Provide training to at least three representatives of the CM and LRO in using the ACRS;
9. At least 2 number of portable pocket personal computers complying with the system requirements as stipulated in PRE.C9.2520 shall be provided for the use of the CM or LRO during the operation period of ACRS.

PRE.C9.2512.9 ARRANGEMENT FOR PRE-OPERATION OF ACRS

1. Within 7 days from the notified date for commencement of the Works, submit to the CM for record the temporary arrangement for pre-operation of ACRS. The temporary arrangement shall include use of log books, card readers or portable pocket personal computers complying with the system requirements as stipulated in PRE.C9.2520 to record the time of entry and departure of all personnel, and issuing temporary passes or smart cards to them;
2. Implement the temporary arrangement to record and verify the information of all personnel as required in the ACRS and their entering and leaving the Site until the ACRS is ready to operate.

PRE.C9.2514.9 DESIGN, OPERATION AND SUBMISSION REQUIREMENTS

Submit the following of the ACRS to the CM for record within 14 days from the notified date for commencement of the Works:

1. Design and operation detail of the system;
2. Format and submission arrangement of the data;
3. Name and details of the service provider;
4. Emergency plan in the event of breakdowns, repairs or regular maintenance.

PRE.C9.2520.A SYSTEM REQUIREMENTS

1. The ACRS shall include the following:
   a. Entrance/Exit Control Unit;
   b. Central Data Computer Unit;
   c. Portable pocket personal computer.

Option 1

2. The ACRS shall be a system utilising biometric recognition technology for identifying the subject (person entering or leaving the Site) in combination with a non-contact type smart card system complying with ISO 14443. The chip inside the smart card shall comply with ISO 14443. The biometric authentication shall be a Handkey II or other products having similar and equivalent functions and performances;

Option 2

2. The ACRS shall be a system with a non-contact type smart card system complying with ISO 14443. The chip inside the smart card shall comply with ISO 14443;
3. The smart card shall be compatible with the Construction Workers Registration Cards issued by the Construction Industry Council (CIC) under the Construction Workers Registration Ordinance (Cap. 583) to registered construction workers. The system's card readers shall be compatible with the smart card and shall be complete with a security access module (SAM) for cryptographic security slot. The Contractor shall obtain the SAM from the CIC;
4. The ACRS shall have sufficient memory to capture and record the information, and produce reports as specified in PRE.C9.2530 to PRE.C9.2550;
5. Adequate and secure backup system shall be provided. In the event of power failure, all memory contained in the data station computer shall be retained;
6. If a personnel (except visitor) is issued with a registration card by the CIC pursuant to the Construction Workers Registration Ordinance (Cap. 583), the card so issued is permitted to be used in lieu of the smart card required under this section;
7. All data stored in the ACRS shall be accessed and retrieved by the microcomputer provided to the LRO. The ACRS shall allow the retrieved data to be printed on paper and exported to electronic files in format of 'Portable Document Format' and 'Microsoft Excel' or other commonly available format acceptable to the CM;
8. The ACRS shall be able to assign an unique Site Personnel Number for each issued smart card complying with the format as stipulated in the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;
9. The ACRS shall be able to compile, print and export forms, schedules and register as required in PRE.C9.140 and PRE.C9.2510 complying with the format similar to the prescribed forms attached to the latest "Contractor's Guideline on Wage Monitoring System" published by HA from time to time;
10. The portable pocket personal computer shall be able to synchronize with the data bank of the ACRS and are capable of recording, verifying and updating the information of the personnel (except visitors) including reading their smart cards and registration cards issued by CIC;
11. The ACRS shall be able to maintain all raw data of in/out records of all Site Personnel and highlight all the records input or edited by manual in reports compiled and printed by ACRS as stipulated in sub-clause (9) for checking.

PRE.C9.2530.9 ENTRANCE/EXIT CONTROL UNIT

Option 1

1. Install sufficient numbers of entrance/exit control unit at all ingress or egress points of the Site and submit the exact locations to the CM for agreement;
2. Each entrance/exit control unit shall be equipped with non-contact type smart card readers with biometric recognition device and access control device, e.g. turnstile;

3. Connect the smart card readers to a secured computer which shall record all personnel's signing in and out of the Site. Provide separate smart card readers with clear labels indicating "IN" and "OUT" for this purpose;

4. Ensure the system can display the photograph of the smart card holder saved in the central data computer unit and the smart card.

Option 2

1. A total of ……. number of portable pocket personal computer complied with the system requirements as stipulated in PRE.C9.2520, which can be synchronized with the data bank of the ACRS and is capable of recording, verifying and updating the information of the Site Personnel and Self-employed workers including their smart cards and registration cards issued by CIC, shall be provided for checking the attendance of site personnel during the operation period of ACRS;

2. One portable pocket personal computer shall be provided at a convenient location (as agreed with the CM) within each Portion of the Site under construction. The Portions of the Site to be provided with portable pocket personal computer shall be determined by the CM from time to time during the contract period.

PRE.C9.2540.9 CENTRAL DATA COMPUTER UNIT

The secured computer unit must have high availability feature of at least 96% uptime or not more than five hours per month outage and shall be loaded with appropriate software to perform the following functions:

1. Automatic recording of the entry/exit information of the smart card holders passing the entry/exit gates;

2. Output and transmit the registration records and the daily entry and exit record, in a format stipulated by HA, to HA's computer facility electronically on frequency prescribed by HA. The transmitted data including its Intellectual Property Right will be owned by HA. HA shall have the right to keep, analyse, compile and further disclose the transmitted data to any person in such form and manner as HA deems fit;

3. Entry and updating of information on smart card holders;

4. Instant retrieval of picture and information of smart card holder;

5. Automatic printout and alarm message in case of faulty operation.

PRE.C9.2550.9 INFORMATION TO BE CAPTURED AND SAVED IN ACRS

1. Provide clear plastic holders to all personnel (except visitors) for holding their smart cards or registration cards issued by CIC. The plastic holder shall be provided with a means to enable it to be displayed in a conspicuous position of the personnel and affixed with a label with the following information shown:

   a. Site Personnel Number;

   b. Name of personnel in Chinese and English;

   c. Name of personnel's employer in Chinese and English (except Self-employed Worker);

   d. Trade of personnel and, if applicable, the relevant trade no. (refer to the trade list issued by CIC);

   e. Photograph of personnel;

   f. Contract no. and Contract title.

Background colour of the label for the Contractor's direct employees shall be red, whilst that for all other Site Personnel shall be green, and Self-employed Workers shall be blue and Specialist Contractors' Workers shall be white.

2. Except for the smart cards which are issued to visitors, the following electronic data shall be contained in smart cards of personnel and the central data unit in encrypt form:

   a. Site Personnel Number;

   b. Name of personnel in Chinese and English;

   c. Hong Kong Identity Card number of personnel;

   d. Details of Construction Workers Registration Card and Trade Test / Intermediate Trade Test Certification Card including the card no., expiry date, trade name and trade no., if available;

   e. Name of Personnel's employer in Chinese and English (except Self-employed Worker);

   f. Trade of personnel and, if applicable, the relevant trade no. (refer to the trade list issued by CIC);

   g. Photograph of personnel;

   h. Contract no. and Contract title;

   i. Employment contract details of Personnel/personal insurance policy details as agreed with the CM (optional for smart card);

   j. Expiry date of the smart card and whether the smart card has been returned or voided;

   k. Signature specimen of personnel (optional for smart card);

   l. Details of Silver Card (if any) including the card no., expiry date and information required in the Record Form (DCEI-F14) and sub-clause (2) of PRE.C6.210. The Record Form (DCEI-F14) can be obtained from the CM upon request in writing;

   m. Details of Safety Card including the card no. and expiry date;

   n. Contact telephone no. of personnel.

3. The following information of all the visitors shall be captured and recorded in the ACRS:

   a. Name of visitor in Chinese or English;

   b. Hong Kong Identity Card number of visitor;

   c. Name of visitor's company/organization;

   d. Contact telephone no. of visitor;

   e. Particulars of staff to be visited:

      i. Name;

      ii. Telephone no.;

      iii. Name of company.

   f. Purpose of the visit;

   g. Site Personnel Number of the smart card issued;

   h. Whether the smart card has been returned.

   The smart card issued to a visitor shall be provided with a means to enable it to be displayed in a conspicuous position of the visitor and in yellow colour.

4. The smart card shall contain sufficient encrypted information for identification of the card holder and access to the master data bank of the system;
5. Comply with the requirements as stipulated in the Personal Data (Privacy) Ordinance for avoiding the abuse of the information collected. Adequate data security control shall be provided to limit the access right to the ACRS on need basis. The usage of the information collected by the ACRS shall be used exclusively for security control and supporting information as required by the Contract e.g. attendance checking;
6. Allow the LRO, representatives of the CM or any other persons authorized by the CM to check the accuracy of the records.

PRE.C9.2560.9 SYSTEM RUNNING AND TERMINATION

1. Operate the ACRS at all times before termination. Replace any component of the ACRS immediately in the event of breakdowns, repairs or regular maintenance;
2. Maintain the operation of ACRS up to the date of the certificate of completion of the Works (or where phased completion of Sections is specified, the last date of completion stated amongst the different certificates of completion for the Sections of the Works) issued by the CM under GCC Clause 8.7. For Contracts with more than one Portion of the Site, and for those Portions with only one Section of the Works, maintain the operation of ACRS for each Portion up to the date of completion of the Section of the Works in such Portion as issued by the CM under GCC Clause 8.7. For Contracts with more than one Portion of the Site, and for those Portions with more than one Section of the Works, maintain the operation of ACRS for each Portion up to the last date of completion stated amongst the different certificates of completion for the Sections of the Works in the same Portion as issued by the CM under GCC Clause 8.7;
3. Seek CM's prior approval for terminating the operation of each ACRS without prejudice to the provisions as specified in sub-clause (2) above;
4. Seek CM's prior approval for dismantling and removal of each access control unit.

WORKS WITHIN THE RAILWAY PROTECTION AREA

PRE.C9.2600.9 GENERAL

Further to the provisions of Clause SCC22.6 of the Special Conditions of Contract, comply with PRE.C9.2605 to PRE.C9.2695 for works to be carried out within the Railway Protection Area as defined in the Contract and as shown on the Drawing referred to in PRE.C6.240.

PRE.C9.2605.9 PROCEDURE FOR POSSESSION

Provided the Contractor has completed all his obligations to obtain a Possession and has made satisfactory arrangements with MTRCL in respect of the extent of working area and procedure for such Possession, MTRCL shall before the Possession advise the Contractor of the detailed time, limits and conditions with which the Contractor must comply.

PRE.C9.2610.9 WORKING IN THE VICINITY OF THE RAILWAY TRACK

Except with the prior written approval of MTRCL the Contractor shall not carry out any works in the vicinity of the railway track without the attendance of a MTRCL's Competent Person to take care of track safety.

PRE.C9.2615.9 TRESPASSING ON RAILWAY PREMISES

The Contractor shall be responsible for ensuring that none of his personnel, sub-contractors or other persons employed by him or on his behalf proceed beyond the agreed limits of the working area or access route or trespass upon railway premises.

PRE.C9.2620.9 PREVENTION OF ACCIDENTS

Before entry is made within the railway premises, the Contractor shall consult MTRCL regarding the latest safety requirements for working within the railway premises. The Contractor shall brief each person employed by or on behalf of him, and those employed by or on behalf of any sub-contractor who may work on or above the track, including persons recruited during the progress of the Works. The Contractor shall ensure that all such persons are fully conversant with the requirements and that those requirements are strictly observed. The Contractor shall arrange induction courses for each and every member of staff (including those of the sub-contractors and the CM) before they are allowed to work within the railway premises and he shall arrange for all personnel to wear identification cards to facilitate control if required by MTRCL.

PRE.C9.2625.9 WORKS DESIGNED BY CONTRACTOR

Where the Contractor is required to carry out any design works for permanent or temporary works, the Contractor shall prepare the design works with reference to the DEVB TC(W) No. 1/2019 on Railway Protection and shall in addition to the requirements specified in other relevant contract documents:

1. Hold early preliminary discussions, through the CM, with MTRCL and make provisional arrangements so that the works can be carried out with the minimum interference to railway traffic and within the extent of Restriction, Possession and Isolation periods that MTRCL can make available. The actual dates for any Restriction, Possession or Isolation previously agreed may, depending on the railway traffic requirements, be subject to amendment by MTRCL when the firm program is drawn up. If MTRCL agrees that such works do not require a Restriction, Possession or Isolation then no early provisional arrangements are necessary;
2. Submit full details, drawings and calculations of such works for consideration by MTRCL. No examination by MTRCL of any document submitted by the Contractor or of any Contractor's drawings of such works or agreement expressed by MTRCL shall absolve the Contractor of his responsibility for the adequacy of the design;
3. Bear in mind that there are certain restraints on the design of and making alteration to properties in close proximity to a railway vent shaft to minimize the possibility of contamination by fire or smoke. Openings of the new structure such as an openable or fixed window, doorway, building ventilation system intake or exhaust and the like in any building shall be located not closer than 5 m to any railway vent shaft, irrespective of whether such vent shaft is free-standing or is accommodated in a building. The distance may be reduced to 2.5 m if the exhaust air from the railway vent shaft is directed away from and is not likely to affect the opening by natural convection.

PRE.C9.2630.A METHOD OF CARRYING OUT THE WORKS AND USE OF PLANT

1. At least six weeks prior to the commencement of those part of the Works within the Railway Protection Area, full details, including calculations, drawings and construction method statements on such permanent works, temporary works, slope works, drainage works, tree planting works, ground investigation works, hoarding works, fire protection measures, lifting operations, construction sequence and program and the likes shall be submitted to MTRCL for comments and agreement. MTRCL's agreement with such submission shall not relieve the Contractor of any of his duties or responsibilities under the Contract;
2. All works and plant operations within the Railway Protection Area shall be carried out in such manner as to avoid risk of danger to the railway traffic facilities and to passengers or to persons entitled to be within the railway premises and so as to avoid (except to the extent previously agreed in writing) any interference with or obstruction of the free movement of the railway traffic or any such passengers or persons;
3. Detailed plans and sections showing the relationship amongst the proposed works, plant operations, railway structures and tracks shall be provided for MTRCL's prior comments and agreement;
4. All works shall be arranged and carried out in compliance with the requirements as stipulated in the "Technical Notes for Guidance in Assessing the Effects of Civil Engineering Construction / Building Development on Railway Structures and Operations" in APPENDIX PRE.C9/XI to this Specification and the "Key industrial safety precautions for Contractors working within railway premises" in APPENDIX PRE.C9/XII to this Specification respectively;
5. Prior to the commencement of any structural works in connection with railway structure, if agreed by MTRCL, a structural compatibility check certified by the original designer of the railway structure or by a Registered Structural Engineer shall be submitted to MTRCL for comments and agreement. As built information of the railway structure can be viewed in MTRCL;
6. Assessment to check the effects induced in railway structures / installations arising from the works in accordance with the "Technical Notes for Guidance in Assessing the Effects of Civil Engineering Construction / Building Development on Railway Structures and Operations" in APPENDIX PRE.C9/XI to this Specification shall be carried out and submitted to MTRCL for prior comments and agreement;
7. Any damage done to railway structures / installations or any works done which affect the safe operation of the railway shall be repaired and reinstated by the Contractor to the satisfaction of MTRCL;
8. Prior to the commencement of any works within the Railway Protection Area, a survey to record the condition of the railway structures / installations constructed within 30 m from the works shall be carried out and submitted to MTRCL for comments and agreement;
9. The movement, deformation, change in stress and vibration induced in any railway structures / installations arising from the works shall be monitored by the Contractor. A monitoring proposal shall be submitted to MTRCL for prior comments and agreement;
10. No excavated materials, building materials, debris, containers, sheds of any kind, huts, compressors, power generators, dangerous goods or inflammable materials shall be placed or stored within 6 m of the railway premises;
11. At all times, a safe, fluent and unimpeded passageway must be maintained on the Site for MTRCL staff to all railway structures / installations;
12. The free and unblocked passenger access, maintenance access and emergency vehicle access (EVA) of the railway must not be affected by the works at all times;

13. Working Hours:

    a. Prior comments and agreement from MTRCL shall be obtained on the working hours for the works such as erection of hoarding, working platform, lifting operations and all other works to be carried out within railway premises as well as in the vicinity of the railway structures and installation such as overhead power cables which will in the opinion of MTRCL affect the safe operation of the railway. MTRCL may require these works to be carried out outside the peak railway traffic hours or to be carried out during the non-traffic hours of the railway.

14. Site Representative:

    a. When working within or above the railway premises and/or within 6 m of the railway track and/or overhead power cables, the Contractor shall provide a competent site representative to supervise the proper execution of the works. The site representative shall be a professionally qualified engineer and a member of the Hong Kong Institution of Engineers or the Institution of Civil Engineers, UK or equivalent, and have site management experience appropriate to the nature of works;

    b. The site representative shall have the authority to receive and carry out the directives and instructions from MTRCL. The site representative shall carry a mobile phone at all times and respond to the MTRCL's calls immediately;

    c. The site representative shall be present on Site full time during the construction works carried out within or above the railway premises and/or within 6 m of the railway track and/or overhead power cables. If such site representative is absent, no works shall be allowed to be executed.

15. MTRCL's Competent Persons:

    a. All works to be carried out within or above the railway premises and/or the works which have high risk on the safe operation of the railway and are required by MTRCL to be carried out during non-traffic hours of the railway, shall be carried out in the presence of a MTRCL's Competent Person and/or MTRCL's engineer's person-in-charge and/or hand signalman and/or lookoutman depending on the nature of the works and its possible effects on the railway. The Contractor shall be required to make request to MTRCL three weeks in advance for such arrangements.

16. With regard to all works to be carried out within railway premises, the Contractor shall apply for the necessary construction noise permit from the relevant Government departments;

17. For safety and operational reasons, MTRCL shall have the authority to stop the works when required. The Contractor shall stop the works immediately when such an instruction is given by MTRCL and the works shall not be resumed until permission is given by MTRCL;

18. Before the Contractor takes over the Site within the Railway Protection Area, the Contractor shall establish an effective communication channel amongst MTRCL, the CM and the Contractor. Such a communication channel shall be adequate to cover all hours;

19. MTRCL shall be informed at least three weeks prior to the actual commencement of any site works.

PRE.C9.2635.A INTERFERENCE WITH DRAINS AND SERVICES

1. The Contractor shall not interfere with the MTRCL's cables, signals, telegraph wires or any other apparatuses affecting the operations of the railway. The Contractor shall give sufficient notice to MTRCL to enable him to arrange for any diversion, protection or support works which MTRCL considers could be and should be carried out prior to the commencement of any works which may affect such apparatuses;
2. The Contractor shall not interfere with any public utility services within the railway premises. The Contractor shall give sufficient notice to the Utility Undertakings, the MTRCL and/or the relevant Government departments to enable them to arrange for any diversion, protection or support works which they consider could be and should be carried out prior to the commencement of any works which may affect such services;
3. The Contractor shall ensure that no metallic object (including metallic surveying tapes) is allowed to come into contact with two or more running rails nor bridge the gap across insulated rail joints. Failure to do so will cause interference with the signaling system and corresponding delays to traffic;
4. The Contractor shall divert to a suitable outlet, by pipes or other means, water from springs, water courses, or drains which may be affected by the works and every reasonable precaution shall be taken by the Contractor to prevent damage to MTRCL's property. The Contractor shall not be allowed without the prior agreement of MTRCL to make temporary or permanent connections to the railway drains, pipes or other services.

PRE.C9.2640.9 CROSSING THE TRACK

Persons engaged on the Works shall not be allowed to cross or convey material across the tracks except under conditions previously agreed in writing by MTRCL.

PRE.C9.2645.9 OVERHEAD ELECTRICIAL EQUIPMENT

The Contractor's attention is drawn to the presence of the overhead electrical equipment which should be treated live at all times unless it has been isolated and earthed. Overhead electrical equipment is charged at high voltage and the Contractor shall observe the following precautions:

1. Works shall not be carried out, cranes or other plant shall not be erected, operated or dismantled, or materials shall not be stored, within the prohibited space which is within 3 m of a vertical plane from the nearest live overhead electrical equipment including return conductors and all supports to such electrical equipment;
2. The prohibited space in sub-clause (1) above shall be increased by the length of any tool or material being handled. However, works below the overhead electrical equipment on the permanent way, platforms, walkways and the like is permitted without special precautions provided that tools or equipment are not at any time raised or extended above head height;
3. The prohibited space in sub-clause (1) above shall be increased by the length of the longest individual unit of any scaffolding. MTRCL may require the scaffolds or similar apparatuses to be earthed;
4. If a crane or other construction equipment is used, crane stops, protective catch fence and warning notices shall be provided by the Contractor to ensure that there can be no encroachment by the crane, load or other construction equipment on the prohibited space defined in sub-clause (1) above even if such crane, load or construction equipment slips, fails, falls or overturns. The design of the protective catch fence shall be agreed with MTRCL;

5. Portable ladders used shall be of non-conducting material and shall not be reinforced by metal attachments running along the stiles of the ladders. Special precautions must be taken to ensure that the ladder cannot slip and encroach on the prohibited space defined in sub-clause (1) above;
6. Any disturbance of or attachment to any equipment forming part of the overhead electrical equipment system must be carried out by authorized personnel of MTRCL;
7. Provided that where it is impracticable to comply with any of the above requirements, the Contractor shall request MTRCL to arrange any possible special precautions which MTRCL considers could be taken.

PRE.C9.2650.9 USE OF EXPLOSIVES

Explosives shall not be used in connection with the Works without the written consent of MTRCL and the Commissioner of Mines, Hong Kong Special Administrative Region. If approval to blast is given then it shall only be carried out under such conditions as the Commissioner of Mines may impose.

PRE.C9.2655.9 EMERGENCY CREW

The Contractor shall provide an emergency crew during heavy rains and typhoons and, if required by MTRCL, at critical stages of the Works. The name of, and the method of communication with, the person who will be in charge of the crew for the following month shall be forwarded to MTRCL not less than two weeks before the first day of that month.

PRE.C9.2660.9 STACKING OF MATERIAL

The Contractor shall stack and place all materials, plant and appliances in such a manner as to prevent their causing injury or damage to persons or property and at a safe distance both from railway tracks and platform edges, normally not less than 2.8 m from the nearest rail of operating track or 2.5 m from a platform edge, but subject to the requirements as specified in PRE.C9.2645. The Contractor shall also strictly observe any instructions given by MTRCL as to the precautions to be taken and the distance from railway tracks and platform edges within which materials, plant and appliances shall not be stacked or placed.

PRE.C9.2665.9 SCREENING OF LIGHTS

All lights provided by the Contractor shall be placed or screened so as not to interfere with any railway signals and shall not form a source of glare to the train operator. The Contractor shall inform MTRCL and obtain his written permission before commencing any temporary works which might interfere with the railway signals or the sighting of such.

PRE.C9.2670.9 FIRE PREVENTION

The Contractor shall during the performance of the works make adequate arrangements, to the satisfaction of MTRCL, for the protection of the works and any adjacent railway premises from fire and shall comply with MTRCL's requirements, if any, with regard to such protection. The Contractor shall give MTRCL all facilitations to inspect the fire prevention arrangements within the railway premises and within such distance from them as MTRCL may consider necessary and shall remove such materials and take such steps to reduce the fire risk as MTRCL may from time to time require.

PRE.C9.2675.9 NOTICE OF ACCIDENTS

In the case of any accident arising out of the works within the railway premises, the Contractor shall without delay notify MTRCL in addition to any other notification which he is required to make by law and/or under the Contract.

PRE.C9.2680.9 ADVERTISEMENTS

The Contractor shall not permit any advertisement to be displayed within the railway premises.

PRE.C9.2685.A CLEARANCE OF LAND AND PROPERTY WITHIN THE RAILWAY PREMISES

The Contractor shall prevent mud or water falling or draining from the Works on to the land or property within the railway premises and particularly on to the track, ballast or walkways. The Contractor shall not leave any rubbish on the land and property within the railway premises. The Contractor shall clear away and remove all Constructional Plant, surplus materials and temporary works as and when in the opinion of MTRCL these cease to be required for the works being carried out. Any damage to the land or property within the railway premises shall be repaired and reinstated to the satisfaction of MTRCL.

PRE.C9.2690.A CONDITIONS FOR WORKING WITHIN / IN THE VICINITY OF THE RAILWAY PREMISES

The Contractor shall be liable for and shall indemnify and keep indemnified MTRCL against any liabilities, claims or proceedings in respect of any damage or injury arising out of or in connection with his works within/in the vicinity of the railway premises. The Contractor shall complete and provide to MTRCL an indemnity and a letter of undertaking in the form set out in APPENDIX PRE.C9/XIII and APPENDIX PRE.C9/XIV to this Worksection respectively.

PRE.C9.2695.9 RATE OF CHARGE FOR SERVICE / INFORMATION PROVIDED BY MTRCL

The Contractor shall be responsible for the payment of service / information provided by MTRCL. The rate of charge for service / information provided by MTRCL is set out in Appendix U to this Specification for reference only.

APPENDIX PRE.C9/I

PRE.C9.APPEND1.9 WASTE FLOW TABLE

Sheet 1 of 2

Contract Title and No. : _____

Monthly Summary Waste Flow Table for Year/Year

Month	Estimated Quantity of Inert C&D Materials (in '000m³)								Estimated Quantity of C&D Wastes													
	Total Quantity Generated		Suitable for Recycled Aggregates		Reused in the Contract		Reused in other Projects		Disposed as Public Fill		Metals		Paper/cardboard packaging		Plastics (see Note 3)		Chemical Waste		Others, e.g. general refuse	
	(a)		(b)		(c)		(d)		(e = a-b-c-d)		(in '000kg)		(in '000kg)		(in '000kg)		(in '000kg)		(in '000kg)	
	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.
Month 1																				
Month 2																				
Month 3																				
Month 4																				
Month 5																				
Month 6																				
Month 7																				
Month 8																				
Month 9																				
Month 10																				
Month 11																				
Month 12																				
Total																				

Notes: (1) The performance targets are stated in PRE.C9.2360.
(2) The waste flow table shall also include C&D materials that are specified in Contract to be imported for use at the Site.
(3) Plastics refer to plastic bottles/containers, plastic sheets/foam from packaging material.

Contract Title and No. :_____

Yearly Summary Waste Flow Table (Grand Summary)

Year	Estimated Quantity of Inert C&D Materials (in ' 000m³)										Estimated Quantity of C&D Wastes									
	Total Quantity Generated		Suitable for Recycled Aggregates		Reused in the Contract		Reused in other Projects		Disposed as Public Fill		Metals		Paper/cardboard packaging		Plastics (see Note 3)		Chemical Waste		Others, e.g. general refuse	
	(a)		(b)		(c)		(d)		(e = a-b-c-d)		(in ' 000kg)		(in ' 000kg)		(in ' 000kg)		(in ' 000kg)		(in ' 000kg)	
	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.	Est.	Act.
Year 1																				
Year 2																				
Year 3																				
Year 4																				
Year 5																				
Year 6																				
Year 7																				
Year 8																				
Year 9																				
Year 10																				
Grand Total																				

Notes: (1) The performance targets are stated in PRE.C9.2360.
(2) The waste flow table shall also include C&D materials that are specified in Contract to be imported for use at the Site.
(3) Plastics refer to plastic bottles/containers, plastic sheets/foam from packaging material.

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APPENDIX PRE.C9/II

PRE.C9.APPEND2.9 DAILY RECORD SUMMARY

" Daily Record Summary" to record daily disposal of C&D materials from the Site

"每日運載記錄撮要" 記錄每日由地盤所傾倒的拆建物料

(1) Contract no. & title 合約編號及名稱: _____

(2) Date of disposal 傾卸日期: _____

(3) Disposal ground (s) designated in the Contract or directed by the Contract Manager 合約指定或合約經理指示接收設施: (a)

(b)

Others 其它

(4) Approved alternative disposal grounds 另可接受的接收設施 _____

CHIT/ DDF no. 載運人帳票/拆建物料運載記錄票編號	**Vehicle registration mark** 車輛登記號碼	**Approx. vol (e.g. Full/Three Quarter/Half/One quarter)** 大約承載量 (例如全、3/4、半、1/4)	**C&D materials type (e.g. inert or non-inert)** 建築廢料種類 (例如惰性或非惰性)	**Disposal ground** 接收設施	**Signature & Name of the Contractor's Designated person before departure** 於離開地盤前，承建商的指定人仕姓名及簽名	**Departure time from Site** 離開地盤時間	**Signature & name of the Contract Manager's supervisory staff before departure or other time as agreed between the Contract Manager's Representative and the Contractor** 於離開地盤前或其它經承建商與合約經理代表同意的時間，合約經理監管人員姓名及簽名	**Actual disposal ground** 真正接收設施	**Arrival time at disposal ground** 抵達接收設施時間	**Remarks** 備註

← Part 1[1] 甲部 → ← Part 2[2] 乙部 →

Submitted by 呈交 : _____ *[Name of Contractor's Designated Person 承建商的指定人仕姓名*

Signature 簽名 : _____

Date 日期: _____

Received by 接收 : _____ *[Name and signature of the Contract Manager's staff] 合約經理監管人員姓名及簽名*

Post 職位 : _____

Date & Time 日期及時間 : _____

---

[1] Part 1 甲部- The Contractor shall complete Part 1 in duplicate and a copy should be kept by the Contract Manager's Representative. 承建商填寫甲部兩份，副本由合約經理代表持有

[2] Part 2 乙部- The Contractor shall complete Part 2 and submit the whole Summary to the Contract Manager's Representative within 1 working day after the records are posted at the EPD's web-site.
承建商須填寫乙部及將整份運載記錄撮要於記錄上載在環境保護署網頁後 1 個工作天內呈交給合約經理代表

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APPENDIX PRE.C9/III

PRE.C9.APPEND3.9 FORMS EPS-F3 AND EPS-F4

FORM EPS-F3 (SHEET 1 OF 2)

Contract Title : _____

Contract No. : _____

Notice of Appointment : Registered Structural Engineer (RSE)* / Registered Geotechnical Engineer (RGE)* Qualified Engineer (QE)* / Design Certifying Consultant (DCC)*

To : Hong Kong Housing Authority

Attention : Contract Manager

In accordance with the provisions of the General Conditions of Contract Clause 5.8, I / we* hereby give you notice that I / we* have appointed (full name of the RSE / RGE / QE / DCC*)

(English) _____ (Chinese) _____ of

(address) _____

_____

Telephone No. _____, Fax No. _____, as RSE / RGE / QE / DCC* for the purpose of General Conditions of Contract Clause 5.8 of the captioned Contract.

Date: _____

_____
Signature of Project Manager

_____
Name in full

_____
Name of Contractor

* Delete whichever is inapplicable

FORM EPS-F3 (SHEET 2 OF 2)

Confirmation of Appointment

I (name in full) _____ (Chinese) _____ confirm that I have been appointed as the RSE / RGE / QE / DCC* for the purpose of General Conditions of Contract Clause 5.8 of the above Contract.

Date: _____

_____
Signature of RSE / RGE / QE / DCC*

Certificate of Registration No.* : _____

Date of Expiry of Registration* : _____

* Delete whichever is inapplicable

Notes :-

1. Certificate of Registration No. and Date of Expiry of Registration are applicable to the appointment of RSE and RGE only.

FORM EPS-F4 (SHEET 1 OF 2)

Contract Title : _____

Contract No. : _____

Works / Certificate* Submission by **Registered Structural Engineer (RSE)* / Registered Geotechnical Engineer (RGE)* / Qualified Engineer (QE)* / Design Certifying Consultant (DCC)***

To : Hong Kong Housing Authority

Attention : Contract Manager

In accordance with the provisions of the Contract for demolition / foundation / building* works as detailed in Specification clause / Drawing no. * _____

I / we* hereby submit the (here specify the type of plans) _____ plans / geotechnical report / supporting documentation / structural details / calculations / certificate on Temporary Works* for your approval / consent* prior to works commencement. The said plans / calculations / certificate* have been prepared by

_____ _____ (RSE / RGE / QE / DCC*)

(name in full) (Chinese)

the appointment of whom has been notified to you in the Form EPS-F3 submitted on _____

Date: _____

_____

Signature of Project Manager

_____

Name in full

_____

Name of Contractor

* Delete whichever is inapplicable

FORM EPS-F4 (SHEET 2 OF 2)

Certificate of **Preparation of Plans***
Checking on Temporary Works*
Foundation Design*

In accordance with the provisions of the Contract, I hereby certify that:

a. the plans / geotechnical report / supporting documentation / structural details / calculations / Temporary Works design / Temporary Works inspected by me on Site as shown on the plans* attached relating to the above demolition / foundation / building works* and which have been signed by me, have been prepared / checked* and found satisfactory as being properly and safely designed / constructed* for the intended purpose by me or under my supervision or direction and that

b. the attached plans / geotechnical report / supporting documentation / structural details / calculations / Temporary Works* comply in all respects with the provisions of the Contract.

Date: _____

_____
Signature of RSE / RGE / QE / DCC*

_____
Name in full

Certificate of Registration No.* : _____

Date of Expiry of Registration* : _____

* Delete whichever is inapplicable

Notes :-

1. Certificate of Registration No. and Date of Expiry of Registration are applicable to RSE or / and RGE's submission only.

APPENDIX PRE.C9/IV

PRE.C9.APPEND4.9 DISPOSAL DELIVERY FORM

Serial No. 0012345678

Date of Use:
使用日期:_____

Disposal Ground :
接收設施:

_____

Vehicle Registration Mark. :
車牌號碼:

_____

Issued By:
簽發:

_____

(This part retained by Disposal Ground)
(此部分由接收設施保留)

_____
Chop of Disposal Ground 接收設施蓋印

Serial No. 0012345678

Construction and Demolition Materials
Disposal Delivery Form
拆建物料運載記錄票

Contract No: _____ Contract Title: _____

合約編號: _____ 合約名稱: _____

Date of Use: 使用日期: _____ Time of departure from site: 離開地盤時間: _____ Vehicle Registration Mark: 車牌號碼:_____

Disposal Ground:
接收設施: _____

Arrival Time/Date:
抵達日期/時間: _____
(This part retained by Contractor/Driver)
(此部分由承建商/司機保留)

_____
Chop of Disposal Ground
接收設施蓋印

_____
Chop of Contract Manager's Representative
合約經理代表蓋印

APPENDIX PRE.C9/V

PRE.C9.APPEND5.9 MONTHLY RECORDING OF DAILY FLOW RATE OF WASTE WATER DISCHARGED ON SITE

Contract Title : _____

Contract No. : _____

Monthly Summary Waste Water Flow Rate Table

Month	Month of the Year	Daily low Rate of Waste Water Discharged on Site (m^3/day)																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Month 1																																
Month 2																																
Month 3																																
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Month 27																																
Month 28																																
Month 29																																
Month 30																																

The limit of flow rate as stipulated in WPCO Licence No. _____ is _____ m^3/day

DELETED

APPENDIX PRE.C9/VI

PRE.C9.APPEND6.9 SUMMARY RECORD OF DELIVERY AND CONSUMPTION OF B5 DIESEL OR EURO V DIESEL / ULTRA LOW SULPHUR DIESEL ON SITE

[N.B. The total for the month is for checking the relative order of quantity of fuel delivered and consumed on Site. The Contractor / Sub-contractor shall provide reasons when there is a discrepancy between monthly intake and monthly consumption, for example, wastage during handling and the like.]

APPENDIX PRE.C9/VII

PRE.C9.APPEND7.9 SAMPLE COMPANY CODE OF ETHICS FOR HONG KONG HOUSING AUTHORITY CONTRACTORS

SAMPLE COMPANY CODE OF ETHICS FOR HONG KONG HOUSING AUTHORITY CONTRACTORS (SHEET 1 OF 6)

Sample Company Code of Ethics for Hong Kong Housing Authority Contractors

The Company is committed to upholding the highest standards of honesty and integrity to enhance the quality and efficiency of service. As we owe a duty to the community, employers, contractors and their employees, we will act professionally and use our best endeavour to practise this code of ethics in order to promote integrity within the construction industry.

1. Laws and Regulations

The Company shall conduct all business dealings strictly according to all the statutory rules and regulations. Directors and employees are not allowed to solicit or accept any advantages, whether in Hong Kong or else where, when conducting business on behalf of the company.

2. Securing of Work/Contract

In accepting or securing work/contract, the Company shall have regard to factors which might reflect adversely upon the integrity, objectivity and judgement in relation to that work/ contract. We shall not directly or indirectly exert undue pressure/influence on any person, for the purpose of securing work/contract.

3. Confidentiality

The Company owes a duty to the employer, contractors and employees to protect any confidential/privileged information entrusted upon us. We shall not disclose to a third party any such information without prior consent.

4. Professionalism

The Company shall discharge its trade related contractual responsibilities with competence and due diligence. We shall at all times perform our work objectively and impartially and free from influence by any consideration, which may, either potentially or actually, conflict with this requirement. The Company shall ensure that the work is carried out with proper regard to technical and professional standard expected of the trade.

5. Respect to Intellectual Property

The Company affords full respect to proprietary intellectual property and shall refrain from using any ideas, products and goods without proper authorisation.

SAMPLE COMPANY CODE OF ETHICS FOR HONG KONG HOUSING AUTHORITY CONTRACTORS (SHEET 2 OF 6)

6. Relationships with Employers and Contractors

The Company shall conduct all business dealings, including the procurement of service and supply, with honesty and fairness and expect the same in the relationships with all those with whom we do business. The Company shall deal with its employers and contractors in a professional, fair and ethical manner.

7. Safety and Training

The Company shall provide a safe and healthy workplace for the employees and workforce and shall encourage continuous professional development and skill enhancement amongst its staff and the workforce.

8. Community and Environment

In the course of business, the Company shall seek to protect public interest and safety. We shall also seek to minimise public nuisance, maximise general safety measures and be sensitive to protection of environment.

9. Declaration

The Company shall declare to its employers, contractors and any business associates whenever any conflict of interest situation which, to its best knowledge, arises or has arisen.

10. Delegation of Duties

To enable the directors and employees to perform at the highest level of integrity, commitment and professionalism, the Company has issued a code of conduct for directors and employees. The Company shall ensure its site staff and those to whom it delegates work (such as employers/contractors) understand the Company's code of conduct and encourage them to comply with these requirements.

SAMPLE COMPANY CODE OF ETHICS FOR HONG KONG HOUSING AUTHORITY CONTRACTORS (SHEET 3 OF 6)

Sample Code of Conduct for Directors and Staff Members of Hong Kong Housing Authority Contractors/Service Providers

Ethical Commitment

1. The *(name of company)* (hereafter referred to as the Company) regards honesty, integrity and fair play as our core values that must be upheld by all directors and staff[1] of the Company at all times. This Code sets out the basic standard of conduct expected of all directors and staff members, and the Company's policy on acceptance of advantage and handling of conflict of interest when dealing with the Company's business.

Prevention of Bribery

2. The Company prohibits all forms of bribery and corruption. All directors and staff are prohibited from soliciting, accepting or offering any bribe in conducting the Company's business or affairs, whether in Hong Kong or elsewhere. In conducting all business or affairs of the Company, they must comply with the Prevention of Bribery Ordinance (POBO) (Cap. 201) and must not:

(a) solicit or accept any advantage from others as a reward for or inducement to doing any act or showing favour in relation to the Company's business or affairs, or offer any advantage to an agent of another as a reward for or inducement to doing any act or showing favour in relation to his principal's business or affairs;

(b) offer any advantage to any public servant (including Government / public body employee) as a reward for or inducement to his performing any act in his official capacity or his showing any favour or providing any assistance in business dealing with the Government / a public body;

(c) offer any advantage to any staff and members of a government department or public body while they are having dealings with the latter; or

(d) use documents containing false information to deceive or mislead the Company, regardless of whether there is any gain or advantage involved.

(The relevant provisions of the POBO are at the **Annex**.)

Acceptance of Advantage

3. It is the Company's policy that directors and staff should not solicit or accept any advantage for themselves or others, from any person, company or organisation having business dealings with the Company or any subordinate, except that they may accept (but not solicit) the following when offered on a voluntary basis:

[1] "Staff" cover full-time, part-time and temporary staff, except where specified.

SAMPLE COMPANY CODE OF ETHICS FOR HONG KONG HOUSING AUTHORITY CONTRACTORS (SHEET 4 OF 6)

(a) advertising or promotional gifts or souvenirs of a nominal value; or

(b) modest gifts given on festive or special occasions, subject to a maximum limit of $_____ in value; or

(c) discounts or other special offers given by any person or company to them as customers, on terms and conditions equally applicable to other customers in general.

4. Gifts or souvenirs described in paragraph 3(a) that are presented to directors and staff in official functions are deemed as offers to the Company. The directors and staff concerned should report the acceptance to the Company and seek direction as to how to handle the gifts or souvenirs from *the approving authority*[2] in writing. If a director or staff member wishes to accept any advantage not covered in paragraph 3, he/she should also seek permission from *the approving authority* in writing.

5. However, a director or staff member should decline an offer of advantage if acceptance could affect his/her objectivity in conducting the Company's business or induce him/her to act against the interest of the Company, or acceptance will likely lead to perception or allegation of impropriety.

6. If a director or staff member has to act on behalf of a client in the course of carrying out the Company's business, he/she should also comply with any additional restrictions on acceptance of advantage that may be set by the client (e.g. directors and staff performing any duties under a Hong Kong Housing Authority (HA) contract are prohibited from accepting advantages (including gifts from tenants/licencees/ occupiers/visitors/third parties/sub-contractors/agents, etc.) in relation to that contract).

Offer of Advantage

7. Directors and staff are prohibited from offering advantages to any director, staff member or agent of another company or organisation, for the purpose of influencing such person in any dealing, whether directly or indirectly through a third party, when conducting the Company's business. Even when an offer of advantage carries no intention of improper influence, it should be ascertained that the intended recipient is permitted by his employer/principal to accept it under the relevant circumstance before the advantage is offered. However, directors and staff must not offer advantage to any staff and member of a government department or public body while they are having dealings with the latter (para. 2(c)).

Entertainment

8. Although entertainment[3] is an acceptable form of business and social behaviour, a director or staff member should not accept lavish or frequent entertainment from persons with whom the Company has business dealings (e.g. tenants, suppliers or

[2] Specify the post of the approving authority in the Code.
[3] Entertainment refers to "entertainment" as defined in the POBO, i.e. food or drink provided for immediate consumption on the occasion, and any other entertainment provided at the same time.

SAMPLE COMPANY CODE OF ETHICS FOR HONG KONG HOUSING AUTHORITY CONTRACTORS (SHEET 5 OF 6)

contractors in HA contracts), or from his/her subordinates to avoid placing himself/herself in a position of obligation. Where acceptance of such invitations are unavoidable for reasons of courtesy, directors and staff should seek permission from *the approving authority*. Moreover, directors and staff are not allowed to offer any excessive entertainment, in particular, to any HA and Housing Department employees or members of their families.

Conflict of Interest

9. Directors and staff should avoid any conflict of interest situation (i.e. situation where their private interest conflicts with the interest of the Company) or the perception of such conflicts. When actual or potential conflict of interest arises (e.g. directors, staff or their family members have interest in the Company's contracts which they are supervising), the directors or staff concerned should make a declaration to *the approving authority* in writing through their supervisors. They should also similarly seek prior approval from the Company before they take up outside work or employment which could create or give rise to a conflict of interest situation.

Gambling

10. Directors and staff should not engage in frequent, excessive or high stake gambling of any kind with persons having business dealings with the Company (including project staff in HA contracts and tenants, etc.) to avoid any actual or potential conflict of interest.

Loans

11. Directors and staff should not accept any loan from, or through the assistance of, any individual or organisation having business dealings with the Company. There is however no restriction on borrowing from licensed banks or financial institutions.

Misuse of Official Position, Company Assets and Information

12. Directors and staff must not misuse their official positions in the Company to pursue their own private interests, which include their financial and personal interests and those of their family members, relatives or close personal friends.

13. Directors and staff in charge of or having access to any Company assets (including funds, property, information, intellectual property, etc.) should use them solely for the purpose of conducting the Company's business. Unauthorised use of Company assets, such as misuse for personal interest, is strictly prohibited.

14. Directors and staff should not disclose any classified information (e.g. tenants' personal or family particulars in a HA contract) without authorisation or misuse any Company information (e.g. unauthorised sale of the information). Directors and staff who have access to or are in control of such information, including information in the Company's computer system, should take security measures to protect the information

SAMPLE COMPANY CODE OF ETHICS FOR HONG KONG HOUSING AUTHORITY CONTRACTORS (SHEET 6 OF 6)

from misuse or unauthorised disclosure. Special care should also be taken in the use of any personal data, including directors', staff's and customers' personal data, to ensure compliance with the Personal Data (Privacy) Ordinance (Cap. 486).

Compliance with the Code

15. It is the responsibility of every director and staff member of the Company to understand and comply with this Code, whether performing his duties of the Company in or outside Hong Kong. Managers and supervisors should also ensure that the staff under their supervision understand well and comply with this Code.

16. Any director or staff member in breach of this Code will be subject to disciplinary action, including termination of appointment. Any reports of suspected breaches or enquiries about this Code should be made to *(post of a designated senior staff member)*. In cases of suspected corruption or other criminal offences, a report should be made to the appropriate authority.

_____

(Name of Company)

Date :

APPENDIX PRE.C9/VIII

PRE.C9.APPEND8.9 STANDARD TEMPLATE FOR CONFIRMATION OF VERBAL INSTRUCTION

CONFIRMATION OF VERBAL INSTRUCTION (CVI)

For Housing Department's Use
Project Ref. : _____
Site Instruction Issued : _____

Post	Name	Signed	Date

Contract No. : _____ **CVI No.** : _____

Contract Title : _____

Contractor : _____

Principles :

1. CVI provides quick means for the Contractor to confirm with the Project Team construction details usually **minor** in nature.
2. CVI shall not relieve the Contractor's obligation under relevant clause of the Conditions of Contract to give adequate notice of request for information for execution of the Works.
3. CVI shall **NOT** be used for measurement and adjustment of the final contract sum.
4. Any variation to the Contract arising from the information in CVI **shall be separately covered by Site Instructions** [SI] with variation drawings incorporating changes confirmed by the CMR. CMR and/or Contractor may raise for discussion any particular CVI not yet covered by SI but involves considerable cost implication (say rough indicative cost +$100,000 or above), and may refer the CVI to the POS for estimating the cost effect for cost reporting and interim payment as necessary.
5. CVI is **NOT** a notice of claim for extension of time or cost claim under the Contract, and **NO** time or cost claim shall be implied under CVI. Any such claim shall be submitted separately in accordance with relevant clauses of the Conditions of Contract.

Part A *(to be completed by the Contractor)*

A.1 Content of Verbal Instruction

A.2 Location of Works

A.3 Drawings/Sketches attached

Ref. of Drawings / Sketches attached	Drawing No. of Contract Drawings (if sketches / drawings / sketches are based on Contract Drawings)

A.4 Details of Verbal Instruction Given

Verbal instruction given by	
Verbal instruction given to	
Date of instruction/discussion	

A.5 Associated Abortive Works

☐ No

☐ Abortive works to be separately submitted
(to attach time bar records / record of agreed / for checking and submission of abortive and claims by project team)

A.6 Remarks *(if any)*

Post	Name	Signed	Date

Distribution

☐ A/__ ☐ SE/__ ☐ BSE/__ ☐ CE/__
☐ GE/__ ☐ COW/__ ☐ IOW/__ ☐ BSI/__
☐ LA/__
☐ Contractor's team : _____
☐ Other : _____

Part B *(to be completed by Contract Manager (CM) and Supervising Officer (SO))*

B.1 Reply to Part A

☐ Part A is **NOT** confirmed, reasons (if any) :

☐ Part A is confirmed but Site Instruction will **NOT** be issued. reasons (if any) :

☐ Part A is confirmed and Site Instruction will be issued with the condition(s) remarked below :

_____

Post	Name	Signed	Date

Distribution

☐ A/__ ☐ SE/__ ☐ BSE/__ ☐ CE/__
☐ GE/__ ☐ COW/__ ☐ IOW/__ ☐ BSI/__
☐ LA/__
☐ Contractor's team : _____
☐ Other : _____

DELETED

APPENDIX PRE.C9/IX

PRE.C9.APPEND9.9 STANDARD TEMPLATE FOR ABORTIVE WORKS RECORD SHEET

ABORTIVE WORKS RECORD SHEET Record Sheet No. : _____

Contract Title : _____ Contract No. : _____

Notes for completing the Record Sheet

1. To be prepared and submitted by Contractor for Main Contractor's Works, or prepared by Nominated Sub-contractor (NSC) and submitted by Contractor for NSC's Works.
2. Abortive works of Main Contractor, NSC, or Main Contractor's abortive works in connection with NSC's works shall be submitted in separate record sheets.
3. This Abortive Works Record Sheet is not a notice of claim for extension of time or cost claim under the Contract. Any claim for extension of time or cost claim shall be submitted separately in accordance with the Contract provisions.
4. Delete as appropriate for items marked with ^ and select one for items marked with #.
5. The Contractor shall notify the CMR before carrying out any abortive works with photo records and submit the duly completed Abortive Works Record Sheet within 7 working days after completion of the abortive works or any specified period as agreed with site staff.

Part A

To : ^PCOW / ^PIOW / ^PBSI _____ (Name and Post) Date : _____

Subject / Details : _____

Item	Description of Works	Location & Section of Works	Dimension	Labour	Man-day with Start and End Dates	Plant	Materials	Remarks

Cause of the abortive works :

Date of carrying out the abortive works : _____

Encl. :

☐ Drawings & Location Plans Ref. No. : _____

☐ Photographs (in ____ No.) :
(Remarks, if any, e.g. photographs showing before and after the completion of the abortive works) _____

☐ S.I. / CVI / Query / Letter Ref. No. :
(with Issue Date) _____

☐ Other Ref. *(if any)* : _____
(e.g. Record sheet of abortive NSC works for submission of related abortive builder's works)

☐ (i)^ For Main Contractor's Works

Prepared and Submitted by Contractor : _____ (Name & Post) Signature : _____

☐ (ii)# For NSC's Works

Prepared by NSC : _____ (Name & Post) Signature : _____

Submitted by Contractor : _____ (Name & Post) Signature : _____

Part B *(PCOW / PIOW / PBSI to complete **within 7 working days** on receipt of Part A from Contractor or any specified period as agreed with the Contractor)*

To : *PA / *PSE / *PBSE / *PCE / *PGE / *PLA _____ (Name and Post) Date : _____

☐ (i)√ The reported abortive works have been verified against site records. The abortive works arose from *changes in Project Team's requirements / *CVI / *S.I. / *other reasons :

_____

_____

☐ (ii)* The reported abortive works are *not in line with the site records/*not due to changes in Project Team's requirements / *S.I. / *CVI / *other valid reasons.

☐ (iii)* The *Contractor / *NSC is required to clarify and / or provide the following: (please specify if required)

_____

Verified by : _____ (Name and Post) Signature : _____

Part C *(CM's Representative (PA / PSE / PBSE / PCE / PGE / PLA) to complete **within 28 working days** on receipt of Part B)*

To : Contractor _____ Date : _____

Attn : _____ (Name and Post)

☐ (i)√ The abortive works submitted in Part A and verified in Part B are agreed. The S.I. concerned *is referred to in Part A / *is to be issued in due course. The *Contractor / *NSC should be entitled to the cost of the abortive works to be assessed by the PQS.

☐ (ii)* The abortive works submitted in Part A are not agreed as stated in Part B(ii). The *Contractor / *NSC shall **NOT** be entitled to any cost due to the abortive works submitted in Part A.

☐ (iii)√ The *Contractor / *NSC is required to provide clarification and / or information as detailed in Part B(iii) and resubmit another record sheet if necessary.

Confirmed by : Name _____

Post _____ Signature : _____

c.c.

☐ BSI/
☐ COW/
☐ IOW/
☐ A/
☐ SA/
☐ SE/
☐ SSE/
☐ LA/
☐ QS/
☐ GE/
☐ CE/
☐ BSE/
☐ Others : e.g. NSC

APPENDIX PRE.C9/X

PRE.C9.APPEND10.9 STANDARD TEMPLATE FOR CVI SUMMARY TABLE FOR MONTHLY SITE MEETINGS

Contract title:
Contract No.:

CVI Summary Table for Monthly Site Meetings
Architectural *(including drainage work and roadworks*)*

CVI Ref. No. (CVI-A-xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

** for the project that PCE is not the CMR*

Contract Title:
Contract No.:

CVI Summary Table for Monthly Site Meetings
Structural

CVI Ref. No. (CVI SE xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

Contract Title:

Contract No.:

CVI Summary Table for Monthly Site Meetings
Building Services

CVI Ref. No. (CVI-BS-xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

Contract Title:

Contract No.:

CVI Summary Table for Monthly Site Meetings
Geotechnical

CVI Ref. No. (CVI GE xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

Contract Title:

Contract No.:

CVI Summary Table for Monthly Site Meetings
Civil Engineering

CVI Ref. No. (CVI CE xxx)	Content of Verbal Instruction	Date issued by Contractor (dd/mm/yyyy)	Date Received by HD (dd/mm/yyyy)	Actual Reply Date to Contractor (dd/mm/yyyy)	Covered by S.I. (✓ or N.A.)	S.I. No.	Date of S.I. (dd/mm/yyyy)	Remarks

APPENDIX PRE.C9/XI

PRE.C9.APPEND11.9 TECHNICAL NOTES FOR GUIDANCE IN ASSESSING THE EFFECTS OF CIVIL ENGINEERING CONSTRUCTION / BUILDING DEVELOPMENT ON RAILWAY STRUCTURES AND OPERATIONS

Technical Notes for Guidance in Assessing the Effects of Civil Engineering Construction/Building Development on Railway Structures and Operations

A. General

All proposals for new building and engineering works including utilities works involving excavation within the limits of the Railway Protection Area shall be subject to special scrutiny by MTRCL prior to giving approval to any plans and consent for commencing construction works. Every proposal shall be assessed individually on its impact on existing railway and related structures/installations including all plant and fixtures necessary for the safe operation of the railway and subject to satisfactory compliance with the following technical requirements.

B. Underground Railway Structures

1. Site Formation/Foundation Works

Where site formation or foundation works or excavation works etc. are proposed above, beneath or adjacent to railway underground structures/installations including cooling water mains system, the effects of such works shall not exceed the following limits: -

(a) The vertical or horizontal pressure change on any underground structures/installations due to the works, including filling, ground improvement, dewatering etc. and due to addition or reduction of loads transmitted from foundations (including any loads arising during construction), shall not exceed 20 kPa.

(b) Differential movement resulting from the works shall not produce distortion in any railway structures/installations including the plinth or track in excess of 1 in 1 000 in any plane or a total movement in any railway structures/installations including the plinth or track exceeding 20 mm in any plane.

(c) The induced level difference between rails of a track in perpendicular plan resulting from the works shall not exceed 5 mm.

(d) The peak particle velocities induced to any railway structures resulting from blasting (where permitted) and from driving or withdrawing of piles or any similar operation which can induce prolonged vibration shall not exceed 25 mm/sec and 15 mm/sec respectively, when measured with a vibrograph.

(e) No pile, foundation, borehole/drillhole, well, soil nail, horizontal drain, rock bolt/dowel or other geotechnical installation shall be driven, constructed or installed within a distance of 3 m from any point of the underground railway structures.

(f) Any part of an anchor, if allowed, shall be more than 3 m away from any part of a railway structure/installation, and the centroid of the fixed length of the anchor shall be more than twice the fixed length away from any railway structure/installation.

2. Ground Investigation Works

Ground investigation proposals should include the following details and requirements: -

(a) Details of the exploration and locations of the proposed exploration holes, trial pits, trenches, field testing or instrumentations relative to any railway structures whether inside or outside the lot;

(b) Proposed depth of boreholes/drillholes, pits or trenches;

(c) A method statement for sinking boreholes/drillholes, excavating trial pits and trenches including back-filling, conducting field testing or installing instrumentation;

(d) A method statement for checking verticality of boreholes/drillholes located within a distance of 10 m on plan of any point of the underground railway structure, should boreholes/drillholes be sunk to a depth of 3 m from the highest point of the railway structures; and

(e) A method statement for controlling depth of boreholes/drillholes sinking within a distance of 3 m on plan of any point of the underground railway structures.

Each proposal will also be judged against the technical guidelines as specified in paragraph B.1 above.

3. Utility Works

Utility trenches/pits which require excavation within the Railway Protection Area shall not be carried out without the approval of MTRCL.

4. Marine Works

Any reclamation, dredging, laying of pipes, dropping of anchors, or other engineering works to be carried out within the Railway Protection Area shall be submitted to MTRCL for approval.

5. Sinking of Wells

Sinking of wells within Railway Protection Area shall not be carried out without the approval of MTRCL.

C. Overhead Railway Structures

1. Scaffolding, Advertising Signs, Projections

Erection of scaffolding, working platforms, advertising signs or any projections at a level above the railway tracks shall not be allowed within a distance of 6 m on plan of any point of the railway tracks, without the agreement from MTRCL. When such works are permitted to be carried out within the 6 m limit, effective measures to protect the railway structures shall be provided. According to individual circumstances it may be necessary for such works to be conducted outside the railway operation hours and all protective works shall be subject to the special approval of MTRCL.

2. Overhead Structures

The requirements of paragraph B.1(b) to B.1(f) shall also apply to overhead structures.

3. Utility Works

When cables, ducts and pipes, etc. are to cross above or below railway overhead structures, the Utility Undertaker shall submit to MTRCL details of the cables, ducts, pipes and the method of construction and seek approval before works can commence. When cables, ducts and pipes, etc. are to pass over the railway, the provisions of paragraphs B.1, C.1 and D shall apply.

D. At-grade Railway Structures

1. When utility works are to be carried out across the at-grade railway tracks, agreement from MTRCL has to be sought.

2. Unless prior special agreement has been obtained from MTRCL, piling works will not be permitted within 3 m on plan from the railway fence or wall along the Railway Protection Area, or 7 m on plan from the centreline of the nearest track when there is no railway fence or wall.

3. Vibration measured on the overhead power line mast or signalling and telecommunication furniture of the railway shall not exceed the peak particle velocity of 10 mm/sec and the vibration amplitudes shall not exceed 80 μm.

4. The requirements of paragraphs B.1, B.2, B.3 and C.1 shall also apply to the at-grade railway structures and tracks.

E. Operation of Stationary Lifting Appliance (tower crane, hoist, piling/drilling rigs)

1. When a stationary lifting appliance is erected adjacent to railway tracks and/or above ground structures/installations, effective measures to protect the railway structures shall be provided. According to individual circumstances it may be necessary for such works to be conducted outside the railway operation hours. All protective works shall be subject to MTRCL's approval. MTRCL may impose conditions on the operation and positioning of the appliance if in its opinion such operation and positioning may endanger the safe operation of the railway.

2. The swings of the lifting appliance shall not encroach within 6 m of the railway tracks and/or above ground structures/installations on plan except with special approval from MTRCL.

F. Mobile Lifting Appliance

Where a mobile lifting appliance (e.g. crane, excavator) operates within 6 m on plan of railway structures and any part of the appliance is higher than the railway track level, the provisions of paragraph E shall apply.

G. Maintenance of Road Lamp Standards

When road lighting tower maintenance vehicles are to be used to service road lamp standards adjacent to railway tracks, the working equipment shall not be positioned closer to the railway tracks than the nearest part of the road lamp standard where the height of the lamp standard is greater than the height of the tracks. If the working equipment is to be operated at a level higher than 1 m above railway tracks and closer than 6 m from the railway tracks, provisions of paragraphs C.1, E and F shall also apply.

H. Fire Services Department/Police Force Vehicles

The operation of Fire Services/Police vehicles adjacent to the railway tracks or vent shafts under emergency situations shall be in accordance with the emergency procedure(s) agreed between MTRCL and the respective organization.

I. Storage of Materials

1. No materials, containers, huts etc. shall be stored within 6 m on plan of the railway structures/tracks and vent shaft openings except with the special approval from MTRCL.

2. No dangerous goods or other inflammable materials shall be stored within 6 m on plan of railway structures/tracks except with the special approval from MTRCL.

J. Demolition Works

Where demolition and removal works for any structure which includes scaffolding, advertising signs, container offices and buildings are proposed above or adjacent to above ground railway structures, such as entrances, vent shafts, power distribution substations, traction substations, plant rooms, overhead railway structures and at-grade railway tracks, effective measures to protect the railway structures shall be provided. Demolition works proposal with the protective measures shall be submitted to MTRCL for approval and consent prior to commencing the works.

K. Exemption

Exemption is given to those works involving only ground breaking and excavations not exceeding 1 m deep, provided that MTRCL has been advised of the works in advance, and under the following condition:

(a) outside the areas measuring at 6 m from the at-grade railway tracks and station entrances; or
(b) outside the areas bounded by railway fence/wall.

APPENDIX PRE.C9/XII

PRE.C9.APPEND12.A KEY INDUSTRIAL SAFETY PRECAUTIONS FOR CONTRACTORS WORKING WITHIN RAILWAY PREMISES

Key industrial safety precautions for Contractors working within railway premises

1 General Requirements

The Contractor shall comply with all of MTRCL's Railway Safety Rules, Procedures and Code of Practice and the relevant Ordinances and statutory regulations, especially the Factories and Industrial Undertakings Ordinance, Dangerous Goods Ordinance and their subsidiary legislations.

2 Breach of Requirements

The Contractor shall be required to stop the works whenever any of the requirements mentioned in these precautions is found breached and shall not resume the works until the satisfactory rectification of the unsafe condition.

3 Site of Works and Routes of Access

Within MTRCL's railway premises, the Contractor shall not work in areas other than the works site defined and agreed by the MTRCL ("the MTRCL Site"). Suitable barriers and warning signs shall be erected where necessary to segregate the Site.

4 Person-in-Charge

The Contractor shall appoint a person-in-charge for the job to ensure that all works are done safely. He shall be present at the Site at all times of works. The person-in-charge shall ensure that all sources of ignition are removed, all power supplies are isolated, and the Site is in a safe condition before leaving the Site.

5 Portable Fire Extinguisher

At least one 4.5 kg dry chemical powder type portable fire extinguisher, or its equivalent, in efficient working state, shall be provided at each working location of the Site to guard against incipient fires. Additional fire extinguishers shall be required as necessary.

6 Flammable Substance

No flammable substance shall be kept at the Site unless prior approval has been obtained from MTRCL. However, if such material shall be used on the Site and permitted by MTRCL it shall be contained in suitable receptacles for the specific work requirement, the quantity shall be kept as low as possible in a closed metal cabinet provided by MTRCL, and the Contractor shall comply with the safety precautions as may be instructed by the Contract Manager.

7 Dangerous Substances

The Contractor shall label all dangerous substances, keep them in suitable containers and handle with extreme care as per statutory requirements.

8 Welding and Flame-cutting

No welding or flame-cutting is permitted without prior authorisation from MTRCL. Only one set of oxy-acetylene is allowed at the Site, and it shall be fitted with proper flashback arrestors. The oxygen and acetylene set shall be in good working conditions and free of cracks and leaks.

9 Painting

Painting and welding or flame-cutting shall not be done simultaneously at the Site.

10 Guarding of Machinery

All machinery in use shall be properly guarded against human bodies reaching its dangerous parts.

11 Electrical Tools, Equipment and Installation

The Contractor shall ensure that all electrical tools, equipment and installation in use shall be –

11.1 suitable for the supply voltage and loading current;
11.2 suitable for the type of environmental condition;
11.3 properly insulated; and
11.4 properly protected against electrocution by earth leakage circuit breakers or by earthing.

12 Temporary Electric Wiring

The Contractor shall ensure that all temporary wiring in use shall be –

12.1 free of frayed portions;
12.2 free of exposed live conductors;
12.3 free of sloppily-taped joints;
12.4 properly connected by plugs and sockets;
12.5 properly protected against mechanical damage;
12.6 properly secured and running at high levels; and
12.7 properly secured at suitable locations.

13 Conveyance of Bulky Items

No bulky items shall be conveyed onto MTRCL's railway premises without the prior permission from the MTRCL.

14 Dangerous Tools and Equipment

Dangerous tools and equipment shall not be brought onto MTRCL's railway premises including –

14.1 cartridge operated fixing tools;
14.2 open type welding transformers;
14.3 spray painting equipment; and
14.4 asbestos products.

15 Pressure Receivers

All air receivers in use on MTRCL Site shall be in good working condition and provided with a valid certificate to prove that they have been properly tested and examined in accordance with the provisions of the Boilers and Pressure Vessels Ordinance.

16 Lifting Appliance

All lifting appliances and gears in use within and in the vicinity of MTRCL's railway premises shall be in good working condition, and shall not be expired on their weekly inspections and 6/14 monthly examinations as per the requirements under the Construction Sites (Safety) Regulations. The Contractor shall obtain valid certificates of inspection and examination before use, and produce them for inspection on demand.

17 Scaffolding

All scaffolding, if permitted, including mobile scaffoldings in use shall be –

17.1 erected by competent persons;
17.2 guarded against overturning by the erection of outriggers or other suitable means;
17.3 displayed with warning signs on the danger of falling objects;
17.4 kept away from causing obstruction to any passageway;
17.5 locked at designated locations after each workshift;
17.6 maintained in good working condition;
17.7 provided with putlogs (metal ties) painted in bright red colour and warning signs to putlogs for alerting workers not to make any alteration to bamboo or metal scaffold and putlogs without the CM's approval. The signs shall display the words "DANGER: DO NOT ALTER SCAFFOLD & PUTLOG) 危險: 不可改動棚架及連牆器)" in red on a white background. The height of each letter / Chinese character on the signs shall not be less than 20mm, and
17.8 inspected periodically by a competent person as per statutory requirements.

18 High Level Working Platform

All high level working platforms shall be –

18.1 without access to MTRCL operating area; and
18.2 closely planked with minimum 2 m long solid planks.

Safety belts, safety nets or fall arrestors shall be used by all workers when working at height.

19 House-keeping

Good house-keeping shall be maintained at the Site at all times. All flammable waste and sources of ignition shall be removed, all power supplies isolated and the Site left in a safe condition after each workshift.

20 Electric Cables

The Contractor shall treat all electric cables and the like installed within MTRCL's railway premises as "LIVE" and no work shall be carried out on or cause any damage to them.

21 Personal Protective Equipment

All workmen on the Site shall wear the necessary personal protective equipment, i.e. safety helmets, eye goggles, ear protectors, respirators and safety belts, etc. as required by the nature of work.

22 Smoking

The Contractor shall ensure that there is no smoking when working within MTRCL's railway premises.

23 Working on MTRCL Equipment

The Contractor and its workers shall not work on any MTRCL equipment unless prior approval has been obtained from MTRCL.

24 Working on or near Railway Tracks

24.1 High-visibility clothing shall be worn when working on or near railway tracks; and
24.2 All persons, tools and materials shall be cleared of the track upon completion of each workshift.

25 Illumination

The Contractor shall provide adequate lighting to the Site within and in the vicinity of MTRCL's railway premises.

26 First Aid Facilities

Sufficient first aid facilities shall be provided in a first aid box at the Site as per statutory requirements.

27 Ladders

27.1 All ladders in use shall be of good construction and be made of good material. Each ladder shall bear an identification mark and be inspected six-monthly by a competent person. The next due date for examination shall be marked on the equipment; and
27.2 No metal ladder shall be permitted to be used on the Site.

28 Additional Safety Precautions

The aforementioned safety precautions are in no way exhaustive and additional ones will be imposed whenever necessary.

APPENDIX PRE.C9/XIII

PRE.C9.APPEND13.9 MTRCL'S INDEMNITY FORM

The Indemnity

In consideration of your permission to allow me/ourselves to visit/work at_____ (site location) from _____ to _____ (duration of work), I, _____ (full name), the duly authorised representative of _____ (name of Company), hereby agree that I/we shall do so entirely at my/our own risk and that the MTR Corporation Limited, its servants and agents shall not be liable in any manner whatsoever to whomsoever in respect of all claims, costs, damages or expenses for any damage to or loss of property, personal injury or loss of life howsoever caused arising out of or in any way connected with my/our visit/work, and I/we for myself/ourselves and for and on behalf of _____ (name of aforesaid Company) hereby agree to indemnify and keep the MTR Corporation Limited indemnified from and against all claims, cost, damages and expenses in respect of any damage to or loss of property, personal injury or loss of life howsoever caused arising out of or in any way connected with my/our visit/work within/in the vicinity of MTR Corporation Limited premises.

Dated this day of 20

Witness: _____ Signed: _____

Name (block letter): _____ Name (block letter): _____

_____ _____

Address: _____ Occupation or description:

_____ _____

Occupation or description: Name of the Company:

_____ _____

Company Chop:

_____

APPENDIX PRE.C9/XIV

PRE.C9.APPEND14.9 LETTER OF UNDERTAKING

To: MTR Corporation Limited

LETTER OF UNDERTAKING

In consideration of your permission to allow me/ourselves to visit/work at _____ (site location) from _____ to _____ (duration of work), I, _____ (full name), the duly authorised representative of _____ (name of Company), hereby agree that I/we shall undertake to indemnify and keep the MTR Corporation Limited indemnified or to make good any damage to its services equipment or property to the satisfaction of MTR Corporation Limited due to my/our activities within/in the vicinity of MTR Corporation Limited premises.

Dated this day of 20

Witness: _____ Signed: _____

Name (block letter): _____ Name (block letter): _____

_____ _____

Address: _____ Occupation or description:

_____ _____

Occupation or description: Name of the Company:

_____ _____

Company Chop:

APPENDIX PRE.C9/XV

PRE.C9.APPEND15.XDELETED

APPENDIX PRE.C9/XVI

PRE.C9.APPEND16.N CERTIFICATE OF OVERHAUL OF MAJOR CONSTRUCTION PLANT ON SITE

CERTIFICATE OF OVERHAUL OF MOBILE CRANE (EXCLUDING CRAWLER CRANE)

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the mobile crane (excluding crawler crane) are correct;

b) The mobile crane (excluding crawler crane) described in this certificate has undergone overhaul and that the critical parts of the mobile crane have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

_____

_____

_____

_____

_____

_____

c) The mobile crane (excluding crawler crane) is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF TRUCK-MOUNTED CRANE

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the truck-mounted crane are correct;

b) The truck-mounted crane described in this certificate has undergone overhaul and that the critical parts of the truck-mounted crane have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

_____

_____

_____

_____

_____

_____

c) The truck-mounted crane is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

CERTIFICATE OF OVERHAUL OF CRAWLER CRANE

Name of plant owner : _____

Address of installation : _____

Type of plant : _____

Brand name : _____

Model no. : _____

Serial no. : _____

Capacity : _____

Country of manufacture : _____

Year of manufacture : _____

Date of inspection : _____

I hereby certify that :

a) The above particulars of the crawler crane are correct;

b) The crawler crane described in this certificate has undergone overhaul and that the critical parts of the crawler crane have been inspected by the method of inspection as stated in the Checklist on Critical Parts for Overhaul Maintenance and a copy of the Checklist is attached, with the exception of (state the deviation, if any, from the Checklist on Critical Parts for Overhaul Maintenance with full justification)

_____

_____

_____

_____

_____

_____

c) The crawler crane is in a safe working condition.

I understand that the Checklist on Critical Parts for Overhaul Maintenance in the Contract is not exhaustive and compliance with which does not relieve any of my professional responsibilities.

Signature of Competent Examiner : _____

Name of Competent Examiner : _____

Qualification : _____

Discipline : _____

Person or firm by whom the person conducting the inspection is employed : _____

Date of certificate : _____

Encl. Checklist on Critical Parts for Overhaul Maintenance

APPENDIX PRE.C9/XVII

PRE.C9.APPEND17.N CHECKLISTS ON CRITICAL PARTS FOR OVERHAUL MAINTENANCE FOR MAJOR CONSTRUCTION PLANT ON SITE

When both English and Chinese are presented, English takes precedence over Chinese.

Mobile Crane (excluding crawler crane)

Critical parts for overhaul maintenances of mobile crane (excluding crawler crane)
檢修流動式起重機（不包括履帶式起重機）的重要部件

Critical Parts 重要部件		Method of checking 檢查方法
1	Drive systems (including motors, winches, gearboxes and drive shafts) 驅動系統（包括「摩打」、絞盤、波箱和驅動軸）	Inspect the drive systems for vibration, fluid leakage and correct operation 就驅動系統有否振動、液體洩漏和正確操作進行檢查
		Inspect and measure drum grooves 檢查和量度滾槽
		Check line pull limitation using test weights 以重塊測試拉力上限
		Check rope fixing clamps / ends 就纜索固定夾／末端進行檢查
		Additional checking as per items (a) to (c) below if failure of the drive system can result in dropping of a load: *如果驅動系統的故障可能會導致荷載下降，須進行以下(a)至(c)項額外檢查* a) NDT parts of the drive system that may be prone to crack 就驅動系統容易出現破裂的部件進行無損測試 b) Remove and strip down the drive systems where practicable to check shafts, gears, valves, bearings and worn components 在切實可行的情況下，拆裝驅動系統的所有部件，以檢查驅動軸、齒輪、閥門、「啤鈴」和磨損的部件 c) Conduct pressure and performance test to hydraulic motors and valves at maximum working pressure 在最大許可壓力下，就液壓「摩打」和閥門進行壓力和性能測試
2	Limit switch / ASLI (automatic safe load indicator) / Safety devices 限位開關／ ASLI（安全荷載自動顯示器）／安全設備	Check for functionality (such as ASLI, anti-two block devices, cut-out devices, boom overhoist limited switches, emergency stops, etc.) and calibrate ASLI by standard weights 進行功能檢查（例如安全荷載自動顯示器、防滑輪組碰撞裝置、斷路設備、吊臂超重開關、緊急停上制等），並利用標準砝碼校準安全荷載自動顯示器
		Slewing visual & audio warning device, CCTV 轉盤的影音警告設備及閉路電視
3	Braking systems 剎車系統	Remove and dismantle hoist and luffing brakes to check pins, springs, valves and bearings 拆除並解裝吊機和變幅制動器，就栓釘、彈簧、閥門和「啤鈴」進行檢查
		Check oil leakage and replace rubber seals 檢查有否漏油並更換橡膠密封墊
		NDT any welds in braking system that may be prone to crack 就驅動系統容易出現破裂的部件進行無損測試
		Check braking mechanism (including brake linings, brake discs, brake pads, etc.) for wear, damage and adjustment 就剎車系統的磨損程度、破損和調校機制進行檢查（包括制動器襯片、制動盤、剎車片等）
4	Bearings 「啤鈴」	Check any deformation and wear 檢查有否任何變形和磨損

5	Hydraulic systems 液壓系統	Check the flow of hydraulic pumps and motors by a flow meter or a time check 利用時間計或流量計檢查油壓泵的流量
		Check pressure of hydraulic pumps 檢查油壓泵的壓力
		Inspect hydraulic cylinders and systems for leaks at maximum working pressure 在最大許可壓力下，檢查液壓缸及其系統有否洩漏
		Measure housing and ram for distortion, ovality, weardown 量度外罩和推桿的扭曲度、橢圓度及磨蝕程度
		Check and test the functionalities and settings of safety valves, non-return valves and holding valves of hydraulic fluids 進行功能測試，以檢測液壓流體安全閥、止逆閥和保持閥的功能和設定
		Check conditions of hydraulic hoses and replace them every six years from the date of manufacture unless otherwise specified by the manufacturer 檢查液壓軟管的狀況，除非製造商另有規定，否則更換由製造日期開始年齡滿六年的軟管
		Check leakage from hydraulic swivels 檢查液壓旋轉接頭有否洩漏
6	Outrigger 支架	Check hydraulic systems, hoses, oil leakage 檢查液壓系統、軟管有否漏油
		Check proper extension and seating 檢查有否適當伸展，以及是否坐落於適當地方
		Inspect the levelling and physical conditions on slider pads / bearings 就滑塊墊／啤鈴的平水和結構是否完好無損進行檢查
		Check all pins, holes and bushes 檢查所有栓釘、孔眼及軸套
		Inspect outrigger floats 檢查支架有否浮動
		Structural NDT inspections at: 就下列結構進行無損檢測 a) connection between outrigger beams and cylinder housings for outrigger jacks 伸臂樑和支架插孔氣缸外罩之間的連接位 b) outrigger boxes and mounting 支架箱及底座
7	Slewing systems 轉盤系統	Check clearance in slew ring at a min. of 4 locations 在轉盤上選擇最少 4 個位置進行間隙檢查
		Check torque or replace slew ring bolts 檢查扭矩或更換轉盤螺栓
8	Undercarriage and slewing device 底盤和轉盤裝置	Visually check for wear and damage 就磨蝕和破損情況進行目視檢查
		Check gear clearance and any abnormal function 檢查齒輪間隙，並測試其功能有否異常
9		Check pins & bushes / bearings 檢查栓釘及軸套／「啤鈴」

	Hooks and hook blocks 吊鈎及吊鈎組	NDT hooks 就吊鈎進行無損測試
		Check throat dimensions of hooks and safety latches 檢查吊鈎尺寸和安全鎖
		Inspect and measure sheave grooves for wear 檢查和量度輪槽的磨損程度
		Check bearings in sheaves 檢查滑輪內的「啤鈴」
		Inspect, measure and, if required, NDT side plates and axles 檢查、量度側板和車軸，如有需要，進行無損測試
10	Booms (hydraulic booms) 吊臂 (液壓吊臂)	Check boom conditions 檢查吊臂狀況
		Fully dismantle the booms and check hidden mechanisms / parts 完全拆解吊臂並檢查隱藏的機件
		NDT critical areas / welds on boom sections and turret frame 就吊臂部分與框架的關鍵範圍或焊接位進行無損測試
		Check boom straightness (Distortion, waviness, buckling measurement) 檢查吊臂的直線度（量度扭曲度、波紋度及彎曲度）
		Check pins & bushes / bearings, slider pads, boom locking pins if fitted 就栓釘及軸套／啤鈴、滑塊墊和吊臂鎖栓釘（如有）進行檢查
		Inspect wire ropes or chains or screw drives if fitted 就纜、鐵鏈或螺桿驅動器（如有）進行檢查
11	Booms (lattice booms, including fly jibs) 吊臂 (格子吊臂，亦包括飛吊臂)	Check all boom sections 檢查所有的吊臂部件
		Check pin & bushes / bearings, boom connectors and pins, sheaves and ropes 就栓釘及軸套／「啤鈴」、吊臂連接器和栓釘、滑輪和纜索進行檢查
		NDT welds connecting male and female clevises 就凸形與內孔連接的焊接位進行無損測試
		NDT welds on boom butt section 就吊臂底部組件焊接位進行無損測試
		NDT welds on boom head and stress concentrated areas 就吊臂頂和應力集中區的焊接位進行無損測試
		NDT lacing welds by a random sample check 就橫綴焊接位隨機抽樣進行無損測試
		Measure thickness on main chords (ultrasonic) 在主弦杆部分厚度（超聲波）
12	Wire Ropes 鋼纜	Inspect all hoist, luffing and pendant ropes if fitted 檢查所有的吊索、變幅索和吊架纜索（如有）
13	Age of Service 使用年期	Verify the age with appropriate methods including reference to the manufacturers' documents 以適當的方法驗證使用年期，包括參考製造商的文件

Remarks 註:

An overall minimum of 10% of welds should be tested by NDT
整體而言，須為最少 10%的焊縫進行無損測試

Truck-mounted Crane*

Critical parts for overhaul maintenances of truck-mounted crane*
檢修隨車起重機的重要部件

Critical Parts 重要部件		Method of checking 檢查方法	
1	Hydraulic systems 液壓系統	Check the flow of hydraulic pumps by a flow meter or a time check 利用時間計或流量計檢測液壓泵的流量	
		Check the pressure of hydraulic pumps 檢測油壓泵的壓力	
		Inspect hydraulic systems and components for leaks 檢測液壓系統及其組件有否洩漏	
		Conduct a sink rate test at 100% of SWL and at maximum hydraulic outreach (without manual extensions, if fitted) 在吊臂以液壓方式全面伸展的狀態下，以 100%安全工作荷載進行下降率測試（但如有手動裝置，切勿啟動手動伸展）	
		Check and test the functionalities and settings of safety valves, pressure relief valves, non-return valves and holding valves for hydraulic fluids by performance test or as manufacturer's recommendations 就液壓流體的安全閥、洩壓閥、止逆閥和截流閥的功能和設定，檢測其性能，或按照製造商的建議進行檢測	
		Check hydraulic hoses for damage, moist areas, leaks, blistering, unevenness of hose casing, signs of aging, etc. 檢查液壓軟管有否損壞、分泌物範圍、洩漏、起泡、不平整的軟管套管、老化跡象等	
		Check leakage from hydraulic swivels 檢查液壓旋轉接頭有否洩漏	
2	Slewing systems 轉盤系統	Check clearance in slew ring at a min. of 4 locations 在轉盤上選擇最少 4 個位置進行間隙檢查	
		Check torque or replace slew ring bolts 檢查扭矩或更換轉盤螺栓	
3	Hooks and hook blocks 吊鈎及吊鈎組	Check pins & bushes / bearings 檢查栓釘及軸套／「啤鈴」	Alternative option: Replace the entire hooks / hook blocks instead of checking all relevant items as stated 替代方案：更換整個吊鈎／吊鈎組，便無須檢查所有相關的項目
		NDT hooks 就吊鈎進行無損測試	
		Check throat dimensions of hooks 檢查吊鈎尺寸	
		Check safety latches 檢查安全鎖	
		Inspect side plates and axles 檢查側板和車軸	
		Inspect and measure sheave grooves for wear 檢查和量度輪槽的磨損程度	
		Check bearings in sheaves 檢查滑輪內的「啤鈴」	
		Measure diameter of rollers 量度滾筒直徑	

		NDT roller mounts 就滾筒底座進行無損測試	
4	Booms (hydraulic booms) 吊臂 (液壓吊臂)	Check boom conditions 檢查吊臂狀況	
		Functional test all control of the boom for smoothness of operation 進行功能測試，以確保所有吊臂的控制系統操作暢順	
		Check pins by performance test, bushes / bearings, slider pads, boom locking pins if fitted & leaks of cylinders 進行性能測試，以檢查栓釘，以及軸套／「啤鈴」、滑塊墊、吊臂鎖栓釘（如有裝設），同時須一併檢查液壓缸有否洩漏	
		Structural NDT inspections at: 就下列結構進行無損測試 a) top of base around upper column bearing 圍繞上柱「啤鈴」的底座頂部 b) rear of base around slew rack guidance 圍繞指導擺架的底座底部 Visual inspection, and NDT when necessary 就下列部分進行目視檢查，如有需要，亦須一併進行無損測試 a) connection between crane base and pendulum beam 起重機底座和擺樑之間的連接位 b) connection between lift ram and column 提升桿和支柱之間的連接位 c) connection between lift ram and 1st boom 提升桿和第一節吊臂之間的連接位 d) connection between 1st boom and column 第一節吊臂和支柱之間的連接位 e) connection between 1st boom and 2nd boom ram 第一節吊臂和第二節吊臂桿之間的連接位 f) connection between 1st boom and 2nd boom 第一節吊臂和第二節吊臂之間的連接位 g) connection between 2nd boom ram and 2nd boom 第二節吊臂桿和第二節吊臂之間的連接位 h) closing welds on underside of booms 吊臂底部的密封焊接 i) suspension points for hook 吊點鈎	
5	Outrigger 支架	Inspect the levelling and physical conditions on bearing 就「啤鈴」的平水和結構是否完好無損進行檢查	
		Check fully extended 在完全伸展的狀態進行檢查	
		Check leakage from cylinders/ hoses/ pipework 檢查汽缸／軟管／管道有否洩漏	
		Inspect outrigger floats 檢查支架有否浮動	

		Structural NDT inspections at: 就下列結構進行無損測試 a) outrigger housings 支架外罩 b) connection between outrigger jacks and outrigger beams (for swing type) 支架插孔和伸臂樑之間的連接位（只適用於擺動式支架）
6	Limit switch / ASLI (automatic safe load indicator)/Safety devices 限位開關／ ASLI（安全荷載自動顯示器）/安全設備	Check for functionality (such as ASLI and cut-out / safety devices) and calibrate ASLI by standard weights 進行功能檢查（例如安全荷載自動顯示器和斷路／安全設備），並利用標準砝碼校準安全荷載自動顯示器
7	Age of Service 使用年期	Verify the age with appropriate methods including reference to the manufacturers' documents 以適當的方法驗證使用年期，包括參考製造商的文件

* "truck-mounted crane" means a loader crane mounted on a truck or lorry.
"隨車起重機" 指附裝了起重機的卡車或貨車。

Crawler Crane

Critical Parts for Overhaul Maintenance of Crawler Crane
檢修履帶式起重機的重要部件

No. 編號	Critical Parts 重要部件	Method of inspection 檢查方法
A	Structural Parts 結構部件	
1	Boom 吊臂	Measure distortion, inspect main cords and bracings damage 量度扭曲度，檢查主杆和撐杆有否損壞
		Measure pins diameter, check pins, visual inspection of wear and cracks at critical parts, NDT* as determined by RPE 量度栓釘的直徑並檢查栓釘，就吊臂重要部件有否磨損和裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check pulleys, bearings and rope protection 檢查滑輪、「啤鈴」和纜索護罩
		Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
2	Upper Carbody & Slewing Bearing 車身上部和轉向「啤鈴」	Inspect the torque of slewing bearing bolts by torque wrench (refer to manufacturer specification) 利用扭力扳鉗檢查轉向「啤鈴」螺栓的扭力（參閱製造商的規格說明書）
		Inspect slewing bearing clearance (refer to manufacturer specification) 檢查轉向「啤鈴」的間隙（參閱製造商的規格說明書）
		Visual inspection wear, damage and crack, NDT* as determined by RPE 就磨損、損壞和裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Visual inspection the welding of upper carbody critical parts, NDT* as determined by RPE 就車身重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
3	Counterweight 尾跎	Visual inspection for any damage 就有否任何損壞進行目視檢查
		Inspect the torque of the mounting bolts by torque wrench (refer to manufacturer specification) 利用扭力扳鉗檢查固定螺栓的扭力。（參閱製造商的規格說明書）
4	Operator Cabin 操作室	Visual inspection for condition 就有否任何損壞進行目視檢查
5	Pins and Holes For All Connection 所有連接位的栓釘和孔眼	Measure pins and holes diameters 量度栓釘和孔眼的直徑
		Visual inspection for wear and damage 就有否磨損和損壞進行目視檢查
		Visual inspection any crack in pins, NDT* as determined by RPE 就栓釘有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*

6	Undercarriage and Crawlers 底盤和履帶	Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Visual inspection for wear and damage 就有否磨損和損壞進行目視檢查
B	Mechanical / Hydraulic / Hoisting Parts 機械／液壓／吊機部分	
1	Wire Rope (Main Hoist, Auxiliary Hoist, Luffing Hoist and Guy Cable) 纜索（主吊機、輔助吊機、變幅吊機和拉索）	Visual inspection for wire rope damage 就纜索有否損壞進行目視檢查
		Measure the rope diameter 量度纜索的直徑
		Visual inspection for wire sockets and rope ends 就纜索套筒接頭和纜索末端進行目視檢查
		Visual inspection for wire rope clips damage and nut tightness 就纜索扣有否損壞和螺帽的鬆緊度進行目視檢查
		Replace guy ropes or pendant ropes every 2 years unless otherwise specified by the manufacturers 除製造商的說明書另有註明外，每兩年更換拉索或吊臂纜索
2	Winch 絞盤	Inspect brakes and clutches mechanism 檢查制動器和離合器的機能
		Visual inspection of welding for critical parts, NDT* as determined by RPE 就重要部件的焊接進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Perform functional test and inspect any damage for the control levers and pedals 進行功能檢查，並檢查控制桿和腳踏有否任何損壞
		Inspect rope fixing ends 檢查纜索固定末端
		Inspect and measure drum grooves 檢查和量度鼓槽
3	Sheaves (Spreader, Luffing, Boom Head and Hooks) 纜轆（伸張器、變幅器、吊臂頂部、吊鈎）	Inspect the pins, bushings / bearings 檢查栓釘、軸套／「啤鈴」
		Inspect the profile of the sheaves' grooves 檢查纜轆鼓槽剖面
		Visual inspection for any crack, NDT* as determined by RPE 就有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check rope guard 檢查導纜器
4	Crawler Power Driving System 履帶驅動系統	Perform functional test 進行功能檢查
		Inspect oil leakage 檢查有否漏油

5	Ball Hook & Hook Block 球形吊鈎和吊鈎滑車	Inspect safety latches 檢查安全扣
		Inspect the pins, bushings / bearings 檢查栓釘、軸套／「啤鈴」
		Visual inspection any crack in the hooks, NDT* as determined by RPE 就有否任何裂痕進行目視檢查。按註冊專業工程師的決定進行無損測試*
		Check all hooks for damage, wear, corrosion and throat opening 就有否損壞、磨損、腐蝕檢查所有吊鈎，並檢查吊鈎保險扣
6	Hydraulic Hoses and Connector 液壓喉管和連接器	Inspect oil leakage 檢查有否漏油
		Inspect coupling tightness 檢查接頭的鬆緊度
		Visual inspection any crack and damage 就有否任何裂痕和損壞進行目視檢查
		Visual inspection for damage and oil leakage. Replace critical hoses every 2 years or 6 years from the date of manufacture unless otherwise specified by the manufacturer. 就有否損壞和漏油進行目視檢查。除製造商的說明書另有註明外，重要喉管在出廠後六年或每兩年更換
7	Operating Pressure 操作壓力	Perform maximum operating pressure test 進行最大操作壓力測試
C	Electrical Parts 電動部件	
1	Control Panel / Lever 控制面板／控制桿	Perform functional test, clear markings 進行功能測試，清除標記
		Inspect any damage 檢查有否任何損壞
2	Electrical Wiring, Connector 電線和連接器	Inspect wire condition and insulation 檢查電線的狀況和絕緣性
3	Lighting, Wiper and Horn 照明系統、水撥和警笛	Perform functional test 進行功能測試
		Inspect any damage 檢查有否任何損壞
D	Safety Devices 安全裝置	
1	Overload & Boom Angle Limited Indicator 超重及吊臂角度限制顯示器	Perform functional test as determined by RPE 按註冊專業工程師的決定進行功能測試

2	Hook Blocks and Boom Overhoist Limited Switches 吊鈎滑車及吊臂防過捲限位掣	Perform functional test and inspect any damage 進行功能測試，並檢查有否任何損壞
3	Slewing Warning Light and Alarm 轉向警告燈號和響號	
4	Emergency Stop 緊急煞停掣	
E	Age of Services 使用年期	
1	Plant Age 裝置使用年期	Verify the age with appropriate methods including reference to manufacturers' documents 裝置使用年期須以適當的方法驗證，包括參閱製造商的文件

***** At least 10% of critical part welded joints shall be tested by NDT other than visual inspection.
重要部件須有最少 10% 的焊接位進行無損測試，不得只進行目視檢查

APPENDIX PRE.C9/XVIII

PRE.C9.APPEND18.N FORM OF DECLARATION AND CONSENT TO THE EMPLOYER

To : Hong Kong Housing Authority
Attention : Contract Manager

Contract No. : _____
Contract Title : _____

In accordance with Clause PRE.C9.005 of the Specification, I declare that the information attached to this form as to my qualifications, experience, employment status and other required information (**"submitted information"**) is true, accurate and complete.

I hereby give consent to you to obtain from and verify the authenticity of any of the submitted information with the relevant parties (including but not limited to my employers, the employers/clients/project managers/professionals of the projects/contracts listed in the submitted information, professional bodies/institutions, universities, any issuing bodies, or the like as to my professional and academic qualifications). I also give consent to you for collection, use and input of the submitted information into your database (if any) for the purposes of contract procurement and management of the Contract and any of your other contracts.

Name : _____
(Note: full name matched with HKID / passport)

Signature : _____

Position : _____

Company Name : _____

Date : _____

PRE.C10 TRAFFIC ARRANGEMENTS

TRAFFIC CONTROL

PRE.C10.010.9 SITE TRAFFIC

1. Ensure that the movement of traffic within the Site is properly supervised, controlled and maintained at all times;
2. Vehicles must be able to enter the Site immediately on arrival as no waiting will be permitted on public roads;
3. Vehicles shall enter and leave the Site in a forward gear;
4. Provision shall be made at the Contractor's expense within the immediate area of the Site entry to allow for parking of haulage vehicles;
5. Parking will not be allowed on public footpaths, verges or roads outside of the Site area;
6. Where works are carried out on highways or footways the flow of traffic must be maintained at all times with minimum interference.

PRE.C10.020.9 COMPLIANCE WITH REGULATIONS

1. Comply in all respects with the Road Traffic (Traffic Control) Regulations;
2. The Contractor's attention is drawn to the Code of Practice for the Lighting, Signing and Guarding of Roadworks, issued by Highways Department;
3. Maintain two copies of the Code of Practice on Site at all times, one copy of which shall be for the exclusive use of the CM.

PRE.C10.030.9 COMPLIANCE WITH AUTHORITIES' REQUIREMENTS

Comply with the requirements of the Commissioner for Transport and/or the Commissioner of Police and/or any other relevant authority regarding any special traffic arrangements which may be necessary.

PRE.C10.040.9 COMPLIANCE WITH PROCEDURES AND REQUIREMENTS

Follow the procedures and requirements given in the Contract or such procedures and requirements as the CM may require for obtaining the prior approval of the relevant authorities and the consent of the CM with respect to any special traffic arrangement, including the erection of any falsework in or over any highway or footway, any road opening or any traffic diversion.

PRE.C10.050.9 CONTRACTOR'S PROPOSALS

1. Submit proposals as required by GCC Clause 5.18 in writing to the CM and the relevant authorities not less than 6 weeks before the proposed date of commencement of any traffic arrangements;
2. Further liaise with the relevant parties and authorities, and submit the final agreed proposal to the CM for Approval at least 10 days before the date of commencement of such special traffic arrangements;
3. Arrange meetings with the relevant parties and authorities to discuss his proposals;

4. The Contractor's proposals shall be clearly marked up on drawings with scales not less than 1:1000 and supported by written descriptions where appropriate;

5. Proposals submitted for Approval shall include details of all lighting, signing and guarding to be implemented.

PRE.C10.060.9 GATES AT VEHICULAR INGRESS / EGRESS FOR TRAFFIC CONTROL

1. Provide an electrically-operated gate system at vehicular ingress / egress points of the hoardings and covered walkways fronting public footpaths, including gantries to control vehicular and pedestrian flow across footpath. Operate the gate system (including vehicular gates and pedestrian gates) by a single action. The pedestrian gates shall be closed before the vehicular gates are opened for ingress / egress of vehicles; and the vehicular gates shall be closed before the pedestrian gates are opened for pedestrian passage at the site vehicular entrance. Refer to drawing no. REF/SS/GA/SK-01 in Appendix U to this Specification for reference only. Submit detail drawings of the electrically-operated gate system for the CM's approval;

2. The Registered Professional Engineer registered under the Engineers Registration Ordinance within the discipline of mechanical engineering shall certify the design and installation of the gate system and proper functioning of the safety devices such that no person or objects shall be trapped during operation of the gates;

3. Station security guards as required under PRE.C9.110 at the vehicular ingress / egress point to operate the gate system, direct the crossing pedestrians, and control the vehicles entering or leaving the Site;

4. Install the gate system with the following warning / safety devices and ensure their function and safe operation:

   a. Flashing amber lights and audible alarms activated automatically when the gate is in operation under the control of the security guards posted at the vehicular ingress / egress point;

   b. The warning devices shall be visible and audible to the pedestrian crossing the vehicular ingress / egress points;

   c. The movement of the gate shall be controlled by continuous pressure type push buttons or switches, i.e. the motion would persist only if the button or switch is being continuously pressed or held on manually. Each button or switch shall be suitably coloured and indicated corresponding to its function;

   d. At least one emergency stop push button shall be provided adjacent to the gate in a conspicuous position to immediately stop the movement of the gate. Emergency stop buttons shall each have a large red mushroom head and be suitably labelled in both English and Chinese;

   e. The terminal stopping of the gate shall normally be effected by limit switches. The limit switches shall be robust in construction and suitable for outdoor operation;

   f. At both ends of the travel, mechanical end stoppers shall be provided to prevent the gate from over-travel;

   g. Safety devices shall be provided for protection against accidental damage to passing objects or injury to persons such that the movement of the gate system could be stopped immediately and the gate system shall immediately be capable of manually operated to relieve the grip on the passing object or person when an obstruction is detected;

h. A simple manual release device shall be incorporated in the driving unit to release the gate from its locked position under power failure or emergency conditions. When the gate system is released from its locked position, it shall be capable of being moved manually by an adult. An instruction for use of the manual release device shall be posted in a conspicuous position adjacent to the drive unit. The instruction shall be properly protected for durable use and frequent reference. The security guard responsible for operation of the gate system shall be trained on the use of the manual release device. Instructions shall be provided in English and Chinese;

i. All associated electrical equipment shall comply with the relevant safety standard. The electrical wiring work shall comply with the requirements of the Electricity Ordinance (Cap. 406) and its associated Regulations. In particular, all metal work of the installation shall be properly earthed.

5. Paint the gates in contrasting colours for clear identification;

6. Provide sign(s) at prominent locations in Chinese and English to give alert of the existence of the gate system, describe how it works, and inform the steps for the pedestrians to follow when the gate system is in operation;

7. Provide a floor mark / line preferably with simple wordings in both Chinese and English on both sides of the ingress / egress point to alert the pedestrians to keep clear of the closing gates when the gate system is in operation;

8. Repair and maintain the gate system and associated warning / safety devices in good working condition till the date of certified completion of the Works as far as practicable, and in any case the gate system and associated warning / safety devices could be dismantled within 3 - 6 months prior to the date of certified completion of the Works and as approved by the CM, unless otherwise proposed by the Contractor and agreed by the CM;

9. Ensure that the gate system and the warning / safety devices are properly re-installed and in operation in the event of any location change of the gantries or openings at hoardings or covered walkways;

10. Leave the gate system and associated warning / safety devices on the Site for use by subsequent contractors, or remove them as directed by the CM at the Contractor's own cost and time.

PRE.C10.070.9 TAKING OVER EXISTING GATES AT VEHICULAR INGRESS / EGRESS FOR TRAFFIC CONTROL

1. Take over existing gate system and associated warning / safety devices and signs;

2. Station security guards as required under PRE.C9.110 at the vehicular ingress / egress point to operate the gate system, direct the crossing pedestrians, and control the vehicles entering or leaving the Site;

3. Repair and maintain the gate system and associated warning / safety devices in good working condition till the date of certified completion of the Works as far as practicable, and in any case the gates and associated warning / safety devices could be dismantled within 3 - 6 months prior to the date of certified completion of the Works and as approved by the CM, unless otherwise proposed by the Contractor and agreed by the CM;

4. Ensure that the gate system and the warning / safety devices are properly re-installed and in operation in the event of any location change of the gantries or openings at hoardings or covered walkways;

5. Leave the gate system and associated warning / safety devices on the Site for use by subsequent contractors, or remove them as directed by the CM at the Contractor's own cost and time.

TEMPORARY TRAFFIC ARRANGEMENTS AND CONTROL

PRE.C10.110.9 CONTRACTOR'S RESPONSIBILITY

Be responsible for all necessary provisioning and repair of temporary diversion ways for the traffic using them.

PRE.C10.120.9 COMPLIANCE WITH AUTHORITIES' REQUIREMENTS

In addition to any other requirements stated in the Contract, temporary traffic arrangements shall be in accordance with conditions and restrictions imposed by the Commissioner for Transport and the Commissioner of Police. In case works with temporary traffic arrangement affecting carriageway, including that with pedestrian diversion onto carriageway, the details of the temporary traffic arrangements, including necessary supporting material such as staging of works, traffic impact assessment, drawings, plans and calculations for obtaining relevant authorities' approvals shall be prepared and submitted by the Contractor. These details shall be prepared and signed by a professional engineer who has been a corporate member of the Hong Kong Institution of Engineers in the Civil Discipline or Logistics and Transportation Discipline (or has possessed equivalent qualifications) for at least 3 years. Temporary lighting, signing, guarding and traffic control arrangements shall be in accordance with conditions and restrictions imposed by the Director of Highways. Traffic signs which are not prescribed by the Road Traffic Ordinance or its subsidiary legislation shall be in accordance with conditions and restrictions imposed by the Commissioner for Transport.

PRE.C10.130.9 OBTAINING AUTHORITIES' APPROVALS

Make all arrangements with and obtain the necessary approvals from the Commissioner for Transport, the Commissioner of Police, the Director of Highways and any other relevant authority for temporary traffic arrangements and control.

PRE.C10.140.9 APPLICATION

Temporary traffic diversions and pedestrian routes shall be provided where work in roads or footways obstructs existing vehicular or pedestrian access. The relevant work shall not commence until the approved temporary traffic arrangements and control have been implemented.

PRE.C10.150.9 COMPLIANCE WITH CODE OF PRACTICE

Temporary traffic arrangements and control for work in roads and footways shall comply with the requirements contained in the current edition of the document 'Code of Practice for Lighting, Signing and Guarding of Road Works' issued by the Hong Kong Government; a copy of the document shall be kept on the Site.

PRE.C10.160.9 INSPECTION AND MAINTENANCE

Temporary traffic arrangements and control shall be inspected and maintained regularly, both by day and night.

PRE.C10.170.9 SUBMISSION FOR CM'S APPROVAL

Submit the following particulars of the proposed temporary traffic arrangements and control for Approval at least 7 days before the traffic arrangements and control are implemented:

1. Details of traffic diversions and pedestrian routes;

2. Details of lighting, signing, guarding, road marking and traffic control arrangements and equipment;
3. When traffic diversion proposals involve the construction of temporary roads or footpaths or alteration of existing road or footpaths, details of road geometry and levels, pavement thickness and composition, road drainage; detailed calculations shall also be submitted to the CM; and
4.
    a. Plan and arrange his work to keep the number of traffic diversions and hence disturbance to traffic to a minimum;
    b. To implement traffic diversions, he shall carry out by himself or make arrangements for, as appropriate, all works necessary for such purpose, such as the construction of temporary carriageway pavement with associated drainage systems, fencing, temporary pedestrian access, resiting/provision of street lights, fire hydrants, sign gantries and other street furniture;
    c. Temporary protection to or alteration of underground utilities etc. after consultation or approval from the appropriate authorities;
    d. Also be responsible for all subsequent maintenance and shall undertake to reinstate all the affected covers to their original state immediately after any phase of temporary arrangement is no longer required.

TRAFFIC CONTROL EQUIPMENT

PRE.C10.210.9 MAINTENANCE OF EQUIPMENT

1. All equipment for traffic control, lighting and guarding shall be maintained throughout the Contract in good working order and in a clean condition;
2. Traffic lights, lights and signs shall be kept clean and easy to read.

PRE.C10.220.9 CHECKING EQUIPMENT

Check regularly, both during the day and during the night, that all equipment is in good working order and correctly positioned and shall immediately carry out such remedial measures or replacements as are necessary.

PRE.C10.230.9 REPAIRING/REPLACING EQUIPMENT

1. Equipment which, in the opinion of the CM, is damaged, dirty, incorrectly positioned or not in working order shall be repaired or replaced immediately;
2. All unsatisfactory equipment shall be removed from the Site by the Contractor.

PRE.C10.240.9 ELECTRIC LAMPS

1. Electric lamps complying with BS 3143:Part 2:1990 shall be used when a connection to a mains electricity supply is available and feasible;
2. Supply voltage for such lamps shall be stepped down to 50 volts or less. When a mains electricity supply is not available, battery powered lamps shall be used.

PRE.C10.250.9 TEMPORARY TRAFFIC LIGHT SIGNALS

Temporary traffic light signals shall be of a type approved by the Commissioner for Transport and shall comply with the requirements contained in the current editions of the documents 'Type Approval Procedure for Portable Traffic Light Signals' and 'Specification for Vehicle Actuated/Fixed Time Portable Traffic Signal Equipment' issued by the Hong Kong Government.

PRE.C10.260.9 TEMPORARY TRAFFIC SIGNS

1. Temporary traffic signs, including posts, backing plates and faces, shall comply with all requirements for traffic signs contained in Worksection EXT4;
2. The thickness of backing plates for temporary traffic signs which will be erected for use of less than 6 months may be reduced to 1.5 mm and the thickness requirement as stipulated in sub-clause (1) of EXT4.M320 may not be complied with; the posts for the signs may be constructed of timber or other material provided that in the opinion of the CM the traffic signs will be stable and safe;
3. In addition to the requirements for traffic signs contained in Worksection EXT4 and sub-clause (2) above, temporary traffic signs shall also comply with the following additional requirements:
    a. All corners of a sign plate shall be rounded to a radius of not less than 18 mm unless otherwise stipulated in the relevant standard drawing(s) published by the Transport Department or Highways Department;
    b. All edges of a sign plate shall be grounded to ensure that they are free from sharp edges, burrs, raggedness and tears;
    c. When a sign plate is located on a footway, it should be positioned so as to minimise inconvenience or hazard to pedestrians. Particular attention shall be paid to cater for safety of the children, the elderly and the disabled;
    d. The arrangement of information contained on sign faces for temporary traffic directional signs shall be designed by the Contractor. The details of the background, borders and legends, including letters, numerals, characters and symbols, shall comply with the requirements of the Commissioner for Transport.

PRE.C10.270.9 TEMPORARY CONCRETE PROFILE BARRIERS

1. Should precast concrete profile barriers be installed temporarily by Contractor to delineate edges of traffic lanes/footpaths/excavations as protectionary measures or as median barriers separating lanes of opposite travelling directions, the Contractor should conduct risk assessments to identify associated risks and to determine appropriate precautionary measures for installation against those risks;
2. Be responsible for all risks associated with the installation of the temporary precast concrete profile barriers including any injuries to motorists, pedestrians as well as construction workers;
3. Temporary concrete profile barriers should be properly fixed in position and so marked so that they stand out conspicuously and are visible by day and by night.

PRE.C10.280.C SAFETY OF SITE VEHICLES AND MOBILE PLANT

In addition to any obligations under GCC Clause 5.11 or similar enactment or Regulation, comply with the requirements in the latest edition on the Guidelines on Safety of Site Vehicles and Mobile Plant issued by CIC and the Guidance Notes on Safe Use of Loadshifting Machines for Earth Moving Operations on Construction Sites issued by LD, with special attention to the following:

1. Establish a safe system of work with risk assessment to identify any risks and formulate safe working procedures for the operation of site vehicles and mobile plant;
2. Provide workers with adequate information, training and instruction in respect of the safe system of work;
3. Provide requisite recognised training to Site Personnel to obtain valid certificates to acquire the knowledge and competency on the inspection, operation, maintenance, testing and examination applicable to a particular type(s) of site vehicles and mobile plant;
4. Properly design site layout and traffic circulation routes as follows:
    a. Minimize movements of vehicles and plant through appropriate measures;
    b. Impose speed limits on traffic routes through erecting of speed limit sign and road humps or other similar devices;
    c. Minimize reversing movements of vehicles and plant. Where reversing cannot be avoided, reversing vehicles or plant is not guided by a banksman, provide and install reversing video device (RVD) for vehicles / plant in accordance with the above mentioned Guidelines enabling the operator to have full view of 360^0 around the vehicles or plant;
    d. Provide appropriate facilities for the safe movement of personnel within the Site. Vehicular circulation shall be segregated from pedestrian access with zebra crossing for pedestrians.
5. For forklift truck, provide operator presence sensing system to cease all operations of forklift truck when the operator is not sitting on the seat to control the truck for more than 2 seconds.

PRE.C10.285.N SAFETY OF AIR HOSE CONNECTED TO AIR COMPRESSOR

1. Disconnect air hoses from air compressor if the air hose is not in use, otherwise the valve of the air hose shall be fitted with handle locking device to prevent the handle from being accidentally turned on.

WORK IN ROADS AND FOOTWAYS

PRE.C10.310.9 WORK IN SECTIONS

1. Work in roads on the Site shall be carried out in sections such that the length of road occupied at any time does not exceed that approved by the relevant authority described in PRE.C10.030 and the width of road occupied at any time does not exceed the width of one traffic lane, unless otherwise approved by the relevant authority and permitted by the CM;
2. Work in each section shall be completed and the road reinstated and opened to traffic before any work commences in the next section. Work in any section, including loading and unloading, shall be carried out in such a manner that the traffic and utilities in the adjacent road and pedestrian access in the adjacent footway will be adequately maintained.

PRE.C10.320.9 DEFINING AREAS OF EXCAVATION

Before excavations are carried out in roads or footways, except in areas covered with paving blocks or tiles, the limits of the area to be reinstated shall be bounded by a continuous saw-cut groove. The groove shall be at least 6 mm wide and at least 50 mm deep. Cutting the groove and breaking out the road or footway shall be carried out in such a manner that the adjacent road or footway, including edges, are not damaged.

PRE.C10.330.9 STORING EXCAVATED MATERIAL

Excavated material shall not be stored adjacent to excavations in roads or footways unless permitted by the CM.

PRE.C10.340.9 BRIDGING EXCAVATIONS

1. Vehicular access across excavations in roads shall be provided by steel covers;
2. The covers shall be designed to BS 449:Part 2:1969 and shall be capable of withstanding the full traffic load permitted to use the road;
3. The covers shall be secured in position and shall have anti-skid coating so that the skid resistance values on the covers measured in accordance with BS 3262:Part 2: 1989 shall not be less than 45;
4. Sufficient steel cover shall be kept on the Site adjacent to excavations in roads to permit vehicular access across the excavations in case of emergency.

PRE.C10.350.9 REMOVAL OF TEMPORARY EQUIPMENT

Temporary diversions, pedestrian access and lighting, signing, guarding and traffic control equipment shall be removed immediately when they are no longer required. Roads, footways and other items affected by temporary traffic arrangements and control shall be reinstated to the same condition as was existing before the work started or, where such work is covered under an Excavation Permit, to the condition as stipulated under the Conditions of Excavation Permit or to such other condition as may be agreed or Instructed.

PRE.C10.360.9 ADJUSTING THE ROAD HARDWARE LEVELS

Be responsible for adjusting the levels of the existing valve pits and covers, manholes/chambers/pits and covers and other utility/services installations affected by the Works.

PRE.C10.370.9 EXISTING STREET LIGHTING

Ensure the proper functioning of all existing street lighting and shall not abandon any existing street lightings before adequate re-provisioning Approved by the CM and the relevant authority.

PRE.C11 TEMPORARY WORKS AND FACILITIES

TEMPORARY WORKS

PRE.C11.010.9 PRIOR APPROVAL

1. Pursuant to GCC Clause 4.3, within a reasonable time (and in any case not less than 28 days) before he intends to commence construction of any Temporary Works, or within the particular times states, the Contractor shall submit full particulars, including Drawings of the same for the Approval of the CM;
2. The consent by the CM of any such particulars shall not relieve the Contractor of his responsibility for the sufficiency of Temporary Works or of his other duties and responsibilities under the Contract;
3. Make safe and reinstate all areas affected by temporary works.

PRE.C11.020.9 EARTH SUPPORT TO RETAINING WALL EXCAVATIONS

1. Design and construct temporary earth support to excavations for the construction of retaining walls shown on the Drawings, and provide a method statement which must take into account all geotechnical considerations;
2. He shall give full details of all materials, plant and timing and sequence of operations involved in the construction of both temporary and permanent works;
3. The Contractor's attention is drawn to Worksection EAR1.

PRE.C11.030.9 PROVISION OF ACCESS ROADS

1. Provide and maintain an all weather, 2-way access road of ..... width at all times between ..... Street and Section ..... for the use of the ..... Department contractors and any other contractors authorised by the Housing Authority to carry out the works within the completed Sections .....;
2. The access road is to be regarded as temporary works for the purposes of this Contract and is required immediately on completion of Section .....;
3. The access road shall be finished with rigid or flexible surfacing and the road pavement design shall be to Guidance Notes on Pavement Design issued by Highways Department;
4. The gradient and construction of this access road shall be capable of taking all vehicles requiring access to/from the building and ..... construction works in the completed Sections .....;
5. Such vehicles shall include, but not be limited to, cars, fully loaded ready mix concrete trucks and articulated and fixed axle material delivery and disposal trucks;
6. Ensure that none of the above vehicles as a result of the use of the access road deposit earth, mud, debris, dust and the like on public roads when leaving the Site;
7. Submit detailed proposals, including drawings and method of construction of the access road to the CM four weeks before commencement of its construction;
8. The agreement by the CM of any particulars shall not relieve the Contractor of his responsibility for the sufficiency of the access road or his other duties and responsibilities under the contract.

PRE.C11.040.A TUNNELLING

Tunnelling will not be allowed unless authorised by the CM. Any hand-dug tunnelling authorised shall comply with the latest Guidance Notes on Safety and Health of Hand-dug Tunnelling Work issued by Labour Department.

PRE.C11.050.9 APPROVAL OF ACCESS POINTS

1. Submit for Approval details of each access point not less than 14 days before the intended date for taking into use. Details shall indicate the location of the access and the equipment and supervision he intends to use;
2. Comply with PRE.C3 of the Specification regarding restrictions on the use of highways for access to the Site and allow for movements of vehicles being restricted in this respect.

PRE.C11.060.9 DIVERSION OF STREAMS OR DRAINS

1. Be responsible for and shall bear the cost of temporary training, diverting or conduiting of open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works when and where in the opinion of the CM such action is desirable;
2. The Contractor's attention is drawn to PRE.C9 and Worksection EAR1;
3. All proposed temporary stream course and drain diversions shall be submitted to the CM for agreement four weeks prior to such diversion works being commenced;
4. Diversions shall be constructed to allow the water flow to discharge adequately and efficiently;
5. The area through which the temporary diversion runs is to be reinstated to the satisfaction of the CM after the permanent drainage system has been completed;
6. No obstruction to flow is to be left in position longer than is necessary for carrying out the works;
7. Ensure that adequate provision is made for dealing with increased flow during the wet season.

PRE.C11.070.9 NEW SIGNBOARDS

1. Provide …… No. publicity board(s) and ……. No. accident statistic board(s) at the Site, as detailed on Drawing(s) Nos. ……., maintain for the duration of the Contract and leave in position in good condition for use by subsequent contractors;
2. Provide …….. No. publicity board(s) for motorists and …… No. publicity board(s) for pedestrians, as detailed on Drawing(s) Nos. ……., at prominent locations as agreed by the CM, where works are carried out on carriageway or footway. Maintain for the duration of the works and update the information of the publicity board(s) as necessary or as required by the CM.

PRE.C11.080.9 PAINTING AND SIGNWRITING ON SIGNBOARDS

1. Paint signboards at commencement of Contract;
2. Provide sign writing in multi-coloured gloss finish over the completed board including English letters and Chinese characters, artist's impressions or diagrammatic plans and logos;
3. Submit draft drawings for Approval before painting;

4. Re-paint and provide new sign writing when necessary as directed by the CM;
5. Provide new sign writing to update the accident statistics at monthly intervals.

PRE.C11.090.9 SUPPLY OF WATER

1. Arrange for an adequate supply of fresh water at the Site, including provision of any storage tanks, so that sufficient fresh water is always available for the execution of the Works;
2. Provide suitable supplies of water for drinking, washing and sanitation and general cleaning down in addition to that required for the execution of the Works;
3. In the event of water restrictions, ensure that there is sufficient water storage capacity on site to supply water in accordance with the detailed requirements of the specification, to maintain the general good health of the plants and to ensure the progress of the Works is not adversely affected;
4. Every water storage tank shall be effectively protected against the breeding of mosquitoes and risk of contamination and shall be thoroughly cleaned and scrubbed with a chloride of lime or bleaching powder solution of not less than fifty parts chlorine to one million parts water during the months of March, June, September and December of each year;
5. If water is taken from a source other than Government mains supply, test it at an Approved laboratory in accordance with BS 3148:1980 when required by the CM;
6. Provide temporary pipe lines and make arrangements for storage, pumping and distributing the water about the site;
7. Submit installation details and routing of the water supply for the information of the CM prior to commencement of the installation.

PRE.C11.095.9 TEMPORARY LIGHTING

Do not use incandescent light bulbs (GLS) to provide lighting inside any buildings, site accommodations, and areas within the Site and around the Site boundary. Use other types of light bulbs with higher luminous efficacy. Provide only electronic ballast for all types of fluorescent fittings.

SITE ACCOMMODATION FOR THE CONTRACTOR

PRE.C11.110.A ACCOMMODATION GENERALLY

In addition to the requirements of GCC Clause 5.31, provide all necessary offices, drinking water, hand washing facilities, temporary toilet accommodation, shoe cleaning trays and the like for all workers engaged in the execution of the Works. Provide lighting, power, telephones, cleaning etc and maintain toilet accommodation, washing facilities and shoe cleaning trays in a sanitary condition at all times. The shoe cleaning trays shall be provided with water supply and brushes at each Site exit. Temporary site accommodation shall be constructed from prefabricated, demountable, reusable components unless otherwise approved by the CM. The use of tropical hardwoods in the construction of temporary site accommodation is expressly prohibited.

PRE.C11.120.9 LOCATION OF STRUCTURES

No structure shall be erected by the Contractor within the Site without the CM's written consent; such consent will not relieve the Contractor of the responsibility of sitting temporary structures clear of the Works. A copy of the plan showing the extent and position of all offices, stores, sheds, toilets facilities, etc. shall be prepared by the Contractor and retained for inspection in the site office.

PRE.C11.130.9 LOCATION OF STORAGE AREAS

As soon as possible after the notified date for commencement of the Works, submit details of the proposed locations and arrangements of the Contractor's site compound, storage areas, stockpiles, casting yard and the like to the CM for agreement.

PRE.C11.140.9 TEMPORARY ACCOMMODATION FOR WORKMAN

No temporary accommodation for workmen shall be erected by the Contractor within the Site without Approval. It shall be kept in a clean and sanitary condition to the satisfaction of the CM.

PRE.C11.150.A TEMPORARY SITE LABORATORY FOR ON-SITE FILL TESTING

1. On-site fill testing as specified in Worksection EAR shall be carried out, under the supervision of the CM, by the Contractor using Approved Laboratories specified at PRE.C8.510;
2. Supply labour and assistance as specified in PRE.C11.810;
3. A calibrated and Approved moisture meter and all necessary apparatus and consumable items shall be provided to carry out the following procedures and tests, as described in latest edition of Model Specification for Soil Testing (Geospec 3)', published by GEO:
    a. Test Method 5.1 or 5.2 of Geospec 3: Determination of moisture content by oven-drying;
    b. Test Method 8.1 or 8.2 of Geospec 3: Determination of particle size distribution by wet sieving;
    c. Test Method 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7 or 10.8 of Geospec 3: : Determination of dry density/moisture content relationship;
    d. Test Method 11.1 of Geospec 3: : Determination of in-situ bulk density and in-situ dry density of soils by sand replacement method suitable for fine- and medium-grained soils (with small pouring cylinder);
    e. Test Method 11.2 of Geospec 3: : Determination of in-situ bulk density and in-situ dry density of soils by sand replacement method suitable for fine- and medium- and coarse-grained soils (with large pouring cylinder).

PRINCIPAL OFFICE ACCOMMODATION FOR THE CM

PRE.C11.210.9 OFFICE BUILDINGS

Provide, erect, service (including payment of all utility charges) and subsequently dismantle at a location approved by the CM and within convenient distance of the Contractor's main site office, offices and toilets for the exclusive use of the CM and the CM's staff including ……. LROs complete with all necessary air conditioning, ventilation, lighting, fire precautions, fresh water supply, drainage, telephone service, attendance, maintenance, watching and protection to the satisfaction of the CM so as to be habitable and operational at all times throughout the course of the Works and during the Maintenance Period as the CM may require.

PRE.C11.220.9 LAYOUT, DESIGN AND SUSTAINABLE PROVISIONS OF SITE ACCOMMODATION

1. The general requirements for the layout, furnishings and services of the CM's temporary accommodation are shown on the Drawings. Orientate and design site accommodation to maximise natural ventilation and daylighting to reduce energy consumption where applicable;
2. Be responsible for the building services and structural design including the foundation design of the CM's principal office;
3. Design, install and maintain building services installations in accordance with the latest edition of the Code of Practice for Energy Efficiency of Building Services Installation issued by EMSD where applicable;
4. Submit design drawings for the CM's agreement before actual construction commences;
5. Make sustainable provisions as follows:
    a. Use demountable office furniture / equipment in modular design layout where applicable to facilitate future re-use and to minimize wastage during transit from one site to another;
    b. Use energy efficient products with energy labels of:
        i. “Grade 1” or “Grade 2” for products fall within the category of “Mandatory Energy Efficiency Labelling Scheme” (MEELS) of EMSD;
        ii. “Recognition Type” for products fall within the category of “Voluntary Energy Efficiency Labelling Scheme” (VEELS) of EMSD.
    c. Use water-consuming appliances registered under the “Water Efficiency Labelling Scheme” (WELS) of WSD;
    d. Use recycled paper with Forest Stewardship Council (FSC) certificate(s) or Programme for the Endorsement of Forest Certification (PEFC) certificate(s) for printing and photocopying.
6. Allow used materials and products which are in reasonable and serviceable conditions;
7. Maintain the site accommodation together with the sustainable provisions in serviceable conditions;
8. Display notices prominently to remind staff to switch off computers and other electrical appliances when they are not in use or after business hours.

PRE.C11.230.9 COVERED HARDSTANDINGS

Approved covered hardstandings for five cars shall be provided as close to the CM's principal office as practicable, and shall be linked to the CM's office by a covered concrete path.

PRE.C11.240.9 OFFICE FITTINGS, SERVICES, FURNITURE, EQUIPMENT AND MACHINERY

Provide for use in the CM's principal office the following items of services, fittings, furniture, equipment and machinery (to be the Contractor's property upon expiry of the Maintenance Period unless otherwise specified) as specified in PRE.C11.250 to PRE.C11.295 and PRE.C11.840 to PRE.C11.860.

PRE.C11.250.9 OFFICE SERVICES

		No.
1.	Telephone as follows:	
	a. Direct line telephone:	1
	b. Direct line for site staff:	1
	c. Extension telephone: (model 4 direct lines plus 12 extensions or equivalent)	.....
2.	Power point (13 amps):	.....
3.	Fire extinguishers and / or any other fire fighting appliances:	conforming to the regulations of the Fire Services Department
4.	Double ring gas cooker unit complete with bottles (including all gas):	.....
5.	Toilet equipment and materials, including mirrors, soap, towels, hot air blowers, toilet paper and the like:	as required
6.	Air conditioner with de-humidifier function (22000 BTU or above):	.....
7.	Dehumidifier (10 litre capacity or above):	.....
8.	Door mat:	.....
9.	Electric water heater to shower:	.....
10.	Exhaust fan:	.....
11.	Cold distilled water dispenser (including continuous supply of distilled water):	.....
12.	First aid kit:	.....
13.	Electric kettle:	.....

PRE.C11.260.9 OFFICE FITTINGS

		No.
1.	Notice board:	
	a. 2.0 m x 1.2 m:	.....
	b. 0.6 m x 0.45 m :	.....
	(Approved white board or equivalent including all pens)	
2.	Edged cork display board (2.0 m x 1.2 m):	.....
3.	Venetian blinds, mosquito screens and burglar bars:	to all windows
4.	Electric fan heater (2 KW) or equivalent:	.....
5.	Refrigerator (100 litres):	.....
6.	Kitchen sink unit, adequate cupboard storage and formica working surface and all necessary crockery, cutlery and cleaning equipment:	as drawings

PRE.C11.270.9 OFFICE FURNITURE

		No.
1.	Lockable desk (1650 x 1000 mm):	.....
2.	Lockable desk (1500 x 800 mm):	.....
3.	Lockable desk (1300 x 800 mm):	.....
4.	Layout table with 4 drawers plan cabinet under:	.....
5.	Conference table (..... x .....):	.....
6.	Draughting Board - and all necessary draughting equipment (free-standing, A.O. size with lamp):	.....
7.	Typists chair:	1
8.	Desk chair (with arms and castors):	.....
9.	Desk chair:	.....
10.	Draughtsman stool with padded seat:	.....
11.	Glass fronted lockable bookcase (1250 mm in length x 3 shelves):	.....
12.	Filing cabinet - 4 drawers:	.....
13.	Filing cabinet - 2 drawers:	.....
14.	Metal vertical cabinet:	.....

PRE.C11.280.9 OFFICE EQUIPMENT

		No.
1.	Office equipment, including rubber stamps, inking pads, pencil sharpeners:	as required.
2.	Waste paper bin:	.....
3.	Correspondence tray:	.....

PRE.C11.290.9 OFFICE MACHINERY

		No.
1.	Scientific electronic portable calculator or equivalent (with power point adaptor):	.....
2.	Facsimile machine together with dedicated telecommunication line, and supply of specialist paper and other consumables:	.....

PRE.C11.292.9 COPIER-PRINTER-SCANNER EQUIPMENT

1. Provide 1 No. monochrome copier-printer-scanner equipment which shall be networked with driver installed in networked PCs to provide functions of printer and scanner in addition to photocopying function. The specification for the copier-printer-scanner equipment is as follows:
   a. Copier:
      i. Copy speed: not less than 20 copies per minute;
      ii. Resolution: up to 600 dpi;
      iii. Multiple copies: up to 999;
      iv. Zoom: 25 - 400%;
      v. Paper input capacity: 2 x 500-sheet paper trays, 1 x 100-sheet bypass trays;
      vi. Paper output capacity: not less than 1,500 sheets;
      vii. Paper size: A3 to A5.
   b. Printer:
      i. Print speed: not less than 20 prints per minute;
      ii. Resolution: 600 dpi minimum.
   c. Scanner:
      i. Scan speed: not less than 40 originals per minute;
      ii. Resolution: up to 1,200 dpi;
      iii. Original size: A3 to A5;
      iv. Output format: PDF, JPEG, TIFF & high compression PDF.
2. Provide adequate supply of paper and other consumables.

PRE.C11.295.9 DIGITAL CAMERAS

1. Provide …… No. of new digital camera for the use of the CM and his representatives for the duration from the date for commencement of the Works up to six months after the date of certified completion of the Works;
2. The new digital camera shall comply with the following:
   a. Be equipped with memory card of not less than 2G and flashes together with batteries and any other consumables required for the cameras and flashes;
   b. Size of the camera: small;
   c. Optical resolution of the camera: 3M pixels or above.

PRE.C11.300.9 ESTABLISHMENT OF ACCOMMODATION

1. Within two weeks of acceptance of tender, submit proposals for location of the principal office, its construction and furnishing to the CM;

2. The office shall be erected, equipped and furnished ready for use by the CM within four weeks from the notified date for commencement of the Works;
3. The installation of the telephones shall be ordered promptly upon acceptance of the tender, and completed at the earliest practicable date;
4. Provide ..... mobile phones for use by the CM before the installation of telephones.

RELOCATABLE OFFICE ACCOMMODATION FOR THE CM

PRE.C11.410.A CONTAINER OFFICE(S)

Provide ..... container office(s), each 13 m² minimum floor area, complete with:

1. Telephone and power supply;
2. Fire extinguishers and / or other fire fighting appliances conforming to the regulations of the Fire Services Department;
3. Separate toilet with water tank for flush water supply, wash hand basin with water tank for fresh water supply, foot pumps to flush toilet and wash hands, vent pipe, waste and foul water disposal, coat hook, paper roller, gender sign, in-use indicator for toilet, mirrors, cleaning materials, soap, towels, toilet paper, chemical treatment for the toilet and the like;
4. Venetian blinds, mosquito screens and burglar bars to all windows;
5. Sustainable provisions as specified in PRE.C11.220 where applicable.

PRE.C11.420.9 FURNITURE, FITTINGS ETC. TO CONTAINER OFFICE(S)

Provide the following items to each container office provided:

		No
1.	Lockable desk (1300 x 800 mm):	.....
2.	Layout table (2300 x 1150 mm) with 4 drawers plan cabinet under:	.....
3.	Chair:	.....
4.	Waste paper bin:	.....
5.	Telephone:	.....
6.	Air conditioner (22000 BTU or above):	.....
7.	Electric fan heater (2 KW):	.....
8.	Power point (13 amp):	.....
9.	Electric kettle:	.....

PRE.C11.430.9 PERIOD REQUIRED

Provide the container office(s) on Site immediately at the start of the Contract for the use of the CM and his staff as instructed by the CM until the principal office is completed. When the principal office is completed and occupied, the container(s) and its equipment shall be returned to the Contractor/re-located to .....

PRE.C11.440.9 RELOCATION

From time to time, move, relocate and re-establish the CM's container office(s) accommodation to suit the staging of the Works.

MAINTENANCE AND REMOVAL OF OFFICE ACCOMMODATION

PRE.C11.510.9 REPAINTING

The CM's principal office and the container office(s) shall be repainted internally and externally with one undercoat and one finishing coat at 18 months intervals after the offices have been erected.

PRE.C11.520.9 REMOVAL

On completion of the Contract, when advised in writing by the CM, remove all the offices, hardstanding, toilets and fixture items leaving the areas in a clean and tidy condition, and make good all damage.

SITE ACCOMMODATION ASSOCIATED WITH IN-SITU CONCRETING WORK

PRE.C11.610.9 CONTAINER OFFICE

Where in-situ concreting work is to be carried out on Site and which forms part of the permanent Works, provide a standard steel container office of nominal size 6000 x 2500 x 2350 mm (as and when required by the CM) for exclusive use of the CM or his appointed Specialist Testing Contractor. Equip the container with the following:

1. A security door-lock;
2. Windows with security metal grilles;
3. Fluorescent lighting;
4. Reversible air conditioner;
5. Work bench 2500 x 900 x 850 mm high;
6. Direct line telephone;
7. Desk with lock up drawers;
8. Pin board;
9. Chair and stool.

PRE.C11.620.9 CONTAINER STORE ROOMS

1. Provide sufficient numbers of steel container rooms, to the satisfaction of the CM, for storing the following core samples:
    a. Samples obtained from sampling and testing founding levels for Type 3 Piles as described in PIL1.T210 & PIL1.T220;
    b. Samples obtained from core testing of Type 3 Piles as described in PIL1.T1220;
    c. Samples obtained from confirmatory core tests of founding strata of Types 3 piles as described in PIL1.T1710.
2. Hand over the steel container rooms and the core samples contained therein to the CM upon completion of the Contract;

3. As directed by the CM, dispose of the core samples and core boxes prior to completion of the Contract.

PRE.C11.630.9 CONTAINER CURING ROOMS AND TANKS

Where in-situ concreting works is to be carried out on site and forms part of the permanent Works, provide sufficient numbers of steel container rooms and steel curing tanks for storing and curing test cubes to the satisfaction of the CM. Take note that:

1. A standard curing tank of nominal size 1650 x 860 x 510 mm will be deemed to have a capacity to accommodate one hundred eighty 100 mm concrete cubes;
2. For curing tanks with different nominal sizes, the number of required curing tanks may be estimated on the basis of the capacity for a standard curing tank of equivalent volume at the discretion of the CM, who will require appropriate adjustments in the pump and heater capacities;
3. A standard steel container room of nominal size 6000 x 2500 x 2350 mm may accommodate up to a maximum of five standard curing tanks;
4. Each curing tank must be accessible, and at least one spare curing tank must be provided at all times for cleaning purpose;
5. Concreting work will not be allowed to commence until curing tanks and steel container rooms have been completed and accepted by the CM;
6. A wall-mounted switch panel on the external face of each curing room, with indication light and due protection against inclement weather and accidental damage, must be provided for ensuring the proper functioning of all electrical curing facilities at all times.

PRE.C11.640.9 STEEL CONTAINER ROOM

Equip each steel container room with the following:

1. A security door-lock;
2. Windows with security metal grilles;
3. Fluorescent lighting;
4. Air conditioner with heating and cooling facilities that is capable to keep the room temperature at 25°C ±5°C;
5. Adequate no. of power plugs for operating the curing tanks;
6. Water supply;
7. Drainage outlets connecting to the drainage valves and overflow system of the curing tanks;
8. Main switch box / control panel to the exterior of curing room and duly protected against inclement weather.

PRE.C11.650.9 STEEL CURING TANK

1. Construct each curing tank of corrosion-resistant material of adequate strength such as galvanised sheet steel to BS EN ISO 1461:2009 for hot dip galvanised coating or BS 2569 for flame sprayed metal coating, fully welded on all seams and equipped with the following accessories:
   a. A lockable insulated lid or cover properly numbered;

b. A recirculating water pump and a stand-by pump both of waterproof types and with capacities not less than 1000 litres per hour, earthed and fitted internally at one end of the tank drawing the water through a pipe from the bottom to the diagonally opposite top of the tank at least 25 mm above the water level to stimulate efficient mixing of the water by free falling;

c. A thermostatically controlled electric immersion heater and a stand-by heater both with wattage of not less than 3 kW and connected with a temperature sensor for continual monitoring of the water temperature at 27°C ± 3°C;

d. A set of three removable lower racks;

e. Two layers of removable racks (ten removable racks per layer) suspending from the sides of the tank;

f. A drainage valve and an overflow system;

g. A steel stand supporting the water tank;

h. Minimum/maximum thermometers for both air and water temperatures;

i. A thermograph for continual recording of the water temperature;

j. Comply with all other requirements for a curing tank as stated in Appendix A of CS1:2010 (Construction Standard for Testing Concrete).

2. Notwithstanding sub-clause (1)(i) above, if a thermograph is proposed for two or more curing tanks, submit for Approval:

a. Details of the water circulating system including the provision of a central water closet to the curing tanks;

b. Measurement records by an Approved laboratory showing efficient mixing of the water to attain a temperature of 27°C ± 3°C in the circulating system under working environment.

PRE.C11.660.9 CURING TANK MAINTENANCE

Clean each tank at regular intervals and change the water in each tank at least once a month in accordance with CS1:2010 and as directed by the CM. In order to provide adequate circulation of water and to facilitate the removal of test cubes from the curing tank, provide at least 15 mm of water horizontally between test cubes and the sides of the tank.

PRE.C11.670.9 CURING RECORDS

Record the daily maximum and minimum moist air and water curing temperatures and keep the records on site at all times for the inspection of the CM.

PRE.C11.680.9 ACCESS BY TESTING CONTRACTOR

Where directed by the CM, allow the Specialist Testing Contractor sole access and use of the curing room and curing tanks together with all the equipment provided under the Contract.

PRE.C11.690.9 ACCOMMODATION MAINTENANCE

Provide attendance including regular cleaning, lighting and power and maintenance to container rooms and curing tanks.

PRE.C11.700.9 STEEL CONTAINERS FOR TEST SAMPLES OF BAR REINFORCEMENT/FABRIC REINFORCEMENT

As and when required by the CM, provide …… lockable steel containers, …… of nominal size (Length x Width x Height) 1500 x 600 x 600 mm and …… of nominal size (Length x Width x Height) 1500 x 150 x 1500 mm, securely adhered to the curing room, for the exclusively use of the CM or his appointed Specialist Testing Contractor.

SITE FACILITIES FOR THE CM

PRE.C11.810.9 GENERAL FACILITIES

Provide all labour, staging, ladders, wire ropes and other equipment, information and assistance required by the CM and his staff for inspecting, measuring, testing and for the supervision of the Works.

PRE.C11.820.9 SURVEY SUPPORT

1. Provide for the exclusive use of the CM and his representatives at all times during the progress of the Works, 3 full-time survey assistants as shall be necessary for the CM and his representatives to carry out checking or surveying works under the Contract or works in connection therewith;
2. The survey assistants as provided under sub-clause (1) shall have at least 2 years of construction site engineering survey experiences and are capable of operating the equipment specified under PRE.C11.860;
3. It may be necessary for these assistants when directed by the CM to be used on other works in connection with this Contract;
4. Any operation of the Works which interferes with the checking of lines, levels and other inspections required by the CM shall be temporarily stopped at the direction of the CM until the checking is complete, and in this connection no time or monetary claim will be considered.

PRE.C11.830.9 TYPIST / CLERK

Provide a typist/clerk for the exclusive use of the CM and CM's staff. The typist/clerk shall be from an independent agency Approved by the CM. The typist/clerk shall be based on the Site in the CM's accommodation and shall be available during normal working hours. The CM reserves the right to have the person replaced at any time if, in the CM's opinion, the person's standard of work is unsatisfactory.

PRE.C11.835.9 UNINTERRUPTIBLE POWER SUPPLY

1. Provide ……. No. Uninterruptible Power Supply (UPS) for the CM or his representatives to protect the computer equipment installed in the site office for the duration of the Contract plus six months commencing from the date of the certificate of completion, and for other longer period as Instructed for the necessary completion of the Works and/or additional works within the Maintenance Period;
2. The UPS shall comply with the following minimum requirements:
   a. Output Power Capacity: 700 Watts/1000VA;
   b. Nominal Input/Output Voltage: 230V;
   c. Backup Time: able to support 15 minutes or more at half load.

PRE.C11.840.9 PROVISION OF INSTRUMENTS AND EQUIPMENT GENERALLY

1. Within 6 weeks from the date for commencement of the Works, provide for the sole use of the CM and his representatives the instruments and equipment specified under PRE.C11.860 which are:
   a. Compatible with each other;
   b. Of specified source or equivalent;
   c. Covered by valid calibration certificate issued by approved laboratory;
   d. Maintained by the service agent and calibrated by an approved laboratory annually. Replacement instrument or equipment of the same condition and specification shall be provided when any instrument or equipment is out of service;
   e. To be returned to the Contractor within 3 months after the date of certified completion of the Works.
2. Be responsible for payment of all bills for maintenance agreements for the instruments and equipment listed under PRE.C11.860.

PRE.C11.850.9 RADIO COMMUNICATION SYSTEM

Provide and maintain in perfect working order for the sole use of the CM and his staff:

1. Four sets of portable transceivers with spare batteries, chargers and hand-free speaker microphone with sprint belt clip for transmission and reception of clear messages between the transmitter / receiver in the CM's principal office and all parts of the Site;
2. The radio communication system shall be capable of being switched in to any radio communication system used by the Contractor and shall include a transmitter / receiver in the vehicles provided for the CM;
3. The radio communication system shall have a range suitable for expected conditions and shall be to the CM's approval;
4. Be responsible for obtaining all licences and permissions necessary for the use of the CM's radio communication system and the Contract rates shall include the cost of such licences.

PRE.C11.860.9 SURVEY EQUIPMENT

Equipment	Quantity	Unit
1. Total Station and Total Station Accessories		

a. The Total Station shall have a valid calibration certificate and shall be under valid maintenance services during the progress of the Works. The Specifications of the Total Station are: – Distance accuracy (prism mode): equal to or better than (1 mm + 1.5 ppm); – Distance accuracy (reflectorless mode): equal to or better than (3 mm + 2 ppm); – Angular accuracy : equal to or better than 3” – Keyboard with touch screen and colour display; – With Total Station container and user manual; – With data conversion and transaction software to generate GSI format data for the CAD application software (i.e. Microstation MX V8i ; AutoCAD 2011 or the latest version to be approved by the CM’s Land Surveyor);	1	Set
b Total Station Accessories:		
– Battery for the Total Station	1	No.
– Battery Charger	2	Nos.
– External Flash memory card	1	No.
– Circular Prism, in container with holder and target plate	2	Sets
– Tribrach with optical plummet and carrier set 1.2.7for the Circular Prism	2	Sets
– Reflector pole, telescopic with circular bubble, cm graduation, extends 2 sets to 2.15m and the 1m extension pole	2	Sets
– Mini Prism and mini reflector pole with circular bubble	2	Nos.
– Wooden Tripod	3	Nos.

2. Digital Level and Accessories a. The Digital Level shall have a valid calibration certificate and shall be under valid maintenance services during the progress of the Works. The Specifications of the Digital Level are: – Standard deviation with invar staff equal to or better than 0.3mm/km; and with aluminium staff equal to or better than 1.0 mm/km; – Measurement programs: aBFFB, BFFB, BF and aBF; – Electronic measurement range: equal to or better than 1.8-100m; – Valid calibration certificate; and – Under valid maintenance services during the progress of the Works.	1	Set
b. Accessories of the Digital Level: – Container and User Manual – Battery for the Digital Level – Battery Charger – Memory Card – Ground Plate – Aluminium Staff, Dual faces, 4.0m – Aluminium tripod	 1 2 1 2 2 2 1	 Set Nos. Set Nos. Nos. Nos. No.
iii. 10 mm wide Nylon Coated Steel Tape (30m) with accuracy equal or better than ± 3.2 mm in 30 m.	1	No.

PRE.C11.870.9 HYDROGRAPHIC EQUIPMENT

Equipment	Quantity	Unit
Raytheon DE719CM Precision Echo Sounder for 12 Volt DC operation or equivalent complete with standard accessories:	1	Set
Transducer Model 7245A of beam width 2.75° inclusive at -3dB points, operating at 204 to 210 kHz:	1	No.
Gravity Corer (Benthos Part No. 55555-1890-CC) or equivalent and necessary core liners with end caps (Benthos Part No. S-2171-CL) or equivalent:	1	Set
A3 size Calcomp 33180 Digitising Tablet with standard accessories, 4-button diamond corded cursor, power cable and cable connect to data storage unit:	1	Set
Hand held remote Mark Switch:	1	No.
Stylus Belts:	4	No.
Stylus:	20	No.

Metric Chart Paper:	40	Roll.
Fuse For Echo Sounder:	10	No.

PRE.C11.880.9 DATA LOGGER UNIT

Equipment	Quantity	Unit
Compaq/Toshiba Portable Data Storage Unit complete with standard accessories and comprising the following: - Intel 33 MHz 486SL - 4M RAM on board - 240 MB hard disk - 1.44M 3.5" internal floppy diskette drive - 1.2M 5.25" external floppy diskette drive - 1 Serial port - 1 Parallel port - 1 External floppy drive port - 1 mouse port - 1 battery - IBM or Microsoft Compatible Tracker Ball - Acer View 33 Super VGA Colour Monitor and installed with the following licensed processing device: complete with manuals and installation disks: - DOS Version 5 or higher - Word Perfect Latest Version - Lotus 123 Release 2.4	1	Set
HP Laser 4L printer complete with: - HP Explorer Software - 100 Multi-purpose tray - HP 92274A Toner Cartridge - Manuals and Installation Disk	1	Set

PRE.C11.890.9 HAND-HELD TRANSCEIVER

Equipment	Quantity	Unit
Shinwa SH-803KX (operate at 72.25 MHz) hand held transceiver complete with antenna, battery pack, carrying case and battery charger:	1	Set

PRE.C11.900.9 PORTABLE COMPUTER EQUIPMENT

Equipment	Quantity	Unit
Computer and multi-media IT package (excluding the digital camera) as detailed in PRE.C13 Appendix 1	……	…….

PRE.C11.910.9 CONSUMABLES

Provide sufficient quantities of the following items as required during the progress of the Works:

1. Plumb bobs, red clothes, pegs, stakes, strings, paints, chart paper, etc. as necessary for field surveying work;
2. Stationery items, computer consumables, e.g. CDs / DVDs, printer toner cartridges and printer papers etc. as necessary for data processing and storage.

TRANSPORT FACILITIES FOR THE CM

PRE.C11.1010.B VEHICULAR TRANSPORT

Option 1

A vehicle for the use of the CM or his representatives is not required for this Contract. The CM may direct vehicles provided under other Housing Authority contracts to visit this Site. Allow the entrance of such vehicles into the Site and provide suitable parking spaces within the Site for these vehicles.

Option 2

1. Provide ..... (no.) petrol vehicle(s) and ..... (no.) electric vehicle(s) with driver(s) for the use of the CM and his representatives, any officials, employees, consultants or agents of the Housing Authority or the Housing Department or any persons authorized or permitted by the CM. The vehicle(s) will be used for any purposes in connection with this Contract or otherwise. The vehicle(s) shall revert to the Contractor upon the expiration of the period defined in sub-clause (2)(c) below;
2. Comply with the following requirements:
   a. Specification for petrol vehicle:
      i. Vehicle design standard: meet the standards for private cars registered on or after 1 July 2017 of the Air Pollution Control (Vehicle Design Standards) (Emission) Regulations (Cap.311J) and shall not be diesel private cars;
      ii. Air conditioning: fitted;
      iii. Body type: saloon / estate;
      iv. Drive: two wheel / four wheel as directed by the CM;
      v. Seating capacity: not less than 5 (including driver);
      vi. Engine capacity: not less than 1600 c.c.;
      vii. Age of vehicle: not more than 30 months with certificate of good condition issued by an approved Car Examination Centre at the time of provision of the vehicle;
      viii. Mobile phone: to be issued to and carried by the driver.
   b. Specification for electric vehicle:
      i. Air conditioning: fitted;

ii. Body type: saloon / estate / hatchback;

iii. Seating capacity: not less than 5 (including driver);

iv. Power: a battery powered automobile which is solely propelled by electric motor(s) and has zero tailpipe emission;

v. Maximum Power: not less than 45kW;

vi. Maximum Torque: not less than 180 N-m;

vii. Battery capacity: not less than 38kWh;

viii. Driving range (in a single charge without operating the air-conditioning system): not less than 280 km tested under the New European Driving Cycle or relevant international / national driving test requirement;

ix. Charging method: equipped with on-board charger with rated capacity not less than 6kW. All necessary cables / accessories / couplers shall be capable of charging the vehicle battery pack with a medium charging via 220V single phase electric vehicle charger with output power of not less than 7kW, and shall comply with IEC 62196 (or SAE J1772);

x. Battery performance: able to deliver the specified electric range in a single charge during the whole period of use;

xi. Age of vehicle: not more than 30 months with certificate of good condition issued by an approved Car Examination Centre;

xii. Mobile phone: to be issued to and carried by the driver.

c. Period of provision:

From the notified date for commencement of the Works to the date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the Works, but in the event that there are works remaining uncompleted after such date stated in the certificate of completion of the Works, or the last of such certificates where a certificate is issued for a part or parts of the Works before completion of the Works, the said period of provision shall be extended until all of the said outstanding works have been completed in accordance with this Contract within the Maintenance Period.

d. Availability:

Make the vehicle(s) available for use during the following periods:

i. Normal working hours and such other times when the Contractor is working;

ii. Outside the times stated in sub-clause (2)(d)(i) above when requested by the CM for emergency situations, for the discharge of his or her duties, or for other purposes as may be authorized or permitted by the CM.

e. Licence and insurance:

i. The vehicle(s) shall be properly licensed;

ii. Provide a fully comprehensive insurance policy for the vehicle(s) as private car under the ownership of the Contractor. The insurance policy shall provide insurance protection to passengers of the vehicle(s) and any third parties and to any use of the vehicle(s) pursuant to sub-clause (1) and sub-clause (2)(d) above;

iii. Present the insurance policy and submit a written confirmation of compliance of the insurance policy of the vehicle(s) with this Specification clause from the insurer or the insurance broker / agent, to the CM, as soon as practicable but in any event no later than the notified date for commencement of the Works.

f. Records of vehicle journeys:

i. Ensure that the driver for each vehicle institutes and maintains a record of the use of the vehicle. Such a record, in the form of a log book, shall include, inter alia, details, times and purpose of journeys together with appropriate meter readings and distances travelled. The driver is required to ensure that the person using the vehicle or authorising the journey signs his name and title against the entries;

ii. Obtain log books from the CM. Ensure the driver presents current log books for inspection when so required by the CM and hand over all completed log books to the CM for safe keeping.

g. Vehicle maintenance:

i. Maintain vehicle(s) in clean and roadworthy condition and bear costs of fuel, electricity, running cost, maintenance and repair charges and other incidental items;

ii. Provide an equivalent substitute or form of transport during any period when the vehicle(s) above is / are not available, or out of service for maintenance or repair.

PRE.C11.1020.9 CM'S MARINE TRANSPORT

1. Where the appropriate item is included in the B of Q, provide a boat capable of carrying a coxswain and the minimum number of passengers under a rain proof cover. The boat must have the appropriate license from Marine Department. The coxswain shall have his Engineer's and Master's Certificates appropriate to the type and size of boat, from Marine Department.

2. The requirements of the boat are as follows:

a. To be licensed for a minimum capacity of ..... passengers;

b. To be in the charge of a coxswain qualified in accordance with sub-clause (1) and assisted by ..... crew;

c. To be available at all times when the Contractor is engaged in ..... and otherwise at 24 hours notice. The service of the boat shall be suspended/terminated 24 hours after the CM's instructions for its suspension/termination of service;

d. To be equipped and manned in accordance with the statutory requirements of the Marine Department and licensed under the Merchant Shipping (Launches and Ferry Vessels) Regulations Chapter 281. A qualified coxswain shall be appointed and shall be available when the marine transport is required by the CM.

3. The Contract Rates for Marine transport shall include for insurances, all running costs and all maintenance and repair charges required to keep the boat in a clean and first class condition at all times. The boat shall be provided with suitable life saving equipment as required by the Director of Marine;

4.

a. Records of journeys shall be kept in log books provided by the CM;

b. Records shall include details of the times and purpose of journeys with appropriate odometer readings and distances travelled;

c. The person using the boat or authorising the journey, shall sign against the log book entries;

d. Log books shall be presented for inspection when required by the CM and all completed log books shall be handed over to the CM.

PRE.C12 ATTENDANCE

SUB-CONTRACTORS, SPECIALIST CONTRACTORS AND UTILITY UNDERTAKING

PRE.C12.020.9 PLANNING AND PROGRAMMING GENERALLY

Attendance in coordinating and sequencing work programmes and making arrangements as regards to:

1. The time and manner of the execution of their work and delivery of their materials and the time and manner of the submission of drawings or schedules of their builder's work requirements;
2.
    a. The obtaining of full particulars of their builder's work requirements for chases, recesses, mortices, openings, holes, sleeves, cuttings on formwork and the like;
    b. Execute all such builder's work including forming openings and holes through reinforced concrete (including holes for pipes exceeding 150 mm diameter) and provision of any additional formwork and reinforcement required in trimming around openings;
    c. Provide and fix where required, or obtain from others and fix where required, or obtain from others and fix when supplied, all slots, sleeves, and the like;
    d. Grout voids between sleeves / equipment and openings and for other openings where required in reinforced concrete members with concrete of the same crushing strength as the members after the sleeves or the equipment are properly fixed in position and provision;
3. The obtaining of full particulars of their further builder's work requirements for equipment bases, foundations and the like;
4. The checking of submitted builder's work requirements for conflict between all services. Submit full particulars of builder's work requirements to the CM for Approval, together with a report detailing any ambiguity, discrepancy or conflict between all services;
5. The supplying of details of the method of construction including all dimensions and other information necessary to ensure that their work is correctly executed or correct goods or materials supplied.

PRE.C12.030.9 PLANNING AND PROGRAMMING NOMINATED SUB-CONTRACTOR'S WORKS

1. Provide additional programmes in compliance with GCC Clause 5.7 in respect of each Nominated Sub-contractor within 14 days of the acceptance of each Nominated Sub-contract;
2. Provide attendance in coordinating the programme to suit special requirements for phasing the Works as applicable in accordance with the following table:

Nominated Sub-contractors	Requirement
Electrical Installation	Making available to Sub-contractor the main switch kiosk, and switch kiosks at least 4 months prior to completion of the hard landscape work. Making available to Sub-contractor the underground cable ducts and draw pits at least 3 months prior to the completion of hard landscape work. Vehicular access for transportation of equipment to the main switch kiosk during the last 3 months prior to completion of the hard landscape work.

PRE.C12.040.9 PLANNING AND PROGRAMMING UTILITY UNDERTAKING'S WORKS

1. This clause shall be read in conjunction with GCC Clause 5.7, and PRE.C6.050;
2. Be responsible for maintaining close liaison with the Utility Undertaking during the progress of the work and no claims for extra costs or delays incurred by the failure of Utility Undertaking to comply with the agreed programme of works will be considered unless, in the opinion of the CM, the Contractor has taken all reasonable steps to cause the Utility Undertaking to proceed with their work in accordance with the agreed programme;
3. Advise the CM the agreed timing of works to be carried out by Utility Undertaking by inclusion of such works in the programme of Works;
4. Maintain regular liaison with the Utility Undertaking throughout the duration of the Works and inform the CM of the date, time and place of every meeting with the Utility Undertaking for the CM to participate as an observer and copy all correspondence to the CM;
5. The agreed programme of work by Utility Undertaking shall mean that programme agreed in writing by the Contractor and the various Utility Undertaking;
6. Confirm in writing to the Utility Undertaking the programme for any section of work to be carried out by a Utility Undertaking no more than four weeks and no less than one week before the agreed commencement date for that section of work. Copy to the CM such confirmation;
7. Inform the CM immediately of any delays in works by Utility Undertaking which will affect the progress of the Works;
8. Nothing in this clause shall relieve the Contractor of his responsibility for the overall planning of the Works and the coordination of the Utility Undertaking;
9. Where it is anticipated that Utility Undertaking will be carrying out substantial works on the Site, this is referred to in PRE.C2.100.

GENERAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS, SPECIALIST CONTRACTORS AND UTILITY UNDERTAKING

PRE.C12.110.9 GENERAL ATTENDANCE

Provide general attendance as defined at clause 7 of Part IV of SMM for CE Works 1992 Edition published by the Hong Kong Government and the following clauses in this sub-section.

PRE.C12.120.9 FREEDOM OF MOVEMENT

Every facility to move about the Site in the legitimate pursuit of their work.

PRE.C12.130.9 USE OF EXISTING PLANT

The use of such plant, ladders, hoisting facilities, scaffolding or staging as may have been provided or erected by the Contractor, provided that there is no obligation to retain any such plant, ladders, hoisting facilities, scaffolding or staging longer than is necessary for the Contractor's own use.

PRE.C12.140.A SPACE FOR STORAGE

1. Having regard to the nature of the Site and the Works, provide sufficient space within the Site or within the Works under construction for work areas and storage sheds for the storage of materials and plant brought onto the Site;
2. Provide a minimum area of 30 m² for special store room for the Electrical Nominated Sub-contractor's use. Such sheds and rooms are to be provided, erected and cleared away by the Nominated Sub-contractors, Specialist Contractors, Government departments and Utility Undertakings;
3. Provide security to all storage areas and illuminate all surrounding areas to any storage sheds and store rooms erected.

PRE.C12.150.9 WATER AND ELECTRIC LIGHTING

1. Adequate temporary water and electrical supplies at convenient positions throughout the Works under construction and to work and storage areas within the Site for lighting, testing and commissioning up to and including final acceptance of the installations by the CM;
2. In compliance with GCC Clause 5.11(4), provide sufficient lighting to all Nominated Sub-contractors where any of their work is carried out in darkness.

PRE.C12.160.9 SITE CONVENIENCES

The use of the telephone, mess rooms, latrines and the usual conveniences of a construction site.

PRE.C12.170.9 UNLOADING

Such assistance as is necessary in the unloading of plant, goods and materials brought onto the Site.

PRE.C12.180.9 SECURITY PROTECTION

Such watchmen or security guards as are reasonably necessary to safeguard the Site.

PRE.C12.190.9 CLEARING AWAY RUBBISH

Such service as is necessary for the clearing away of rubbish as it accumulates.

PRE.C12.200.9 REINSTATEMENT

Any making good on completion of work disturbed by the use on removal of the above facilities.

SPECIAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS AND SPECIALIST CONTRACTORS

PRE.C12.210.9 GENERALLY

Provide electricity supply for the operation of power tools.

PRE.C12.220.9 TEMPORARY ELECTRICAL SUPPLY REQUIRED FOR TESTING

Provide supply as follows:

Nominated Sub-contractors and Specialist Contractors Installation	Capacity	Location
Electrical	60 A 3 Phase	Main Switch Kiosk
	30 A Single Phase	Each Switch Kiosk

Note: The temporary electrical supply and a permanent water supply for testing to be made available for each installation at least 1 month before the completion date of the hard landscape work.

PRE.C12.230.9 SPECIAL ATTENDANCE ON NOMINATED SUB-CONTRACTORS

Nominated Sub-contractors	Special Attendance
Electrical installation	Provision of draw wires to all underground ducts. Lubricating all inaccessible ducts with graphite powder. Painting all exposed wiring and conduits upon the completion of the installation.

PRE.C12.240.9 ATTENDANCE ON SPECIALIST CONTRACTORS OF PILING WORKS

1. Provide information for the preparation of the report, all as required by the Specialist Contractors;
2. Be responsible for the coordination of testing and for ensuring that the appropriate piles and materials are made available for such testing and commence early enough in the piling works and avoid subsequent delays in performing the pile load test.

PRE.C12.250.9 CONCRETE CORING AND TESTING EXCLUDING CORE TESTING OF TYPE 1(C) & TYPE 3 PILES

Additional materials for coring and testing and making good after coring.

PRE.C12.260.9 NON-DESTRUCTIVE TESTS ON PILES & ULTRASONIC ECHO SOUNDER TEST FOR TYPE 3 PILE

1. Provide the following Special Attendance:
    a. Compliance with all the requirements of PIL1 - Testing;
    b. Provision of all necessary power including electricity, labour, materials, plant and equipment including welding facilities as required;
    c. Provision of access to the test pile including access to pile when pitched;

d. Provision of all necessary water at the locations as required by the Specialist Contractor and/or Housing Department Materials Testing Laboratory, and a labourer for full attendance during the testing period, and ladder(s) as required in carrying out the test;

e. Expose and prepare pile heads for non-destructive tests such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads;

f. Provision of preliminary pile testing information to Specialist Contractor and/or Housing Department Materials Testing Laboratory;

g. Provision and installation of sonic access tubes in the Type 3 piles for sonic logging tests; details of the sonic access tubes are shown at PIL Appendix .....;

h. Provision of driving equipment for piles selected for pile driving analyser test;

i. Extend the test pile to a level as and when required so that pile driving analyser tests can be carried out.

2. Non-destructive tests on piles shall include Pile Driving Analyser Test, Pile Integrity Test and Sonic Test.

PRE.C12.270.9 CORE TESTING OF TYPE 1(C) & TYPE 3 PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of access to the test pile;
3. Expose and prepare pile heads for the tests such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads;
4. Provision of suitable working platforms for supporting the coring equipment in the execution of coring;
5. Provision of water and electricity as required 24 hours a day for the coring and site testing;
6. Fill cored holes solid with non-shrinkage grout of at least the same crushing strength as the pile cored.

PRE.C12.280.9 CONFIRMATORY CORE TESTING OF FOUNDING STRATA OF TYPE 3 PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of access to the test pile;
3. Expose and prepare pile heads for the tests such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads;
4. Provision of suitable working platforms for supporting the coring equipment in the execution of coring;
5. Provision of water and electricity as required 24 hours a day for the coring and site testing;
6. Fill cored holes and sonic tubes solid with non-shrinkage grout of at least the same crushing strength as the pile cored.

PRE.C12.290.9 PROVING BEDROCK AFTER INSTALLATION - TYPES 5 & 6 PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of access to the test pile;
3. Provision of suitable working platforms for supporting the coring equipment in the execution of coring;
4. Provision of water and electricity as required 24 hours a day for the coring and site testing;
5. Backfill the drillholes with clean sand.

PRE.C12.300.9 NON-DESTRUCTIVE TESTS ON WELDS OF PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of access to the test pile including access to pile when pitched;
3. Provision of electricity as required for the weld tests;
4. Provision of welders and welding facilities when required.

PRE.C12.310.9 LOADING TESTS OF WORKING PILES

Provide the following Special Attendance:

1. Compliance with all the requirements of PIL1 - Testing;
2. Provision of electricity as required 24 hours a day for the loading tests;
3. Provision of access to the test piles;
4. Provision of reactions by means of kentledge, anchor piles or other anchorage with adequate stability and safety and approved by the CM;
5. As and when required, extend the test piles to a suitable level for the carrying out of the test and design and construct a suitable pile cap to the test pile;
6. Expose and prepare pile heads such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads;
7. Provision of transportation of the testing equipment within the Site. Place the testing equipment at the location as required by the CM or the Specialist Contractor;
8. Throughout the period of the test, make observations of the settlement of the pile being tested by a suitable surveyor's level;
9. On completion of the test, remove the kentledge, anchor piles or other anchorage, demolish the test pile cap, make good the test pile and the Site back to their original condition and remove all debris arising from the test from the Site.

PARTICULAR REQUIREMENTS OF UTILITY UNDERTAKING

PRE.C12.410.9 GENERAL OBLIGATIONS

1. The requirements in this sub-section are not meant to be exhaustive;
2. Establish further requirements with the Utility Undertaking;

3. Compliance with this clause shall in no way relieve the Contractor of his obligation and liabilities under the Contract.

PRE.C12.420.9 SITE PREPARATION

Prior to the handover of any part of the Site to a Utility Undertaking:

1. Ensure that this particular part of the Site is clear and free from all surface and sub-surface obstruction which shall include ground slabs, ground beams, pits, wells and underground tanks;
2. Ensure that this particular part of the Site is in a dry condition and that the surface drains freely throughout the duration of the utility diversion activity;
3. Ensure that, in respect of any underground diversions or new installation by a Utility Undertaking, the particular part of the Site is prepared, to finished earthworks level plus or minus 150 mm;
4. Ensure that in respect of overhead diversions involving the installation of poles or towers by a Utility Undertaking, the part of the Site within 6 metres from the pole or tower in any direction shall be prepared to finished earthworks level plus or minus 150 mm.

PRE.C12.430.9 ACCESS

Provide and maintain free access for staff of the Utility Undertaking and their contractors, with necessary plant and vehicles, to enter the Site for carrying out installation, maintenance and repair works.

PRE.C12.440.9 TRAFFIC DIVERSIONS

Provide all necessary traffic diversions to meet the requirements of the Utility Undertaking whilst making connections to existing services within roads.

PRE.C12.450.9 SETTING OUT

Provide reference lines and levels and kerb alignment of the roads on site for the working of the Utility Undertaking.

PRE.C12.460.9 PROVISION OF TEMPORARY WORKS AREAS

Make available areas of the Site for use as temporary works areas by Utility Undertaking in connection with works related to the Contract.

PRE.C12.470.9 LOCATIONS OF TEMPORARY WORKS AREAS

1. Agree with the respective Utility Undertaking the arrangements and locations of the temporary works areas to suit the working programme and method of working;
2. Agree with Utility Undertaking the precise arrangements and locations 4 weeks prior to commencement of their respective works;
3. Made available the temporary works areas in a dry condition 25 days prior to commencement of respective Utility Undertaking's works;
4. Arrange with the Utility Undertaking when it is considered necessary to move any of these works areas during the Contract period, and bear all costs arising from such an operation;
5. Ensure that an unobstructed and motorable vehicular access with an all weather surface capability is provided and maintained at all times to the Utility Undertaking's temporary works areas.

PRE.C12.480.9 SPECIFIC REQUIREMENTS

Comply with the requirements of each respective Utility Undertaking which requirements will include but not be limited to the following:

1. Water Supplies Department (WSD) or his agent - agree on Site the minimum length of site to be made available to WSD or his agent for mainlaying works. Provide adequate working space on each side of pipe trench. WSD or his agent will require a minimum of two months' notice before commencement of their works;
2. Fixed Telecommunication Network Services (FTNS) Operators - agree on Site the minimum length of site to be made available to the FTNS operators. FTNS operators will require a minimum of one month's advance notice before commencement of their works;
3. CLP Power Hong Kong Limited (CLP) - agree on Site the minimum length of site to be made available to CLP. CLP will require a minimum of one month's advance notice before commencement of their works;
4. Hong Kong and China Gas Company Limited (HKCG) - agree on Site the minimum length of site to be made available to the HKCG shall be agreed on site. In the case of road crossings, then the relevant length of the crossing only is required. HKCG will require a minimum of two months' advance notice before commencement of their works. Made available the portion of Site to HKCG at formation level and section by section in a continuous manner;
5. CLP Engineering Limited (CLPEL) - with regard to new installations, lighting, complete all civil works as required before commencement of the street lighting works. CLPEL will require a minimum of three months' advance notice before commencement of their works.

ATTENDANCE ON CONTRACTORS TENDERING FOR SPECIALIST AND NOMINATED SUB-CONTRACT WORKS

PRE.C12.510.9 FACILITIES

Provide every facility to inspect the Site and the Works in the legitimate pursuit of their submission of a tender.

PRE.C12.520.9 INFORMATION

Provide such information as can reasonably be requested as to method of construction, programme of Works, and the like.

GENERAL OBLIGATIONS

PRE.C12.610.9 REMEDIAL WORKS OR EXPENSES

Carry out all work necessitated by any failure in the above arrangements or pay to the Authority all expenses properly incurred as a result of such failure.

PRE.C13 APPENDIX 1

COMPUTER AND IT MULTI-MEDIA FACILITIES

PRE.C13.A030.9 OTHER REQUIREMENTS

1. Provide …... No. of broadband line(s) for the exclusive use of the CM and his representatives for the duration from the date of commencement of the Works up to six months after the date of certified completion of the Works;
2. The broadband line shall comply with the following:
    a. Unlimited 24 hours internet access through Internet Service Provider (ISP) via broadband with minimum 3M connected individually to each of the computer systems in CM's principal office and the container office(s). Security hardware / software systems shall be provided to protect the computer systems from hackers / unauthorized intruders;
    b. Networking to connect each of the computer equipment in CM's principal office and the container office(s). The broadband router or switch used to connect the network to the ISP must support Virtual Private Network (VPN) using IPSec technology;
    c. Maintenance and support under an agreement between the Contractor and the original supplier for all equipment so provided for the internet service;
    d. All necessary training, manuals and instructions in operating the internet service for all the users as directed by the CM or his representatives.

PRE.C14 APPENDIX 2

STANDARD FEATURE CODE FOR ENGINEERING SURVEY

PRE.C14.A010.9 STANDARD FEATURE CODE FOR ENGINEERING SURVEY

Ref. No.	Description	Feature Type	Level Shown
1.	Archway	L	
2.	Balcony/Canopy	L	
3.	Beacon/Light house	P	
4.	Bench	3P	
5.	Bench mark	P	Y
6.	Berm	L	Y
7.	Bollard at quay	P	
8.	Bollard at road	P	
9.	Boulder/Rock	L	Y
10.	Building outline curve	C	Y
11.	Building outline straight	LC	Y
12.	Burial urn	P	
13.	Bus shelter/Terminus	3P	
14.	Cable Duct	L	
15.	Catch pit	P	Y
16.	Catchwater	L	Y
17.	Channel curve	C	Y
18.	Channel straight	LC	Y
19.	Chimney	L	
20.	Cliff	L	Y
21.	Column	L	Y
22.	Control Station	P	
23.	Covered walkway	L	Y
24.	Cultivation bund/limit	L	Y
25.	Culvert	L	Y
26.	Dolphin	P	
27.	Drain curve	C	Y
28.	Drain straight	LC	Y
29.	Electric pole	P	
30.	Electric transformer	P	

31.	Fanned outlet	L	
32.	Fence curve	C	Y
33.	Fence straight	LC	Y
34.	Fire hydrant	P	
35.	Flower bed limit	L	Y
36.	Footpath	L	Y
37.	Foot/Rail bridge	L	Y
38.	Free standing wall curve	C	Y
39.	Free standing wall straight	LC	Y
40.	Gas pipe	L	
41.	Gate	2PM	Y
42.	Grating (1 point)	P	
43.	Grating (2 points)	2PO	
44.	Grave	L	Y
45.	Gully	P	
46.	Hedge	L	Y
47.	High water mark	L	
48.	Hoarding	L	Y
49.	Inclinometer tube	P	Y
50.	Inspection chamber	3P	
51.	Kerb top curve	C	Y
52.	Kerb top straight	LC	Y
53.	Kowloon-Canton railway	L	Y
54.	Lamp post	P	
55.	Letter box	P	
56.	Level string curve	C	Y
57.	Level string straight	LC	Y
58.	Light rail transit	L	Y
59.	Manhole	P	
60.	Manhole foul water	P	Y
61.	Manhole foul water (2 points)	2PO	Y
62.	Manhole storm water	P	Y
63.	Manhole telephone	P	
64.	Manhole waterworks	P	
65.	Manhole waterworks (2 points)	2PO	
66.	Manhole (2 points)	2PO	
67.	Marsh/Swamp	L	
68.	Mass transit railway	L	Y
69.	Monument/Scuplture/Statue	P	

70.	Nullah	L	Y
71.	Oil tank/Water tank/Fuel tank	L	Y
72.	Pavement	L	Y
73.	Pavillion	L	Y
74.	Peak tramway	L	Y
75.	Pedestrian subway	L	Y
76.	Piezometer tube	P	Y
77.	Pipeline	L	Y
78.	Platform	L	Y
79.	Podium line	L	Y
80.	Pond/Pool/Moat/Reservoir/Foundation	L	Y
81.	Pylon	3P	
82.	Quarry bottom	L	Y
83.	Quarry top	L	Y
84.	Railing curve	C	
85.	Railing straight	LC	
86.	Random level point	P	Y
87.	Restricted access	P	
88.	Road margin line	L	Y
89.	Rocky area/Group of boulders	L	Y
90.	Ruin	L	Y
91.	Seawall	L	Y
92.	Shrine	L	
93.	Sign board	2PM	
94.	Sign pole	P	
95.	Slope bottom	L	Y
96.	Slope top	L	Y
97.	Soil nail	P	Y
98.	Stair/Step edge	L	Y
99.	Stepped channel arc	C	Y
100.	Stepped channel straight	LC	Y
101.	Stream course	L	Y
102.	Telephone kiosk	P	
103.	Telephone pole	P	
104.	Temporary structure	L	Y
105.	Tide gauge	P	
106.	Track	L	Y
107.	Traffic light	P	
108.	Tramway	L	Y

109.	Tree	P	
110.	Tunnel	L	Y
111.	Unclassified dot/point feature	P	
112.	Unclassified firm line structure curve	C	Y
113.	Unclassified firm line structure straight	LC	Y
114.	Unclassified long dash line	L	Y
115.	Unclassified short dash line	L	Y
116.	Valve	P	
117.	Valve fire	P	
118.	Valve gas	P	
119.	Valve waterworks	P	
120.	Vertical cutting/masonry/retaining wall	L	Y
121.	Water main	L	
122.	Well	P	
123.	Works in progress limit	L	Y
124.	Normal contour	L	Y
125.	Index contour	L	Y
126.	Text height < 0.15 cm	Text	
127.	Text height 0.15 cm - 0.2 cm	Text	
128.	Text height 0.2 cm - 0.25 cm	Text	
129.	Text height > 0.25 cm	Text	

PRE.C15 APPENDIX 3

TECHNICAL SPECIFICATION FOR TOPOGRAPHICAL SURVEY

DETAIL SURVEY

PRE.C15.A010.9 ACCURACY FOR PLANIMETRIC DETAILS

Classification	Description	Accuracy
Hard Features	Artificial features such as buildings, kerblines, channels, culverts, bridges, tunnels, walls, drains and fences.	10 mm
Soft Features	Natural features such as top and bottom line of slope, footpaths, trees, street furniture, underground utilities and random points of three dimensional strings for digital ground model.	25 mm
Linear Measurements	All direct measurements such as offset distances and plus measurements.	10 mm
Water Features	Water courses, streams, reservoirs, ponds, high water marks etc.	0.25 m
Nearshore Soundings	The sounding positions	0.5 m

PRE.C15.A020.9 ACCURACY FOR VERTICAL INFORMATION

Classification	Description	Accuracy
Hard Features	Permanent structures such as kerblines, surface drains, invert and cover levels of manholes, centre line of roads, pavements, elevated platforms and seawalls.	10 mm
Soft Features	Natural features such as top and bottom of slopes, tracks, footpaths, rock outcrops, and random level points of three dimensional strings for digital ground model.	25 mm
Depths	Approximate depth of underground pipelines and cables.	0.1 m
Nearshore Soundings	The sounding positions	0.3 m

PRE.C15.A030.9 PLANIMETRIC FEATURES TO BE SURVEYED

1. Building / Structures:
    a. The plinth line of all permanent buildings;
    b. The plinth line of all temporary structures.
2. Boundary Features:
    a. Fences;

b. Gates;

c. Walls;

d. Boundary stones;

e. Hoardings.

3. Roads, tracks and footpaths:

   a. Kerb lines or edges of surfacing to carriageways;

   b. Tracks and verges;

   c. Ramps and Drives;

   d. Paths;

   e. Pedestrian crossings;

   f. Steps / staircases.

4. Street Furniture:

   a. Letter boxes;

   b. Bus stops with shelters;

   c. Lamp posts;

   d. Telephone poles;

   e. Electricity poles;

   f. Traffic signals and control boxes;

   g. Sign posts;

   h. Drains or gullies;

   i. Fire hydrants;

   j. Various types of manholes or inspection chambers;

   k. Barriers and bollards;

   l. Telephone kiosks;

   m. Electric cabinets and transformer.

5. Slopes and Earthworks:

   a. Cuttings and embankments;

   b. Terraced slopes;

   c. Retaining walls;

   d. Cliff;

   e. Rock outcrops;

   f. Stockpiles;

   g. Boulders greater than 2 m diagonally;

   h. Slope conventions shall be drawn as near as possible to indicate the actual shape of the slope face, i.e. all berms and terraces shall be detailed. Any other features not listed, which are likely to affect construction works shall also be shown.

6. Vegetation:

   a. All trees of a trunk diameter measures 95 mm or more at a height of 1.3 m above ground level.

7. Water Features:
    a. All water features including ditches, rivers, streams, nullah with the indication of direction of flow.

PRE.C15.A040.9 SPOT LEVELS

1. Sufficient spot levels shall be surveyed such that the ground topography is accurately represented on drawing;
2. The maximum distance between adjacent spot levels shall not exceed 50 mm at plan scale unless otherwise specified by the CM;
3. Spot levels shall also be surveyed at the features listed below:
    a. Back of footpaths, pavements, top and bottom of kerbs, surface channels and centre line of road at 10 m intervals or at change of gradients;
    b. Top and bottom of staircase and ramps;
    c. Corners of buildings and other artificial structures;
    d. Top and bottom of slopes;
    e. Catchwater, ditches, outfalls, streams, culverts and drains at significant changes of gradients;
    f. Cover and invert levels of manholes, and inspection covers;
    g. Top and bottom of retaining walls;
    h. Top level of boulders greater than 2 m diagonally.

SURVEY RESULTS

PRE.C15.A110.9 SURVEY

Supply copies of raw data, field notes, computations, survey reports etc. in relation to the Survey as and when required by the CM.

PRE.C15.A120.9 DIGITAL DATA

The digital data for the Survey shall be labelled and recorded in optical media (e.g. CD / DVD) for input to the Contract Manager's computer system.

APA APPENDIX A - SITE/PHASE/ESTATE BOUNDARY PLAN 2

APA.A010.9 SITE/PHASE/ESTATE BOUNDARY PLANS 2

APA APPENDIX A - SITE/PHASE/ESTATE BOUNDARY PLAN

APA.A010.9 SITE/PHASE/ESTATE BOUNDARY PLANS

APB APPENDIX B - LIST OF CONTRACT DRAWINGS 2
APB.A010.9 LIST OF CONTRACT DRAWINGS 2

APB APPENDIX B - LIST OF CONTRACT DRAWINGS

APB.A010.9 LIST OF CONTRACT DRAWINGS

Option 1

List of Contract Drawings:

1. Architectural Drawings

Drawing No.	Revision	Drawing Title

2. Structural Drawings

Drawing No.	Revision	Drawing Title

Option 2

List of Contract Drawings:

Drawing No.	Revision	Drawing Title

APC APPENDIX C - SKETCHES AND DETAILS 2

APC.A010.9 SKETCHES AND DETAILS 2

APC APPENDIX C - SKETCHES AND DETAILS

APC.A010.9 SKETCHES AND DETAILS

TABLE 1: Miscellaneous Details	
Drawing No	Drawing Title
SES/TB/S/SK-001	Formwork Tile Hole - Standard Sealing Details
RSMS/SITE/S/SK-01	Stand Pole Details for RSMS Camera
RSMS/SITE/S/SK-02	Wall Mount Details for RSMS
RSMS/SITE/S/SK-03	Pole Mount Details for RSMS Control Unit
RSMS/SITE/S/SK-04	Plastic (Sandwich Type) Label
CMDTS/SITE/S/SK-01	Stand Pole Details for CMDTS
CMDTS/SITE/S/SK-02	Plastic (Sandwich Type) Label for CMDTS
(PSE to fill in sketch number)	Block …… Settlement Marker Layout
SVY/SM/SMS/01	Settlement Marker Set – Details
(PSE to fill in sketch number)	Block …… Verticality Marker Layout
SVY/VM/VMS/01	Verticality Marker Set – Details
SVY/VM/VMS/02	Verticality Marker Set – Details of Linear Scale
CPT/LDBP/S/SK-001	Conceptual Method for Fixing Single Layer Re-bars for Large Diameter Bored Pile (Sheet 1 of 4)
CPT/LDBP/S/SK-002	Conceptual Method for Fixing Single Layer Re-bars for Large Diameter Bored Pile (Sheet 2 of 4)
CPT/LDBP/S/SK-003	Conceptual Method for Fixing Single Layer Re-bars for Large Diameter Bored Pile (Sheet 3 of 4)
CPT/LDBP/S/SK-004	Conceptual Method for Fixing Single Layer Re-bars for Large Diameter Bored Pile (Sheet 4 of 4)
CPT/LDBP/S/SK-101	Conceptual Method for Fixing Double Layer Re-bars for Large Diameter Bored Pile (Sheet 1 of 6)
CPT/LDBP/S/SK-102	Conceptual Method for Fixing Double Layer Re-bars for Large Diameter Bored Pile (Sheet 2 of 6)
CPT/LDBP/S/SK-103	Conceptual Method for Fixing Double Layer Re-bars for Large Diameter Bored Pile (Sheet 3 of 6)

CPT/LDBP/S/SK-104	Conceptual Method for Fixing Double Layer Re-bars for Large Diameter Bored Pile (Sheet 4 of 6)
CPT/LDBP/S/SK-105	Conceptual Method for Fixing Double Layer Re-bars for Large Diameter Bored Pile (Sheet 5 of 6)
CPT/LDBP/S/SK-106	Conceptual Method for Fixing Double Layer Re-bars for Large Diameter Bored Pile (Sheet 6 of 6)
CPT/SC/S/SK001	General Arrangement of Steel Set Chair
(PSE to fill in sketch number for type 3 pile only)	Sonic Logging Tube Drawing
(PSE to fill in sketch number)	Profile of Backfilling around Foundations
(PSE to fill in sketch number)	Summary of Description of Marine Mud in Different Drillhole Records

TABLE 2: Drawing List of Trial Panel	
Drawing No	Drawing Title
(PSE to fill in sketch number)	General Plans & Sections
(PSE to fill in sketch number)	R.C. Details of Roof Slab
(PSE to fill in sketch number)	R.C. Details of Walls
(PSE to fill in sketch number)	R.C. Details of Ground Slab & Roof Beam
(PSE to fill in sketch number)	R.C. Details of Ground Beam

TABLE 3: Radio Frequency Identification (RFID) Tag	
Drawing No	Drawing Title
RFID/TAG/SK-01	Details of a Typical RFID Tag

TABLE 4: Miscellaneous Safety Details	
Drawing No	Drawing Title
CIC-SK-01	Anti-heat stress uniform
CIC-SK-02	Anti-heat stress uniform
RJ-SK-01	Reflective vests

APD APPENDIX D - SCHEDULE OF SAMPLES TO BE PROVIDED BY THE CONTRACTOR 2

APD.A010.9 SCHEDULE OF SAMPLES TO BE PROVIDED BY THE CONTRACTOR 2

APD APPENDIX D - SCHEDULE OF SAMPLES TO BE PROVIDED BY THE CONTRACTOR

APD.A010.9 SCHEDULE OF SAMPLES TO BE PROVIDED BY THE CONTRACTOR

In accordance with PRE.B9.410 and PRE.B9.420, provide the following samples for Approval before confirming orders, and delivery to and use on Site. Samples to be retained by the CM on or off Site. Samples may be sent by the CM, for testing to the appropriate Government of Hong Kong, Polytechnic or University Department in Hong Kong. Any test results which indicate a quality other than that specified will require the replacement and rectifying of any work carried out by the Contractor to comply with the Specification.

Schedule of Samples	Weight/Volume of Sample
1. Aggregate	2.0 kg
2. Artificial plants	1 No. of each material
3. Ballast	2.0 kg
4. Compost	2 x 0.5 kg each
5. Fertilizer	0.5 kg each
6. Filter layer	250 x 250 mm
7. Grass seed	0.5 kg each mix
8. Grass sprigs	10 No. of each species
9. Grass turves	2 No. (500 x 300 mm)
10. Imported DG	0.5 kg
11. Imported subsoil	0.5 kg
12. Imported topsoil	2 x 0.5 kg
13. Fabricated soil	0.5 kg
14. Limestone	0.5 kg
15. Mulch	0.5 kg each
16. Pea gravel	2.0 kg
17. Gravel	2.0 kg
18. Plant label & tie	1 No.
19. Jute string	500 mm
20. Soil conditioner	2 x 0.5 kg each
21. Synthetic soil conditioner	0.5 kg
22. Tree tie	1 No.
23. Trunk protection pad	1 No.
24. Stake (painted)	300 mm
25. Guys and fixings	300 mm + 1 No. of each

APP APPENDIX P - LIST OF SUB-CONTRACT DRAWINGS 2

APP.A010.9 LIST OF SUB-CONTRACT DRAWINGS 2

APP APPENDIX P - LIST OF SUB-CONTRACT DRAWINGS

APP.A010.9 LIST OF SUB-CONTRACT DRAWINGS

List of Sub-contract Drawings:

Drawing No.	Revision	Drawing Title

APQ APPENDIX Q - EXTRACTS FROM THE MAIN CONTRACT 2

APQ.A010.A EXTRACTS FROM THE MAIN CONTRACT 2

APQ APPENDIX Q - EXTRACTS FROM THE MAIN CONTRACT

APQ.A010.A EXTRACTS FROM THE MAIN CONTRACT

1. NOTES TO TENDERERS/SPECIAL CONDITIONS OF TENDER

2. SPECIAL CONDITIONS OF CONTRACT AND APPENDICES TO CONDITIONS OF CONTRACT

3. SPECIFICATION

4. WORKSECTION PRE.B6 OF THE SPECIFICATION OF THE MAIN CONTRACT

5. MAIN CONTRACT FORM OF TENDER - APPENDIX

General Conditions of Contract Clause No.

1.1	Maintenance Period	.....months
5.3	Amount of Bond (On-demand Bond)	Refer to Specification clause in relation to GCC Clause 5.3 in Section PRE.B6 of the Specification
5.14(2)	Minimum amount of third party insurance	$20,000,000.00 in respect of any one accident and unlimited for the period of insurance.
8.1	Period of time after the date of the Letter of Acceptance within which the notified date for commencement of the Works shall occur	#.....
8.3	Time for completion of the Works	#.....
	Time for completion of required Sections	
	.....……..	#.....
	.....……..	#.....
	.....……..	#.....
	.....……..	#.....

	8.6	Amount of liquidated damages for the Works	$.....per day
		Amount of liquidated damages for each Section	
		.....……..	$.....per day
		.....……	$.....per day
		.....……..	$.....per day
		.....……..	$.....per day
**	11.1(7)	Period of Final Measurement	.....months
	14.1(1)	Period of interim certificates	.....
	14.2(1)	Percentage of certified value retained	..... per cent
	14.2(1)	Limit of Retention Money	$.....
	14.2(4)	Minimum payment for interim certificates	$.....

Special Conditions of Contract Clause No.

**	SCC8.3	Amount of Additional Liquidated Damages for each Section	Refer to Specification clause in relation to SCC Clause SCC8.3 in Section PRE.B6 of the Specification
**	SCC8.4	Amount of Second Liquidated Damages for the Works	$..... per day
		Amount of Second Liquidated Damages for each Section	Refer to Specification clause in relation to SCC Clause SCC8.4 in Section PRE.B6 of the Specification

** SCC11.1(6) Period of Final Measurement..... months

All times stated are including General Holidays.

** Delete as appropriate by project officer.

APR APPENDIX R - INFORMATION REQUIRED BY CONDITIONS OF SUB-CONTRACT 2

APR.A010.9 INFORMATION REQUIRED BY CONDITIONS OF SUB-CONTRACT 2

APR APPENDIX R - INFORMATION REQUIRED BY CONDITIONS OF SUB-CONTRACT

APR.A010.9 INFORMATION REQUIRED BY CONDITIONS OF SUB-CONTRACT

Special Conditions of Sub-contract

The following information is to be read in conjunction with the Special Conditions of Sub-contract and is to form part of the Sub-contract:

NS13.1 Price Fluctuations

For the purpose of determining the material fluctuation pursuant to Clause SCC20.1 of the Special Conditions of Contract, the "Cash Seller and Settlement" price in Hong Kong dollar equivalent for Copper Grade A forming the Base or the Current Material Index shall be calculated by multiplying,

1. the "Cash Seller and Settlement" price for Copper Grade A quoted in US dollar per tonne from the London Metal Exchange (LME) (hereinafter referred as "Copper Price") published in LME's official Internet website at the date for fixing the Base or the Current Material Index with;
2. the six-month forward selling exchange rate for US dollar to Hong Kong dollar quoted in the Opening Indicative Counter Exchange Rates Table issued daily by the Hong Kong Association of Banks at the date for fixing the Base or the Current Material Index.

The product obtained from the above multiplication shall be to two decimal places. Decimal places in excess of two shall be rounded up or down to the nearest second decimal place.

In the event that there is any disagreement or doubt as to the correctness of the Copper Price(s) published in LME's official Internet website mentioned in sub-clause (1) above, or the Copper Price(s) is unavailable from LME's official Internet website, or the discontinuation of publishing the Copper Prices in LME's official Internet website, the correct Copper Price(s) shall be obtained from LME. Any provisional calculation of the material fluctuation adjustments based on the latest Copper Price(s) published in LME's official Internet website shall subsequently be corrected upon the obtainment of the correct Copper Price(s). The Sub-contractor shall make all necessary arrangement as instructed by the Contract Manager and shall bear all costs for the obtainment of the correct Copper Price(s) from LME. If after a reasonable time the Sub-contractor fails to obtain the correct Copper Price(s) from LME, the Contract Manager after giving reasonable notice in writing to the Sub-contractor may obtain the correct Copper Price(s) from LME all at the costs, including handling charges, of the Sub-contractor and such costs to be deducted from payment due to the Sub-contractor.

APS APPENDIX S - BUILDING SERVICES MATERIAL DELIVERY INVENTORY RECORD 2

APS.A010.9 BUILDING SERVICES MATERIAL DELIVERY INVENTORY RECORD 2

APS APPENDIX S - BUILDING SERVICES MATERIAL DELIVERY INVENTORY RECORD

APS.A010.9 BUILDING SERVICES MATERIAL DELIVERY INVENTORY RECORD

SPECIFICATION
APPENDIX 'S'

From : (BSNSC)
Ref :
Tel. :
Date :

To : (Building Contractor)

(Project Title)
Building Services Material Delivery Inventory Record
(Sub-contract to Contract No.)

Item No.	Material Description	Make & Model No.	Place of Origin of Manufacture	Quantity Delivered	Date of Delivery	Delivery Note Number Attached	Accumulative Quantity on Site	Material Being Kept at	Quantity of Material Removed	Reason and Date of Removal	Remark

(Signature and Name of the BSNSC)

Encl. (Delivery notes)

c.c. Project COW
Project BSI

APU APPENDIX U - LIST OF REFERENCE DRAWINGS / DOCUMENTS 2

APU.A010.A LIST OF REFERENCE DRAWINGS / DOCUMENTS 2

APU APPENDIX U - LIST OF REFERENCE DRAWINGS / DOCUMENTS

APU.A010.A LIST OF REFERENCE DRAWINGS / DOCUMENTS

The drawings / documents listed in this Appendix are for reference only. They are not part of the Drawings and do not form part of the Contract. These drawings / documents are given in good faith for the Contractor's reference and information only and are given without any assurance as to their accuracy. The provision of these reference drawings / documents shall not prejudice the Contractor's obligations and liabilities under the Contract. These reference drawings / documents are not issued as part of the tender documents but can be inspected at the CM's office by prior arrangement.

List of Reference Drawings / Documents:

Drawing No.	Revision	Description
Temporary Protection to Lift Shaft Openings (PRE.B10.1020)		
STD/HC/A/662/AS-001	D	Indicative Temporary Steel Barrier to Lift Well Opening
Protective Canopy (PRE.B10.860)		
STD/TPC/S/SK-001	-	Indicative Design of Temporary Protective Canopy
Scaffolding Screens (PRE.B10.820)		
SES/EF/S/EG001	-	Bamboo Scaffold Erection Sequence
Large Panel Formwork (CON2.D420)		
SES/LP/S/EG001	-	Large Panel Formwork- Details of Walkway and Railing
Protection of Workers from Protruded Reinforcement Bars (PRE.B8.252)		
REF/HS/S/SK001	-	Coverings to Protruded Reinforcement Bars
Typical Temporary Support Details for Precast Facade Installation (CON5.W660)		
MF/PCF/S/ED-201	A	Installation of Precast Facade (Sheet 1 of 6)
MF/PCF/S/ED-202	A	Installation of Precast Facade (Sheet 2 of 6)
MF/PCF/S/ED-203	A	Installation of Precast Facade (Sheet 3 of 6)
MF/PCF/S/ED-204	A	Installation of Precast Facade (Sheet 4 of 6)
MF/PCF/S/ED-205	A	Installation of Precast Facade (Sheet 5 of 6)
MF/PCF/S/ED-206	A	Installation of Precast Facade (Sheet 6 of 6)
Typical Falsework System for Modular Flat Semi-precast Slab Construction (CON7.W1105) **(Non-VPB Option)**		
MF/2/PSL/S/1/EL-002	D	Shoring Layout of Slab inside Domestic Flat for Type A-1(a, b1 & b2) Flat
MF/2/PSL/S/1/EL-004	D	Shoring Layout of Slab inside Domestic Flat for Type B-1 Flat

MF/2/PSL/S/1/EL-006	D	Shoring Layout of Slab inside Domestic Flat for Type B-2 Flat
MF/2/PSL/S/1/EL-008	D	Shoring Layout of Slab inside Domestic Flat for Type C-1(a & b) Flat
MF/2/PSL/S/1/EL-010	D	Shoring Layout of Slab inside Domestic Flat for Type C-2(a & b) Flat
MF/2/PSL/S/1/EL-013	D	Shoring Layout of Slab inside Domestic Flat for Type D-1(a & b) Flat
MF/2/PSL/S/1/EL-016	D	Shoring Layout of Slab inside Domestic Flat for Type D-2(a & b) Flat
(VPB Option)		
MF/VPB/PSL/S/EL-002	D	Shoring Layout of Slab inside Domestic Flat for Type A-1(a, b1 & b2) Flat
MF/VPB/PSL/S/EL-004	D	Shoring Layout of Slab inside Domestic Flat for Type B-1 Flat
MF/VPB/PSL/S/EL-006	D	Shoring Layout of Slab inside Domestic Flat for Type B-2 Flat
MF/VPB/PSL/S/EL-008	D	Shoring Layout of Slab inside Domestic Flat for Type C-1(a & b) Flat
MF/VPB/PSL/S/EL-010	D	Shoring Layout of Slab inside Domestic Flat for Type C-2(a & b) Flat
MF/VPB/PSL/S/EL-013	D	Shoring Layout of Slab inside Domestic Flat for Type D-1(a & b) Flat
MF/VPB/PSL/S/EL-016	D	Shoring Layout of Slab inside Domestic Flat for Type D-2(a & b) Flat
(VPB & VPK Option)		
MF/VBK/PSL/S/EL-002	-	Shoring Layout of Slab inside Domestic Flat for Type A-1(a, b1 & b2) Flat
MF/VBK/PSL/S/EL-005	-	Shoring Layout of Slab inside Domestic Flat for Type B-1 Flat
MF/VBK/PSL/S/EL-008	-	Shoring Layout of Slab inside Domestic Flat for Type B-2 Flat
MF/VBK/PSL/S/EL-011	-	Shoring Layout of Slab inside Domestic Flat for Type C-1(a & b) Flat
MF/VBK/PSL/S/EL-014	-	Shoring Layout of Slab inside Domestic Flat for Type C-2(a & b) Flat
MF/VBK/PSL/S/EL-018	-	Shoring Layout of Slab inside Domestic Flat for Type D-1(a & b) Flat
MF/VBK/PSL/S/EL-022	-	Shoring Layout of Slab inside Domestic Flat for Type D-2(a & b) Flat
Typical Falsework System for Modular Flat with Acoustic Balcony Semi-precast Slab Construction (CON7.W1105**)** **(Non-VPB Option)**		
MF/AB/PSL/S/EL-002	C	Shoring Layout of Slab inside Domestic Flat for Type A-2 Flat

MF/AB/PSL/S/EL-005	C	Shoring Layout of Slab inside Domestic Flat for Type B-3 Flat
MF/AB/PSL/S/EL-010	C	Shoring Layout of Slab inside Domestic Flat for Type C-3(a), C-4(a) & C-5(a) Flat
MF/AB/PSL/S/EL-013	C	Shoring Layout of Slab inside Domestic Flat for Type C-3(b), C-4(b) & C-5(b) Flat
(VPB Option)		
MF/AB/VPB/PSL/S/EL-003	A	Shoring Layout of Slab inside Domestic Flat for Type A-2 Flat
MF/AB/VPB/PSL/S/EL-006	A	Shoring Layout of Slab inside Domestic Flat for Type B-3 Flat
MF/AB/VPB/PSL/S/EL-009	A	Shoring Layout of Slab inside Domestic Flat for Type C-3(a), C-4(a) & C-5(a) Flat
MF/AB/VPB/PSL/S/EL-012	A	Shoring Layout of Slab inside Domestic Flat for Type C-3(b), C-4(b) & C-5(b) Flat
(VPB & VPK Option)		
MF/AB/VBK/PSL/S/EL-003	A	Shoring Layout of Slab inside Domestic Flat for Type A-2 Flat
MF/AB/VBK/PSL/S/EL-006	A	Shoring Layout of Slab inside Domestic Flat for Type B-3 Flat
MF/AB/VBK/PSL/S/EL-009	A	Shoring Layout of Slab inside Domestic Flat for Type C-3(a), C-4(a) & C-5(a) Flat
MF/AB/VBK/PSL/S/EL-012	A	Shoring Layout of Slab inside Domestic Flat for Type C-3(b), C-4(b) & C-5(b) Flat
Typical Falsework System for Modular Flat with Acoustic Window Semi-precast Slab Construction (CON7.W1105) **(Non-VPB Option)**		
MF/AW/PSL/S/EL-002	B	Shoring Layout of Slab inside Domestic Flat for Type A-3 Flat
MF/AW/PSL/S/EL-005	B	Shoring Layout of Slab inside Domestic Flat for Type B-5 Flat
MF/AW/PSL/S/EL-008	B	Shoring Layout of Slab inside Domestic Flat for Type C-6(a & b) Flat
MF/AW/PSL/S/EL-011	B	Shoring Layout of Slab inside Domestic Flat for Type C-7(a & b) Flat
MF/AW/PSL/S/EL-014	B	Shoring Layout of Slab inside Domestic Flat for Type C-8(a & b) Flat
MF/AW/PSL/S/EL-017	B	Shoring Layout of Slab inside Domestic Flat for Type D-6(a & b) Flat
MF/AW/PSL/S/EL-020	B	Shoring Layout of Slab inside Domestic Flat for Type D-7(a & b) Flat
(VPB Option)		
MF/AW/VPB/PSL/S/EL-002	B	Shoring Layout of Slab inside Domestic Flat for Type A-3 Flat
MF/AW/VPB/PSL/S/EL-005	B	Shoring Layout of Slab inside Domestic Flat for Type B-5 Flat

MF/AW/VPB/PSL/S/EL-008	B	Shoring Layout of Slab inside Domestic Flat for Type C-6(a & b) Flat
MF/AW/VPB/PSL/S/EL-011	B	Shoring Layout of Slab inside Domestic Flat for Type C-7(a & b) Flat
MF/AW/VPB/PSL/S/EL-014	B	Shoring Layout of Slab inside Domestic Flat for Type C-8(a & b) Flat
MF/AW/VPB/PSL/S/EL-017	B	Shoring Layout of Slab inside Domestic Flat for Type D-6(a & b) Flat
MF/AW/VPB/PSL/S/EL-020	B	Shoring Layout of Slab inside Domestic Flat for Type D-7(a & b) Flat
(VPB & VPK Option)		
MF/AW/VBK/PSL/S/EL-002	A	Shoring Layout of Slab inside Domestic Flat for Type A-3 Flat
MF/AW/VBK/PSL/S/EL-005	A	Shoring Layout of Slab inside Domestic Flat for Type B-5 Flat
MF/AW/VBK/PSL/S/EL-008	A	Shoring Layout of Slab inside Domestic Flat for Type C-6(a & b) Flat
MF/AW/VBK/PSL/S/EL-011	A	Shoring Layout of Slab inside Domestic Flat for Type C-7(a & b) Flat
MF/AW/VBK/PSL/S/EL-014	A	Shoring Layout of Slab inside Domestic Flat for Type C-8(a & b) Flat
MF/AW/VBK/PSL/S/EL-017	A	Shoring Layout of Slab inside Domestic Flat for Type D-6(a & b) Flat
MF/AW/VBK/PSL/S/EL-020	A	Shoring Layout of Slab inside Domestic Flat for Type D-7(a & b) Flat
Typical Falsework System for Modular Flat Enhanced Semi-precast Slab Construction (CON7.W1105) **(Non-VPB Option)**		
MF/2/EPSL/S/1/EL-002	B	Shoring Layout of Slab inside Domestic Flat for Type A-1(a, b1 & b2) Flat
MF/2/EPSL/S/1/EL-005	B	Shoring Layout of Slab inside Domestic Flat for Type B-1 Flat
MF/2/EPSL/S/1/EL-008	B	Shoring Layout of Slab inside Domestic Flat for Type B-2 Flat
MF/2/EPSL/S/1/EL-011	B	Shoring Layout of Slab inside Domestic Flat for Type C-1(a & b) Flat
MF/2/EPSL/S/1/EL-014	B	Shoring Layout of Slab inside Domestic Flat for Type C-2(a & b) Flat
MF/2/EPSL/S/1/EL-017	B	Shoring Layout of Slab inside Domestic Flat for Type D-1(a & b) Flat
MF/2/EPSL/S/1/EL-020	B	Shoring Layout of Slab inside Domestic Flat for Type D-2(a & b) Flat
(VPB Option)		
MF/VPB/EPSL/S/EL-002	B	Shoring Layout of Slab inside Domestic Flat for Type A-1(a, b1 & b2) Flat

MF/VPB/EPSL/S/EL-005	B	Shoring Layout of Slab inside Domestic Flat for Type B-1 Flat
MF/VPB/EPSL/S/EL-008	B	Shoring Layout of Slab inside Domestic Flat for Type B-2 Flat
MF/VPB/EPSL/S/EL-011	B	Shoring Layout of Slab inside Domestic Flat for Type C-1(a & b) Flat
MF/VPB/EPSL/S/EL-014	B	Shoring Layout of Slab inside Domestic Flat for Type C-2(a & b) Flat
MF/VPB/EPSL/S/EL-017	B	Shoring Layout of Slab inside Domestic Flat for Type D-1(a & b) Flat
MF/VPB/EPSL/S/EL-020	B	Shoring Layout of Slab inside Domestic Flat for Type D-2(a & b) Flat
(VPB & VPK Option)		
MF/VBK/EPSL/S/EL-002	A	Shoring Layout of Slab inside Domestic Flat for Type A-1(a, b1 & b2) Flat
MF/VBK/EPSL/S/EL-005	A	Shoring Layout of Slab inside Domestic Flat for Type B-1 Flat
MF/VBK/EPSL/S/EL-008	A	Shoring Layout of Slab inside Domestic Flat for Type B-2 Flat
MF/VBK/EPSL/S/EL-011	A	Shoring Layout of Slab inside Domestic Flat for Type C-1(a & b) Flat
MF/VBK/EPSL/S/EL-014	A	Shoring Layout of Slab inside Domestic Flat for Type C-2(a & b) Flat
MF/VBK/EPSL/S/EL-018	A	Shoring Layout of Slab inside Domestic Flat for Type D-1(a & b) Flat
MF/VBK/EPSL/S/EL-022	A	Shoring Layout of Slab inside Domestic Flat for Type D-2(a & b) Flat
Typical Falsework System for Modular Flat with Acoustic Balcony Enhanced Semi-precast Slab Construction (CON7.W1105**)** **(Non-VPB Option)**		
MF/AB/EPSL/S/EL-002	B	Shoring Layout of Slab inside Domestic Flat for Type A-2 Flat
MF/AB/EPSL/S/EL-005	B	Shoring Layout of Slab inside Domestic Flat for Type B-3 Flat
MF/AB/EPSL/S/EL-007	B	Shoring Layout of Slab inside Domestic Flat for Type C-3(a), C-4(a) & C-5(a) Flat
MF/AB/EPSL/S/EL-010	B	Shoring Layout of Slab inside Domestic Flat for Type C-3(b), C-4(b) & C-5(b) Flat
(VPB Option)		
MF/AB/VPB/EPSL/S/EL-003	B	Shoring Layout of Slab inside Domestic Flat for Type A-2 Flat
MF/AB/VPB/EPSL/S/EL-006	B	Shoring Layout of Slab inside Domestic Flat for Type B-3 Flat
MF/AB/VPB/EPSL/S/EL-009	B	Shoring Layout of Slab inside Domestic Flat for Type C-3(a), C-4(a) & C-5(a) Flat

MF/AB/VPB/EPSL /S/EL-012	B	Shoring Layout of Slab inside Domestic Flat for Type C-3(b), C-4(b) & C-5(b) Flat
(VPB & VPK Option)		
MF/AB/VBK/EPSL /S/EL-003	B	Shoring Layout of Slab inside Domestic Flat for Type A-2 Flat
MF/AB/VBK/EPSL /S/EL-006	B	Shoring Layout of Slab inside Domestic Flat for Type B-3 Flat
MF/AB/VBK/EPSL /S/EL-009	B	Shoring Layout of Slab inside Domestic Flat for Type C-3(a), C-4(a) & C-5(a) Flat
MF/AB/VBK/EPSL /S/EL-012	B	Shoring Layout of Slab inside Domestic Flat for Type C-3(b), C-4(b) & C-5(b) Flat
Typical Falsework System for Modular Flat with Acoustic Window Enhanced Semi-precast Slab Construction (CON7.W1105**)** **(Non-VPB Option)**		
MF/AW/EPSL/S/EL-002	B	Shoring Layout of Slab inside Domestic Flat for Type A-3 Flat
MF/AW/EPSL/S/EL-005	B	Shoring Layout of Slab inside Domestic Flat for Type B-5 Flat
MF/AW/EPSL/S/EL-008	B	Shoring Layout of Slab inside Domestic Flat for Type C-6(a & b) Flat
MF/AW/EPSL/S/EL-011	B	Shoring Layout of Slab inside Domestic Flat for Type C-7(a & b) Flat
MF/AW/EPSL/S/EL-014	B	Shoring Layout of Slab inside Domestic Flat for Type C-8(a & b) Flat
MF/AW/EPSL/S/EL-017	B	Shoring Layout of Slab inside Domestic Flat for Type D-6(a & b) Flat
MF/AW/EPSL/S/EL-020	B	Shoring Layout of Slab inside Domestic Flat for Type D-7(a & b) Flat
(VPB Option)		
MF/AW/VPB/EPSL/S/EL-002	B	Shoring Layout of Slab inside Domestic Flat for Type A-3 Flat
MF/AW/VPB/EPSL/S/EL-005	B	Shoring Layout of Slab inside Domestic Flat for Type B-5 Flat
MF/AW/VPB/EPSL/S/EL-008	B	Shoring Layout of Slab inside Domestic Flat for Type C-6(a & b) Flat
MF/AW/VPB/EPSL/S/EL-011	B	Shoring Layout of Slab inside Domestic Flat for Type C-7(a & b) Flat
MF/AW/VPB/EPSL/S/EL-014	B	Shoring Layout of Slab inside Domestic Flat for Type C-8(a & b) Flat
MF/AW/VPB/EPSL/S/EL-017	B	Shoring Layout of Slab inside Domestic Flat for Type D-6(a & b) Flat
MF/AW/VPB/EPSL/S/EL-020	B	Shoring Layout of Slab inside Domestic Flat for Type D-7(a & b) Flat
(VPB & VPK Option)		
MF/AW/VBK/EPSL/S/EL-002	B	Shoring Layout of Slab inside Domestic Flat for Type A-3 Flat

MF/AW/VBK/EPS L/S/EL-005	B	Shoring Layout of Slab inside Domestic Flat for Type B-5 Flat
MF/AW/VBK/EPS L/S/EL-008	B	Shoring Layout of Slab inside Domestic Flat for Type C-6(a & b) Flat
MF/AW/VBK/EPS L/S/EL-011	B	Shoring Layout of Slab inside Domestic Flat for Type C-7(a & b) Flat
MF/AW/VBK/EPS L/S/EL-014	B	Shoring Layout of Slab inside Domestic Flat for Type C-8(a & b) Flat
MF/AW/VBK/EPS L/S/EL-017	B	Shoring Layout of Slab inside Domestic Flat for Type D-6(a & b) Flat
MF/AW/VBK/EPS L/S/EL-020	B	Shoring Layout of Slab inside Domestic Flat for Type D-7(a & b) Flat
Movable Noise Barrier (PRE.B8.856)		
CPT/NB/S/SK001	-	General Arrangement of Movable Noise Barrier
Hoarding (PRE.B10.730)		
(Two Stages Hoarding – Bolt Type)		
STD/BN/EFHO/S/ GN001	A	Hoarding General Notes and Miscellaneous Details (Bolt Type)
STD/BN/EFHO/S/E D001	B	Details of 6m Width Hoarding Entrance Gantry (Bolt Type)
STD/BN/EFHO/S/E D002	B	Details of 7m Width Hoarding Entrance Gantry (Bolt Type)
STD/BN/EFHO/S/E D003	B	Connection Details & Footing RC Details for Hoarding Entrance Gantry (Bolt Type)
STD/BN/EFHO/S/E D004	A	Details of Single Deck Type 1 Hoarding – 2 Stages Construction (Bolt Type)
STD/BN/EFHO/S/E D005	A	Details of Double Deck Type 2 Hoarding – 2 Stages Construction (Bolt Type)
STD/BN/EFHO/S/E D006	A	Connection Details & Footing RC Details for Type 1 & Type 2 Hoarding with Publicity Board (Bolt Type)
STD/BN/EFHO/S/E D007	-	Details of Single Board Type 3 Hoarding (Bolt Type)
STD/BN/EFHO/S/E D008	-	Details of 8m Width Hoarding Entrance Gantry (Bolt Type) (Sheet 1 of 2)
STD/BN/EFHO/S/E D009	-	Details of 8m Width Hoarding Entrance Gantry (Bolt Type) (Sheet 2 of 2)
(Two Stages Hoarding – Weld Type)		
STD/WD/EFHO/S/ GN001	A	Hoarding General Notes and Miscellaneous Details (Weld Type)
STD/WD/EFHO/S/ ED001	B	Details of 6m Width Hoarding Entrance Gantry (Weld Type)
STD/WD/EFHO/S/ ED002	B	Details of 7m Width Hoarding Entrance Gantry (Weld Type)

STD/WD/EFHO/S/ ED003	B	Connection Details & Footing RC Details for Hoarding Entrance Gantry (Weld Type)
STD/WD/EFHO/S/ ED004	A	Details of Single Deck Type 1 Hoarding – 2 Stages Construction (Weld Type)
STD/WD/EFHO/S/ ED005	A	Details of Double Deck Type 2 Hoarding – 2 Stages Construction (Weld Type)
STD/WD/EFHO/S/ ED006	A	Connection Details & Footing RC Details for Type 1 & Type 2 Hoarding with Publicity Board (Weld Type)
STD/WD/EFHO/S/ ED007	-	Details of Single Board Type 3 Hoarding (Weld Type)
STD/WD/EFHO/S/ ED008	-	Details of 8m Width Hoarding Entrance Gantry (Weld Type) (Sheet 1 of 2)
STD/WD/EFHO/S/ ED009	-	Details of 8m Width Hoarding Entrance Gantry (Weld Type) (Sheet 2 of 2)
Use of Tower Cranes (PRE.B8.242), **Use of Static and Mobile Cranes** (PRE.B8.245), **Requirements for Precast Concrete Facades to Domestic Blocks** (PRE.B8.260), and **Safety of Cranes, Hoists, etc.** (PRE.C9.250)		
REF/SS/ID/SK-01	-	Reference Design of Interlocking Device for Crane Hooks
Platforms for Working at Different Heights (PRE.B8.251) (PRE.C9.290)		
REF/SS/EL/SK-01	A	Reference Design of Extendable and Adjustable Ladder for Reverse Circulation Drill (Sheet 1 of 4)
REF/SS/EL/SK-02	-	Reference Design of Extendable and Adjustable Ladder for Reverse Circulation Drill (Sheet 2 of 4)
REF/SS/EL/SK-03	-	Reference Design of Extendable and Adjustable Ladder for Reverse Circulation Drill (Sheet 3 of 4)
REF/SS/EL/SK-04	-	Reference Design of Extendable and Adjustable Ladder for Reverse Circulation Drill (Sheet 4 of 4)
REF/SS/WP/SK-01	-	Reference Design of Extendable Reinforcement Cage Working Platform
REF/SS/CD/SK-01	-	Reference Design of Visual and Audio Alarm System for Monitoring the Reverse Circulation Drill Clamping device (Sheet 1 of 3)
REF/SS/CD/SK-02	-	Reference Design of Visual and Audio Alarm System for Monitoring the Reverse Circulation Drill Clamping device (Sheet 2 of 3)
REF/SS/CD/SK-03	-	Reference Design of Visual and Audio Alarm System for Monitoring the Reverse Circulation Drill Clamping device (Sheet 3 of 3)
Precast Concrete Facades (PRE.B8.260)		

REF/SS/PP/SK-01	-	Reference Design of Permanent Working Platform on the Trailer for Rigging of Precast Facades (Sheet 1 of 3)
REF/SS/PP/SK-02	-	Reference Design of Permanent Working Platform on the Trailer for Rigging of Precast Facades (Sheet 2 of 3)
REF/SS/PP/SK-03	-	Reference Design of Permanent Working Platform on the Trailer for Rigging of Precast Facades (Sheet 3 of 3)
Safety of Reinforcement Bar Bending Machines (PRE.B8.256 & PRE.C9.291)		
REF/SS/BM/SK-01	-	Reference Design of Safety Measures for Reinforcement Bar Bending Machines
Installations to Reduce Risk of Manual Handling and Working at Height (PRE.B8.265 & PRE.C9.292)		
REF/SS/WB/SK-01	-	Reference Design of Two-wheel Wheelbarrow
REF/SS/BR/SK-01	-	Reference Design of Semi-automatic Breaker Rack
REF/SS/DL/SK-01	-	Reference Design of Double Lock Remote Release Shackle
REF/SS/TF/SK-01	-	Reference Design of T-Frame for Lifting Re-bars
REF/SS/BC/SK-01	-	Reference Design of Bridging Chains on Corners of Steel Frame (Sheet 1 of 3)
REF/SS/BC/SK-02	-	Reference Design of Bridging Chains on Corners of Steel Frame (Sheet 2 of 3)
REF/SS/BC/SK-03	-	Reference Design of Bridging Chains on Corners of Steel Frame (Sheet 3 of 3)
REF/SS/PT/SK-01	-	Reference Design of Power-Assisted Trolley
REF/SS/FB/SK-01	-	Reference Design of Fencing Barrier Clamp
Wireless Communication Technologies (PRE.B8.267 & PRE.C9.294)		
REF/SS/WT/SK-01	-	Reference Design of Wireless Communication Technologies (1)
REF/SS/WT/SK-02	-	Reference Design of Wireless Communication Technologies (2)
REF/SS/WT/SK-03	-	Reference Design of Wireless Communication Technologies (3)
REF/SS/WT/SK-04	-	Reference Design of Wireless Communication Technologies (4)
REF/SS/WT/SK-05	-	Reference design of RFID Material Hoist Landing Gate Locking System (Sheet 1 of 4)
REF/SS/WT/SK-06	-	Reference design of RFID Material Hoist Landing Gate Locking System (Sheet 2 of 4)
REF/SS/WT/SK-07	-	Reference design of RFID Material Hoist Landing Gate Locking System (Sheet 3 of 4)

REF/SS/WT/SK-08	-	Reference design of RFID Material Hoist Landing Gate Locking System (Sheet 4 of 4)
REF/SS/WT/SK-09	-	Reference design of IoT Lift Shaft Control System (Sheet 1 of 2)
REF/SS/WT/SK-10	-	Reference design of IoT Lift Shaft Control System (Sheet 2 of 2)
REF/SS/WT/SK-11	-	Reference design of Mobile Phone Apps for Lift Shaft Works
REF/SS/WT/SK-12	-	Reference design of RFID Lift Shaft Control System
Protection to the public against falling objects (PRE.B8.286)		
REF/SS/CF/SK-01	-	Reference Design of Wall Mounted Catch Fan Immediately below the External Wall Mounted Working Platform (Sheet 1 of 4)
REF/SS/CF/SK-02	-	Reference Design of Wall Mounted Catch Fan Immediately below the External Wall Mounted Working Platform (Sheet 2 of 4)
REF/SS/CF/SK-03	-	Reference Design of Wall Mounted Catch Fan Immediately below the External Wall Mounted Working Platform (Sheet 3 of 4)
REF/SS/CF/SK-04	-	Reference Design of Wall Mounted Catch Fan Immediately below the External Wall Mounted Working Platform (Sheet 4 of 4)
Dust Control (PRE.B8.455)		
REF/SS/AC/SK-01	-	Reference Design of Advanced Cement Grout Mixing System
Submission Requirements (Robotic Construction) (PRE.B8.3005)		
REF/RO/S/SK-001	-	Works Area Access for Robots
Generators for Site's Temporary Electricity Supply (PRE.B8.870 & PRE.C9.950)		
REF/SS/CH/SK-01	-	Reference Design of Cable Hanger of Generators
Other Lifting Appliances (PRE.B10.040)		
REF/SS/GO/SK-01	A	Reference Design of Movable Slanting Aluminium Plate of Gondolas
Falsework (PRE.B10.065)		
REF/SS/TS/SK-01	-	Reference Design of Temporary Supporting Device for Strut Removal
Gates at Vehicular Ingress/Egress for Traffic Control (PRE.B10.740 & PRE.C10.060)		
REF/SS/GA/SK-01	-	Gate System at Vehicular Ingress/Egress Points
Temporary Protection Above Steel Bending Yard (PRE.B10.1021)		
REF/SS/PN/SK-01	-	Reference Design of Protection Net above Steel Bending Yard

APV APPENDIX V - LIST OF SUB-CONTRACT REFERENCE DRAWINGS / DOCUMENTS 2

APV.A010.9 LIST OF SUB-CONTRACT REFERENCE DRAWINGS / DOCUMENTS 2

APV APPENDIX V - LIST OF SUB-CONTRACT REFERENCE DRAWINGS / DOCUMENTS

APV.A010.9 LIST OF SUB-CONTRACT REFERENCE DRAWINGS / DOCUMENTS

The drawings / documents listed in this Appendix are for reference only. They are not part of the Sub-contract Drawings and do not form part of the Sub-contract. These drawings / documents are given in good faith for the Sub-contractor's reference and information only and are given without any assurance as to their accuracy. The provision of these reference drawings / documents shall not prejudice the Sub-contractor's obligations and liabilities under the Sub-contract. These reference drawings / documents are not issued as part of the tender documents but can be inspected by prior arrangement with the Housing Department officer referred to in the Special Conditions of Tender.

List of Sub-contract reference drawings / documents:

Drawing No.	Revision	Drawing Title
Document Ref.	Date	Document Title

APW APPENDIX W - BEAM PLUS REQUIREMENTS IN BUILDING SERVICES NOMINATED SUB-CONTRACTS 2

APW.A010.9 BEAM PLUS REQUIREMENTS IN BUILDING SERVICES NOMINATED SUB-CONTRACTS 2

APW APPENDIX W - BEAM PLUS REQUIREMENTS IN BUILDING SERVICES NOMINATED SUB-CONTRACTS

APW.A010.9 BEAM PLUS REQUIREMENTS IN BUILDING SERVICES NOMINATED SUB-CONTRACTS

1. SPECIFICATION

APZ APPENDIX Z - COMMISSIONING MANAGEMENT PLAN 2

APZ.A010.9 COMMISSIONING MANAGEMENT PLAN 2

APZ APPENDIX Z - COMMISSIONING MANAGEMENT PLAN

APZ.A010.9 COMMISSIONING MANAGEMENT PLAN

Commissioning Management Plan (CxM Plan) is a plan developed by the Commissioning Authority (CxA) and lists out all systems and equipment to be commissioned, all commissioning tasks, all functional performance tests to be performed, all related reference documents and all responsible parties involved in the commissioning process.

The CxM Plan for this project is attached.

HONG KONG HOUSING AUTHORITY

SPECIFICATION LIBRARY 2022 (BATCH 4) EDITION

Architectural Works Specification

CLA CLADDING

CLA1 PROFILED SHEET ROOFING AND CLADDING 5

MATERIALS 5

PROFILED SHEETS 5

CLA1.M010.9 GENERAL 5
CLA1.M020.9 GALVANIZED CORRUGATED STEEL 5
CLA1.M030.9 COATED PROFILED STEEL 5
CLA1.M040.9 PROFILED ALUMINIUM 5
CLA1.M050.9 COLOUR COATED PROFILED ALUMINIUM 5
CLA1.M060.9 PROFILED GRP 6
CLA1.M070.9 PROFILED PVC 6
CLA1.M080.9 PROFILED FIBRE CEMENT 6
CLA1.M090.9 LINING SHEETS 6
CLA1.M100.9 FACTORY COATED PROFILED STEEL INSULATED SHEETS 6
CLA1.M110.9 PROFILED SHEET ROOFING AND CLADDING FOR DOMESTIC BLOCK 6

ACCESSORIES FOR PROFILED SHEETS 7

CLA1.M210.9 ACCESSORIES FOR CORRUGATED STEEL 7
CLA1.M220.9 ACCESSORIES FOR COLOUR COATED PROFILED STEEL 7
CLA1.M230.9 ACCESSORIES FOR PROFILED ALUMINIUM 7
CLA1.M240.9 ACCESSORIES FOR COLOUR COATED PROFILED ALUMINIUM 7
CLA1.M250.9 ACCESSORIES FOR PROFILED FIBRE CEMENT 7

FIXINGS AND ANCILLARY MATERIALS 7

CLA1.M310.9 FIXINGS GENERALLY 7
CLA1.M320.9 WASHERS 7
CLA1.M330.9 FIXING HEADS FOR COLOURED SHEETS 7
CLA1.M340.9 METALLIC ZINC RICH PRIMING PAINT 8

INSULATION 8

CLA1.M410.9 GLASS FIBRE INSULATION 8

WORKMANSHIP 9

PREPARATION OF PROFILED SHEETS 9

CLA1.W010.9 FIXING HOLES 9
CLA1.W020.9 TREATING CUT OR DRILLED ZINC COATINGS 9

LAPS ON PROFILED SHEETING 9

CLA1.W110.9 END LAPS ON STEEL SHEETING 9
CLA1.W120.9 END LAPS ON ALUMINIUM SHEETING 9
CLA1.W130.9 END LAPS ON GRP SHEETING 9
CLA1.W140.9 END LAPS ON PVC SHEETING 9
CLA1.W150.9 END LAPS ON FIBRE CEMENT SHEETING 10
CLA1.W160.9 SIDE LAPS 10
CLA1.W170.9 SEALING LAPS 10

FIXING PROFILED SHEETING 10

CLA1.W210.9 GENERAL 10
CLA1.W220.9 FIXING TO STEELWORK 10
CLA1.W230.9 FIXING TO TIMBER 10
CLA1.W240.9 EAVES, ENDS AND END LAPS 10
CLA1.W250.9 INTERMEDIATE SUPPORT 10
CLA1.W260.9 SELF TAPPING SCREWS 10
CLA1.W270.9 FIXING GALVANIZED, CORRUGATED SHEETING AND ACCESSORIES 10
CLA1.W280.9 FIXING PROFILED ALUMINIUM SHEETING 10
CLA1.W290.9 MOVEMENT JOINTS 11

CLA1.W300.9 FIXING COATED PROFILED STEEL 11
CLA1.W310.9 FORMING CURVES 11
CLA1.W320.9 FIXING PROFILED SHEET ROOFING AND CLADDING TO STANDARD DOMESTIC 11

CLA2 CHINESE TILING 12

MATERIALS 12

CHINESE TILES 12
CLA2.M010.9 TILES GENERALLY 12
CLA2.M020.9 SIZES OF TILES 12
CLA2.M030.9 SPECIAL TILES 12

ANCILLARY MATERIALS 12
CLA2.M110.9 MORTAR 12
CLA2.M120.9 CHUNAM MORTAR 12
CLA2.M130.9 NAILS 12
CLA2.M140.9 REINFORCEMENT FOR CHUNAM BEDDING MORTAR 12
CLA2.M150.9 TIMBER TILING BATTENS 12

WORKMANSHIP 13

FIXING CHINESE TILING 13
CLA2.W010.9 SINGLE LAYER TILING 13
CLA2.W020.9 DOUBLE LAYER TILING 13
CLA2.W030.9 FIXING TILES TO CONTINUOUS DECKS 13
CLA2.W040.9 FIXING TILES TO BATTENS 13
CLA2.W050.9 ROLL TILES TO BE LEFT EXPOSED 13
CLA2.W060.9 GLAZED TILES 13
CLA2.W070.9 VERGES 13
CLA2.W080.9 RIDGES AND HIPS 14
CLA2.W090.9 VALLEYS 14
CLA2.W100.9 EAVES TO SINGLE LAYER TILING 14
CLA2.W110.9 EAVES TO DOUBLE LAYER TILING 14
CLA2.W120.9 ABUTMENTS AND PIPES ETC 14

CLA4 SHEET METAL COVERINGS 15

MATERIALS 15

LEAD SHEET AND ANCILLARY MATERIALS 15
CLA4.M010.9 MILLED LEAD SHEET AND STRIP 15
CLA4.M020.9 ISOLATION LAYER 15
CLA4.M030.9 UNDERLAY 15
CLA4.M040.9 CLIPS AND TACKS 15
CLA4.M050.9 NAILS 15
CLA4.M060.9 WOOD SCREWS 16
CLA4.M070.9 PLUGS 16
CLA4.M080.9 SOLDER 16

ALUMINIUM SHEET AND ANCILLARY MATERIALS 16
CLA4.M110.9 ALUMINIUM SHEET 16
CLA4.M120.9 UNDERLAY FOR TIMBER DECKS 16
CLA4.M130.9 UNDERLAY FOR CEMENTITIOUS DECKS 16
CLA4.M140.9 CLIPS 16
CLA4.M150.9 NAILS 16
CLA4.M160.9 WOOD SCREWS 16
CLA4.M170.9 BITUMEN COATING SOLUTION 16

COPPER SHEET AND ANCILLARY MATERIALS 17
CLA4.M210.9 HOT ROLLED COPPER SHEET AND STRIP 17
CLA4.M220.9 UNDERLAY 17
CLA4.M230.9 CLIPS 17
CLA4.M240.9 NAILS 17
CLA4.M250.9 WOOD SCREWS 17
CLA4.M260.9 PLUGS 17
CLA4.M270.9 MORTAR FOR POINTING 17

WORKMANSHIP 18
GENERAL 18
CLA4.W010.9 STORAGE 18
CLA4.W020.9 ROOF CONDITION 18
CLA4.W030.9 FIXINGS 18
CLA4.W040.9 LAYING UNDERLAY GENERALLY 18
CLA4.W050.9 LAYING, JOINTING AND FIXING COVERING GENERALLY 18
CLA4.W060.9 LAYING SEQUENCE 18
LAYING LEAD SHEET COVERINGS 18
CLA4.W110.9 GENERAL 18
CLA4.W120.9 LAYING UNDERLAY ON CEMENTITIOUS DECKS 18
CLA4.W130.9 LAYING UNDERLAY ON TIMBER DECKS 19
CLA4.W140.9 CLIPS AND TACKS 19
CLA4.W150.9 FIXING CLIPS TO TIMBER 19
CLA4.W160.9 FIXING CLIPS TO MASONRY/CONCRETE 19
CLA4.W170.9 SOLDERING 19
CLA4.W180.9 SHEET SIZES FOR ROOF COVERINGS 19
CLA4.W190.9 SHEET SIZES FOR WALL COVERINGS 19
CLA4.W200.9 INTERMEDIATE FIXINGS FOR WALL COVERINGS 19
CLA4.W210.9 COVER FLASHINGS TO FLAT ROOF COVERINGS 19
CLA4.W220.9 LEAD SLATES, FLASHINGS AND COLLARS 19
CLA4.W230.9 WEDGES 20
LAYING ALUMINIUM SHEET COVERINGS 20
CLA4.W310.9 STANDARD 20
CLA4.W320.9 CONTACT BETWEEN DISSIMILAR METALS 20
CLA4.W330.9 STORING ALUMINIUM 20
CLA4.W340.9 LAYING UNDERLAY ON CEMENTITIOUS DECKS 20
CLA4.W350.9 LAYING UNDERLAY ON BOARDED OR SHEETED DECKS 20
CLA4.W360.9 CLIPS FOR STANDING SEAMS 20
CLA4.W370.9 LAYING ALUMINIUM COVERINGS GENERALLY 20
CLA4.W380.9 STANDING SEAM JOINTS 20
CLA4.W390.9 ABUTMENTS TO MASONRY AND CONCRETE SURFACES 21
LAYING SHEET COPPER COVERINGS 21
CLA4.W410.9 STANDARD 21
CLA4.W420.9 CONTACT BETWEEN DISSIMILAR METALS 21
CLA4.W430.9 LAYING UNDERLAY ON CEMENTITIOUS DECKS 21
CLA4.W440.9 LAYING UNDERLAY ON BOARDED OR SHEETED DECKS 21
CLA4.W450.9 FIXING CLIPS TO TIMBER 21
CLA4.W460.9 FIXING CLIPS TO MASONRY/CONCRETE 21
CLA4.W470.9 USE OF SOLDER 21
CLA4.W480.9 LAYING GENERALLY 21
CLA4.W490.9 SHEET SIZES 21
CLA4.W500.9 STANDING SEAM JOINTS 22
CLA4.W510.9 UPSTANDS AT ABUTMENTS 22
CLA4.W520.9 FLASHINGS 22

CLA4.W530.9 FIXING WEDGES TO COVER FLASHINGS 22

CLA1 PROFILED SHEET ROOFING AND CLADDING

MATERIALS

PROFILED SHEETS

CLA1.M010.9 GENERAL

All profiled sheet must generally comply with BS 5427:1976.

CLA1.M020.9 GALVANIZED CORRUGATED STEEL

To BS 3083:1988 and:

1. Minimum coated thickness: 0.6 mm;
2. BS designation: G350;
3. Each sheet marked with the BS number and the type;
4. Complying with the appropriate corrugation profile described in the BS.

CLA1.M030.9 COATED PROFILED STEEL

Hot-dip zinc coated steel with surface coating and:

1. Thickness including zinc coatings but excluding surface finishes not less than 0.7 mm;
2. Profile and coating type: as shown on Drawings;
3. Colour: as shown on Drawings.

CLA1.M040.9 PROFILED ALUMINIUM

To BS 4868:1972:

1. Profile type:
   a. Type S (Sinusoidal);
   b. Type A (Assymmetrical Trapezoidal);
   c. Type B (Symmetical trapezoidal).
2. Minimum thickness: 0.6 mm;
3. Finish: plain or Stucco embossed finish.

CLA1.M050.9 COLOUR COATED PROFILED ALUMINIUM

Generally to BS 4868:1972 with aluminium substrate to BS 1470:1987, designation 3103 H18, and:

1. Profile type and pitch and coating type: as shown on Drawings;
2. Minimum thickness: 0.6 mm;
3. Colour: as shown on Drawings.

CLA1.M060.9 PROFILED GRP

Glass reinforced plastic sheets to BS 4154:Part 1:1985 with thermo-setting polyester resin to BS 3532:1990:

1. Profile: to BS 4154:Part 2:1985, Table 1;
2. Light diffusion class: to BS 4154:Part 1:1985;
3. Colour: as shown on Drawings;
4. Fire performance requirements:
   a. Fire exposure rating for roofing to BS 476:Part 3:1975;
   b. Surface spread of flame classification to BS 476:Part 7:1997.
5. Marked with the manufacturer's name or trademark, the BS number 4154 and the designation of samples tested to BS 476:Part 3:1975 where applicable.

CLA1.M070.9 PROFILED PVC

Unreinforced, rigid PVC sheets to BS 4203:Parts 1 and 2:1980

1. Profile: to BS 4203:Part 1:1980;
2. Light diffusion characteristics: to BS 4203:Part 2:1980;
3. Colour: as shown on Drawings;
4. Thickness: as shown on Drawings;
5. Marked with the manufacturer's name or trademark, the BS number and the date of manufacture.

CLA1.M080.9 PROFILED FIBRE CEMENT

Free of asbestos materials of any kind with profile and colour as shown on Drawings.

CLA1.M090.9 LINING SHEETS

1. Material and coating type: as shown on Drawings;
2. Colour: as shown on Drawings;
3. Thickness: as shown on Drawings, including any zinc coatings but excluding finishes.

CLA1.M100.9 FACTORY COATED PROFILED STEEL INSULATED SHEETS

Composite profiled sheets with bonded internal insulation:

1. Sheet thickness including zinc coatings but excluding surface finishes: not less than 0.7 mm;
2. Profile, weight, coatings and insulation required: as specified in Project Specific Specification;
3. Colour: as shown on Drawings;
4. Ensure the design of composite sheets allow for differential expansion.

CLA1.M110.9 PROFILED SHEET ROOFING AND CLADDING FOR DOMESTIC BLOCK

Proprietary product as follows:

1. Sheeting: 0.47 mm factory painted zinc/aluminium alloyed coated steel with 550 Mpa minimum yield strength, crimp curved as shown on the Drawings;
2. Colour: as shown on the Drawings or to Approval;

3. Accessories: longitudinal and transverse metal flashings, colour-matched to roofing sheets, produced to dimensions and profiles shown on the Drawings;
4. Sealant: one-part silicone as recommended by the manufacturer for sealing between flashings and concrete walls and in compliance with WAT5.M110.

ACCESSORIES FOR PROFILED SHEETS

CLA1.M210.9 ACCESSORIES FOR CORRUGATED STEEL

1. Of proprietary manufacture;
2. Manufactured from 0.6 mm thick galvanized steel sheet.

CLA1.M220.9 ACCESSORIES FOR COLOUR COATED PROFILED STEEL

Obtain from the sheet manufacturer.

CLA1.M230.9 ACCESSORIES FOR PROFILED ALUMINIUM

1. Obtain from the sheet manufacturer;
2. Manufactured from aluminium flat sheet at least 0.6 mm thick and with a similar finish to the profiled sheets.

CLA1.M240.9 ACCESSORIES FOR COLOUR COATED PROFILED ALUMINIUM

1. Obtain from the sheet manufacturer;
2. Manufactured from aluminium flat sheet at least 0.6 mm thick and similar in colour and finish to the profiled sheets.

CLA1.M250.9 ACCESSORIES FOR PROFILED FIBRE CEMENT

Obtain from the sheet manufacturer.

FIXINGS AND ANCILLARY MATERIALS

CLA1.M310.9 FIXINGS GENERALLY

Design to prevent the ingress of rainwater when fixed according to this Specification and as specified from the following;

1. Hook bolts and nuts, drive screws, washers, self-tapping screws, roofing bolts, nuts and clips, roofing screws and sheeting clips to BS 1494:Part 1:1964:
   a. Sizes: as shown on the Drawings;
   b. Finish: hot dip galvanized, zinc, aluminium plated or otherwise specified.
2. As recommended by the sheeting manufacturer.

CLA1.M320.9 WASHERS

Must be capable of withstanding uplift during typhoon conditions.

CLA1.M330.9 FIXING HEADS FOR COLOURED SHEETS

Fitted with plastic caps of a matching colour to that of the sheets.

CLA1.M340.9 METALLIC ZINC RICH PRIMING PAINT

To BS 4652:1995, Type 2.

INSULATION

CLA1.M410.9 GLASS FIBRE INSULATION

Resin bonded, non-combustible, semi-rigid slabs with density, thermal conductivity and thickness of insulation as specified in Project Specific Specification.

WORKMANSHIP

PREPARATION OF PROFILED SHEETS

CLA1.W010.9 FIXING HOLES

Drill fixing holes:

1. In the crown of corrugations for roofing;
2. In the trough of corrugations for cladding;
3. 2 mm larger than bolts or screws;
4. Not less than 40 mm from the edges of sheets.

CLA1.W020.9 TREATING CUT OR DRILLED ZINC COATINGS

Make good damage to zinc coatings and galvanizing by applying two coats of metallic, zinc-rich priming paint.

LAPS ON PROFILED SHEETING

CLA1.W110.9 END LAPS ON STEEL SHEETING

Lay:

1. Sloping sheets with a minimum end lap of 150 mm;
2. Vertical sheets with a minimum end lap of 75 mm;
3. So that all laps are located over a supporting member.

CLA1.W120.9 END LAPS ON ALUMINIUM SHEETING

Lay:

1. Sloping sheets with a minimum end lap of 150 mm;
2. Vertical sheets with a minimum end lap of 75 mm;
3. So that all laps are located over a supporting member.

CLA1.W130.9 END LAPS ON GRP SHEETING

Lay:

1. Sloping sheets with a minimum end lap of 150 mm;
2. Vertical sheets with a minimum end lap of 75 mm;
3. So that all laps are located over a supporting member.

CLA1.W140.9 END LAPS ON PVC SHEETING

Lay:

1. Sloping sheets with a minimum end lap of 225 mm;
2. Vertical sheets with a minimum end lap of 75 mm;
3. So that all laps are located over a supporting member.

CLA1.W150.9 END LAPS ON FIBRE CEMENT SHEETING

Lay:

1. Sloping sheets with a minimum end lap as shown on Drawings;
2. Vertical sheets with a minimum end lap as shown on Drawings;
3. So that all laps are located over a supporting member.

CLA1.W160.9 SIDE LAPS

Lay sheets with open joint of side lap away from the prevailing wind.

CLA1.W170.9 SEALING LAPS

Seal laps with lap sealant in accordance with the sheet manufacturer's recommendations.

FIXING PROFILED SHEETING

CLA1.W210.9 GENERAL

Fix sheeting:

1. In accordance with this Specification; or alternatively,
2. Fix in accordance with the sheeting manufacturer's recommendations but, nevertheless, to withstand uplift under typhoon conditions.

CLA1.W220.9 FIXING TO STEELWORK

Fix with hook bolts at maximum centres of 300 mm.

CLA1.W230.9 FIXING TO TIMBER

Fix with hook bolts at maximum centres of 300 mm.

CLA1.W240.9 EAVES, ENDS AND END LAPS

Fix with two fixings per sheet width.

CLA1.W250.9 INTERMEDIATE SUPPORT

Where no lap occurs, fix sheets with two fixings per sheet width.

CLA1.W260.9 SELF TAPPING SCREWS

Tighten self-tapping screws to the torque recommended by the manufacturer.

CLA1.W270.9 FIXING GALVANIZED, CORRUGATED SHEETING AND ACCESSORIES

1. Fix sheeting in accordance with CP 143:Part 10:1973;
2. Cut, fit and dress accessories to fit corrugations and:
   a. Where possible, fix with the same fixings used to secure sheeting;
   b. Elsewhere, fix to the sheeting with roofing bolts.

CLA1.W280.9 FIXING PROFILED ALUMINIUM SHEETING

Fix sheeting generally in accordance with CP 143:Part 1:1958.

CLA1.W290.9 MOVEMENT JOINTS

1 Provide movement joints in locations shown on the Drawings, or otherwise in all lengths of roofing or cladding over 45 metres, with one joint for lengths up to 75 metres and one for every additional 30 metres;

2. Fix movement joint cover to sheets on only one side of the joint.

CLA1.W300.9 FIXING COATED PROFILED STEEL

Fix sheets in accordance with the manufacturer's recommendations and:

1. Cut sheets by shearing, without the use of circular saws or abrasive wheels;

2. Make good damage in accordance with clause CLA1.W020.

CLA1.W310.9 FORMING CURVES

Bend sheets requiring to be bent to a radius for fixing to curved roofs, eaves etc by means of a proper profiling machine, designed for this purpose.

CLA1.W320.9 FIXING PROFILED SHEET ROOFING AND CLADDING TO STANDARD DOMESTIC

Fix sheeting:

1. In accordance with the Drawings; and,

2. Fix in accordance with the sheeting manufacturer's recommendations but, nevertheless, to withstand uplift under typhoon conditions.

CLA2 CHINESE TILING

MATERIALS

CHINESE TILES

CLA2.M010.9 TILES GENERALLY

Red in colour, sound, well burnt, unglazed clay, whole and free from cracks and blemishes.

CLA2.M020.9 SIZES OF TILES

Approximate sizes to be as specified for the following:

1. Plain tiles: 225 mm × 225 mm;
2. Roll tiles: 165 mm long and tapered;
3. Valley tiles: 300 mm × 225 mm.

CLA2.M030.9 SPECIAL TILES

1. Roll tiles to be left exposed: specially selected and semi-circular in section;
2. Glazed tiles: to be obtained from an Approved manufacturer.

ANCILLARY MATERIALS

CLA2.M110.9 MORTAR

Cement and lime mortar as MAS3.W170.

CLA2.M120.9 CHUNAM MORTAR

To consist, by volume of:

1. One part of Portland cement type CEM I in BSEN 197-1:2000;
2. Three parts of hydrated lime to BS 890:1972; and
3. Twenty parts of inorganic soil, free from organic matter and containing no more than 30% of soil particles passing a 63 micron BS Test Sieve.

CLA2.M130.9 NAILS

Aluminium or galvanized steel, 2 mm minimum diameter and 30 mm long with plain heads.

CLA2.M140.9 REINFORCEMENT FOR CHUNAM BEDDING MORTAR

Mesh size and finish of reinforcement are shown on Drawings.

CLA2.M150.9 TIMBER TILING BATTENS

As Worksection TIM1.

WORKMANSHIP

FIXING CHINESE TILING

CLA2.W010.9 SINGLE LAYER TILING

Lay tiles in a single layer:

1. Gauge of plain tiles: exceeding 75 mm but not exceeding 115 mm;
2. Gauge of roll tiles: 120 mm.

CLA2.W020.9 DOUBLE LAYER TILING

Lay tiles in two identical layers, the second superimposed on the first:

1. Gauge of plain tiles: exceeding 75 mm but not exceeding 115 mm;
2. Gauge of roll tiles: 120 mm.

CLA2.W030.9 FIXING TILES TO CONTINUOUS DECKS

1. With cement mortar:
   a. Bed corners of plain tiles in mortar dabs;
   b. Lay roll tiles with a 50 mm lap, bedding both edges in mortar;
   c. Cover roll tiles with mortar to a minimum thickness of 15 mm and trowel smooth.
2. With chunam mortar:
   a. Lay a continuous, reinforced, chunam, mortar bed evenly on the substrate: 15 mm thick;
   b. Bed plain tiles onto freshly laid mortar bed;
   c. Lay roll tiles with a 50 mm lap, bedding both edges in mortar;
   d. Cover roll tiles with mortar to a minimum thickness of 15 mm and trowel smooth.

CLA2.W040.9 FIXING TILES TO BATTENS

1. Drive nails into battens and leave projecting 15 mm as a key for mortar dabs;
2. Bed corners of plain tiles in mortar dabs;
3. Lay roll tiles with a 50 mm lap, bedding both edges in mortar;
4. Cover roll tiles with mortar to a minimum thickness of 15 mm and trowel smooth;
5. Neatly point the underside if exposed.

CLA2.W050.9 ROLL TILES TO BE LEFT EXPOSED

Bed and point in cement mortar.

CLA2.W060.9 GLAZED TILES

Fix in accordance with the manufacturer's recommendations.

CLA2.W070.9 VERGES

Finish with a mortar fillet, trowelled smooth.

CLA2.W080.9 RIDGES AND HIPS

Form ridges and hips with rows of inverted tiles, with rows of roll tiles over.

CLA2.W090.9 VALLEYS

1. Lay valley tiles up the valley to gauge as shown on Drawings;
2. Cut roof tiles to rake and finish both sides with mortar, trowelled smooth.

CLA2.W100.9 EAVES TO SINGLE LAYER TILING

Finish eaves with a double layer of tiles.

CLA2.W110.9 EAVES TO DOUBLE LAYER TILING

Finish eaves with roll tiles or tile slips placed centrally between rolls to form weep hole and fill edge with mortar, trowelled smooth.

CLA2.W120.9 ABUTMENTS AND PIPES ETC

Cut and fit tiling at abutments and around pipes etc and finish with a mortar fillet, trowelled smooth.

CLA4 SHEET METAL COVERINGS

MATERIALS

LEAD SHEET AND ANCILLARY MATERIALS

CLA4.M010.9 MILLED LEAD SHEET AND STRIP

To BS 1178:1982 and of the code specified for the situation given in the table below unless shown otherwise on the Drawings:

Situation	Code
Flat and pitched roof coverings	6
Gutter linings	6
Cesspool linings	6
Skirts	6
Wall covering	5
Ridges and hip coverings	5
Valleys	5
Cornice covering	5
Flashings, collars, aprons and soakers	4
Other weatherings	4

CLA4.M020.9 ISOLATION LAYER

Waterproof building paper to BS 1521:1972, Class A, Type A1F.

CLA4.M030.9 UNDERLAY

1. Needled non-woven polyester textile;
2. Weight: not less than 200 g/m².

CLA4.M040.9 CLIPS AND TACKS

1. Cut from Code 6 lead sheet and not less than 50 mm wide; or
2. Cut from sheet copper to BS 2870:1980 and of ¼ H temper, not less than 0.6 mm thick and 50 mm wide. Lead coated when used as visible fixing.

CLA4.M050.9 NAILS

1. Copper, to BS 1202:Part 2:1974, Table 2 with annular ring, helical ring or serrated shank, not less than 20 mm long with a minimum shank diameter of 3.35 mm and head diameter not less than 6 mm;
2. Austenitic stainless steel with annular ring, helical ring or serrated shank, not less than 19 mm long with a minimum shank diameter of 2.65 mm and head diameter not less than 6 mm;
3. Galvanized felt nails: to BS 1202:Part 1:1974, Table 4.

CLA4.M060.9 WOOD SCREWS

1. Brass, to BS 1210:1963:Table 3 and not less than 19 mm long and 3.35 mm diameter;
2. Stainless steel: to BS 1210:1963:Table 3, not less than 19 mm long and 3.35 mm diameter.

CLA4.M070.9 PLUGS

Proprietary fibre or plastics of length and diameter to suit screw fixings.

CLA4.M080.9 SOLDER

To BS 219:1977, Grade D or J.

ALUMINIUM SHEET AND ANCILLARY MATERIALS

CLA4.M110.9 ALUMINIUM SHEET

To BS 1470:1987:

1. Grade 1050A, temper grade H12;
2. 0.8 mm thick;
3. With mill finish.

CLA4.M120.9 UNDERLAY FOR TIMBER DECKS

Bitumen felt to BS 747:1994, type 4A(ii), No 1 inodorous.

CLA4.M130.9 UNDERLAY FOR CEMENTITIOUS DECKS

Polyethylene sheet, 300 microns (0.3 mm) thick.

CLA4.M140.9 CLIPS

1. Plain clips: cut from aluminium sheet specified for roofing to dimensions shown in Fig. 4, CP 143:Part 15:1973;
2. Expansion clips: aluminium or stainless steel 0.8 mm thick, type A or B to Fig. 3, CP 143:Part 15:1973.

CLA4.M150.9 NAILS

Aluminium to BS 1202:Part 3:1974 and:

1. For securing underlay: 20 mm long x 3 mm diameter clout type;
2. For securing clips: 25 mm long x 3.25 mm diameter.

CLA4.M160.9 WOOD SCREWS

Aluminium to BS 1210:1963, anodized and dipped in lanolin and:

1. Not less than 25 mm long x No 8 gauge for securing clips;
2. Appropriate length x No 14 gauge for securing wood rolls.

CLA4.M170.9 BITUMEN COATING SOLUTION

To BS 6949:1991, Type 1.

COPPER SHEET AND ANCILLARY MATERIALS

CLA4.M210.9 HOT ROLLED COPPER SHEET AND STRIP

To BS 2870:1980, designation C104:

1. For roofing and cladding: 0.7 mm thick, temper grade 0 for hand applied coverings and temper grade ¼H for machine bending and welding systems;
2. For flashings and weathering: 0.7 mm thick, temper grade ½H.

CLA4.M220.9 UNDERLAY

1. Needled non-woven polyester textile;
2. Weight: not less than 200 g/m².

CLA4.M230.9 CLIPS

Sheet copper to BS 2870:1980, designation C104, hot rolled, temper grade ¼H.

CLA4.M240.9 NAILS

Copper to BS 1202:Part 2:1974, Table 3, jagged shank, 25 mm long.

CLA4.M250.9 WOOD SCREWS

Brass to BS 1210:1963, Table 3.

CLA4.M260.9 PLUGS

Proprietary fibre or plastics of length and diameter to suit screw fixings.

CLA4.M270.9 MORTAR FOR POINTING

As specified in Worksection MAS3.

WORKMANSHIP

GENERAL

CLA4.W010.9 STORAGE

1. Store sheets and strip clear of the ground in a dry place. Protect from distortion and damage to surfaces and edges;
2. Store rolls of underlay and isolation layer upright on a clean, flat surface in a dry place.

CLA4.W020.9 ROOF CONDITION

Before laying coverings ensure that

1. All surfaces are clean, dry, smooth and free from projections;
2. All preliminary works including formation of any grooves, provision of rolls and drips are complete;
3. Roof substructure is to falls shown on the Drawings.

CLA4.W030.9 FIXINGS

Drive heads of nails and screws below surfaces to be covered, to ensure outer layer of sheeting is not pierced.

CLA4.W040.9 LAYING UNDERLAY GENERALLY

Keep base and underlay dry and do not lay more underlay than can be covered with sheeting before end of day's work.

CLA4.W050.9 LAYING, JOINTING AND FIXING COVERING GENERALLY

1. Do not use sharp scribers for marking out;
2. Lay sheets flat on base and dress neatly to profile of upstands and projections etc without causing injury to the surface.

CLA4.W060.9 LAYING SEQUENCE

Lay sheeting in the following sequence: cesspools, gutters, aprons, roof and wall surfaces.

LAYING LEAD SHEET COVERINGS

CLA4.W110.9 GENERAL

1. Lay, joint and fix lead sheet coverings in accordance with BS 6915:1988;
2. Ensure that persons employed on work which exposes them to lead in such a form that it may be inhaled, ingested or otherwise absorbed are aware of the risks from lead and the precautions which should be observed.

CLA4.W120.9 LAYING UNDERLAY ON CEMENTITIOUS DECKS

1. Loose lay building paper onto concrete and screeded bases, and up 50 mm at edges;
2. Loose lay needled non-woven polyester textile onto building paper and butt at edges;

3. Continue underlay around and up abutments to flashing line.

CLA4.W130.9 LAYING UNDERLAY ON TIMBER DECKS

1. Fix needled non-woven polyester textile to timber with galvanized nails at 300 mm centres, butt jointed to horizontal surfaces with 50 mm wide lap joints to sloping and vertical surfaces;
2. Continue around and up abutments to flashing line.

CLA4.W140.9 CLIPS AND TACKS

Twice fix and turn 20 mm over free edge of covering.

CLA4.W150.9 FIXING CLIPS TO TIMBER

Fix clips to timber with 25 mm x 3.25 mm copper nails or 25 mm x No. 8 brass screws.

CLA4.W160.9 FIXING CLIPS TO MASONRY/CONCRETE

Fix clips to concrete, brickwork and stonework with fibre or plastics plugs and 25 mm x No. 8 brass screws.

CLA4.W170.9 SOLDERING

Use solder only where unavoidable.

CLA4.W180.9 SHEET SIZES FOR ROOF COVERINGS

1. Not more than 2500 mm long;
2. Not more than 2.25 m^2 in area.

CLA4.W190.9 SHEET SIZES FOR WALL COVERINGS

1. Not more than 2400 mm long;
2. Not more than 1.7 m^2 in area.

CLA4.W200.9 INTERMEDIATE FIXINGS FOR WALL COVERINGS

Form at centres as shown on Drawings with 25 mm long, raised head brass screws and 10 mm diameter tinned, brass washers set in 40 mm diameter x 8 mm deep recess in base filled with solder and wiped smooth.

CLA4.W210.9 COVER FLASHINGS TO FLAT ROOF COVERINGS

1. Form from sheets not more than 1500 mm long and lap ends 100 mm;
2. Secure with lead tacks left on underlap at 450 mm centres and turned over 20 mm;
3. Turn top edge 25 mm into groove in brick and concrete surfaces, wedge at 450 mm centres and point in 1:3 cement: sand mortar;
4. Lap upstand by not less than 75 mm;
5. Finish lead 50 mm clear of flat roof coverings with 150 mm minimum depth-on-face of flashing.

CLA4.W220.9 LEAD SLATES, FLASHINGS AND COLLARS

1. Form in Code 4 lead in positions shown on the Drawings;
2. Fit slates around pipes etc penetrating the roof;

3. Dress into roofing for full slate/tile lap;
4. Lead burn collar to lead slate.

CLA4.W230.9 WEDGES

Drive 25 mm wide x 20 mm finished depth, wedge-shaped lead strips full depth into groove.

LAYING ALUMINIUM SHEET COVERINGS

CLA4.W310.9 STANDARD

Lay, fix and joint aluminium coverings in accordance with the recommendations of CP 143:Part 15:1973 unless specified otherwise.

CLA4.W320.9 CONTACT BETWEEN DISSIMILAR METALS

1. Prevent direct contact between aluminium and copper, brass or bronze;
2. Isolate iron and steel in direct contact with aluminium with isolating tape, bitumen coating solution or Approved equivalent.

CLA4.W330.9 STORING ALUMINIUM

In accordance with clause CLA4.W010 and protected from contact with dissimilar metals, alkaline and any other damage.

CLA4.W340.9 LAYING UNDERLAY ON CEMENTITIOUS DECKS

Lay polyethylene underlay with 50 mm lapped joints. Carry up underlay at wall abutments to flashing level.

CLA4.W350.9 LAYING UNDERLAY ON BOARDED OR SHEETED DECKS

Lay felt underlay butt jointed and secured with clout nails. On vertical and steeply pitched surfaces, ensure underlay is securely fastened before fixing clips. Carry up underlay at wall abutments to flashing level.

CLA4.W360.9 CLIPS FOR STANDING SEAMS

Space at 300 mm centres along line of seams and fix to:

1. Timber decks with nails;
2. Cementitious decks with screws and plugs.

CLA4.W370.9 LAYING ALUMINIUM COVERINGS GENERALLY

1. Cut, form and bend sheet to required dimensions in workshop wherever possible;
2. Allow for upstands or verge apron welting in first and last bays when setting out;
3. Lay flat and true to surface of roof.

CLA4.W380.9 STANDING SEAM JOINTS

1. Secure seams up to 3 m long with plain clips;
2. Secure seams longer than 3 m with plain clips for first 3 m from top of slope and remainder of seam with expansion clips;
3. Space clips at 300 mm centres;

4. Machine or hand form seams to dimensions shown on the Drawings.

CLA4.W390.9 ABUTMENTS TO MASONRY AND CONCRETE SURFACES

1. Ensure that there is either an underlay backing to aluminium upstand or coat reverse of sheet with bitumen coating solution;
2. Form upstand in sheeting to abutments to dimensions shown on Drawings;
3. Provide and form cover flashing as specified in Worksection WAT4.

LAYING SHEET COPPER COVERINGS

CLA4.W410.9 STANDARD

Lay, joint and fix copper coverings in accordance with the recommendations of CP 143:Part 12:1970 unless specified otherwise.

CLA4.W420.9 CONTACT BETWEEN DISSIMILAR METALS

Prevent contact between copper sheeting and dissimilar metals other than brass and lead. Coat contact surfaces with bituminous coating solution, protective tape or equivalent.

CLA4.W430.9 LAYING UNDERLAY ON CEMENTITIOUS DECKS

Lay underlay with butt joints across fall. Continue around gutters and up abutments to flashing line.

CLA4.W440.9 LAYING UNDERLAY ON BOARDED OR SHEETED DECKS

Lay underlay with butt joints and nail with 25 mm x 3.25 mm diameter copper nails at 150 mm centres at edges and at 150 mm centres staggered over area of sheets. Continue around gutters and up abutments to flashing line.

CLA4.W450.9 FIXING CLIPS TO TIMBER

Fix clips to timber with 25 mm x 3.25 mm diameter copper nails or 25 mm x No. 8 brass screws.

CLA4.W460.9 FIXING CLIPS TO MASONRY/CONCRETE

Fix clips to concrete, brickwork and stonework with fibre or plastic plugs and 25 mm x No. 8 brass screws.

CLA4.W470.9 USE OF SOLDER

Do not solder sheets.

CLA4.W480.9 LAYING GENERALLY

Cut and bend to required size and profile before laying. Ensure sheets lie flat on base on completion of laying.

CLA4.W490.9 SHEET SIZES

Do not use sheets exceeding the following size unless otherwise Instructed:

1. Length: 1800 mm;
2. Width: 750 mm (to form bay 650 mm wide between joints).

CLA4.W500.9 STANDING SEAM JOINTS

1. Form 20 mm high in direction of fall;
2. Turn up adjacent sheets and double-lock welt together;
3. Secure with copper clips twice fixed at 380 mm centres.

CLA4.W510.9 UPSTANDS AT ABUTMENTS

1. Turn sheeting up at abutments by not less than the following:
   a. Pitch up to 15°: 200 mm;
   b. Pitch over 15° and up to 30°: 150 mm;
   c. Pitch over 30°: 100 mm.
2. Single-lock welt joints and secure with copper clips at 450 mm centres.

CLA4.W520.9 FLASHINGS

1. Form at square abutments with 0.7 mm copper giving 100 mm minimum cover over upstands;
2. Form from sheets not more than 1800 mm long with single-lock welt joints;
3. Welt bottom edge to 12 mm depth of welt;
4. Turn clips down over top of upstand and 25 mm up over bottom edge of flashing;
5. Turn top edge 25 mm into groove, secure with copper wedges and point in mortar.

CLA4.W530.9 FIXING WEDGES TO COVER FLASHINGS

Drive 25 mm wide x 20 mm finished depth wedge-shaped copper strips full depth into groove.

COM COMPONENTS

COM1 STAINLESS STEEL WINDOWS, DOORS AND LOUVRES 15

DESIGN 15

GENERAL 15

COM1.D010.9 SPECIFICATION REQUIREMENTS 15
COM1.D020.9 WINDOWS AND DOORS 15

DESIGN PARAMETERS 15

COM1.D110.9 TOLERANCES 15
COM1.D120.9 GLASS THICKNESS 15
COM1.D130.9 WIND LOADING FOR GLAZED WINDOWS, DOORS AND LOUVRES 15
COM1.D140.9 DRAINAGE 15

SUBMISSION 16

COM1.D210.9 GENERAL 16
COM1.D220.9 SHOP DRAWINGS AND STRUCTURAL CALCULATION 16
COM1.D240.9 SAMPLES 16

MATERIALS 17

WINDOWS, DOORS, LOUVRES AND FIXINGS 17

COM1.M010.9 WEATHERSTRIP 17
COM1.M020.9 STAINLESS STEEL PLATE, SHEET AND STRIP 17
COM1.M030.9 STUD ANCHORS AND FIXING BOLTS 18
COM1.M040.9 EXPOSED FIXINGS 18
COM1.M050.9 CONCEALED FIXINGS 18
COM1.M060.9 STAINLESS STEEL BEADS 18
COM1.M070.9 SEALANT FOR ASSEMBLING COMPOSITE UNITS 18

WINDOW AND DOOR FITTINGS 19

COM1.M110.9 FRICTION PIVOTS AND SLIDING STAYS 19
COM1.M120.9 CASEMENT FASTENERS, LOCKING HANDLES ETC 19
COM1.M130.9 PULL HANDLES 19
COM1.M140.9 ROLLERS, GUIDES ETC 19

REMOTE CONTROL EQUIPMENT 19

COM1.M210.9 HAND OPERATED SYSTEM 19
COM1.M220.9 REMOTE CONTROL SYSTEM 19

ANCILLARY MATERIALS 19

COM1.M310.9 BITUMINOUS PAINT 19
COM1.M320.9 WATERPROOF BEDDING MORTAR 19

WORKMANSHIP 20

FABRICATION AND ASSEMBLY - OFF SITE 20

COM1.W010.9 SECTIONS 20
COM1.W020.9 FIXING WEATHERSTRIPS 20
COM1.W030.9 WELDING FRAMES 20
COM1.W040.9 SASH MEMBERS 20

FABRICATION AND ASSEMBLY - ON SITE 20

COM1.W110.9 COMPOSITE UNITS 20

INSTALLATION ON SITE 20

COM1.W120.9 FIXING ANCHOR BOLTS 20
COM1.W130.9 WINDOWS AND DOORS 20
COM1.W140.9 TOLERANCES 20
COM1.W145.9 BEDDING AND GROUTING FRAMES 20
COM1.W147.9 POINTING TO PERIMETER OF WINDOWS, DOORS AND LOUVRES 20

EQUIPOTENTIAL BONDING TO WINDOWS AND LOUVRES 21
COM1.W210.9 EQUIPOTENTIAL BONDING TO STAINLESS STEEL WINDOWS, DOORS AND LOUVRES 21
COM1.W220.9 EQUIPOTENTIAL BONDING REQUIREMENTS FOR COMPOSITE WINDOWS 21

PROTECTION 22
COM1.W310.9 PRIMING 22
COM1.W320.9 TEMPORARY PROTECTIVE COATINGS TO EXPOSED STAINLESS STEEL 22
COM1.W330.9 PROTECTION OF WINDOWS, DOOR UNITS AND OTHER ASSOCIATED MATERIALS 22

COMPLETION OF THE WORKS 22
COM1.W410.9 REMOVAL OF PROTECTIVE COATINGS 22
COM1.W420.9 ON COMPLETION 22

TESTING 23

ON-SITE VERIFICATION TEST 23
COM1.T010.9 TESTING INSTALLED WINDOWS FOR WATERTIGHTNESS 23

COM2 ALUMINIUM WINDOWS AND LOUVRES 24

DESIGN 24

GENERAL 24
COM2.D010.9 SPECIFICATION REQUIREMENTS 24
COM2.D020.9 WINDOWS 24
COM2.D030.9 ADJUSTABLE LOUVRE FRAMES 24

GENERAL 24
COM2.D040.9 ACOUSTIC PANEL AT ACOUSTIC BALCONY AND ACOUSTIC WINDOW 24

DESIGN PARAMETERS 25
COM2.D110.9 TOLERANCES 25
COM2.D120.9 GLASS THICKNESS 25
COM2.D130.9 WIND LOADING FOR GLAZED WINDOWS, DOORS, ACOUSTIC PANELS AND LOUVRES 25
COM2.D132.9 MULLIONS, TRANSOMS AND CORNER POSTS 25
COM2.D135.9 STRUCTURAL CALCULATIONS 25
COM2.D140.9 DRAINAGE 25

DESIGN PARAMETERS 25
COM2.D150.9 ALUMINIUM SLIDING WINDOW AT ACOUSTIC BALCONY 25

SHOP DRAWINGS / CALCULATIONS FOR SUBMISSION 26
COM2.D210.9 ALUMINIUM WINDOWS, DOORS, ACOUSTIC PANELS AND LOUVRES 26
COM2.D230.A COMPLIANCE WITH STANDARDS 26

OTHER SUBMISSION 27
COM2.D310.9 MILL CERTIFICATES 27

MATERIALS 28

GENERAL 28
COM2.M001.N ALUMINIUM WINDOWS AND COMPONENT 28
COM2.M005.A ALUMINIUM WINDOWS, DOORS, GRILLES AND ACOUSTIC PANELS 28

ALUMINIUM MEMBERS AND FINISHES 36
COM2.M010.9 SECTIONS 36
COM2.M020.9 CLEAR ANODIZING 36

COM2.M030.9 COLOUR ANODIZING....36

ALUMINIUM MEMBERS AND FINISHES....36

COM2.M040.9 PERFORATED ALUMINIUM SHEET AT ACOUSTIC INSTALLATIONS....36

FIXINGS, FASTENINGS ETC....37

COM2.M110.9 WEATHER STRIP....37
COM2.M120.9 ALUMINIUM BEADS....37
COM2.M130.9 EXPOSED FIXINGS....37
COM2.M140.9 CONCEALED FASTENING DEVICES....37
COM2.M145.9 FIXING LUGS....37
COM2.M160.9 PERIMETER SEALANT....37
COM2.M170.9 SEALANT FOR ASSEMBLING COMPOSITE UNITS....38
COM2.M171.9 SEALANT FOR FIXING GLAZING....38
COM2.M172.9 SMALL GAP SEALANT....38
COM2.M190.9 WATERPROOF BEDDING MORTAR....38
COM2.M195.9 WATER BARS....38

WINDOWS FITTINGS....38

COM2.M210.9 FRICTION PIVOTS, SLIDING STAYS, BASE RAILS AND SCREWS OF FRICTIONAL HINGES....38
COM2.M220.9 CASEMENT FASTENERS, LOCKING HANDLES ETC....39
COM2.M230.9 WINDOWS LOCKS....39
COM2.M240.9 PULL HANDLES....39
COM2.M250.9 ROLLERS, GUIDES ETC....39
COM2.M260.9 EARTHING LUGS....39
COM2.M300.9 REINFORCEMENT....39
COM2.M305.9 IDENTIFICATION....39

WINDOWS FITTINGS....39

COM2.M306.9 ROLLER AT ALUMINIUM SLIDING WINDOW....39
COM2.M307.9 STOPPER AT ALUMINIUM SLIDING WINDOW....40

REMOTE CONTROL EQUIPMENT....40

COM2.M310.9 HAND OPERATED SYSTEM....40
COM2.M320.9 REMOTE CONTROL SYSTEM....40

PROTECTIVE PAINTS....40

COM2.M410.9 BITUMINOUS PAINT....40

ACOUSTIC BALCONY ALUMINIUM DOOR FITTINGS....40

COM2.M510.9 DOOR LOCK, FURNITURE AND ACCESSORIES....40

SOUND ABSORPTIVE MATERIAL....40

COM2.M610.9 SOUND ABSORPTIVE MATERIAL (SAM) FOR ACOUSTIC INSTALLATIONS....40

WORKMANSHIP....41

APPROVAL PRIOR TO FABRICATION AND SITE INSTALLATION....41

COM2.W020.9 SAMPLES AND SHOP DRAWING APPROVAL....41

FABRICATION AND ASSEMBLY....41

COM2.W110.9 FIXING WEATHERSTRIPS....41
COM2.W120.9 WELDING WEATHERSTRIPS....41
COM2.W130.9 FRAMES....41
COM2.W140.9 SASH MEMBERS....41
COM2.W150.9 SIDE AND TOP HUNG WINDOWS....41
COM2.W170.9 OPENING LIGHT FRAMES....41

INSTALLATION OF ALUMINIUM WINDOWS TO CAST IN-SITU CONCRETE WALLS....41

COM2.W210.9 COMPOSITE UNITS....41

COM2.W220.9 CUTTING, TRIMMING AND WELDING 41
COM2.W230.9 TOLERANCES 42
COM2.W231.9 FIXING LUGS 42
COM2.W232.9 POSITIONING 42
COM2.W233.9 OPENING LIGHTS 42
COM2.W234.9 BEDDING AND GROUTING FRAMES 42
COM2.W236.9 FIXING WATER BARS 42
COM2.W265.9 POINTING TO PERIMETER OF WINDOWS AND LOUVRES 42

FIXING LOUVRE FRAMES 42
COM2.W310.9 HANDLING AND STORAGE 42
COM2.W320.9 POSITIONING 42
COM2.W330.9 FIXING 42
COM2.W340.9 BEDDING AND GROUTING IN MORTAR 43
COM2.W350.9 LOUVRE FRAMES 43

INSTALLATION OF ALUMINIUM WINDOWS TO PRECAST CONCRETE FACADES .. 43
COM2.W415.9 FIXING LUGS 43
COM2.W420.9 POSITIONING 43
COM2.W430.9 FIXING 43
COM2.W450.9 POINTING TO PERIMETER OF WINDOWS AND LOUVRES 43

EARTH / EQUIPOTENTIAL BONDING 43
COM2.W465.9 EQUIPOTENTIAL BONDING TO WINDOWS, DOORS, ACOUSTIC PANELS AND LOUVRES 43
COM2.W470.9 EQUIPOTENTIAL BONDING REQUIREMENTS FOR COMPOSITE WINDOWS 44

TRANSPORTATION, HANDLING AND STORAGE 44
COM2.W490.9 TRANSPORTATION, HANDLING AND STORAGE 44

PROTECTION 44
COM2.W510.9 PRIMING STEEL REINFORCEMENT ETC 44
COM2.W515.9 ALUMINIUM FRAME AND SASH 44
COM2.W520.9 ALUMINIUM IN CONTACT WITH OTHER MATERIALS 44
COM2.W525.9 PROTECTION OF ALUMINIUM IN CONTACT WITH OTHER MATERIALS 44
COM2.W530.9 TEMPORARY PROTECTIVE COATINGS TO EXPOSED ALUMINIUM 45
COM2.W540.9 WINDOWS AND OTHER ASSOCIATED MATERIALS 45
COM2.W550.9 REMOVAL OF TEMPORARY PROTECTIVE COATINGS 45

COMPLETION 45
COM2.W610.9 ON COMPLETION 45

TESTING 46

ON-SITE VERIFICATION TEST 46
COM2.T210.9 TESTING INSTALLED WINDOWS AND ACOUSTIC BALCONY DOORS FOR WATERTIGHTNESS 46

SURVEILLANCE TESTS 47
COM2.T405.A SURVEILLANCE TESTS FOR ALUMINIUM WINDOWS 47
COM2.T410.A ON-SITE OPERATION TESTS FOR ALUMINIUM WINDOWS 48

APPENDIX COM2/I 50
COM2.APPEND1.9 SITE WATERTIGHTNESS TEST 50

COM3 UPVC WINDOWS 51

DESIGN 51

GENERAL **51**
COM3.D010.9 SPECIFICATION REQUIREMENTS 51
COM3.D020.9 WINDOWS 51
DESIGN PARAMETERS **51**
COM3.D110.9 TOLERANCES 51
COM3.D120.9 GLASS THICKNESS 51
COM3.D130.9 WIND LOADING FOR GLAZED WINDOWS 51
COM3.D140.9 DRAINAGE 51
SUBMISSION **52**
COM3.D210.9 SHOP DRAWINGS AND STRUCTURAL CALCULATION 52
COM3.D230.9 COMPLIANCE WITH STANDARDS 52
MATERIALS **53**
GENERAL **53**
COM3.M010.9 UPVC WINDOWS AND GRILLES 53
MEMBERS AND FIXINGS **57**
COM3.M110.9 FRAME PROFILES AND SECTIONS 57
COM3.M120.9 REINFORCEMENT 57
COM3.M130.9 GLAZING GASKETS AND WEATHERSTRIP 57
COM3.M140.9 UPVC GLAZING BEADS 57
COM3.M150.9 EXPOSED FIXINGS 57
COM3.M160.9 CONCEALED FASTENING DEVICES 57
COM3.M170.9 BEDDING AND GROUTING MATERIAL 57
COM3.M180.9 PERIMETER SEALANT 58
WINDOW FITTINGS/HARDWARE **58**
COM3.M210.9 FRICTION PIVOTS AND SLIDING STAYS 58
COM3.M220.9 LOCKING HANDLES & PULL HANDLES ETC. 58
COM3.M230.9 IRONMONGERY 58
WORKMANSHIP **59**
APPROVAL PRIOR TO FABRICATION AND SITE INSTALLATION **59**
COM3.W010.9 TESTING REPORT 59
COM3.W020.9 SHOP DRAWING AND SAMPLE APPROVAL 59
OFF SITE FABRICATION AND ASSEMBLY **59**
COM3.W110.9 FIXING WEATHERSTRIPS 59
COM3.W130.9 SIDE AND TOP HUNG WINDOWS 59
FIXING OF UPVC WINDOWS TO CAST IN-SITU CONCRETE FACADE **59**
COM3.W210.9 COMPOSITE UNITS 59
COM3.W220.9 CUTTING TRIMMING AND WELDING 59
COM3.W230.9 TOLERANCES 59
COM3.W260.9 POSITIONING 59
COM3.W270.9 INSTALLATION 59
COM3.W280.9 PERIMETER POINTING OF EXTERNAL WINDOWS 60
FIXING UPVC WINDOWS TO PRECAST CONCRETE FACADES **60**
COM3.W410.9 POSITIONING 60
COM3.W420.9 OPENING LIGHT FRAMES 60
COM3.W425.9 POSITIONING OF WINDOWS AND WINDOW FRAMES 60
COM3.W430.9 CURING OF CONCRETE 60
COM3.W440.9 POINTING TO PERIMETER OF WINDOW 60
HANDLING, STORAGE AND PROTECTION **60**
COM3.W610.9 TRANSPORTATION, HANDLING AND STORAGE 60
COM3.W620.9 PROTECTION 60
TESTING **61**

SURVEILLANCE TESTS FOR UPVC WINDOWS AND GRILLES 61
COM3.T050.A SURVEILLANCE TESTS 61
ON-SITE VERIFICATION TEST 61
COM3.T310.9 TESTING INSTALLED WINDOWS FOR WATERTIGHTNESS 61

COM4 GLAZING 62

MATERIALS 62

GLASS GENERALLY 62
COM4.M001.9 SUBMISSION REQUIREMENTS FOR GLASS MATERIALS 62
COM4.M010.9 FLOAT GLASS 63
COM4.M020.9 CLEAR SHEET GLASS 64
COM4.M030.9 CLEAR PATTERNED GLASS 64
COM4.M040.9 WIRED GLASS 65
COM4.M050.9 MIRROR GLASS 65
COM4.M060.9 THERMALLY TOUGHENED GLASS / TEMPERED GLASS 65
COM4.M070.A ANTI-BANDIT GLASS 67
COM4.M080.9 BULLET RESISTANT GLASS 67
COM4.M090.9 TINTED GLASS 67
COM4.M100.9 REFLECTIVE GLASS 68
COM4.M110.9 LAMINATED GLASS 69
COM4.M120.9 GLASS LOUVRE BLADES 70
COM4.M130.9 FIRE RESISTANT LAMINATED SAFETY GLASS 70

PLASTIC GLAZING MATERIALS 72
COM4.M210.9 POLYCARBONATE SHEET 72
COM4.M220.9 SURFACE HARDENED POLYCARBONATE SHEET 72
COM4.M230.9 PLASTICS GLAZING MATERIALS 72

SAMPLES 73
COM4.M310.9 GLAZING SAMPLES 73

ANCILLARY MATERIALS 73
COM4.M410.9 DISTANCE PIECES 73
COM4.M420.9 SETTING BLOCKS 73
COM4.M430.9 LOCATION BLOCKS 73
COM4.M440.9 NON-SETTING COMPOUND 73
COM4.M450.9 PLASTIC SHEET GLAZING COMPOUND 73
COM4.M460.9 LINSEED OIL PUTTY 73
COM4.M470.9 PUTTY FOR HARDWOOD APPLICATION 73
COM4.M480.9 SILICONE SEALANT 73
COM4.M485.9 STRUCTURAL SEALANTS 73
COM4.M490.9 GLAZING SPRIGS 74

WORKMANSHIP 75

GENERAL 75
COM4.W010.9 STANDARD 75
COM4.W020.9 DELIVERY 75
COM4.W030.9 STORAGE 75
COM4.W040.9 FIRE RESISTANT LAMINATED SAFETY GLASS 75

PREPARATION OF SURROUNDS 75
COM4.W110.9 PREPARATION OF REBATES 75
COM4.W120.9 PRIMING OF WOODEN SURROUNDS 75

FIXING GLASS GENERALLY 75
COM4.W210.9 GENERALLY 75
COM4.W220.9 CAST OR PATTERNED GLASS FOR EXTERNAL GLAZING 75
COM4.W230.9 WIRED GLASS 75

COM4.W240.9 CUT EDGES OF WIRED GLASS 75
COM4.W250.9 DIRECTIONALLY PATTERNED GLASS 75
COM4.W260.9 EDGE CLEARANCES OF SEALANT FOR ALUMINIUM WINDOWS 75
COM4.W270.9 EDGE COVER 76
COM4.W275.9 EDGE COVER FOR SINGLE GLASS GLAZED IN PUTTY OR NON-SETTING COMPOUND 76
COM4.W280.9 SETTING, LOCATION BLOCKS AND DISTANCE PIECES 76
COM4.W290.9 POSITIONING AND SETTING LOCATION BLOCKS 76
COM4.W300.9 BEDDING FOR NON-SETTING COMPOUND 76
COM4.W310.9 STRIPPING SURPLUS NON-SETTING COMPOUND 76
COM4.W320.9 SILICONE SEALANT 76
COM4.W330.9 PREFORMED TAPES, SHIMS AND COMPRESSION GASKETS FOR GLAZING 76

GLAZING TIMBER WINDOWS 76
COM4.W410.9 SECURING GLASS 76
COM4.W420.9 BACK PUTTY 76
COM4.W430.9 FRONT PUTTY 76
COM4.W440.9 OPENING LIGHTS 77
COM4.W450.9 SEALING PUTTY 77
COM4.W460.9 BEDDING GLAZING BEADS 77
COM4.W470.9 SECURING WOODEN GLAZING BEADS 77

GLAZING ALUMINIUM WINDOWS 77
COM4.W540.9 GLAZING ALUMINIUM WINDOWS 77

LOUVRES 77
COM4.W610.9 FIXING LOUVRE BLADES 77

GLAZING WITH PLASTIC SHEETS 77
COM4.W710.9 CUTTING PLASTIC SHEETS 77
COM4.W720.9 EDGE CLEARANCE 77
COM4.W730.9 PROTECTIVE COVERING 77

FINISHING 77
COM4.W810.9 CLEANING 77
COM4.W820.9 BROKEN OR DAMAGED GLAZING 78

COM5 TIMBER DOORSETS 79

MATERIALS 79

DOORSETS GENERALLY 79
COM5.M001.A MATERIALS OF TIMBER DOORSETS 79
COM5.M005.9 USE OF SUSTAINABLE TIMBER 80
COM5.M010.9 TIMBER QUALITY 81
COM5.M015.9 COMPOSITE JOINTED (LAMINATED) TIMBER AND FINGER JOINTED TIMBER 81
COM5.M020.9 AVERAGE PERMISSIBLE MOISTURE CONTENT 82
COM5.M025.9 SOFTWOOD FOR CORE BATTENS, STILES AND RAILS AND ARCHITRAVE OF DOOR LEAVES 82
COM5.M030.9 HARDWOOD FOR CORE BATTENS, STILES, RAILS, ARCHITRAVE AND LINING OF DOOR LEAVES 82
COM5.M035.9 HARDWOOD FOR LIPPING AND FRAME 82
COM5.M040.9 TIMBER DOORSETS 82
COM5.M050.9 DOORSET TYPE (PAINT FINISH) 96
COM5.M060.9 DOORSET TYPE (TIMBER VENEER FINISH) 96
COM5.M070.9 IDENTIFICATION 97
COM5.M080.9 INTUMESCENT STRIP 97

COM5.M090.9 SMOKE SEAL....97
COM5.M100.9 FIRE RESISTANT GLASS....98
DIMENSIONAL ACCURACY....98
COM5.M210.9 DOORSETS, DOOR LEAVES AND FRAMES GENERALLY....98
PREFORMING AND DRILLING....98
COM5.M310.9 DOORSETS....98
COM5.M320.9 EXPANDING ANCHOR FOR FIXING DOOR TO CONCRETE....98
COM5.M330.9 EXPANDING ANCHOR FOR FIXING DOOR TO PANEL WALL....98
DOORSET FINISHES....98
COM5.M410.9 SURFACE FINISH....98
COM5.M420.A PLYWOOD FOR DOOR FACINGS....99
COM5.M430.A LAMINATED PLASTIC SHEET FOR BATHROOM DOOR FACINGS....99
IRONMONGERY AND OTHER MATERIALS....99
COM5.M510.9 IRONMONGERY....99
COM5.M520.9 WOOD SCREWS....100
COM5.M525.9 ADHESIVES FOR WOOD....100
COM5.M530.9 FIRE RESISTANT LAMINATED SAFETY GLASS....100
WORKMANSHIP....101
GENERALLY....101
COM5.W010.9 FRAME ASSEMBLY....101
COM5.W020.9 HEAD FIXING....101
COM5.W030.9 PELLETING....101
COM5.W040.9 SPLAY EDGES....101
COM5.W050.9 JOINTS....101
COM5.W060.9 SPREAD OF ADHESIVE....101
FIXING SEQUENCE....101
COM5.W110.9 INSTALLATION....101
TESTING....103
SURVEILLANCE TESTS FOR TIMBER DOORSETS....103
COM5.T1605.A SURVEILLANCE TESTS....103
COM5.T1610.A SURVEILLANCE TESTS FOR MECHANICAL SMOKE SEAL....104
APPENDIX COM5/I....106
COM5.APPEND1.9 TESTS FOR TIMBER DOORSETS....106
FIG. 4 - AIMING PATTERNS FOR HARD BODY INPACT TEST....107
COM6 STEEL DOORS....109
DESIGN....109
GENERAL....109
COM6.D010.9 SPECIFICATION REQUIREMENTS....109
COM6.D020.9 STEEL DOORS AND LOUVRES....109
COM6.D030.9 INSIDE GLAZING....109
SUBMISSION....109
COM6.D040.9 SHOP DRAWINGS AND STRUCTURAL CALCULATION....109
COM6.D050.9 SAMPLES....109
DESIGN PARAMETERS....109
COM6.D110.9 WIND LOADING FOR EXTERNAL STEEL DOORS AND LOUVRES....109
MATERIALS....111
STEEL MEMBERS AND FINISHES....111
COM6.M010.9 SECTIONS....111

COM6.M020.9 FRAMES 111
COM6.M030.9 FINISH 111
FIXINGS, FASTENING ETC 111
COM6.M110.9 SEALANT 111
COM6.M130.9 IRONMONGERY 111
WORKMANSHIP 112
FABRICATION AND ASSEMBLY 112
COM6.W010.9 STEEL DOORS AND LOUVRES 112
COM6.W020.9 POSITIONING 112
COM6.W030.9 EQUIPOTENTIAL BONDING TO STEEL DOORS AND LOUVRES 112
COM6.W040.9 BEDDING MORTAR 112
COM6.W050.9 POINTING TO PERIMETER OF STEEL DOORS AND LOUVRES 112
COM6.W060.9 PAINTING 112
TRANSPORTATION, HANDLING AND STORAGE 113
COM6.W110.9 STEEL DOORS AND LOUVRES 113
TOLERANCES 113
COM6.W210.9 GENERAL 113
COM7 GATESETS 114
GENERAL 114
APPLICATION OF SPECIFICATION 114
COM7.G010.9 GATESETS 114
DESIGN 115
GENERAL 115
COM7.D010.9 DESIGN RESPONSIBILITY 115
PERFORMANCE CRITERIA 115
COM7.D140.9 GATESET OPERATION 115
MATERIALS 116
GALVANISED MILD STEEL GATESETS 116
COM7.M010.9 GALVANIZED MILD STEEL GATESETS 116
COM7.M020.9 SAMPLES 124
COM7.M030.9 DIMENSIONAL ACCURACY 124
COM7.M040.9 CONSTRUCTION 124
COM7.M050.9 CONSTRUCTION (STAINLESS STEEL PARTS) 124
COM7.M060.9 GATESET ASSEMBLY 124
COM7.M070.9 GATESET FINISH 125
COM7.M080.9 LOCKSET 125
COM7.M090.9 PULL HANDLE 125
WORKMANSHIP 126
INSTALLATION OF GATESETS 126
COM7.W005.9 SAMPLES AND SHOP DRAWING APPROVAL 126
COM7.W010.9 CLEANING AND PROTECTION 126
COM7.W015.A EQUIPOTENTIAL BONDING TO GATESETS 126
COM7.W020.9 GATESET ASSEMBLY 126
TOLERANCES 127
COM7.W110.9 GENERAL 127
MOCK UP 127
COM7.W200.9 MOCK UP 127
TESTING 128

SURVEILLANCE TESTS FOR GALVANIZED MILD STEEL GATESETS 128
COM7.T010.A SURVEILLANCE TESTS 128

ON SITE VERIFICATION TEST FOR GATESET LOCK 128
COM7.T020.9 VERIFICATION TEST ON NO REPEAT OF KEY CHANGES 128

COM8 ROLLER SHUTTERS AND DOORS 130

DESIGN 130

GENERAL 130
COM8.D010.9 CONTRACTOR'S RESPONSIBILITY 130
COM8.D020.9 GENERAL DESCRIPTION 130
COM8.D030.9 MATERIALS AND WORKMANSHIP 130

OPERATING MECHANISM 130
COM8.D040.9 SELF CLOSING SHUTTERS 130
COM8.D050.9 MANUALLY OPERATED SHUTTERS 130
COM8.D060.9 ELECTRICALLY OPERATED SHUTTERS 130

CONSTRUCTION 131
COM8.D110.9 WIND LOAD 131
COM8.D120.9 STEEL SLATS 131
COM8.D130.9 HORIZONTAL BARREL FOR CARRYING SHUTTER CURTAIN 131
COM8.D140.9 BARREL SUPPORT 131
COM8.D150.9 VERTICAL GUIDES 131
COM8.D160.9 HOODS AND CASINGS 132
COM8.D170.9 LOCKING DEVICE 132
COM8.D180.9 FITTINGS AND FIXINGS 132
COM8.D190.9 RUST PROOFING 132

FIRE RESISTING DOORS AND SHUTTERS 132
COM8.D210.9 STANDARD 132
COM8.D220.9 PERFORMANCE 132

SUBMISSION 132
COM8.D310.9 SHOP DRAWINGS 132
COM8.D320.9 INSTRUCTION MANUALS 132

COM9 COOKING BENCH / SINK UNITS 133

DESIGN 133

SUBMISSION 133
COM9.D110.9 SHOP DRAWINGS 133

MATERIALS 134

GENERAL 134
COM9.M010.A COOKING BENCH / SINK UNIT 134
COM9.M020.9 SERIAL NUMBER 136
COM9.M030.9 SAMPLES 136
COM9.M040.9 DIMENSIONAL ACCURACY 136

STAINLESS STEEL SHEET 136
COM9.M110.9 STAINLESS STEEL SHEET FOR SINK UNIT 136

STAINLESS STEEL SUPPORTING FRAME 137
COM9.M115.9 STAINLESS STEEL SUPPORTING FRAME FOR COOKING BENCH 137

POLYMER RESIN WORKTOP 137
COM9.M120.9 POLYMER RESIN WORKTOP FOR COOKING BENCH 137

FIXING AND POINTING MATERIALS 138
COM9.M210.9 ANCHORS AND FIXING BOLTS 138

COM9.M220.9 BONDING AGENT 138
COM9.M230.9 SILICONE SEALANT 138
COM9.M240.9 CEMENT MORTAR 138
COM9.M250.9 EARTHING LUG 138

WORKMANSHIP 139

SUPPORTING LEGS 139
COM9.W010.9 CRACK REPAIR IDENTIFICATION AND RESPONSIBILITY 139
COM9.W020.9 CLASSIFICATION AND REMEDIAL REPAIR OF CRACKS 139

POLYMER RESIN WORKTOP 140
COM9.W050.9 MINOR REPAIR TO POLYMER RESIN WORKTOP 140

INSTALLATION 140
COM9.W110.9 FIXING COOKING BENCH/SINK UNITS 140
COM9.W120.9 EQUIPOTENTIAL BONDING TO COOKING BENCH/SINK UNITS 140

ACCURACY AND TOLERANCES 140
COM9.W210.9 ERECTION ACCURACY 140

PROTECTION 140
COM9.W310.9 PROTECTION OF FINISHES 140

COM10 GLASS PANELS 141

DESIGN 141

GENERAL 141
COM10.D010.9 SPECIFICATION REQUIREMENTS 141
COM10.D020.9 SHOP DRAWINGS 141
COM10.D030.9 METHOD STATEMENT 141
COM10.D040.9 SAMPLES 141
COM10.D050.9 MOCK UP 141
COM10.D060.9 FIRE RESISTANCE PERFORMANCE OF THE FIRE RESISTANT GLAZING SYSTEM 141

DESIGN PARAMETERS 142
COM10.D110.9 GENERAL 142
COM10.D120.9 MINIMUM HORIZONTAL IMPOSED LOADS 142
COM10.D130.9 DEFLECTION LIMITS 142
COM10.D140.9 FIXING 142
COM10.D150.9 HANDRAIL ATTACHMENT FOR FREE-STANDING GLASS PANEL BALUSTRADE 142

MATERIALS 144
COM10.M010.9 METALWORKS 144
COM10.M020.9 GLASS 144
COM10.M030.9 SETTING BLOCKS 144
COM10.M040.9 DISTANCE PIECES 144
COM10.M050.9 SEALANTS 144

WORKMANSHIP 145

GENERAL 145
COM10.W010.9 STANDARD 145
COM10.W020.9 DELIVERY 145
COM10.W030.9 STORAGE 145
COM10.W040.9 FIRE RESISTANT LAMINATED SAFETY GLASS 145

FIXING GLASS GENERALLY 145
COM10.W110.9 EDGE COVER 145
COM10.W120.9 CLIP FIXING OF GLASS INFILL PANEL 145

COM10.W130.9 BOLT FIXING OF GLASS INFILL PANELS 145
COM10.W140.9 FREE-STANDING GLASS PANEL BALUSTRADE 145
COM10.W150.9 BOLT FIXING OF FREE-STANDING GLASS PANEL BALUSTRADE 145
COM10.W160.9 POSITIONING SETTING BLOCKS 146
COM10.W170.9 POSITIONING DISTANCES PIECES 146
COM10.W180.9 SILICONE SEALANT 146

FINISHING 146
COM10.W210.9 BROKEN OR DAMAGED GLAZING 146

COM11 RADIO FREQUENCY IDENTIFICATION AND WEB-BASED DATABASE SYSTEM FOR BUILDING COMPONENTS 147

DESIGN 147

GENERAL 147
COM11.D010.9 RADIO FREQUENCY IDENTIFICATION (RFID) SYSTEM 147
COM11.D020.9 MAIN COMPONENTS OF THE RADIO FREQUENCY IDENTIFICATION (RFID) SYSTEM 147
COM11.D030.9 OUTLINE OF THE OPERATION OF THE RADIO FREQUENCY IDENTIFICATION (RFID) SYSTEM 148
COM11.D040.9 SUPPLY OF RFID TAGS AND RFID READERS 148
COM11.D050.9 RFID WEB-BASED DATABASE SYSTEM 148

SUBMISSIONS 148
COM11.D110.9 PROVISIONAL APPROVAL 148
COM11.D120.9 PROGRAMME 149

RESOURCES 149
COM11.D210.9 RFID PROJECT COORDINATOR 149

MATERIALS 150

RADIO FREQUENCY IDENTIFICATION TAGS 150
COM11.M010.9 STANDARD 150
COM11.M020.9 TECHNICAL PERFORMANCE 150

RADIO FREQUENCY IDENTIFICATION READERS 150
COM11.M110.9 STANDARD 150
COM11.M120.9 MIDDLEWARE FOR DATA TRANSFER WITH RFID TAGS 151
COM11.M130.9 TECHNICAL PERFORMANCE 151

RADIO FREQUENCY IDENTIFICATION (RFID) WEB-BASED DATABASE SYSTEM 151
COM11.M210.9 RADIO FREQUENCY IDENTIFICATION (RFID) WEB-BASED DATABASE SYSTEM 151
COM11.M220.9 BACKUP AND RECOVERY OF PROGRAMME AND DATA 153
COM11.M230.9 INTEGRITY OF DATA 153
COM11.M240.9 HANDLING OF DATA 153
COM11.M250.9 REMOVAL OF EQUIPMENT AND DATA UPON COMPLETION 153

WORKMANSHIP 155

INSTALLATION OF RFID TAGS 155
COM11.W010.9 INSTALLATION OF RFID TAGS 155
COM11.W020.9 REPLACEMENT OF INSTALLED TAGS 155

DATA TRANSFER 155
COM11.W110.9 DAILY UPLOADING OF DATA AND RECORDS 155
COM11.W120.9 CORRECTNESS OF DATA 155
COM11.W130.9 VIEWING OF RECORDS 155

DATA FORMAT 155
COM11.W210.9 DOCUMENT FORMAT 155
COM11.W220.9 SECURITY 155

COM11.W230.9 CHANGE CONTROL 156
COM11.W240.9 HARDWARE AND SOFTWARE 156
COM11.W250.9 TAG STRUCTURE 156

TESTING 157

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM 157

COM11.T010.9 SYSTEM ACCEPTANCE TEST 157
COM11.T020.9 FIELD TRIAL AND DEMONSTRATION 157
COM11.T030.9 PROCEDURE 157

APPENDIX COM11/I 158

COM11.APPEND1.9 CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM - PRECAST CONCRETE FAÇADE 158

APPENDIX COM11/II 162

COM11.APPEND2.9 CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM - ALUMINIUM WINDOW 162

APPENDIX COM11/III 167

COM11.APPEND3.9 CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM - TIMBER DOOR 167

APPENDIX COM11/IV 172

COM11.APPEND4.9 CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM - METAL GATESET 172

APPENDIX COM11/V 176

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM 176

COM11.APPEND5.9 CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM – VOLUMETRIC PRECAST BATHROOM (VPB) AND VOLUMETRIC PRECAST KITCHEN (VPK) 176

APPENDIX COM11/VI 180

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM 180

COM11.APPEND6.9 SUGGESTED USER-INTERFACE LAYOUT FOR THE RFID WEB-BASED DATABASE SYSTEM 180

APPENDIX COM11/VII 188

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM 188

COM11.APPEND7.9 LOCATIONS OF RFID TAGS 188

APPENDIX COM11/VIII 195

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM 195

COM11.APPEND8.9 RFID TAG STRUCTURE 195

APPENDIX COM11/IX 197

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM 197

COM11.APPEND9.9 RFID ALERT FUNCTION 197

APPENDIX COM11/X 200

COM11.APPEND10.9 RFID DEVICE REQUIREMENTS 200

COM12 PLASTIC FOLDING DOORS 201

MATERIALS 201

PLASTIC FOLDING DOORS 201

COM12.M010.9 PLASTIC FOLDING DOORS 201

WORKMANSHIP 203

PLASTIC FOLDING DOORS 203
COM12.W010.9 PLASTIC FOLDING DOORS 203

TESTING 204

SURVEILLANCE TESTS 204
COM12.T010.A SURVEILLANCE TESTS FOR PLASTIC FOLDING DOORS 204

COM1 STAINLESS STEEL WINDOWS, DOORS AND LOUVRES

DESIGN

GENERAL

COM1.D010.9 SPECIFICATION REQUIREMENTS

Design and construct all stainless steel windows, doors and louvres, complete with glazing, in accordance with the clauses in this Worksection and the relevant clauses in Worksection COM4.

COM1.D020.9 WINDOWS AND DOORS

Must be:

1. Suitable for inside glazing, unless otherwise shown on the Drawings;
2. An Approved glazing system with stainless steel beads.

DESIGN PARAMETERS

COM1.D110.9 TOLERANCES

Design window, door and louvre so that the tolerances are coordinated with the building tolerances for the structural works as described in Appendix H to this Specification.

COM1.D120.9 GLASS THICKNESS

Design glass thickness to withstand the wind load as specified in COM1.D130 and in no case allow it to be less than 6 mm. Calculate and check the correct thickness.

COM1.D130.9 WIND LOADING FOR GLAZED WINDOWS, DOORS AND LOUVRES

1. The maximum design wind pressure, with topography factor taken into account, adopted for the structural design of the non-domestic buildings and domestic buildings of the Works are ……. kPa and ……. kPa respectively;
2. When fixed in position and glazed, windows, doors and louvres must withstand:
   a. A wind load calculated in accordance with the current Code of Practice on Wind Effects, Hong Kong;
   b. The resultant resistance to wind loading of a minimum of:
      i. 3.0 kPa for non-domestic buildings such as schools, commercial centres etc.;
      ii. 3.8 kPa for domestic buildings excluding ground floor or podium.
3. A maximum permissible deflection of less than 1/180 the length of a particular member or 20mm;
4. Use galvanized mild steel cores, anchors, brackets, etc. as stiffeners, where necessary.

COM1.D140.9 DRAINAGE

As COM2.D140.

SUBMISSION

COM1.D210.9 GENERAL

Ensure that drawings and structural calculations are carried out by a Registered Structural Engineer.

COM1.D220.9 SHOP DRAWINGS AND STRUCTURAL CALCULATION

Submit shop drawings and structural calculations for Approval in accordance with the following:

1. Six months prior to fabrication for windows, doors and louvres;
2. Re-submit for Approval where amendments are necessary;
3. Include design parameters specified on Drawings, design details of section members, fixing details of window, door and louvre members to the adjoining structures, positions of anchor bolts, equipotential bonding connection, ironmongery and accessories, type and thickness of glass in accordance with COM2.D110 to COM2.D140, details of equipotential bonding connection for composite windows in accordance with COM2.W470 and other relevant information;
4. Method statement for fixing friction pivots and sliding stays onto galvanised mild steel bars to window frames and sashes;
5. Structural design for window to be in accordance with either CP 118:1969 or BS 8118:Part 1 & 2:1991. Structural calculation shall be prepared, endorsed and submitted by RSE;
6. Fixing details of floor spring, top pivot and bottom strap for the stainless steel doors using Approved floor spring, including the inspection access for the door pivots fixing screws.

COM1.D240.9 SAMPLES

Submit material samples of windows, doors and louvres for CM's approval prior to the commencement of fabrication.

MATERIALS

WINDOWS, DOORS, LOUVRES AND FIXINGS

COM1.M010.9 WEATHERSTRIP

1. For doors: an Approved proprietary product of chloroprene rubber, polyvinylchloride or woolpile type;
2. For windows: an Approved proprietary product of UV resistant thermoplastic vulcanizate rubber designed for glazing and sealing applications, sized and shaped to fit the proposed window system.

COM1.M020.9 STAINLESS STEEL PLATE, SHEET AND STRIP

1. To BS EN 10095:1999;
2. Grade:
   a. Grade 316 in accordance with MET1.M060 (1)(c);
   b. Grade 304 in accordance with MET1.M060 (1)(b).
3. Thickness: Minimum 1.5 mm or as shown on the Drawings;
4. Finish: in accordance with MET1.M060 (4) or as shown on the Drawings;
5. On Site Delivery Verification (for grade 316 stainless steel items):
   a. Verification required at delivery stage for the following items:
      i. Window or louvre frame;
      ii. Window sash;
      iii. Louvre;
      iv. Non-pipe duct door leaf and door frame;
      v. As directed by the CM.
   b. At delivery stage, submit the following documents:
      i. Manufacturer's certificate:

         Provide the original or a certified true copy of the manufacturer's certificate of compliance with chemical analysis for each consignment delivered to Site. The certificate shall state the standard that the material complies with, and show that the material has been tested and found to comply with the chemical composition specifically required under the standard quoted;
      ii. Written confirmation that the materials delivered to Site conform with the requirements stated at sub-clause (1) to (4) above;
      iii. Delivery notes for all materials delivered to Site.
   c. Chemical Drop Test:

      Carry out and submit report on the following verifications for items stated in sub-clause 5(a) using an Approved proprietary chemical test kit to distinguish the grade of stainless steel. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
- Window frame - Window sash - Louvre - Non-pipe duct door leave and door frame	Approved proprietary Chemical drop test (e.g. single drop of solution to distinguish between low and high molybdenum content)	Change of colour at the tested spot matching the colour indicated at the test chemical's instruction / catalogue

ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under one delivery note]
- Window frame - Window sash - Louvre - Non-pipe duct door leaf and door frame	One test sample per item per batch	Same batch of material delivered to Site under one delivery note

d. When any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, carry out verification using an Approved test method for identification of the grade of stainless steel on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM1.M030.9 STUD ANCHORS AND FIXING BOLTS

As MET1.M220.

COM1.M040.9 EXPOSED FIXINGS

1. Stainless steel screws, nuts, bolts, washers and rivets; nylon washers and caps for window grilles to match finish;
2. For stainless steel door using approved floor spring, all exposed screws to be Allen screws to prevent vandalism.

COM1.M050.9 CONCEALED FIXINGS

Galvanized mild steel fasteners as shown on Drawings.

COM1.M060.9 STAINLESS STEEL BEADS

Fix beads securely to the frame with stainless steel screws or are an integral part of the frame.

COM1.M070.9 SEALANT FOR ASSEMBLING COMPOSITE UNITS

Silicone sealant as per WAT5.M130.

WINDOW AND DOOR FITTINGS

COM1.M110.9 FRICTION PIVOTS AND SLIDING STAYS

1. All friction pivots and sliding stays to be 3 mm thick. All sliding stays and base rails are stainless steel of UNS Designation S30400 to ASTM A240/A240M-09c or equivalent grade of other recognised standards Approved by the CM:
   a. For side hung window, providing a minimum clearance of 100 mm between frame and window when opening at 90°;
   b. For top hung window, providing, a minimum clearance of 70 mm between frame and window when opening at 90°.
2. Friction pivots and screws are to be stainless steel of either UNS Designation S30200, S30400 or S30430 to ASTM A493-09, or equivalent grade of other recognised standards Approved by the CM;
3. All friction pivots and sliding stays are to be fixed with at least 3 nos. of 5 mm diameter stainless steel screws onto galvanized mild steel bar 12 mm minimum (width) x 3 mm (thick) in nominal size, as follows:
4. Length of the friction pivots and sliding stays for side hung window shall be of at least 60% of the width of the side hung window.

COM1.M120.9 CASEMENT FASTENERS, LOCKING HANDLES ETC

1. Stainless steel with satin finish; or
2. Die-cast zinc alloy to BS EN 1774:1998 and BS EN 12844:1999 suitably coloured to match the anodised window.

COM1.M130.9 PULL HANDLES

Stainless steel with hairline finish or anodized aluminium as shown on Drawings.

COM1.M140.9 ROLLERS, GUIDES ETC

Stainless steel with nylon or brass rollers to suit weight of window or door and adjustable after installation.

REMOTE CONTROL EQUIPMENT

COM1.M210.9 HAND OPERATED SYSTEM

As COM2.M310.

COM1.M220.9 REMOTE CONTROL SYSTEM

As COM2.M320.

ANCILLARY MATERIALS

COM1.M310.9 BITUMINOUS PAINT

As COM2.M410.

COM1.M320.9 WATERPROOF BEDDING MORTAR

As COM2.M190.

WORKMANSHIP

FABRICATION AND ASSEMBLY - OFF SITE

COM1.W010.9 SECTIONS

Fabricate from stainless steel plates, sheets and strips as COM1.M020 with projections along external opening edges of sections for weatherstripping.

COM1.W020.9 FIXING WEATHERSTRIPS

Securely fix weatherstrip to projection along the external opening edge of the window or door section to provide a continuous contact between each opening part and its fixed frame.

COM1.W030.9 WELDING FRAMES

Weld joints of frames to form rigid and secure connections. Do not use excessive heat during welding.

COM1.W040.9 SASH MEMBERS

Mechanically joint or mitre sash members and flush butt weld to develop the full strength of members and provide a neat weather-tight joint. Do not use excessive heat during welding.

FABRICATION AND ASSEMBLY - ON SITE

COM1.W110.9 COMPOSITE UNITS

Assemble all composite units on Site and provide all bolts, screws etc and silicone sealants.

INSTALLATION ON SITE

COM1.W120.9 FIXING ANCHOR BOLTS

Fix anchor bolts in accordance with manufacturer's recommendations and at positions to Approved shop drawings.

COM1.W130.9 WINDOWS AND DOORS

Hang to open as indicated on the Drawings and fit with fittings shown on the Drawings.

COM1.W140.9 TOLERANCES

Check the position, size and alignment etc. of all windows, doors and louvres in accordance with the tolerances specified at COM1.D110 and report any discrepancy to the CM. Rectify any fault or discrepancy to the satisfaction of the CM and bear the cost of all such remedial work.

COM1.W145.9 BEDDING AND GROUTING FRAMES

As COM2.W234.

COM1.W147.9 POINTING TO PERIMETER OF WINDOWS, DOORS AND LOUVRES

As COM2.W265.

EQUIPOTENTIAL BONDING TO WINDOWS AND LOUVRES

COM1.W210.9 EQUIPOTENTIAL BONDING TO STAINLESS STEEL WINDOWS, DOORS AND LOUVRES

Unless otherwise specified on Drawings, provide equipotential bonding connection for stainless steel windows, doors and louvers as follows:

1. Louvres for services room and doors:
   a. Weld one end of 1.5 mm thick stainless steel earthing lug(s) to the louvers and doors;
   b. Form a 5 mm diameter hole at the other end of the earthing lug(s) for connection of the bonding conductor by the Nominated Sub-contractor for Electrical Installation;
   c. Ensure that full electrical continuity is maintained between all the component elements of the metal doors and louvres.
2. Windows and louvres in public access areas:
   a. Provide a 20 mm x 1.5 mm thick steel plates earthing lug electroplated zinc galvanized to BS 1706:1990, class B and 13 μm to the outer frame of the windows and louvers. The cut edges of earthing lug shall be painted with zinc rich primer to BS 4652:1995;
   b. Fix one end of the earthing lug to the window with 2 No. M4 self-tapping stainless steel screws at 60 mm centres;
   c. Provide a 5 mm diameter hole at the other end for connection of the bonding conductor by the Nominated Sub-contractor for Electrical Installation;
   d. For window:
      i. The fixing position of the earthing lug should be as far away from the hinge of the window as possible;
      ii. Ensure that full electrical continuity is maintained between all the component elements of composite windows as COM1.W220.
   e. Louvres for services rooms: ensure that full electrical continuity is maintained between all the component elements of the louvres.
3. As COM2.W465 (6).

COM1.W220.9 EQUIPOTENTIAL BONDING REQUIREMENTS FOR COMPOSITE WINDOWS

1. Maintain electrical conductivity with negligible impedance between each member and component of window sets constructed either by means of screw joints, mortice and tenon joints, or riveting;
2. Maintain electrical continuity for composite window construction:
   a. Use appropriate number of stainless steel screws;
   b. Determine number of stainless steel screws and positions to be fixed on windows so as to maintain electric conductivity with negligible impedance between each member and component of the window set.
3. Submit samples of the windows completed with shop drawings showing detailed construction of window sets, including stainless steel screws for earth continuity, all for Approval prior to actual delivery and installation on site.

PROTECTION

COM1.W310.9 PRIMING

Prime reinforced steel framework, cores, anchors and brackets with zinc rich priming paint to BS 4652:1995 with two coats of bituminous paint.

COM1.W320.9 TEMPORARY PROTECTIVE COATINGS TO EXPOSED STAINLESS STEEL

1. Protect all exposed stainless steel surfaces with a strippable coating or low-tack masking tape;
2. Maintain and renew protective coatings as necessary.

COM1.W330.9 PROTECTION OF WINDOWS, DOOR UNITS AND OTHER ASSOCIATED MATERIALS

As COM2.W530.

COMPLETION OF THE WORKS

COM1.W410.9 REMOVAL OF PROTECTIVE COATINGS

Return to Site on completion of the building works and carefully remove protective coatings and leave clean.

COM1.W420.9 ON COMPLETION

As COM2.W610.

TESTING

ON-SITE VERIFICATION TEST

COM1.T010.9 TESTING INSTALLED WINDOWS FOR WATERTIGHTNESS

As COM2.T210.

COM2 ALUMINIUM WINDOWS AND LOUVRES

DESIGN

GENERAL

COM2.D010.9 SPECIFICATION REQUIREMENTS

Design, supply and construct aluminium windows, doors, acoustic panels and louvres, complete with glazing, in accordance with this Worksection and the relevant clauses of Worksection COM4 and COM11.

COM2.D020.9 WINDOWS

Must be:

1. Suitable for inside glazing, unless otherwise shown or scheduled on the Drawings;
2. An Approved glazing system with aluminium beads.

COM2.D030.9 ADJUSTABLE LOUVRE FRAMES

Must be designed:

1. For hand or pole operations;
2. With single or double control(s);
3. To lock automatically when closed;
4. With adjustable louvre clips suitable for receiving either 100; 150 or 230 mm wide glass blades with a minimum nominal thickness of 6 mm;
5. With subframes for louvre frames which provide slotted adjustable lugs and screws for building in.

GENERAL

COM2.D040.9 ACOUSTIC PANEL AT ACOUSTIC BALCONY AND ACOUSTIC WINDOW

1. A composite panel system primarily composed of:
   a. Perforated aluminium sheet to COM2.M040;
   b. Sound absorptive material to COM2.M610;
   c. Black fibre glass tissue covering the sound absorptive material.
2. Dimensions as shown on Drawings;
3. Noise reduction coefficient (NRC) of minimum 0.7 (ASTM C423 or equivalent);
4. Fire performance to BS 476:Part 4:1970 or BSEN 13501:Part 1:2007, or an equivalent international Standard on non-combustibility.

DESIGN PARAMETERS

COM2.D110.9 TOLERANCES

Design windows, doors, acoustic panels and louvres in both precast concrete facades, precast concrete balconies and in-situ concrete walls so that the tolerances are coordinated with the appropriate building tolerances for the structural works as described in Appendix H to this Specification.

COM2.D120.9 GLASS THICKNESS

Design glass thicknesses to withstand the wind load as COM2.D130 and in no case allow it to be less than nominal thickness of 6 mm. Calculate and check the correct thickness.

COM2.D130.9 WIND LOADING FOR GLAZED WINDOWS, DOORS, ACOUSTIC PANELS AND LOUVRES

1. The maximum design wind pressure, with topography factor taken into account, adopted for the structural design of the non-domestic buildings and domestic buildings of the Works are _____ kPa and _____ kPa respectively;
2. When fixed in position and glazed, windows, doors, acoustic panels and louvres must withstand:
    a. A wind load calculated in accordance with the current Code of Practice on Wind Effects, Hong Kong;
    b. The resultant resistance to wind loading of a minimum of:
        i. 3.0 kPa for non-domestic buildings such as schools, commercial centres, etc.;
        ii. 3.8 kPa for domestic buildings excluding ground floor or podium.
3. A maximum permissible deflection of 1/180 the length of a particular member or 20 mm;
4. Use galvanized mild steel cores, anchors, brackets, etc as stiffeners, where necessary.

COM2.D132.9 MULLIONS, TRANSOMS AND CORNER POSTS

1. Mullions and transoms to be reinforced with hot dip galvanized mild steel reinforcement, subject to structural calculation where necessary;
2. The reinforcement bar inside the mullion shall be extended 15 mm from one end of the mullion to facilitate checking.

COM2.D135.9 STRUCTURAL CALCULATIONS

Structural design for aluminium windows, doors, and acoustic panels to be in accordance with either CP 118:1969 or BS 8118:Part 1 & 2:1991. Acoustic panel anchor bolt characteristic capacities to have minimum factor of safety of 3. Structural calculation shall be prepared, endorsed and submitted by RSE.

COM2.D140.9 DRAINAGE

Design the bottom frame members of the openable windows to drain away water and condensation from other frame members. Provide adequate drainage to the bottom frame members whenever necessary.

DESIGN PARAMETERS

COM2.D150.9 ALUMINIUM SLIDING WINDOW AT ACOUSTIC BALCONY

1. Design the aluminium sliding window so that removal of the sliding sash from the window frame is possible only purposefully actuate or remove a safety device;
2. Rollers to be heavy duty nonferrous metal sized and detailed to suit weight of the sliding sash.

SHOP DRAWINGS / CALCULATIONS FOR SUBMISSION

COM2.D210.9 ALUMINIUM WINDOWS, DOORS, ACOUSTIC PANELS AND LOUVRES

Shop drawings and calculations must:

1. Be submitted for Approval in accordance with the following:
   a. Six months prior to fabrication for aluminium windows, doors, acoustic panels and louvres fixed to cast in-situ concrete walls;
   b. Within two months of the notified date of the commencement of the Works for aluminium windows, doors and louvres fixed to precast concrete facades and / or precast concrete balconies.
2. Be re-submitted for Approval where amendments are necessary;
3. Include design details of die section members, position of fixing lugs, equipotential bonding connection, ironmongery and accessories, type and thickness of glass in accordance with the design parameters specified in COM2.D110 to COM2.D150, details of equipotential bonding connection for composite windows in accordance with COM2.W470 and other relevant information;
4. Include fixing details of Radio Frequency Identification tags as specified in the Worksection COM11 for aluminium windows.

COM2.D230.A COMPLIANCE WITH STANDARDS

Design aluminium windows, doors and acoustic panels in compliance with the appropriate Standards as listed below:

1. Code of Practice on Wind Effects in Hong Kong 2019, Code of Practice for Fire Safety in Buildings 2011, Code of Practice for Structural Use of Glass 2018 and all other applicable Ordinances, Regulations and Codes in Hong Kong;
2. BS 1470:1987 – Aluminium plate, sheet and strip;
3. BS 1471:1972 – Aluminium drawn tube;
4. BS 1473:1972 – Aluminium rivets, bolts and screws;
5. BS 1474:1987 and BS 18:1987 – Aluminium bars and extrusions;
6. BS 1161:1977 – Specification for aluminium alloy sections for structural purposes;
7. BS EN 12373-1:2001 – Clear anodic oxidation coatings on aluminium and its alloy;
8. BS 3987:1991 and BS EN ISO 1463:1995 – Anodic oxidation coatings on coloured aluminium and its alloy;
9. BS 4479:1990 – Recommendations for the design of metal articles that are to be coated;
10. BS 7773:1995 – Cleaning and preparation of metal surfaces;
11. BS 6262:1982 – Code of Practice for glazing for buildings;
12. BS 952:Part 1:1995 – Glass for glazing;
13. BS 6375:Part 1:2009 and BS 6375:Part 2:2009 – Test requirements for window performance;
14. CP 118:1969 – Code of Practice for the structural use of aluminium;
15. BS 8118:Part 1 & 2:1991 – Structural use of aluminium;
16. BS 5889:1989 – Sealant;
17. BS EN ISO 3506-1 to 2:1998 – Corrosion-resistant stainless steel fasteners;
18. BS EN 1774:1998 and BS EN 12844:1999 – Die-cast zinc alloy;
19. Code of Practice for the Electricity (Wiring) Regulations, 2003 Edition;
20. BS 7671:2001 – Requirements for Electrical Installation;
21. BS 4873:2004 – Aluminium alloy windows;

22. BS 3111 – Stainless steel fasteners;
23. PD 6484:1979 – Commentary on corrosion at bimetallic contacts and its alleviation;
24. ASTM A240/A240M -09c – Stainless steel for the sliding stays and base rails of frictional hinges;
25. ASTM A493-09 – Stainless steel for the friction pivots and screws of frictional hinges.

OTHER SUBMISSION

COM2.D310.9 MILL CERTIFICATES

Submit mill certificates to verify compliance of the following:

1. Aluminium alloy to BS 1474:1987 and include:
   a. Requirement and result of chemical analysis;
   b. Requirement and result of mechanical property:
      i. Tensile strength;
      ii. Yield strength;
      iii. Elongation.
2. Anodic oxidation coating on aluminium: to BS EN 12373-1:2001 for clear anodizing and BS 3987:1991 for coloured anodizing;
3. Stainless steel grade for sliding stays and base rails: of UNS Designation S30400 to ASTM A240/A240M-09c, or equivalent grade of other recognised standards Approved by CM;
4. Stainless steel grade for friction pivots: of either UNS Designation S30200, S30400 or S30430 to ASTM A493-09, or equivalent grade of other recognised standards Approved by CM.

MATERIALS

GENERAL

COM2.M001.N ALUMINIUM WINDOWS AND COMPONENT

1. At sample submission and approval stage, submit manufacturer's written confirmation for the product components including frame, glass, surface treatments, etc. that the components shall not contain the following substances or their compounds:
   a. Arsenic;
   b. Cadmium;
   c. Hexavalent chromium;
   d. Lead;
   e. Mercury;
   f. Organic tin;
   g. Phthalates.

COM2.M005.A ALUMINIUM WINDOWS, DOORS, GRILLES AND ACOUSTIC PANELS

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed aluminium windows, doors, grilles and acoustic panels for CM's approval together with all the following substantiation for CM's information:
      i. Job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or the document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
      v. When the aluminium windows, doors, grilles and acoustic panels are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
         - Submit a sample board similar to the one maintained by the Housing Department showing the extrusions, ironmongeries and accessories for the proposed aluminium windows, doors, grilles and acoustic panels if applicable. Submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;
         - Submit the proposed Radio Frequency Identification tag and fixing method as specified in Worksection COM11;
         - Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body

ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

vi. Original or certified true copy of the mill certificates of the stainless steel grades used for manufacturing the sliding stays, base rails and friction pivots as specified in COM2.D310;

vii. Original or certified true copy of the test reports from the manufacturer of frictional hinges showing the relevant batches of rolls of stainless steel materials to be used for manufacturing the sliding stays, base rails and friction pivots are in full compliance with the requirements of mechanical property and chemical composition of the referenced standard as specified in COM2.D310;

viii. When acoustic panels are supplied for domestic blocks, submit original or certified true copy of the test report from the manufacturer of acoustic panels showing:

- The sound absorptive material (SAM) used is non-combustible as per COM2.M610 (3);
- The composite acoustic panel system is in compliance with the noise reduction requirement as per COM2.D040 (3);
- The composite acoustic panel system is in compliance with the fire performance requirement as per COM2.D040 (4).

Date of the tests shall be generally within five years prior to the notified date for commencement of the Works;

ix. Job reference for the weather strip as specified in COM2.M110 (2).

b. For aluminium windows used in domestic blocks, except for the ancillary facilities at lower floors, submit original or a certified true copy of the product conformity certificate to the "Product Conformity Certification Scheme For Aluminium Windows" published by the Hong Kong Institute of Steel Construction to the CM for information. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM:

i. The product conformity certificate shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a) above or at a time not later than 12 months from the date of commencement of the Works;

ii. In the event that the product conformity certificate has not been submitted for CM's information, the CM may order the removal of materials or delivered products off Site. Bear all associated costs and no extension of time will be allowed.

c. A summary of the test results under the audit testing of the "Product Conformity Certification Scheme For Aluminium Windows". The summary shall be prepared by the accredited laboratory carried out the testing or the certified manufacturer. If so directed by the CM, submit a full set of the audit test reports to the CM for record;

d. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(a) below for CM's information unless the test requirements are covered by the scope of the "Product Conformity Certification Scheme For Aluminium Windows":

i. The date of the test shall be generally within five years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a) above, or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a) below;

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. The quality and performance requirements are as follows:

Items	Method	Acceptance Standards	Remarks
i. Dimensional Tests			
- Overall Size	Measure the peripheral and diagonal dimensions of the sample to nearest 0.5 mm. Indicate the measurements in the report with aid of schematic diagrams.	- Peripheral dimensions: ±1.0 mm for length < 2 m ±1.5 mm for 2 m ≤ length < 3.5 m ±2.0 mm for 3.5 m ≤ length < 5 m ±3.0 mm for length ≥ 5 m - Diagonal dimensions: ±1.5 mm for length < 2 m ±2.5 mm for 2 m ≤ length < 3.5 m ±3.5 mm for length ≥ 3.5 m	• Three specimens are required, one for tests (i), (ii)(a) to (c) and (iii), one for tests (ii)(d) and (v) and the other for test (iv) unless otherwise specified. • For tests (i), refer to the shop drawings submitted by the suppliers for dimensions of each type of windows.

- Individual Member	Select one structural member to be tested. Choose three positions, each 300 mm apart, along the length of the member. Carry out dimensional tests to BS 1474:1987:Cl. 7.4 on width, angular dimensions, corner radii, straightness, concavity and thickness;	- Width - BS 1474:1987: Table 6 - Angular dimensions - BS 1474:1987: Table 9 - Corner radii - BS 1474:1987: Table 10 - Straightness - BS 1474:1987: Table 14 - Concavity - BS 1474:1987: Table 16 - Thickness - Minimum 2 mm	• For test on individual member under test (i), suppliers should provide additional sections of the members 300 mm long, in case suitable testing positions are difficult to access in complete windows set. • For tests (ii)(a) to (ii)(c): Sequence of tests from (ii)(a) to (ii)(c) shall be followed. Failure of any test will have the whole sequence re-tested. Test (ii)(c) apply to side hung windows only. •For test (ii)(d) Full size sample of window with glazing shall be used, and shall be tested separately from all the above operation or strength tests. • For tests (iv): Full size sample of window with glazing shall be used.
	Perform the test for structural member above to one non-structural member.	Same as above.	
ii. Operation & Strength Tests			
(a) Operating Forces	BS 6375-2:2009: Cl. 5.1 and BS EN 12046-1:2003	BS 6375-2:2009:Cl 5.1 and Table 1	
(b) Resistance to Static Torsion	BS 6375-2:2009: Cl. 5.2.1 and BS EN 14609:2004 Static test load F=300 N	BS 6375-2:2009: Cl. 5.2.1 and BS EN 13115:2001 Cl.3	
(c) Resistance to Racking	BS 6375-2:2009: Cl 5.2.2 and BS EN 14608:2004 Static test load F=600 N	BS 6375-2:2009: Cl 5.2.2 and BS EN 13115:2001 Cl.3	
(d) Endurance of Fastener or Hardware	SS212:2007 Annex E Test 8 Include Test 1 and Test 2	SS212:2007 Cl.10.2.2.7, 10.2.2.1.1, 10.2.2.1.2 and 10.2.2.2 No visual damage, and forces and torque not to exceed the appropriate values in Tables 2 and 3.	
iii. Tests on Coating			
- Visual Inspection	BS 3987:1991: Cl.3 and Appendix G	Surface shall be free from visible coating defects.	
- Thickness of Coating	BS EN ISO 1463: 1995:for thickness Class 25	Minimum average thickness is 25 μm, and minimum local thickness is 20 μm.	

iv. Weathertightness Tests			
- Air Permeability Test	BS 6375-1:2009: Cl. 6 and BS EN 1026:2000 Pa max = 600Pa	BS 6375-1:2009:Cl. 6 and Figure 1 : Graph C No damage and functional defects shall be noted.	
- Watertightness Test	BS 6375-1:2009: Cl. 7 and BS EN 1027:2000 test procedure A Pa max = 770Pa	BS 6375-1:2009:Cl. 7 Pa max = 770Pa No water leakage, damage and functional defects shall be noted.	
- Resistance to Wind Test	BS 6375-1:2009: Cl. 8 and BS EN 12211: 2000 Positive wind pressure : P_1 = design wind loading in accordance with COM2.D130 $P_2 = 0.5\ P_1$, $P_3 = 1.5\ P_1$; Negative wind pressure : P_1'= design wind loading in accordance with COM2.D130 $P_2'= 0.5\ P_1'$, $P_3'= 1.5\ P_1'$	- BS 6375-1:2009: Cl. 8 and BS EN 12210: 2000 Cl.6 - For deflection test at pressure P_1 and P_1', permissible deformation of any member shall be less than 1/180 the length of the particular member and shall not be greater than 20 mm	BS 6375-1:2009 Annex B Figure B1 to be used as sequence of operation.
- Water Penetration Test by Cyclic Static Air Pressure Difference	ASTM:E547 -00 Test pressure difference =770Pa Ten test cycles	No water leakage, damage and functional defects shall be noted.	This Test to be carried out after the Repeated Pressure Test (i.e. pulsating test to P_2 and P_2') and the Repeated Air Permeability Test, but before the Safety Test at pressure P_3 and P_3' of the Resistance to Wind Test.
v. Tensile Test	BS 18:1987	BS 1474:1987	

b. Frictional hinge surface quality:
   i. Free from rust, cracks;
   ii. Friction pivots are correctly positioned at the sliding stays, squarely pinned and not over-clamped.
c. When the aluminium windows and grilles are supplied for domestic blocks except those for the ancillary facilities at lower floors, standard of visual quality shall be comparable with the benchmark samples maintained by the Housing Department;
d. Weather strip to COM2.M110.

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a) above;

ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site;

iv. For the weather strip, the following delivery notes certified by the aluminium window manufacturer:

- From manufacture plant of the thermoplastic vulcanizate (TPV) raw material to the weather strip manufacturing plant complete with a lot number; date of delivery generally within three years prior to the notified date for commencement of the Works;
- From the weather strip manufacturing plant to the aluminium window manufacturing plant at sub-clause (1)(a)(v) showing the lot number of the TPV used; date of delivery to be generally within one year prior to the notified date for commencement of the Works.

b. Carry out and submit report on the following verifications for aluminium windows and grilles upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Window Manufacturer's Certificate of Origin & Delivery Note Traceability record of raw material of weather strip submitted according to sub-clause (3)(a)(iv)	Document Check	From an Approved origin with information of product identification numbers Identical lot numbers of vulcanizate elastomeric material used to manufacture the weather strips for the aluminium windows delivered to Site.
Dimension Check	By measurement	COM2.M005 (2)(a) on overall size, COM2.M010 (2), (3), (4)
Surface Quality	Visual	Aluminium Windows: No discolouration, no damage, no staining, no blemish, acceptable colour consistency, no visible coating defects. Frictional Hinges: Refer to COM2.M005 (2)(b), and no damage to hinge fixing. Bituminous paint to COM2.M410 to be fully coated
Weather strip	Visual	COM2.M110 (1)
Aluminium Beads	Visual	COM2.M120
Exposed Fixings	Visual	COM2.M130

Sealant for assembling composite units	Visual	Neat & tidy and in accordance with COM2.M170 and Approved drawings
Small gap sealant	Visual	Neat & tidy and in accordance with COM2.M172 and Approved drawings
Friction Pivots, Sliding stays, base rails and screws of frictional hinges	By measurement	COM2.M210
Casement fasteners, locking handles	Visual	COM2.M220 and Approved drawings
Window locks	Visual and by measurement	COM2.M230 and Approved drawings
Pull handles	Visual	COM2.M240 and Approved drawings
Rollers, Guides	Visual	COM2.M250
Identification	Visual	COM2.M305
Coating Thickness Check	Clear anodizing – Hand held dry film thickness measuring equipment	Clear anodizing – Minimum average thickness is 25 μm and minimum local thickness is 20 μm to COM2.M020.
Dimension of the Structural Reinforcement Bars (if Required)	By measurement	The nominal dimensions in accordance with the structural calculation and the projection from the aluminium section to be 15 mm minimum at one end to COM2.D132
Reinforcement bar at frictional hinges and mullion	By strong magnet	Magnetic attraction on the position of the reinforcement bars to COM2.M300

ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note specified in COM2.M005 (3)(a)]
Manufacturer's Certificate of Origin & Delivery Note	Each batch	Same batch of material delivered to Site under one Delivery Note

Dimension Check	1 sample for every 400 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Surface Quality	1 sample for every 400 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Fixings, Fastenings & Fittings Check as per sub-clause (3)(b)(i)	1 sample for every 400 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Coating Thickness Check	1 sample for every 400 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Hinge and Structural Reinforcement Bars Check (if required)	1 sample for every 400 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Dimension of the Structural Reinforcement Bars (if required)	1 sample for every 400 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note

c. When any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

4. Open Up Inspections:
   a. When instructed, open up a sample of aluminium window for verification of the concealed parts by the CM before the window is installed to the concrete surrounds at:
      i. Precast concrete component factory;
      ii. Site.
   b. Inspection samples:
      i. For sub-clause (a)(i), one set of aluminium window for installation at a precast façade selected by the CM;
      ii For sub-clause (a)(ii), one set of aluminium window with a reinforcement bar at the mullion for installation on Site selected by the CM;
      iii. For the purpose of sub-clause (4), the representative batch of the samples means the same type of aluminium window in the same batch of material delivered to the precast concrete component factory or to Site under a delivery note as specified in sub-clause (3)(a)(ii).
   c. Inspection to include the following concealed items:
      i. Reinforcement bar inside mullion;
      ii. Reinforcement bar inside the window frame and sash for fixing the frictional hinges;
      iii. Angle bracket at corners of sashes.
   d. All checked items to be in compliance with the Approved drawings;

e. In the event that any of the verifications fails to meet the acceptance standards, either remove the representative batch off Site, or apply to the CM for re-inspection for the representative batch in accordance with the test methods specified in sub-clauses (4)(c) and (4)(d) above on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed;

f. When the representative batch of aluminium windows is removed off Site, replace with another new batch (hereinafter referred to as the "replacement batch"). Apply to the CM for inspection in accordance with the methods as specified in sub-clause (4)(a), (4)(b), (4)(c) and (4)(d)) above for one set of samples selected by the CM from the replacement batch. In case any one sample fails the inspection, follow the action stated in sub-clause (4)(e);

g. Bear the costs of any failed open up inspections and all associated costs for the inspection(s) and re-inspection(s) required in sub-clauses (4)(e) and (4)(f). No extension of time will be allowed.

ALUMINIUM MEMBERS AND FINISHES

COM2.M010.9 SECTIONS

Extruded aluminium alloy to BS 1474:1987, and:

1. Alloy designation: 6063 - T5 or T6;
2. Structural members: minimum wall thickness 2 mm;
3. Non-structural members: minimum wall thickness 2 mm;
4. Glazing bead: minimum wall thickness 1.0 mm;
5. Dovetailed groove for weather stripping;
6. Handle: minimum wall thickness as per Approved shop drawings.

COM2.M020.9 CLEAR ANODIZING

To BS EN 12373-1:2001, thickness Class 25 (average thickness of 25 microns minimum and local thickness of 20 microns minimum) for aluminium window frames.

COM2.M030.9 COLOUR ANODIZING

1. To BS 3987:1991 and not less than 25 microns thick;
2. Colour: as shown on the Drawings.

ALUMINIUM MEMBERS AND FINISHES

COM2.M040.9 PERFORATED ALUMINIUM SHEET AT ACOUSTIC INSTALLATIONS

Comply with the following requirements:

1. Acoustic panel at acoustic window –
   a. 2mm thick aluminium sheet with 40% perforation subject to project specific Environmental Assessment Report;
   b. Surface to be natural anodize finished.
2. Acoustic panel at acoustic balcony –
   a. 3mm thick aluminium sheet with 23% perforation subject to project specific Environmental Assessment Report;
   b. Surface finish to be polyvinylidene difluoride (PVDF) coating finished to AAMA 2605-11 requirements, factory applied 3 coat system of 30 microns minimum total dry film thickness;

c. Colour to CM's approval;

d. Provide aluminium stiffeners at locations as required by structural calculations and to show on shop drawings for Approval;

e. Fold aluminium sheet to form the acoustic panel; maintain along the folded edges of the panel a solid margin without perforations.

FIXINGS, FASTENINGS ETC

COM2.M110.9 WEATHER STRIP

1. An Approved weather strip, manufactured from a thermoplastic vulcanizate (TPV) material, designed for weather strip applications, sized and shaped to securely dovetail into the window section groove, black in colour, free of porosity, surface defects, and dimensional irregularities;
2. The weather strip shall have a record of minimum five local projects completed within five years prior to the notified date for commencement of the Works;
3. Fire retardant performance of the elastomeric material for the weather strip to comply with either -
   a. UL 94 Class V-0; or
   b. ASTM C1166-06, flame propagation max 100mm.
4. Physical properties of weather strip to comply with the following requirements:

Properties	Requirements	Test method
Hardness	nominal Shore A durometer 70 ± 5	ASTM D2240
Tensile strength	6 MPa min.	ASTM D412, Die C
Elongation at rupture	400 % min.	ASTM D412, Die C
Heat resistance and accelerated ageing - 70 hrs @ 100°C	10 durometer points max.	BS 903-A19:1986

COM2.M120.9 ALUMINIUM BEADS

Use beads which securely clip to the frame or are an integral part of the frame.

COM2.M130.9 EXPOSED FIXINGS

Screws, nuts, bolts, washers and rivets: use aluminium alloy, stainless steel (grade 304/A2-70 for bolts and grade 302/A2-50 for screws), copper with chromium plated finish or nylon washers and caps for window grilles to match finish, where possible.

COM2.M140.9 CONCEALED FASTENING DEVICES

Galvanized mild steel or aluminium fasteners as shown on Drawings.

COM2.M145.9 FIXING LUGS

Galvanized steel to BS EN10346:2009, Coating Designation Z200 and 14 μm, size as shown on the Drawings unless otherwise Approved, with the cut edges to be painted with zinc rich primer to BS 4652:1995.

COM2.M160.9 PERIMETER SEALANT

1. In compliance with WAT5.M110;
2. Low modulous silicone rubber sealant to BS 5889:1989, Type A.

COM2.M170.9 SEALANT FOR ASSEMBLING COMPOSITE UNITS

1. In compliance with WAT5.M110;
2. Silicone sealant to BS 5889:1989, Type B.

COM2.M171.9 SEALANT FOR FIXING GLAZING

1. In compliance with WAT5.M110;
2. Silicone sealant to BS 5889:1989 (neutral type), Type B.

COM2.M172.9 SMALL GAP SEALANT

1. In compliance with WAT5.M110;
2. Synthetic rubber base sealant for aluminium section joints.

COM2.M190.9 WATERPROOF BEDDING MORTAR

1. Cement and sand (1:3) with non-shrinkage waterproofing additives as recommended by the manufacturer or;
2. Proprietary mortar with non-shrinkage waterproofing additives as recommended by the manufacturers suitable for bedding and grouting window frames.

COM2.M195.9 WATER BARS

Aluminium with keyed surface bent to shape as shown on the Drawings.

WINDOWS FITTINGS

COM2.M210.9 FRICTION PIVOTS, SLIDING STAYS, BASE RAILS AND SCREWS OF FRICTIONAL HINGES

1. All sliding stays are to be 2.5 mm minimum thick. All sliding stays and base rails are stainless steel of UNS Designation S30400 to ASTM A240/A240M-09c or equivalent grade of other recognised standards Approved by CM:
   a. For side hung window, provide a minimum clearance of 100 mm between frame and window when it opens at 90°;
   b. For top hung window, provide a minimum clearance of 70 mm between frame and window when it opens at 90°.
2. Friction pivots and screws are to be stainless steel of either UNS Designation S30200, S30400 or S30430 to ASTM A493-09, or equivalent grade of other recognised standards Approved by CM;
3. All friction pivots and sliding stays are to be fixed with at least 3 nos. of 5 mm diameter stainless steel screws onto galvanized mild steel bar 12 mm minimum (width) x 3 mm (thick) in nominal size, as follows:
   a. Frame members:
      i. At location with aluminium box section, the galvanized mild steel bar is to be inserted and pre-fixed inside the box;
      ii. At location with single web aluminium frame section, the galvanized mild steel bar is to be pre-fixed directly underneath the web.
   b. Sash members:
      i. The galvanized mild steel bar is to be inserted and pre-fixed inside the box, terminated at the aluminium alloy angle bracket at the corner for mechanical fixing of the mitre joint;
      ii. One screw is to be fixed onto the pre-tapped aluminium alloy angle bracket close to the mitre joint and the remaining screws are to be fixed onto the pre-fixed galvanized mild steel bar.

4. Length of the friction pivots and sliding stays for side hung window shall be of at least 60% of the width of the side hung window.

COM2.M220.9 CASEMENT FASTENERS, LOCKING HANDLES ETC

1. Stainless steel with satin finish; or
2. Die-cast zinc alloy to BS EN 1774:1998 and BS EN 12844:1999 suitably coloured to match the anodised window.

COM2.M230.9 WINDOWS LOCKS

1. Dual lock, triple point lock and cam lock:
   a. Dual lock for side hung window up to 1200 mm high and triple point lock for side hung window exceeding 1200 mm high. The guiding system for both dual lock and triple point lock shall prevent loosening and sideway movement of the lock handles;
   b. Cam lock: one at 800 mm width for top hung window;
   c. The locks shall be of matching style and finishes;
   d. When the locks are supplied for domestic blocks, the profile and the visual quality of the locks shall be comparable with the latest benchmark samples of the locks maintained by the Housing Department.
2. Lock for fixed window to be operated by a hex key or equivalent as shown on the Drawings;
3. Locks for the sliding window at acoustic balcony –
   a. Dual shootbolt lock at both verticals of sash;
   b. Operate lock by handle with a hex key or equivalent.

COM2.M240.9 PULL HANDLES

Anodized aluminium.

COM2.M250.9 ROLLERS, GUIDES ETC

Electroplated zinc galvanized steel with nylon or brass rollers to suit weight of window and adjustable after installation.

COM2.M260.9 EARTHING LUGS

A 20 mm x 1.5 mm thick steel plate earthing lug electroplated zinc galvanized to BS 1706:1990, Class B and 13 μm to the outer frame of window and louvers with cut edges painted with zinc rich primer to BS 4652:1995.

COM2.M300.9 REINFORCEMENT

1. Galvanized mild steel in compliance with BS EN 10025-Part 1 – Part 6:2004;
2. Securely fixed as recommended by the window supplier.

COM2.M305.9 IDENTIFICATION

Supply RFID tags as specified in COM11 with a unique serial number and marked in an inconspicuous position on each aluminium window. Identify and record the date of manufacture.

WINDOWS FITTINGS

COM2.M306.9 ROLLER AT ALUMINIUM SLIDING WINDOW

Heavy duty non-ferrous metal rollers and comply with requirements at COM2.D150 (2).

COM2.M307.9 STOPPER AT ALUMINIUM SLIDING WINDOW

Comply with requirements at COM2.D150 (1).

REMOTE CONTROL EQUIPMENT

COM2.M310.9 HAND OPERATED SYSTEM

Approved proprietary product with shaft and lever.

COM2.M320.9 REMOTE CONTROL SYSTEM

Approved proprietary product. Conduit and cable system with bronze or die-cast zinc alloy bevel gear boxes, adjustable arms and keyed shafts.

PROTECTIVE PAINTS

COM2.M410.9 BITUMINOUS PAINT

Black bitumen coating solution to BS 6949:1991, Type 1.

ACOUSTIC BALCONY ALUMINIUM DOOR FITTINGS

COM2.M510.9 DOOR LOCK, FURNITURE AND ACCESSORIES

Provide the following according to Drawings -

1. Multi point lock to be:
   a. Mortised into the door stile;
   b. Operated from inside the flat only by turning the door lever handle together with press and hold the snib at the lever handle.
2. Pull handle profile on the outside and inside to be identical;
3. Butt hinge to be exposed type with metal washers and an internal stainless steel rod;
4. Laminated tempered glass to COM4.M060 and COM4.M110; pattern shown on Drawings to be either by ceramic frits fused to glass surface #4 or using patterned pvb interlayer;
5. Elastomeric weather strip along perimeter of door leave and frame to COM2.M110.

SOUND ABSORPTIVE MATERIAL

COM2.M610.9 SOUND ABSORPTIVE MATERIAL (SAM) FOR ACOUSTIC INSTALLATIONS

Comply with the following requirements:

1. A proprietary product of glass fibre, mineral fibre or equivalent;
2. No release of toxic emission;
3. Fire performance to BS 476:Part 4:1970 or BS EN 13501 Part 1:2007 Class A1, or an equivalent international Standard on non-combustible;
4. When installed in acoustic panels at Acoustic Balcony or Acoustic Window, the SAM shall comply with the noise reduction requirements for the composite acoustic panel system as per COM2.D040 (3).

WORKMANSHIP

APPROVAL PRIOR TO FABRICATION AND SITE INSTALLATION

COM2.W020.9 SAMPLES AND SHOP DRAWING APPROVAL

Do not commence fabrication or site installation works until all samples and shop drawings have been Approved.

FABRICATION AND ASSEMBLY

COM2.W110.9 FIXING WEATHERSTRIPS

Securely fix weatherstrip into the dovetailed groove of the window section. Ensure there is continuous contact between each opening part and its fixed frame.

COM2.W120.9 WELDING WEATHERSTRIPS

Weld all corner joints of weatherstrips and provide a neat weathertight joint.

COM2.W130.9 FRAMES

Mechanically joint using mortice and tenon construction to provide a rigid and secure connection.

COM2.W140.9 SASH MEMBERS

Mechanically joint or mitre sash members to develop the full strength of members and provide a neat weathertight joint. Fix aluminium angle plate at the back of mitre joint of sash members with silicone sealant (neutral type).

COM2.W150.9 SIDE AND TOP HUNG WINDOWS

Hang to open as indicated on the Drawings and fit as specified with:

1. Friction pivots and sliding stays;
2. Pull handle with dual or triple-point lock for side hung windows;
3. Cam lock for top hung windows.

COM2.W170.9 OPENING LIGHT FRAMES

Ensure tightness and clearance between sash and frame of all opening lights before deliver to Site or precast concrete component yard.

INSTALLATION OF ALUMINIUM WINDOWS TO CAST IN-SITU CONCRETE WALLS

COM2.W210.9 COMPOSITE UNITS

Assemble all composite units on Site and provide all bolts, screws etc and sealants.

COM2.W220.9 CUTTING, TRIMMING AND WELDING

Do not cut, trim or weld during erection on Site.

COM2.W230.9 TOLERANCES

1. Check the position, size and alignment etc. of all openings for windows, doors, acoustic panels and adjustable louvres in accordance with the tolerances specified in Appendix H to this Specification and report any discrepancy to the CM;
2. Rectify any fault or discrepancy to the satisfaction of the CM, and bear the cost of such remedial work.

COM2.W231.9 FIXING LUGS

1. Space galvanized steel fixing lugs, formed to the dimensions shown on the Drawings, at 150 mm from corner edge and 300 mm maximum centre to the outer frame of each unit and where shown fix lugs with cartridge driving pin or proprietary anchoring system;
2. Form or cut pockets in heads etc. to receive fixing lugs, fixing/anchor bolts, build in lugs or insert bolts and screw to frames using packing pieces where necessary. Do not distort frames when tightening fixings.

COM2.W232.9 POSITIONING

Position windows, doors, acoustic panels and louvres plumb, level and square.

COM2.W233.9 OPENING LIGHTS

Check tightness and clearance between sash and frames of all opening lights.

COM2.W234.9 BEDDING AND GROUTING FRAMES

Mix and apply waterproof bedding mortar strictly in accordance with the mortar manufacturer's recommendations. Fully bed and grout frames leaving no gaps.

COM2.W236.9 FIXING WATER BARS

Fixed full height water bars at locations as shown on the Drawings.

COM2.W265.9 POINTING TO PERIMETER OF WINDOWS AND LOUVRES

1. Remove filler board from the pre-formed joint, if any, around external perimeter of window frames;
2. Mask any adjoining surfaces which would be impossible to clean if smeared with sealant;
3. Point external perimeter of window frames with sealant to form a smooth flat joint; and
4. Remove excess sealant from the adjoining surfaces and wipe clean.

FIXING LOUVRE FRAMES

COM2.W310.9 HANDLING AND STORAGE

Avoid distortion during handling and storage.

COM2.W320.9 POSITIONING

Position frames plumb, level and square.

COM2.W330.9 FIXING

When fixing:

1. Form or cut pockets to receive fixing lugs, where required. Build in lugs and screw to sub-frames; or
2. Where necessary, plug and screw sub-frames using packing pieces; and
3. Plug and screw louvre frames and weatherstrips, where required.

COM2.W340.9 BEDDING AND GROUTING IN MORTAR

Mix and apply waterproof bedding mortar in accordance with manufacturer's recommendation. Fully bed and grout sub-frames leaving no gaps.

COM2.W350.9 LOUVRE FRAMES

Screw louvre frames to sub-frames at maximum 225 mm centres to centre. Do not distort frames when tightening fixings.

INSTALLATION OF ALUMINIUM WINDOWS TO PRECAST CONCRETE FACADES

COM2.W415.9 FIXING LUGS

Space fish-tail galvanized steel fixing lugs by slotting into the window frame at 150 mm from corner edge and 300 mm maximum centre to centre.

COM2.W420.9 POSITIONING

Position windows plumb, level and square.

COM2.W430.9 FIXING

Fix windows and window frames in position with adequate supports to avoid distortion and damage to windows before placing concrete in moulds for the facade / balcony units.

COM2.W450.9 POINTING TO PERIMETER OF WINDOWS AND LOUVRES

1. Mask any adjoining surfaces which would be impossible to clean if smeared with sealant;
2. Point external perimeter of window frames with sealant to form a smooth flat joint; and
3. Remove excess sealant from adjoining surfaces and wipe clean.

EARTH / EQUIPOTENTIAL BONDING

COM2.W465.9 EQUIPOTENTIAL BONDING TO WINDOWS, DOORS, ACOUSTIC PANELS AND LOUVRES

1. Provide earthing lugs as per COM2.M260;
2. Fix one end of the earthing lug to the windows, doors, acoustic panels and louvers with 2 nos. M4 self-tapping stainless steel screws at 60 mm centres;
3. Provide a 5 mm diameter hole at the other end for connection of the bonding conductor by the Nominated Sub-contractor for Electrical Installation;
4. For window:
   a. The fixing position of the earthing lug should be as far away from the hinge of the window as possible;
   b. Ensure that full electrical continuity is maintained between all the component elements of composite windows as COM2.W470.
5. Louvres for services rooms: ensure that full electrical continuity is maintained between all the component elements of the louvres;

6. The Nominated Sub-contractor for Electrical Installation shall ensure the bonding for extraneous conductive parts is sound and the result complies with the CoP for the Electricity (Wiring) Regulation and BS 7671:2001 by proper measurement with records at good time. For those parts of equipotential bonding system found not electrical conductive, the Main Contractor and the Nominated Sub-contractor for Electrical Installation shall be responsible for rectification of their own works as early as possible.

COM2.W470.9 EQUIPOTENTIAL BONDING REQUIREMENTS FOR COMPOSITE WINDOWS

1. Maintain electrical conductivity with negligible impedance between each member and component of window sets constructed either by means of screw joints, mortice and tenon joints, or riveting;
2. Maintain electrical continuity for composite window construction:
   a. Use appropriate number of stainless self-tapping stainless steel screws;
   b. Determine number of stainless steel screws and positions to be fixed on windows so as to maintain electric conductivity with negligible impedance between each member and component of the window set.
3. Submit samples of the windows completed with shop drawings showing detailed construction of window sets, including stainless steel screws for earth continuity, all for Approval prior to actual delivery and installation on site.

TRANSPORTATION, HANDLING AND STORAGE

COM2.W490.9 TRANSPORTATION, HANDLING AND STORAGE

1. Avoid distortion during handling and storage, transporting to and within Site and the precast concrete component yard;
2. Do not allow working platform rest on windows and/or window frames to prevent damage or distortion;
3. Keep upright during handling to prohibit sagging and stack off ground on levelled hard standing under cover, clear of mud and site traffic.

PROTECTION

COM2.W510.9 PRIMING STEEL REINFORCEMENT ETC

Prime the cut edges of galvanized steel reinforcement, cores, anchors and brackets, (except fixing lugs), with zinc rich primer to BS 4652:1995 and paint the whole piece of material with two coats of bituminous paint.

COM2.W515.9 ALUMINIUM FRAME AND SASH

Provide adequate backing supports to all fixed accessories on frame and sash such as dual lock, cam lock, glazing bead and etc.

COM2.W520.9 ALUMINIUM IN CONTACT WITH OTHER MATERIALS

Protect concealed aluminium surfaces which may come in contact with wet mortar, cement, plaster or similar materials with one coat of bituminous paint.

COM2.W525.9 PROTECTION OF ALUMINIUM IN CONTACT WITH OTHER MATERIALS

Avoid contact with concrete, mortar, plaster or other similar materials. Where there is not possible refer to COM2.W530 and COM2.W540.

COM2.W530.9 TEMPORARY PROTECTIVE COATINGS TO EXPOSED ALUMINIUM

Protect all exposed aluminium surfaces with a strippable coating or low-tack masking tape.

COM2.W540.9 WINDOWS AND OTHER ASSOCIATED MATERIALS

Wrap in stout waterproof paper or polythene to protect against damp and scratching. Avoid premature delivery to Site.

COM2.W550.9 REMOVAL OF TEMPORARY PROTECTIVE COATINGS

Maintain and renew protective coating as necessary and carefully remove to leave clean on completion of the works.

COMPLETION

COM2.W610.9 ON COMPLETION

Lubricate and adjust moving components and leave in perfect working order on completion.

TESTING

ON-SITE VERIFICATION TEST

COM2.T210.9 TESTING INSTALLED WINDOWS AND ACOUSTIC BALCONY DOORS FOR WATERTIGHTNESS

1. Testing Arrangements:
   a. Carry out watertightness test to properly fixed windows at external walls, balcony doors or any doors with weather seal gasket installed all round, as early as possible before scaffolding is removed or gondola is dismantled/removed unless the CM is satisfied that testing and any subsequent remedial work can adequately be executed after the dismantling/removal of scaffolding or gondola.
2. Testing Samples:
   a. 100% of properly fixed windows at external walls, balcony doors or any doors with weather seal gasket installed all round, except those windows with louvers and doors, in accordance with the procedures as specified in sub-clauses (3)(a) to (3)(i).
3. Testing Methods:
   a. Test joints between window frames, and between window and door frames, and:
      i. The concrete surround;
      ii. Frames of casements;
      iii. Fixed panels;
      iv. Transoms and mullions; and
      v. Sashes.
   b. Use brass nozzle comprising:
      i. 13 mm diameter outlet fitted with diffuser connected to a 20 mm garden hose; and
      ii. A control valve and a pressure gauge as illustrated at Appendix COM2/I to this Worksection.
   c. Carry out the test with the water jet from the outside, with the window and door in the closed position;
   d. Spray a continuous jet of water, at a nozzle pressure of between 210 kPa and 240 kPa, at approximately 300 mm from the window and door joints;
   e. Move the spraying nozzle to and fro along the joints, starting at the lowest horizontal joint at the cill then the middle horizontal joints, then the vertical joints and lastly the topmost horizontal joint at the window and door head;
   f. Test the joints between the window and door frames and the surrounding structure for a period of 1 minute for every 2 metres of joint length, and other joints for a period of 1 minute for every 3 metres of joint length or on pro-rata basis;
   g. Observe the whole watertightness test from indoor. Tap the lowest glazing bead slightly to check for water leakages or seepage;
   h. All watertightness tests must be witnessed by the Contractor or his representative and the CM or his representatives;
   i. Submit three copies, or other number of copies as directed by the CM, of the test reports for the watertightness tests for record.
4. Non-compliance:

a. The window or door joints will be deemed to have failed where there are signs of water seeping through the joints or ironmongeries during the watertightness test specified in this Worksection or within half an hour to two hours after the test;

b. In the event that any test failed to meet the requirements:

i. Remedy all such failed joints by Approved methods. Retest all remedial joints until all the joints meet the specified criteria;

ii. Bear the cost of all remedial work and the retest. No extension of time will be allowed.

SURVEILLANCE TESTS

COM2.T405.A SURVEILLANCE TESTS FOR ALUMINIUM WINDOWS

1. Test Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or Direct Testing Contractor;
   b. Comply with the following pertaining to the surveillance tests:
      i. Provide attendance on the Site and in the manufacturers' factories in the supply chain, including the aluminium window and precast concrete component manufacturing factories;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified;
      iii. Arrange transportation for the parties referred to in sub-clause 1(a) above for passages to and from the manufacturers' factories in the supply chain for sampling of materials;
      iv. Provide attendance on the selection, examination of aluminium windows and detachment of hinges from aluminium windows.
2. Test Samples:
   a. Provide one set of test samples from the batch of material delivered to or manufactured in:
      i. Site under the delivery note as specified in COM2.M005 (3)(a); or
      ii. The manufacturer's factory of aluminium window; or
      iii. The manufacturer's factory of precast concrete components; or
      iv. Locations as instructed by the CM.

      (hereinafter referred to as the "representative batch");
   b. One set of test samples shall consist of two representative frictional hinges and three representative aluminium windows of any type without louvre. Sample shall be the completed component as to be installed, including glazing, all fixed parts, casements, top-hung and fixings necessary to ensure normal operation. Bear all cost for any replacement of samples.
3. Test methods:
   a. Aluminium window quality and performance requirements: As per COM2.M005 (2)(a);
   b. Open up inspection as per COM2.M005 (4);
   c. Mechanical property and chemical composition tests for sliding stays and base rails of the frictional hinges: As referred to in ASTM A240/A240M-09c;
   d. Mechanical property and chemical composition tests for friction pivots and screws of the frictional hinges: As referred to in ASTM A493-09.
4. Non-compliance:

a. In the event that any of the test samples fails to meet the test requirements, follow either one of the following actions:
   i. Remove the representative batch off Site or from the factory of precast concrete components or from further production or fabrication in the material supply chain for HA's construction contracts where appropriate; or
   ii. Apply to the CM for re-test for the representative batch in accordance with the test methods as specified in sub-clause (3) above by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for three separate sets of samples selected by the CM from the representative batch. The CM shall have the discretion to approve or not the commissioning of the latter laboratory for the re-test. In case any one sample for the re-test fails, remove the representative batch off Site.

b. When the representative batch of aluminium windows is removed off Site or from further production or fabrication in the material supply chain for HA's construction contracts, replace with another new batch (hereinafter referred to as the "replacement batch"). Apply to the CM for test in accordance with the test methods as specified in sub-clause (3) above by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for one set of samples selected by the CM from the replacement batch. The CM shall have the discretion to approve or not the commissioning of the latter laboratory for the test. In case any one sample fails the test, follow action stated in sub-clause (4)(a);

c. Bear the costs of any failed surveillance tests and all associated costs for the test(s) and re-test(s) required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

COM2.T410.A ON-SITE OPERATION TESTS FOR ALUMINIUM WINDOWS

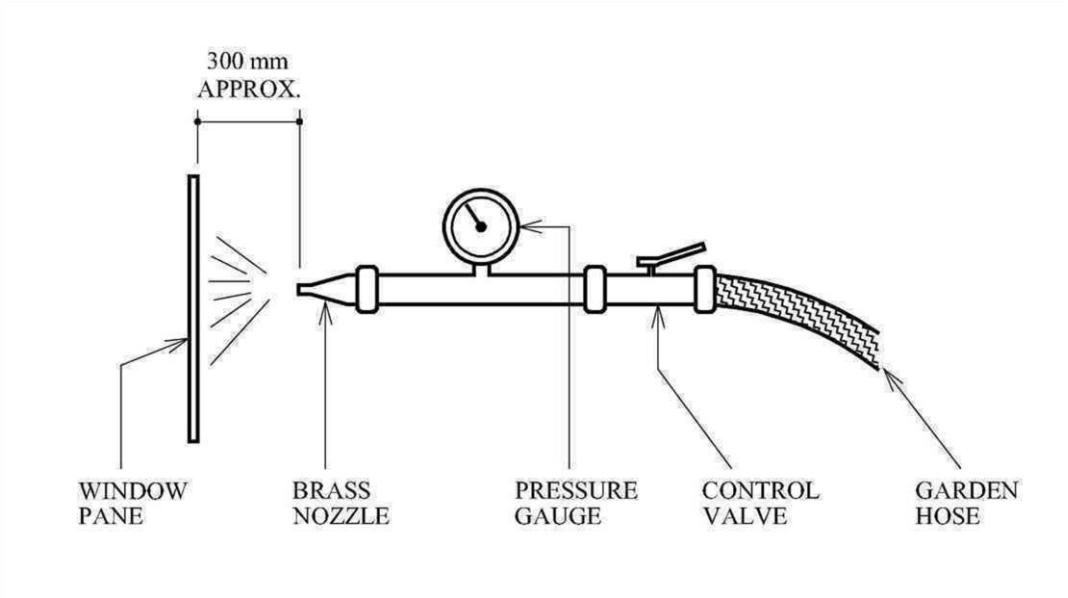
1. Test Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or Direct Testing Contractor;
   b. Comply with the following pertaining to the surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Test Samples:
   a. The test locations and samples are selected by the CM from the batch of material delivered to Site under the delivery note as specified in COM2.M005 (3)(a) (hereinafter referred to as the "representative batch");
   b. Each set of samples consists of 2 window sashes.
3. Test methods:
   As per COM2.M005 (2)(a)(ii(a)) "Operating Forces".
4. Non-compliance:
   a. In the event that any of the test samples fails to meet the test requirements, follow either one of the following actions:
      i. Remove the representative batch of associated frictional hinges off Site; or
      ii. Apply to the CM for re-test in accordance with the test methods as specified in sub-clause (3) above by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for three separate sets of samples selected by the CM from the representative batch. The CM shall have the discretion to approve or not the commissioning of the latter laboratory for the re-test. In case any one sample for the re-test fails, remove the representative batch off Site.

b. When the representative batch of frictional hinges is removed off Site, replace with another new batch (hereinafter referred to as the "replacement batch"). Apply to the CM for test in accordance with the test methods as specified in sub-clause (3) above by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for one set of samples selected by the CM from the replacement batch. The CM shall have the discretion to approve or not the commissioning of the latter laboratory for the test. In case any one sample fails the test, follow actions stated in sub-clause (4)(a);

c. Bear the costs of any failed surveillance tests and all associated costs for the test(s) and re-test(s) required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

APPENDIX COM2/I

COM2.APPEND1.9 SITE WATERTIGHTNESS TEST



COM3 UPVC WINDOWS

DESIGN

GENERAL

COM3.D010.9 SPECIFICATION REQUIREMENTS

Design and construct uPVC windows, complete with glazing, in accordance with this Worksection and the relevant clauses of COM4.

COM3.D020.9 WINDOWS

1. Must be suitable for inside glazing, unless otherwise shown on the Drawings;
2. Must be an Approved glazing system with uPVC beads;
3. Heat welded corner joints. Welded joints are to be mitred and neat;
4. The size of the window profile must provide sufficient glazed area to satisfy with the requirement stipulated in all applicable Ordinances, Regulations and Codes in Hong Kong;
5. Colour to be consistent for all windows profiles.

DESIGN PARAMETERS

COM3.D110.9 TOLERANCES

Design window so that the tolerances are coordinated with the appropriate building tolerances for the structural works as described in Appendix H to this Specification.

COM3.D120.9 GLASS THICKNESS

Design glass thickness to withstand the wind load as COM3.D130 and in no case allow it to be less than 5 mm. Calculate and check the correct thickness.

COM3.D130.9 WIND LOADING FOR GLAZED WINDOWS

1. When fixed in position and glazed, windows must withstand:
   a. A wind load calculated in accordance with the current Code of Practice on Wind Effects, Hong Kong; and
   b. The resultant resistance to wind loading of a minimum of:
      i. 3.0 kPa for non-domestic buildings such as schools, commercial centres etc.;
      ii. 3.8 kPa for domestic buildings excluding ground floor or podium.
2. A maximum permissible deflection of 1/180 the length of a particular member or 20 mm;
3. Use galvanized mild steel cores, anchors, brackets, etc as stiffeners, where necessary.

COM3.D140.9 DRAINAGE

1. Design the bottom frame members of the openable windows to drain away water and condensation from other frame members. Provide adequate drainage to bottom frame members whenever necessary;
2. Drainage paths should prevent water running through the reinforcement chamber of the profile which are to be fully sealed when the main profiles are welded together.

SUBMISSION

COM3.D210.9 SHOP DRAWINGS AND STRUCTURAL CALCULATION

Structural calculation by RSE, shop drawings and test reports in COM3.M010 (1)(a)(v) showing compliance with the design parameters specified in the Worksection must:

1. Be submitted for Approval in accordance with the following:
    a. Six months prior to fabrication for uPVC windows fixed to cast in-situ concrete walls;
    b. Within two months of the notified date for the commencement of the Works for uPVC windows fixed to precast concrete facade;
2. Be re-submitted for Approval where amendments are necessary;
3. Shop drawings must include
    a. Design and technical details of members, reinforcement, ironmongery and accessories;
    b. Type and position of fixings;
    c. Method statement for fixing friction pivots and sliding stays onto galvanized mild steel bars to window frames and sashes;
    d. Waterproofing design details between window frame and opening;
    e. Design of drainage;
    f. Type and thickness of glass;
    g. Calculation on the net glazing and openable areas of windows in compliance with the minimum area required under Building Regulations.

COM3.D230.9 COMPLIANCE WITH STANDARDS

Design uPVC windows in compliance with the appropriate Standards listed below:

1. All applicable Ordinances, Regulations and Codes in Hong Kong (i.e. the 'Hong Kong Building Code');
2. BS 6262:1982 - Code of Practice for glazing for buildings;
3. BS 952:Part 1:1995 - Glass for glazing;
4. BS 6375:Part 1:1989, BS 6375:Part 2:1987 and ASTM E547-00 - Test requirements for window performance.

MATERIALS

GENERAL

COM3.M010.9 UPVC WINDOWS AND GRILLES

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed uPVC windows and grilles for CM's approval together with all the following substantiation for CM's information:
      i. Job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or the document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
      v. When the uPVC windows and grilles are supplied for domestic blocks, except for the ancillary facilities at lower floors, comply with the following in the submission:
         - Submit a sample board similar to the sample boards for all other windows maintained by the Housing Department showing the extrusions, ironmongeries and accessories for the proposed uPVC windows and grilles. Submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;
         - Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
   b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(a) for CM's information:
      i. The date of the test shall be generally within five years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;
      ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);
      iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
2. Quality Requirements:
   a. The quality and performance requirements are as follows:

Items	Method	Acceptance Standards	Remarks
i. Dimensional Tests			
- Overall Size	Measure the peripheral and diagonal dimensions of the sample to nearest 0.5 mm. Indicate the measurements in the report with aid of schematic diagrams.	- Peripheral dimensions: ±1.0 mm for length < 2 m ±1.5 mm for 2 m ≤ length < 3.5 m ±2.0 mm for length ≥ 3.5 m - Diagonal dimensions: ±1.5 mm for length < 2 m ±2.5 mm for 2 m ≤ length < 3.5 m ±3.5 mm for length ≥ 3.5 m	• Two specimens are required, one for tests (i) to (vi) and the other for test (vii) to (x). Separate sections are also required for test on outer wall thickness of individual member under test (i). • For tests (i), please refer to the shop drawings submitted by the suppliers for dimensions of each type of windows.
- Individual Member (Select three members)	Outer wall thickness of frame profile and glazing bead.	COM3.M110 and COM3.M130	• For test on individual member under test (i), suppliers should provide additional sections of the members 1000 mm long, in case suitable testing positions are difficult to access in complete windows set. • For tests (ii) to (vi): Sequence of tests from (ii) to (vi) shall be followed. Failure of any test will have the whole sequence re-tested.
ii. Operation Tests			Test (vi) does not apply to top hung windows.
- Ease of Fastener Operations	BS 6375:Part 2: 1987:Cl. 6.1.1, 6.1.2 and A2	BS 6375:Part 2: 1987:Cl 5.1, 6.1.2 and Table 2	• For tests (vii) to (x):
- Movement of Sash	BS 6375: art 2: 1987:Cl. 6.1.3 and A3	BS 6375:Part 2: 1987:Cl 6.1.3 and Table 3	Full size sample of window with glazing shall be used.
iii. Release of Jammed Sash	BS 6375:Part 2: 1987:Cl. 6.2.2, A2 and A5	BS 6375:Part 2: 1987:Cl 6.2.2	Sequences and stipulated requirements indicated in the BS 6375:Part 1: 1989:Cl. 4.2 shall be followed.
iv. Resistance to Obstructed Stay Track	BS 6375:Part 2: 1987:Cl. 6.3 and A6	BS 6375:Part 2: 1987:Cl 6.3	• For tests (xi):

v. Strength of Restricted Opening Devices, Location Devices and Maximum Opening Stops	BS 6375:Part 2: 1987:Cl. 6.4 and A7 but testing force of 1000 N shall be used.	BS 6375:Part 2: 1987:Cl. 6.4	Three specimens are required, one taken from the sash, one taken from the frame, and one taken from the mullion.
vi. Resistance to Accidental Loading	BS 6375:Part 2: 1987:Cl. 6.5 and A8	BS 6375:Part 2: 1987:Cl. 6.5	
vii. Air Permeability Test	BS 6375:Part 1: 1989:Cl. 5 and BS 5368: Part 1: 1976 Pa max = 600 Pa	BS 6375:Part 1: 1989:Cl. 5 and Figure 1 : Graph C No damage and functional defects shall be noted.	
viii. Water Penetration (Static) Test	BS 6375:Part 1: 1989:Cl. 6 and BS 5368:Part 2: 1980 Pa max = 770Pa	BS 6375:Part 1: 1989:Cl. 6 No damage and functional defects shall be noted.	
ix. Structural Adequacy (Static) Test	BS 6375:Part 1: 1989:Cl. 7 and BS 5368:Part 3: 1978 Positive wind pressure : $P_1 = 0.5\ P_2$, $P_3 = 1.25\ P_2$; Negative wind pressure : $P_1' = 0.5\ P_2'$, $P_3' = 1.25\ P_2'$; P_2 and P_2' are the maximum designed positive and negative wind loadings respectively in accordance with COM3.D130 n = 5 (Diagram 2 to be used as sequence of operation)	- BS 6375:Part 1: 1989:Cl. 7.2 to 7.5 (Permissible deformation to any member quoted in Cl. 7.3 is amended to less than 1/180 the length of the particular member and shall not be greater than 20 mm) - Extent of recovery of deformation 15 minutes after the removal of the test load should be at least 95%.	
x. Water Penetration Test by Cyclic Static Air Pressure Differential	ASTM:E547 - 00 Test pressure difference = 770Pa Ten test cycles	No water leakage, damage and functional detects shall be noted.	
xi. Test on Steel Reinforcement Coating			
- Mass per unit area	BS 729:1971 Appendix A BS EN ISO 1460: 1995	BS EN:10142: 1991 Minimum 275 g/m²	
- Uniformity of coating	BS 729:1971 Appendix B	BS 729:1971 Appendix B	

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:
   i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
   ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
   iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for uPVC windows and grilles upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may present to witness the verifications:
   i. Method:

Verification Items	Method	Acceptance Standards
Dimension Check	By measurement	COM3.M010 (2)(a)(i) on overall size
Surface Quality	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency, no visible coating defects.
Ironmongery Check	Visual	Same as the CM's Approved sample.
Hinge and Structural (if required) Reinforcement Bars Check	By strong magnet	Magnet attraction on the position of all the reinforcement bars
Dimension of the Structural Reinforcement Bars (if required)	BS 4360:1990	The nominal dimensions in according with the structural calculation and the projection from the uPVC section to be 15 mm minimum at one end

   ii. Frequency:

Items	Sampling Frequency	Representative Batch
Dimension Check	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Surface Quality	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Ironmongery Check	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Hinge and Structural (if required) Reinforcement Bars Check	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note

Dimension of the Structural Reinforcement Bars (if required)	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat the verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

MEMBERS AND FIXINGS

COM3.M110.9 FRAME PROFILES AND SECTIONS

1. unplasticised polyvinyl chloride (uPVC) must not be carcinogenic;
2. Profiles for windows: extruded sections of a multi-chambered design and of a four-corner hot welded construction;
3. Transoms/mullions: weld onto frames or mechanically fix onto frames with joints filled with windows supplier's recommended sealant in compliance with WAT5.M110 or Approved equivalent to provide a neat weather-tight joint;
4. Outer wall thickness (maximum tolerance allowed 0.3 mm) for frames and transom: 2.5 mm minimum;
5. Colour of profile: white or Approved, uniform in colour when viewed by normal vision. The external and internal face surfaces of the profile are to be free from foreign bodies, cracks, sink marks or die lines when similarly viewed.

COM3.M120.9 REINFORCEMENT

1. Galvanized mild steel in compliance with BS EN 10142:2000 and BS EN 10143:1993;
2. Securely fixed as recommended by the window supplier.

COM3.M130.9 GLAZING GASKETS AND WEATHERSTRIP

Glazing gaskets and weatherstrip shall have no adverse effect on the uPVC profile as recommended by window supplier.

COM3.M140.9 UPVC GLAZING BEADS

1. Use beads which securely clip to the frame or are an integral part of the frame;
2. Wall thickness of glazing bead: 2 mm minimum with maximum tolerance of 0.3 mm.

COM3.M150.9 EXPOSED FIXINGS

Screws, nuts, bolts washers and rivets: stainless steel (grade 304 for bolts and grade 302 for screws), or nylon washer and caps for window grilles to match finish.

COM3.M160.9 CONCEALED FASTENING DEVICES

Galvanized mild steel.

COM3.M170.9 BEDDING AND GROUTING MATERIAL

Bedding and grouting material shall be compatible with the use of uPVC windows as recommended by the window supplier.

COM3.M180.9 PERIMETER SEALANT

External perimeters: seal with a low modulus silicone rubber sealant in compliance with WAT5.M110 or an Approved equivalent, which is of a compatible formula to adhere to uPVC and the building materials, i.e. concrete, sand/cement, plaster, tiles etc., at the abutment between the window frame and the fabric of the structure.

WINDOW FITTINGS/HARDWARE

COM3.M210.9 FRICTION PIVOTS AND SLIDING STAYS

1. All friction pivots and sliding stays to be 3 mm thick stainless steel of grade 304/A2-70 or Approved equivalent:
   a. For side hung window, providing a minimum clearance of 100 mm between frame and window when opening at 90°;
   b. For top hung window, providing, a minimum clearance of 70 mm between frame and window when opening at 90°.
2. All friction pivots and sliding stays to be fixed with stainless steel screws onto galvanized mild steel bars 12 mm minimum (width) x 3 mm (thick) in nominal size to all frame members and sash members.

COM3.M220.9 LOCKING HANDLES & PULL HANDLES ETC.

Polyester powder coated aluminium alloy or an Approved equivalent.

COM3.M230.9 IRONMONGERY

1. All ironmongery and metal components of hardware are to be corrosion resistant materials;
2. Metals that are in contact with each other are to be compatible so as to prevent galvanitic corrosion of dissimilar metals by electrolytic action.

WORKMANSHIP

APPROVAL PRIOR TO FABRICATION AND SITE INSTALLATION

COM3.W010.9 TESTING REPORT

Do not commence fabrication until test reports in COM3.M010 (1)(a)(v) have been approved.

COM3.W020.9 SHOP DRAWING AND SAMPLE APPROVAL

Do not commence fabrication until all shop drawings and samples have been Approved.

OFF SITE FABRICATION AND ASSEMBLY

COM3.W110.9 FIXING WEATHERSTRIPS

Securely fix weatherstrip. Ensure there is continuous contact between each opening part and its fixed frame.

COM3.W130.9 SIDE AND TOP HUNG WINDOWS

Hang to open as indicated on the Drawings and fit as specified with:

1. Friction pivots and sliding stays;
2. Pull handle with dual lock for side hung window; and
3. Cam lock for top hung window.

FIXING OF UPVC WINDOWS TO CAST IN-SITU CONCRETE FACADE

COM3.W210.9 COMPOSITE UNITS

Assemble all composite units on Site and provide all bolts, screws etc. and sealants.

COM3.W220.9 CUTTING TRIMMING AND WELDING

Do not cut, trim or weld during erection on Site.

COM3.W230.9 TOLERANCES

1. Check the position, size and alignment etc. of all openings for windows in accordance with the tolerances specified in Appendix H to this Specification and report any discrepancy to the CM;
2. Rectify any fault or discrepancy to the satisfaction of the CM, and bear the cost of such remedial work.

COM3.W260.9 POSITIONING

Position windows plumb, level and square.

COM3.W270.9 INSTALLATION

1. Install uPVC windows in accordance with window supplier's recommendation;
2. Apply bedding and grouting materials in accordance with window supplier's recommendation.

COM3.W280.9 PERIMETER POINTING OF EXTERNAL WINDOWS

1. Remove filler board from the preformed joint, if any, around external edges of window and door frames;
2. Mask adjoining surfaces which would be impossible to clean if smeared with sealant;
3. Point around external edges of window frames with Approved sealant in COM3.M180 to form a neat, smooth and flat joint;
4. Remove excess sealant from the adjoining surfaces and leave clean.

FIXING UPVC WINDOWS TO PRECAST CONCRETE FACADES

COM3.W410.9 POSITIONING

Position windows plumb, level and square.

COM3.W420.9 OPENING LIGHT FRAMES

Check tightness and clearance between sash and frames of opening lights which are to be fixed before and during concreting of the facade units.

COM3.W425.9 POSITIONING OF WINDOWS AND WINDOW FRAMES

Fix windows and window frames in position before placing concrete in moulds for the facade units.

COM3.W430.9 CURING OF CONCRETE

In case of steam curing, ensure that temperatures are not to exceed the softening temperature of uPVC profile.

COM3.W440.9 POINTING TO PERIMETER OF WINDOW

Point perimeter of window frames with Approved sealant in COM3.M180 to form a neat, smooth, flat joint and:

1. Mask any adjoining surfaces which would be impossible to clean if smeared with sealant; and/or
2. Remove excess sealant from adjoining surfaces and wipe clean.

HANDLING, STORAGE AND PROTECTION

COM3.W610.9 TRANSPORTATION, HANDLING AND STORAGE

As COM2.W490.

COM3.W620.9 PROTECTION

1. Wrap all windows and other associated materials in stout waterproof paper or polythene to protect against damp and scratching;
2. Protect all exposed surfaces with a strippable coating or low-track masking tape;
3. Maintain and renew protective coating as necessary;
4. Carefully remove protective coating and leave clean on completion of building works.

TESTING

SURVEILLANCE TESTS FOR UPVC WINDOWS AND GRILLES

COM3.T050.A SURVEILLANCE TESTS

1. Testing Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in COM3.M010 (3)(a) or as instructed by the CM;
   b. One set of test sample shall consist of two representative uPVC window specimens of any type without louvre. Sample shall be the completed component as to be installed, including glazing, all fixed parts, casements, top-hung and fixings necessary to ensure normal operation. Bear all cost for any replacement of samples.
3. Testing methods:
   As per COM3.M010 (2)(a) except (vii), (viii), (ix) & (x).
4. Non-compliance:
   a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch off Site; or
      ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.
   b. When the representative batch of uPVC window is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
   c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

ON-SITE VERIFICATION TEST

COM3.T310.9 TESTING INSTALLED WINDOWS FOR WATERTIGHTNESS

As COM2.T210.

COM4 GLAZING

MATERIALS

GLASS GENERALLY

COM4.M001.9 SUBMISSION REQUIREMENTS FOR GLASS MATERIALS

1. Submission Requirements:

   At sample submission and approval stage, submit:

   a. Sample(s), 300 mm minimum square, for each type of glass and plastic sheet in accordance with PRE.B9.410 for CM's approval;

   b. The following substantiation for CM's information:

      i. Catalogue, brand name / model name and job reference;

      ii. Name, address and contact person of the local supplier;

      iii. Name, address and contact person of the manufacturer;

      iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or the document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

      v. Original or a certified true copy of the certification to ISO 9001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS;

      vi. Original or certified true copy of the test reports from the manufacturer showing that the glass material is in full compliance with the quality and performance requirements of the referenced standard specified for the type of glass product:

      - The date of the test shall be generally within five years prior to the notified date for commencement of the Works or at an earlier date subject to CM's consideration on the track records as maintained by the Housing Department;
      - The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material to Site;
      - In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. On Site Delivery:

   a. At delivery stage, submit the following documents for CM’s information:

      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all materials delivered to site.

b. Carry out and submit report on the material verification upon delivery to Site as applicable. Prior to carrying out the verifications, inform the CM who may be present to witness the verifications.

COM4.M010.9 FLOAT GLASS

1. Submission Requirements as per COM4.M001;
2. Quality Requirements:
   a. Clear float glass to BS 952:Part 1:1995;
   b. Thickness as shown on Drawings.
3. On Site Delivery Verification:
   a. Further to the submission requirements at delivery stage in COM4.M001 (2)(a), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Dimension Check	By measurement	As specified
Surface Quality	Visual	Same as the CM's Approved Sample Free from warping, oil canning effects

      ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note]
Manufacturer's Certificate of Origin & delivery note	Each batch	Same batch of material delivered to Site under one delivery note
Dimension Check	2 samples per batch	Same batch of material delivered to Site under one delivery note
Surface Quality	2 samples per batch	Same batch of material delivered to Site under one delivery note

   b. When any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM4.M020.9 CLEAR SHEET GLASS

To BS 952:Part 1:1995 and of a general quality for glazing, thickness as shown on Drawings.

COM4.M030.9 CLEAR PATTERNED GLASS

1. Submission Requirements as per COM4.M001;
2. Quality Requirements:
   a. To BS 952: Part 1:1995;
   b. Type: clear patterned glass;
   c. Quality: to BS EN 572-5:2004;
   d. Degree of obscuration / diffusion: medium or approved;
   e. Thickness as shown on the Drawings.
3. On Site Delivery Verification:
   a. Further to the submission requirements at delivery stage in COM4.M001 (2)(a), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Dimension Check	By measurement	As specified
Surface Quality	Visual	Same as the CM's Approved Sample Free from warping, oil canning effects

      ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note]
Manufacturer's Certificate of Origin & delivery note	Each batch	Same batch of material delivered to Site under one delivery note
Dimension Check	2 samples per batch	Same batch of material delivered to Site under one delivery note
Surface Quality	2 samples per batch	Same batch of material delivered to Site under one delivery note

   b. When any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM4.M040.9 WIRED GLASS

To BS 952:Part 1:1995,

1. Type: as shown on Drawings;
2. Square mesh wire, 13 mm squares, electrically welded at each intersection;
3. Thickness: as shown on Drawings.

COM4.M050.9 MIRROR GLASS

Selected float glass to BS 952:Part 1:1995 suitable for silvering:

1. Edges: square or bevelled as shown on the Drawings;
2. Exposed arrises: ground smooth.

COM4.M060.9 THERMALLY TOUGHENED GLASS / TEMPERED GLASS

1. Submission Requirements:
   a. Further to the submission requirements at sample submission and approval stage as per COM4.M001 (1), submit also a compliance report for heat soak process issued by the glass manufacturer containing the following information:
      i. Total number and surface area of tempered glass panes used in the Contract;
      ii. Location and identity number of the ovens, in which the heat soak process of the glass panes in (c) was conducted;
      iii. Calibration report of the ovens in accordance with BS EN 14179-1: 2005 or equivalent;
      iv. Quantity and configuration of thermocouples used to measure the glass surface temperatures in the oven. A minimum of 8 thermocouples shall be used. The location of these thermocouples shall be determined from the calibration report of the oven;
      v. Recorded temperature versus time graphs for each of the 8 thermocouples during the heating phase, holding phase and cooling phase of the heat soak process;
      vi. Quantity, dimensions and thickness of the tempered glass panes conforming to BS EN 14179-1: 2005 or other equivalent international standards, and the record of breakages of panes in each heat soak process with corresponding oven number;
      vii. Date of carrying out the heat soak process.

      The compliance report shall be endorsed by a RSE, who shall also provide a signed statement confirming that the report has adequate provisions in ensuring the heat soak process has been duly carried out to all tempered glass;
   b. Submit as per sub-clauses (c), (d) and (e) for the following installations:
      i. When the least dimension of the structural opening for window and window wall exceeds 1.8 m; or
      ii. When the area of structural opening exceeds 6 m2; or
      iii. When a window or window wall, glass wall, glass shop front or glass door with design span of its structural elements exceeds 6 m; or
      iv. When a window or window wall system that functions as a protective barrier.

c. A copy of the Quality Assurance Scheme of the tempered glass manufacturer containing the following information and appended with a statement signed by Contractor's appointed RSE mentioned in sub-clause (1)(a) above declaring that the RSE has studied the Quality Assurance Scheme and confirming that there are adequate measures incorporated in the Quality Assurance Scheme to ensure the quality of the tempered glass products is in compliance with the provisions of the Building Ordinance and the Approved plans:

i. Heat soak process to all tempered glass panes;

ii. Calibration of heat soak oven and laboratory equipment for quality control tests;

iii. Residual surface compressive stress measurement of tempered glass;

iv. Testing procedures and requirements;

v. Frequency and extent of inspection and audit by in-house staff of the manufacturer, and independent parties.

d. A copy of the quality supervision plan for the quality supervision of manufacturer's heat soak process of the tempered glass. Assign a quality control supervisor to provide full time continuous supervision of the heat soak process of all tempered glass panes in the factory. The minimum qualification and experience of the quality control supervisor are to be the same as TCP grade T1 under the RC's stream, as stipulated in the CoPSS;

e. A copy of the quality supervision report prepared by Contractor's appointed RSE mentioned in sub-clause (1)(a) and (1)(b) above which shall include a statement signed by Contractor's appointed RSE, to confirm that adequate supervision has been provided in accordance with the quality supervision plan, including streams of Registered General Building Contractor.

2. Quality Requirements:

a. To BS 952:Part 1:1995 and manufactured:

i. To precise glazing sizes and thickness as shown on the Drawings;

ii. With permanent identification markings showing the compliance Standards as provided by the glass manufacturer and are marked in position which is visible but not prominent after fixing.

b. The glass shall be heat treated to approximately three times the strength and impact resistance of untreated glass and upon fracture would break into small fragments;

c. The glass shall be heat soak treated to reduce the risk of spontaneous breakage by accelerating the expulsion of the nickel sulphide in the glass through the heat soak process conforming to BS EN 14179-1: 2005 or other equivalent international standards;

d. Quality Assurance Scheme as per sub-clause (1)(c).

3. On Site Delivery Verification:

a. Further to the submission requirements at delivery stage in COM4.M001 (2)(a), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards

Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin with information of product identification numbers / markings
Dimension Check	By measurement	As specified
Surface Quality	Visual	Same as the CM's Approved Sample Free from warping, oil canning effects
Permanent Identification Marking printed on Glass Panel	Visual	Information in accordance with the Approved sample

ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note]
Manufacturer's Certificate of Origin & delivery note	Each batch	Same batch of material delivered to Site under one delivery note
Dimension Check	2 samples per batch	Same batch of material delivered to Site under one delivery note
Surface Quality	2 samples per batch	Same batch of material delivered to Site under one delivery note
Permanent Identification Marking printed on Glass Panel	2 samples per batch	Same batch of material delivered to Site under one delivery note

b. When any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM4.M070.A ANTI-BANDIT GLASS

To BS 5544:1978 or BS EN 356:2000 Class P3A, thickness as shown on Drawings.

COM4.M080.9 BULLET RESISTANT GLASS

To BS 5051:Part 1:1988, category as shown on Drawings.

COM4.M090.9 TINTED GLASS

1. Submission Requirements as per COM4.M001;
2. Quality Requirements:
   a. To BS 952:Part 1:1995;

b. Type of tint, colour and intensity: as specified in Project Specific Specification;

c. Thickness as shown on Drawings.

3. On Site Delivery Verification:

a. Further to the submission requirements at delivery stage in COM4.M001 (2)(a), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Dimension Check	By measurement	As specified
Surface Quality	Visual	Same as the CM's Approved Sample Free from warping, oil canning effects

ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note]
Manufacturer's Certificate of Origin & delivery note	Each batch	Same batch of material delivered to Site under one delivery note
Dimension Check	2 samples per batch	Same batch of material delivered to Site under one delivery note
Surface Quality	2 samples per batch	Same batch of material delivered to Site under one delivery note

b. When any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM4.M100.9 REFLECTIVE GLASS

1. Submission Requirements as per COM4.M001;
2. Quality Requirements:
   a. To BS 952:Part 1:1995;
   b. Surface to be coated reflective, colour and performance as specified in Project Specific Specification;
   c. Thickness as shown on Drawings.
3. On Site Delivery Verification:

a. Further to the submission requirements at delivery stage in COM4.M001 (2)(a), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Dimension Check	By measurement	As specified
Surface Quality	Visual	Same as the CM's Approved Sample Free from warping, oil canning effects

ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note]
Manufacturer's Certificate of Origin & delivery note	Each batch	Same batch of material delivered to Site under one delivery note
Dimension Check	2 samples per batch	Same batch of material delivered to Site under one delivery note
Surface Quality	2 samples per batch	Same batch of material delivered to Site under one delivery note

b. When any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM4.M110.9 LAMINATED GLASS

1. Submission Requirements as per COM4.M001;
2. Quality Requirements:
   a. To BS 952:Part 1:1995, thickness as shown on Drawings;
   b. Type of tint: .....;
   c. Colour: .....;
   d. Intensity: .....;
   e. Thickness: as shown on Drawings.
3. On Site Delivery Verification:

a. Further to the submission requirements at delivery stage in COM4.M001 (2)(a), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Dimension Check	By measurement	As specified
Surface Quality	Visual	Same as the CM's Approved Sample Free from warping, oil canning effects

ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note]
Manufacturer's Certificate of Origin & delivery note	Each batch	Same batch of material delivered to Site under one delivery note
Dimension Check	2 samples per batch	Same batch of material delivered to Site under one delivery note
Surface Quality	2 samples per batch	Same batch of material delivered to Site under one delivery note

b. When any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM4.M120.9 GLASS LOUVRE BLADES

With bevelled edges and ground to remove sharp arrises, thickness as shown on Drawings.

COM4.M130.9 FIRE RESISTANT LAMINATED SAFETY GLASS

1. Submission Requirements as per COM4.M001;
2. Quality Requirements:
   a. Generally:
      i. Laminated safety glass with interlayer(s) of fire resistant non-gel type material to BS EN ISO 12543-2: 2011 or BS EN 14449: 2005;
      ii. Permanent identification mark(s) showing the name or logo of the glass manufacturer and the relevant compliance Standards in sub-clauses (2)(a)(i), (2)(b)(i) and (2)(c)(i) at corner of glass panel;

iii. Appearance:

- In accordance with BS EN ISO 12543-6: 2011; and
- When inspected at less than 2m from the glass surface, no accumulation of four or more spot defects of size less than 0.5mm at a distance of less than 200mm from each other.

b. For installing at fire rated timber doorsets at domestic block:

i. Forming part of the whole of a fire rated timber doorset, which is capable of resisting the action of fire and meeting the prescribed fire resistant rating when tested in accordance with BS 476 Parts 20: 1987 and 22: 1987, or BS EN 1634-1: 2008;

ii. Durability to BS EN ISO 12543-2: 2011 sub-clause 6.2 of the standard "humidity test for glass that is not normally exposed to direct solar radiation".

c. For installing at external wall or other locations:

i. Forming part of the whole of a fire resistant assembly, which is capable of resisting the action of fire and meeting the prescribed fire resistant rating when tested in accordance with BS 476 Parts 20: 1987 and 22: 1987, or BS EN 1363-1: 1999 and 1364-1: 1999;

ii. Durability to BSEN ISO 12543-2: 2011sub-clause 6.3 of the standard "humidity test for glass that is normally exposed to direct solar radiation";

iii. Impact resistance to BS 6206:1981 (Class A) or BS EN 12600:2002 (Class 1B1).

3. On Site Delivery Verification:

a. Further to the submission requirements at delivery stage in COM4.M001 (2)(a), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin	Document Check	From an Approved origin with information of product identification numbers / markings
Surface Quality	Visual	Same as the Approved sample Free from warping, oil canning effects
Identification Marking printed on Glass Panel	Visual	Information in accordance with the Approved sample

ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note]

Manufacturer's Certificate of Origin	Each batch of timber doorset as per COM5	Same batch of material delivered to Site for timber doorset
	Each batch of glass panes or part thereof for installation at external wall or other locations	Same batch of material delivered to Site for installation at external wall or other locations
Surface Quality	1 sample of timber doorset for every 200 pieces or part thereof; and 1 sample for every 40 panes of glazing for installation at external wall or other locations or part thereof	Same batch of material delivered to Site
Identification Marking printed on Glass Panel	1 sample for every 200 pieces of timber doorsets or part thereof; and 1 sample for every 40 panes of glazing or part thereof for installation at external wall or other locations	Same batch of material delivered to Site

b. When any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

PLASTIC GLAZING MATERIALS

COM4.M210.9 POLYCARBONATE SHEET

Thickness: as shown on Drawings.

COM4.M220.9 SURFACE HARDENED POLYCARBONATE SHEET

Thickness: as shown on Drawings.

COM4.M230.9 PLASTICS GLAZING MATERIALS

Plastics type and thickness: as shown on Drawings.

SAMPLES

COM4.M310.9 GLAZING SAMPLES

Submit samples, 300 mm minimum square, for each type of glass and plastic sheet for Approval in accordance with PRE.B9.410.

ANCILLARY MATERIALS

COM4.M410.9 DISTANCE PIECES

PVC to BS 2571:1990, and:

1. Length: 10 mm minimum;
2. Width: equal to space between glass and rebate or bead;
3. Depth: giving 5 mm minimum cover of sealant.

COM4.M420.9 SETTING BLOCKS

1. Manufactured from either:
   a. PVC to BS 2571:1990, with a softness number between 35 and 45;
   b. Neoprene with Shore A hardness number between 80 and 90.
2. Length: 30 mm/m² of glazing but:
   a. In no circumstance less than 25 mm;
   b. Not less than 60 mm in vertically pivoted windows.

COM4.M430.9 LOCATION BLOCKS

Do not use location blocks if sealant is used in lieu of glazing compound.

COM4.M440.9 NON-SETTING COMPOUND

Of proprietary type as recommended by the window manufacturer: colour to Approval.

COM4.M450.9 PLASTIC SHEET GLAZING COMPOUND

Of proprietary type and compatible with proprietary sheets: colour to Approval.

COM4.M460.9 LINSEED OIL PUTTY

To BS 544:1969.

COM4.M470.9 PUTTY FOR HARDWOOD APPLICATION

A proprietary type recommended by the window manufacturer.

COM4.M480.9 SILICONE SEALANT

1. In compliance with WAT5.M110;
2. For mirror: one-part sealant to BS 5889:1989, Type A, neutral type sealant;
3. For glazing: one-part sealant to BS 5889:1989, Type B, neutral type sealant.

COM4.M485.9 STRUCTURAL SEALANTS

Where structural sealant is used in the construction of curtain wall, window or window wall system, the structural sealant shall be compatible with the glazing system and the structural frame with which it is in contact, which shall develop an allowable strength of 138 kPa with its substrates for short term wind load and has a safety factor suitable for the application. Compliance certificates comprising the sealant compatibility report, sealant adhesion report and the print review report issued by the manufacturers / suppliers and endorsed by a Contractor's appointed RSE shall be submitted for the CM's approval.

COM4.M490.9 GLAZING SPRIGS

Small, headless, non-corrodible nails or pins.

WORKMANSHIP

GENERAL

COM4.W010.9 STANDARD

Comply with BS 6262:1982 unless specified otherwise.

COM4.W020.9 DELIVERY

Ensure glass and plastic sheet is kept dry and clean during delivery.

COM4.W030.9 STORAGE

Store glass and plastic sheet vertically in a well ventilated location, protected from condensation and other moisture.

COM4.W040.9 FIRE RESISTANT LAMINATED SAFETY GLASS

Fire resistant laminated safety glass used as a fire barrier shall be installed in accordance with the glazing system manufacturer's recommendations to satisfy the fire resistance criteria stipulated on Drawings.

PREPARATION OF SURROUNDS

COM4.W110.9 PREPARATION OF REBATES

Ensure rebates are clean, dry and unobstructed at time of priming and glazing.

COM4.W120.9 PRIMING OF WOODEN SURROUNDS

Ensure priming paint, in accordance with Worksection FIN7, has been applied to rebates before glazing with linseed oil putty.

FIXING GLASS GENERALLY

COM4.W210.9 GENERALLY

Ensure external glazing is wind and water tight on completion.

COM4.W220.9 CAST OR PATTERNED GLASS FOR EXTERNAL GLAZING

Fix cast or patterned glass for external glazing with patterned side inside.

COM4.W230.9 WIRED GLASS

Fix wired glass with the wires parallel to surround and align wire in adjacent panes.

COM4.W240.9 CUT EDGES OF WIRED GLASS

Grind the edge of cut glass smooth and paint cut edges of wired glass with black bituminous base paint to inhibit rusting.

COM4.W250.9 DIRECTIONALLY PATTERNED GLASS

Fix directionally patterned glass with the pattern parallel to surround.

COM4.W260.9 EDGE CLEARANCES OF SEALANT FOR ALUMINIUM WINDOWS

Ensure edge clearances are equal all round each pane and are at least 3 mm.

COM4.W270.9 EDGE COVER

1. Provide edge cover with sealant in accordance with the following table:

Glass area	Edge cover
Up to 0.5 m²	5 mm
0.5 to 1.5 m²	9 mm
1.5 to 4.0 m²	12 mm
Over 4.0 m²	As recommended by the sealant Manufacturer

COM4.W275.9 EDGE COVER FOR SINGLE GLASS GLAZED IN PUTTY OR NON-SETTING COMPOUND

Ensure the cover is in accordance with Tables 13 & 14 of BS 6262:1982.

COM4.W280.9 SETTING, LOCATION BLOCKS AND DISTANCE PIECES

1. Use setting blocks for all panes exceeding 0.2 m²;
2. Use distance pieces for all panes exceeding 0.2 m² and use minimun 2 Nos. of distance pieces on each side of the glass pane at 600 mm centres or less;
3. Use location blocks for all panes without sealant.

COM4.W290.9 POSITIONING AND SETTING LOCATION BLOCKS

Locate setting and location blocks in accordance with BS 6262:1982, Figure 22 and not less than 30 mm from corner of surround to end of block nearest corner.

COM4.W300.9 BEDDING FOR NON-SETTING COMPOUND

Ensure that no voids or spaces are left in backing or bedding non-setting compounds and there is no glass to frame contact.

COM4.W310.9 STRIPPING SURPLUS NON-SETTING COMPOUND

Strip surplus backing or bedding non-setting compound as follows:

1. To top and side edges: flush with top of rebate or bead;
2. To bottom edges: at 45° angle.

COM4.W320.9 SILICONE SEALANT

Where specified, seal the joint between the glass and bead with an Approved silicone sealant.

COM4.W330.9 PREFORMED TAPES, SHIMS AND COMPRESSION GASKETS FOR GLAZING

Obtain Approval before use and comply with manufacturer's recommendations.

GLAZING TIMBER WINDOWS

COM4.W410.9 SECURING GLASS

Secure glass to wooden surrounds with glaziers sprigs at 450 mm maximum centres.

COM4.W420.9 BACK PUTTY

Of regular thickness and 2 mm minimum.

COM4.W430.9 FRONT PUTTY

Form front putty to a neat triangular fillet stopping 2 mm short of sight lines.

COM4.W440.9 OPENING LIGHTS

Ensure opening lights remain in closed position until putty has set sufficiently to prevent displacement of glass.

COM4.W450.9 SEALING PUTTY

Seal linseed oil putty once sufficiently hard and within manufacturer's recommended times with primer and paint as specified in Worksection FIN7.

COM4.W460.9 BEDDING GLAZING BEADS

Bed glazing beads in glazing compound for external glazing.

COM4.W470.9 SECURING WOODEN GLAZING BEADS

Secure wood glazing beads with rustproof panel pins or with countersunk brass screws and cups at 200 mm maximum centres and 75 mm maximum from each corner.

GLAZING ALUMINIUM WINDOWS

COM4.W540.9 GLAZING ALUMINIUM WINDOWS

To be carried out by the specialist contractor supplying and fixing the windows in accordance with Worksection COM2 as specified.

LOUVRES

COM4.W610.9 FIXING LOUVRE BLADES

Fix louvre blades into adjustable frames using clips as recommended by the frame manufacturer.

GLAZING WITH PLASTIC SHEETS

COM4.W710.9 CUTTING PLASTIC SHEETS

Cut plastic sheets with a fine tooth saw and smooth or chamfer edges.

COM4.W720.9 EDGE CLEARANCE

Allow edge clearance and cover as recommended by the sheet manufacturer.

COM4.W730.9 PROTECTIVE COVERING

Remove only sufficient of the protective covering around edges to allow glazing.

FINISHING

COM4.W810.9 CLEANING

1. Remove paint drips whilst wet;
2. Remove mortar, plaster or concrete spillage whilst wet;
3. Prior to practical completion of works:
    a. Remove all smears and excess glazing compound;
    b. Remove protective covering from plastic sheets;
    c. Leave clean, inside and out and free from scratches.

COM4.W820.9 BROKEN OR DAMAGED GLAZING

Replace glass or fixing materials broken or damaged before completion of the Works and redecorate as Instructed.

COM5 TIMBER DOORSETS

MATERIALS

DOORSETS GENERALLY

COM5.M001.A MATERIALS OF TIMBER DOORSETS

1. Non-fire rated doorsets and doorsets with fire resistance rating of 30 minutes:

Parts of doorsets	Materials
a. Door leaves	
i. Core battens	Softwood or hardwood
ii. Stiles and rails	Softwood or hardwood
iii. Facing	Plywood
iv. Lipping	Hardwood
b. Door frame	Hardwood
c. Architrave	Softwood or hardwood

2. Doorsets with fire resistance rating of 60 minutes:

Parts of doorsets	Materials
a. Door leaves	
i. Core battens	Softwood or hardwood
ii. Stiles and rails	Softwood or hardwood
iii. Fire rated covering sheet (optional as per Drawing)	Non-timber fire-rated materials such as calcium silicate, perlite or magnesium board subject to the CM's approval
iv. Facing	Plywood
v. Lipping	Hardwood
b. Door frame	Hardwood
c. Architrave	Softwood or hardwood

3. Proprietary doors:

   Proprietary design recommended by door manufacturers to the CM's approval.

4. Environmental standards for timber doorsets:
   a. Submit manufacturer's written confirmation to declare the following:
      i. All wood panels shall be of Class E1 under EN 13986:2004+A1:2015 in respect of formaldehyde emission;
      ii. The product shall not contain any heavy metals or their compounds as listed below:
         - Arsenic;
         - Cadmium;
         - Copper;
         - Lead;
         - Mercury;

iii. The following substances shall not be added during manufacturing:
- elemental chlorine;
- fluorine;
- PCP (pentachlorophenol);
- tar oils containing benzo(a)pyrene;

iv. The product shall have no flame retardant of polybrominated biphenyl (PBB), polybrominated diphenyl ether (PBDE) or short-chain chlorinated paraffin added as formulated components.

b. Submit VOC data for materials used in timber doorsets:
i. Architectural paints as FIN7.M010;
ii. Adhesives for wood as COM5.M525.

COM5.M005.9 USE OF SUSTAINABLE TIMBER

1. All softwood used in timber doorsets shall be from sustainable sources;
2. At least 50% of all timber by volume for doorsets shall be from sustainable sources;
3. The hardwood or softwood to be regarded as sustainable shall be originated from a well-managed source which is governed under an internationally recognised, globally applicable, independent certification scheme for sustainable forest management;
4. The softwood or hardwood to be regarded as sustainable shall be originated from a well-managed source under the following independent certification scheme with a chain of custody system:
   a. Forest Stewardship Council (FSC); or
   b. Programme for the Endorsement of Forest Certification Schemes (PEFC); or
   c. Other equivalent internationally recognized, globally applicable, independent certification scheme for sustainable forest management in terms of environmental, ecological, biodiversity, social and economic needs.
5. Submit the following documents as specified in COM5.M040 to demonstrate that softwood or hardwood from a well-managed source in sub-clause (4) has been purchased, processed and delivered to Site:
   a. Document proof of a forestry product Chain-of-Custody (COC) certification providing the doorsets from sustainable sources with a certificate code of an independent certification scheme as specified in sub-clause (4). The submission shall include:
      i. The original or certified true copy of a certificate of registration issued by an independent certification body certifying that the doorset supplier / manufacturer meeting the COC standard of an independent certification scheme as specified in sub-clause (4) for production of the doorsets from sustainable sources;
      ii. Specimens of the doorset supplier / manufacturer's Certificate of Origin and delivery note that an original of which will be submitted for each batch of the doorsets from sustainable sources delivered to Site at delivery stage. The specimen shall indicate the name and COC number of the doorset supplier / manufacturer and the certificate code of the independent certification scheme for the doorsets delivered;
   b. Additional documents for the other independent certification scheme in sub-clause (4)(c) if applicable:
      i. The species and country of origin of softwood or hardwood;
      ii. The name of the concessions or plantations from which the hardwood or softwood originate;

iii. Copies of the forestry policies implemented by these concessions or plantations which confirm that the management of the timber resource is sustainable.

COM5.M010.9 TIMBER QUALITY

To comply with the following:

1. Class and exposure to BS 1186:Part 1:1991, as follows:

Component		BS 1186:Part 1:1991	
		Class	Exposure
a. Door frame		2	Exposed
b. Door leaf			
i. Stiles and rails		2	Concealed
ii. Eggcrate ribs		2	Concealed
iii. Core (lamels)		3	Concealed
iv. Lipping		2	Exposed

2. Grading of defect limits to BS 1186:Part 1:1991 for knot size and distribution limits as follows:

Component	Maximum face width (mm)	Maximum ratio of knot size to face width (%)
a. Door frame	90	25
b. Door leaf		
i. Stiles and rails	35	50
	100	45
ii. Eggcrate ribs	35	50
iii. Core (lamels)	40	50
iv. Lipping	15	40
	50	30

COM5.M015.9 COMPOSITE JOINTED (LAMINATED) TIMBER AND FINGER JOINTED TIMBER

1. Laminated timber and finger jointed timber may be used at door frames, stiles and rails of door leaves subject to CM's approval;
2. Laminated timber and finger jointed timber shall be to BS 1186:Part 2:1988 and comply with the following dimensional requirements:

a. Composite jointed (Laminated) timber:	
i. Min. dimension of each piece	25 mm
ii. Max. no. of laminated pieces in stiles/ rails	2 nos.
iii. Max. no. of laminated pieces in door frames	4 nos.

b. Finger jointed timber:	
i. Min. length of each segment	150 mm
ii. Min. length of end pieces	100mm
iii. Min. overlapping of adjacent segments	50 mm
iv. Max. no. of finger jointed segments in vertical stiles	7 nos.

v. Max. no. of finger jointed segments in horizontal rails	4 nos.

3. Detailed composition and dimension of laminated timber and finger jointed timber components / segments shall be clearly indicated in shop drawings submission for CM's approval.

COM5.M020.9 AVERAGE PERMISSIBLE MOISTURE CONTENT

For timber incorporated into the work:

1. The average permissible moisture content is13% to 17%;
2. Measure the moisture content of timber using an electrical resistance moisture meter in accordance with clause 7 of BS 1186:Part 1:1991;
3. Draw to the CM's attention any situations where these percentages cannot be attained due to local circumstances of supply and availability.

COM5.M025.9 SOFTWOOD FOR CORE BATTENS, STILES AND RAILS AND ARCHITRAVE OF DOOR LEAVES

1. Softwood shall be originated from sustainable source as specified in COM5.M005;
2. The softwood used in the core battens, stiles and rails and architrave of door leaves etc. shall be Douglas Fir, Larch, Hemlock, Radiata Pine, Red Cedar, Spruce, Yellow Cypress or other softwood as approved;
3. The minimum average density of softwood at 15% moisture shall be 450 kg/m³.

COM5.M030.9 HARDWOOD FOR CORE BATTENS, STILES, RAILS, ARCHITRAVE AND LINING OF DOOR LEAVES

"Meranti" or equivalent wood species of minimum average density of 450 kg/m³ at 15% moisture content for the construction of the door leaves.

COM5.M035.9 HARDWOOD FOR LIPPING AND FRAME

1. The hardwood used for the lipping and frame shall be "San Cheung" (Kapore), Ash Wood, Obar Suluk or other hardwood as approved;
2. The minimum average density of hardwood at 15% moisture content shall be 620 kg/m³.

COM5.M040.9 TIMBER DOORSETS

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed wooden doorsets for CM's approval together with all the following substantiation for CM's information:
      i. Job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
      v. Original or a certified true copy of product conformity certificate for the doorsets of fire rated construction, covering the following typical door types:
         - domestic flat entrance doors; and
         - domestic flat kitchen doors.

This shall be submitted at sample submission and approval stage, or at a time not later than the delivery of the material. The certification shall be to the "Product Conformity Certification Scheme For Passive Fire Protection Products" published by the Hong Kong Institute of Steel Construction. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM.

The product conformity certificate shall cover tests in accordance with either set of standards below:

- BS 476: Part 20:1987 and BS 476: Part 22:1987; or
- BS EN 1634: Part 1:2008, BS EN 1634: Part 2:2008 and BS EN 1634:Part 3:2004.

It shall be certified as being capable of resisting the action of fire and smoke, if applicable for the specified periods by a laboratory which must be accredited for the specific test by HKAS under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS with appropriate qualifications and experience in fire resisting construction;

vi. The detail specification of the doorsets selected for the product conformity certification audit testing by the certification body, together with drawings and photographs sufficient to completely describe the doorset's construction, materials, fittings used and installation details;

vii. A copy of the test reports, assessment reports or fire / smoke test certificate which are certified true by the accredited laboratory or QCM and generally within 5 years prior to the notified date for commencement of the Works;

viii. Shop drawings for Approval showing the materials and exact dimensions of all doorset components, fixing, joint details, the internal arrangements of the rail and battens, and particularly routing of the cavity reserved for the wiring of the electrical locksets. Where laminated timber and finger jointed timber are used, detailed composition and dimension of the components / segments shall be incorporated in the shop drawings;

ix. Samples of wooden veneer faced plywood and door frame if timber veneer finished doorsets are shown on Drawings;

x. Confirmation in writing with a declaration from the doorset supplier / manufacturer on the composition and sources (e.g. sustainable source / non-sustainable source) of all the solid timber and plywood used for manufacturing of timber doorsets, and that the quality of timber used, and the laminated timber / finger jointed timber used if applicable, comply with COM5.M010 and COM5.M015 respectively;

xi. When the doorsets are supplied for domestic blocks also include the following in the submission:

- Submit a sample board similar to the one maintained by the Housing Department showing the quality, species and country of origin of timber for the doorsets; Submit an additional sample board of the approved sample for keeping in the Housing Department’s Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;

- Test report showing the average density of not less than 3 nos. of timber samples of proposed species;
- Documents for the doorsets from sustainable sources as specified in sub-clause (5) of COM5.M005;
- Calculation to demonstrate at least 50% of all timber by volume for the doorsets is from sustainable source;
- One sample each for kitchen, bathroom, flat entrance and exit staircase doorsets in Standard Domestic on Site for the purposes of inspection and Approval. The Approved samples shall be kept on Site until completion of the doorset installation work;
- Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

- A test report showing compliance with sub-clause (3)(b)(iii) for doorsets produced by the proposed doorset manufacturer to demonstrate the effectiveness of the insecticidal control on the production of doorsets.

xii. When the doorsets are supplied with fire resistant glass:

- Catalogue, brand name / model name, origin and job reference of the fire resistant glass;
- Name of the manufacturer of the fire resistant glass;
- Sample of fire resistant glass with an identification mark for the proprietary product;
- Confirmation in writing with a declaration from the door supplier / manufacturer that the fire resistant glass complies with the requirement as specified in sub-clause (1) of COM4.M130.

xiii. When the doorsets are supplied with fire rated covering sheet such as calcium silicate or magnesium board:

- Catalogue, brand name / model name, origin and job reference of the fire rated covering sheet;
- Name of the manufacturer of the fire rated covering sheet;
- Sample of the fire rated covering sheet;
- Confirmation in writing with a declaration from the door supplier that the fire rated covering sheet is asbestos free.

xiv. When the doorsets are supplied with smoke seal:

- Catalogue, brand name / model name, origin and job reference of the smoke seal;
- Name of the manufacturer of the smoke seal;
- Sample board of the proposed smoke seal with all accessories;
- Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements as specified in sub-clause (1) & (2) of COM5.M090 for CM's information. The date of the test shall be generally within five years prior to the notified date for commencement of the Works.

xv. Confirmation in writing with a declaration from the doorset supplier / manufacturer that the doorset paint finish and the adhesive used on timber and plywood are in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation;

xvi. The proposed Radio Frequency Identification tag and fixing method as specified in Worksection COM11.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clauses (2)(d) to (2)(e) for the doorset and COM5.M100 for the fire rated vision panel installed at doorsets for CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Doorsets must be capable of withstanding incidental static and dynamic loads imposed during use, including forced opening and closing and impacts from human bodies and hard objects. The loads must not result in significant damage or deformation to the doorsets, nor dislodge or shatter any composite parts in a dangerous manner;

b. Doorsets with fire resistance rating of 30 minutes:

i. A fire resistance rating of 30 minutes, 30/30 (30 minutes integrity, 30 minutes insulation) or 30/- (30 minutes integrity with no specified requirement for insulation) shall be provided when tested to BS 476:Part 22:1987 or BS EN 1634:Part 1:2008;

ii. Timber doorsets including frame, hinges, door closers and any other hardware shall be as specified in Appendix A.2.3 of BS 476:Part 22:1987 or clause 6.7 of BS EN 1634:Part 1:2008;

iii. Should be closely fitted around the edges to impede the passage of smoke and flame. Bottom gap shall not be more than the designed values of the door specified in the relevant fire test reports and should not exceed 10mm (between the bottom of the door and the floor when the smoke seal is lifted up).

c. Doorsets with fire resistance rating of 60 minutes:

i. A fire resistance rating of 60 minutes, 60/60 (60 minutes integrity, 60 minutes insulation) or 60/- (60 minutes integrity with no specified requirement for insulation) when tested to BS 476:Part 22:1987 or BS EN 1634:Part 1:2008;

ii. Timber doorsets including frame, hinges, door closers and any other hardware shall be as specified in BS 476:Part 22:1987:Appendix A.2.3 or BS EN 1634:Part 1:2008:6.7;

iii. Should be closely fitted around the edges to impede the passage of smoke and flame. Bottom gap shall not be more than the designed values of the door specified in the relevant fire test reports and should not exceed 10 mm (between the bottom of the door and the floor when the smoke seal is lifted up).

d. Satisfy the requirements of the following tests. After each test, the doorset must function properly and any damage or deformations are to be within the limits prescribed in sub-clauses (2)(f) to (2)(p). Two brand new samples are required for the tests below. Test number 1 to 3 to be carried out on Sample A in any order, and evaluation of result need not be terminated because of failure of one test. Test number 4 to 11 to be carried out on Sample B in sequence;

Test No.	Test Items	Test Methods	Acceptance Standards
1	Dimensional Accuracy, Squareness	Refer sub-clause (2)(f)	BS 5278:1976
2	General Flatness, Evenness	Refer sub-clause (2)(g)	BS 5277:1976
3	Behaviour Under Humidity Variations	Refer sub-clause (2)(h)	BS 5369:1987 (Test No. 3)
4	Resistance to Impact, Hard Body	Refer sub-clause (2)(i)	Same as Test No. 8 and in addition, the maximum residual deformation at any point must not exceed 1.25 mm.
5	Resistance to Torsion	Refer sub-clause (2)(j)	Same as Test No. 8 and in addition, the residual deformation must not exceed 3 mm.
6	Strength in the Plane of the Door Leaf	Refer sub-clause (2)(k)	Same as Test No. 8 and in addition, the residual deformation must not exceed 1 mm.
7	Slamming Open	Refer sub-clause (2)(l)	Same as Test No. 8.
8	Slamming Closed	Refer sub-clause (2)(m)	No damage or deformation including loosening of fixings or joints which would render the doorsets unfit for use, No dislodgement or dangerous shattering of their composite parts.

9	Resistance to Jarring and Vibration	Refer sub-clause (2)(n)	Same as Test No. 8.
10	Resistance to Impact - At 20 Nm for kitchen and bathroom doorsets, and at 40 Nm for flat entrance and exit staircase doorsets - At 20 Nm for kitchen and bathroom doorsets, and at 80 Nm for flat entrance and exit staircase doorsets	Refer sub-clause (2)(o)	Same as Test No. 8 and in addition, the maximum residual deformation at any point must not exceed 2 mm.
11	Resistance to Closing Against an Obstruction	Refer sub-clause (2)(p)	Same as Test No. 8.
12	Endurance of mechanical smoke seal	Refer sub-clause (2)(q)	Intact to perform the normal drop and lift up function smoothly without any distortion

e. Record the following information in the test reports:
   i. Description of product: a detailed specification and any necessary drawings or photographs, sufficient to completely identify the product and its fittings;
   ii. Test results:
      - Numerical test results expressed in the units prescribed for the appropriate test;
      - Any other specified criteria, e.g. "no damage occurred" etc.;
      - A graph of performance against increasing stress wherever applicable;
      - Diagrams or photographs to show points of failure where appropriate.
   iii. Test conditions: details of atmosphere i.e. conditions prior to and during testing where appropriate.

f. Test No. 1 - dimensional accuracy, squareness:
   i. Specified linear dimensions and squareness will be measured in accordance with BS 5278:1976, except that the height and width of doors will be measured with a maximum uncertainty of ±1.0 mm.

g. Test No. 2 - general flatness, evenness:
   i. The defects of general flatness of a door leaf will be measured in accordance with BS 5277:1976;
   ii. Evenness of surfaces will be measured by metal straight edges, one each of 50 ± 2 mm and 200 ± 2 mm and a set of feeler gauges which enables measurement of 0.2 to 1.0 mm in increments of 0.1 mm;

iii. Each door will be examined along four horizontal lines and two vertical lines, equally spaced, on each face of the doors, for any deviation in position exceeding the specified limits;

iv. Each continuous gap will be measured once at the point of maximum deviation;

v. The position of the point measured together with the magnitude of deviation will be recorded and reported.

h. Test No. 3 - behaviours under humidity variations:

i. Tests will be conducted in accordance with BS 5369:1987;

ii. Measurements of bending and twist will be taken within 6 hours of removal from the chamber;

iii. Doors that cannot be measured within the above specified period will be stored in the relevant climate or sealed in plastic wrapping;

iv. Have a maximum deviation due to bending of 7.5 mm, measured vertically;

v. The range between maximum deviation, due to twisting of any corner of the door in relation to the other three corners under the three climatic conditions, must not exceed 10 mm.

i. Test No. 4 - resistance to impact, hard body:

i. Test apparatus:

- The impactor will be a solid steel ball of diameter 50 ± 2.5 mm, which can be dropped down the inside of a release tower of 100 mm internal diameter, with a flat base and weighing about 5 kg, excluding the steel ball. The tower will incorporate a means of releasing the ball quickly and freely.

ii. Test method:

- The test doorset will be laid horizontally on a solid base, supported along three edges (top and both sides). Impacts of 3 Nm will be applied to fifteen points on the surface as specified below.

iii. Object of impact pattern:

- The object of the impact pattern is to control the spread of test points so that an undue concentration on places of high or low resistance is avoided;
- Figure 4(a) in Appendix COM5/I to this Worksection illustrates the principles by which a pattern is constructed, and shows one-half of the specimen;
- Aiming points are chosen from the centres of those sub-areas marked X;
- One point is selected from each of the fifteen rows, so that aiming points are spread in consecutive columns as shown in figure 4(a).

iv. Standard impact patterns:

- Figure 4(b) in Appendix COM5/I to this Worksection indicates four different sets of aiming patterns developed in this way;
- Some door constructions may require different aiming points from the remaining sub-areas marked Y but alternatives will not give such a balanced pattern;
- Any of the four patterns shown may be used for a test but the location which is expected to be most vulnerable will be included;
- The development of alternative patterns is not essential.

v. Repeat testing template:

- Where repeated testing is expected, such as for door leaves of standard size, a template may be used to avoid the need to mark out the face of a door leaf.

vi. Measurement of indents:

- The depth of indent caused by an impact will be measured by a dial gauge mounted on a reference bar;
- The contact between the reference bar and the door leaf surface is by a flattened knife edge at one end and a single rounded point contact at the other;
- The knife edge will be positioned at right angles to the length of the bar and set at a separation of 200 mm from the point of contact;
- The dial gauge will be positioned centrally between the knife edge and the point of contact;
- The extent of damage caused by an impact will be assessed by a transparent sheet on which a circle of 15 mm diameter has been inscribed.

vii. Test method sequence:

The sequence of the test method will be carried out as follows:

- An aiming point will be selected;
- A dial gauge reading will be taken at this point with the bar in a known orientation relative to the door edges;
- The tower will be positioned with its central axis over the aiming point;
- The ball will be dropped from a height where the distance from its underside to the door leaf surface corresponds to the specified impact energy;
- The tower will be removed and the depth of indent measured (by the difference of readings) with the bar and dial gauge in the previous position and orientation;
- Any consequent cracking of the material of the door together with any other damage caused by the impact will be assessed;
- This procedure will be repeated for the remainder of the specified aiming points.

j. Test No. 5 - resistance to torsion:

i. Test apparatus:

- The doorset will be mounted vertically and fixed in accordance with the manufacturer's recommendations;
- Arrangements will be made whereby the door leaf can be held open at 90 degrees by means of a clamp to top lockside corner;
- A means of applying force normal to the plane of the door leaf will be provided acting at its mid height;
- The force will act at the lockside edge of the door leaf;
- Deflection normal to the plane of the door leaf will be measured at the lower lockside corner.

ii. Initial loading:

- Slack in the hinges will be taken up initially by preloading;
- Preloading will be carried out by carefully applying a force of 200 N to the attachment point in increments not exceeding 100 N, the force acting at right angles to the door leaf;

- The force will be removed in the same incremental stages as in the loading procedure;
- The position of the lockside lower corner will be noted as a datum for deflection measurements.

iii. Test loading:

- A force of 400 N will be applied in increments not exceeding 100 N, the force acting at right angles to the door leaf;
- The deflection will be measured after the door leaf has stabilised at each increment, the movement of the dial gauge being less than 0.02 mm per minute;
- After the recording of the deflection under maximum force the reverse procedure will be adopted to remove the load. The final residual deflection at least 1 hour after all force has been removed will be recorded;
- Refer to Figure 5 - Torsion in Appendix COM5/I to this Worksection.

k. Test No. 6 - strength in the plane of the door leaf:

i. Test specimen:

- Doorset with factory-finish or finished as specified.

ii. Test method:

As Test No. 5 - resistance to torsion test:

- The doorset will remain in the rig position described;
- In the resistance to torsion test, the force will be applied, acting downwards in the plane of the door leaf, to a point at about mid -height of the door leaf near the lockset in a vertical direction;
- The point of measurement will be on the centre line of the bottom edge of the door leaf and 10 mm in from the locking edge.

iii. Test reading:

- The initial and final reading of the dial gauge will be taken with no force whatsoever applied to the door leaf (including the weight of the rope).

iv. Loading door:

- A downward vertical force of 500 N will be applied in increments of 50 N;
- The final force will be maintained for 5 minutes when the maximum deformation is recorded;
- The reverse procedure will be adopted and the residual deformation measured one hour after all downward forces have been released.

v. Test criteria:

- The maximum and residual deformation must not exceed 1.00 mm.

l. Test No. 7 - slamming open:

i. Mount for test:

- The doorset, including any architraves, trims, door stop, check or similar as specified, will be mounted, positioned and supported as in intended operational use, with the door leaf fully opened.

ii. Test method:

- The door leaf will be moved towards the closed position through an angle of 30 degrees and allowed to open freely under the influence of a 4 kg weight applied to the middle of the edge opposite the hinges at right angles to the plane of the fully open door;
- The procedure will be repeated 10 times at a rate not exceeding 15 times per minute;
- Double swing doors will be slammed open 10 times in each direction;
- If no closer or stop is specified, a floor mounted door stop will be provided at the 90 degrees open position;
- Refer to Figure 2 - slamming open, in Appendix COM5/I to this Worksection.

m. Test No. 8 - slamming closed:

i. Test apparatus:

- The doorset will be placed vertically in a rigid rig, fixed by a method recommended by the manufacturer;
- A light strong line will be arranged, that allows the door leaf to be closed from 60 degrees open by the descent of a weight of mass of 15 kg;
- The line will be attached to the leaf at the lockset or if this is more than 150 mm from the lockside edge at some point within 150 mm of that edge at the level of the lockset;
- The line will be passed horizontally from the door leaf and then over a 25 mm diameter, horizontal bar of smooth steel arranged with its axis parallel to the plane of the door frame;
- The bar will be positioned 400 mm from the door leaf face when the door leaf is closed and spanning the width of the doorset;
- The line will descend vertically from the bar and carry the weight at its lower extremity so arranged that, at the point of closure, the weight strikes a platform removing further tension from the line.

ii. Test method:

- The door leaf will be opened to 60 degrees and released, the door will be slammed shut by the action of the falling weight;
- Carry out test 20 times;
- Refer to Figure 1. - slamming closed, in Appendix COM5/I to this Worksection.

n. Test No. 9 - resistance to jarring and vibration:

i. Mount for test:

- The doorset will be mounted vertically in a rigid rig and fixed in accordance with the manufacturer's recommendations.

ii. Test apparatus:

- A spheroconical bag to BS EN 596:1995 Clause 6.2 will be hung from an independent support at about the same height as the top of the door leaf as a pendulum capable of striking the door's closing face;
- The bag will be hung so that, at rest, with the door open at 45 degrees, it just contacts the surface of the door leaf with its centre of gravity at the level of the lockset, and at mid-width of the door frame;
- The lockset will be removed where this would be struck.

iii. Test method:

- The door leaf will be opened from the closed position through an angle of 45°;
- If any closing device is fitted, the door leaf will be restrained slightly against closing, but not against opening; otherwise the door leaf will be unrestrained;
- If no closer or stop is specified, a floor mounted door stop at the 90° open position will be provided;
- The test body will be drawn away from the door leaf in a vertical plane normal to the door frame through an arc of 250 mm vertical height then released to strike the door leaf;
- Carry out test 100 times;
- Refer to Figure 7 - jarring, in Appendix COM5/I to this Worksection.

o. Test No. 10 - resistance to impact; heavy body:

i. Test apparatus:

- A spheroconical bag to BS EN 596:1995 Clause 6.2 will be hung as a pendulum capable of striking the door leaf;
- The bag will be placed so that, at rest, it just contacts the surface of the door leaf with its centre of gravity at the level of the lockset, such that when swung in a vertical plane normal to the door leaf it will impact the door leaf at mid-width of the door leaf.

ii. Mount for test:

- The doorset will be mounted vertically and fixed in accordance with the manufacturer's recommendations. The door leaf, will be closed and locked.

iii. Test method:

- With the door leaf closed and locked, the test body will be swung against the door leaf three times to the closing face, with an impact energy of:
  - 20 Nm each time for kitchen and bathroom doorsets and;
  - 40 Nm each time for flat entrance and exit staircase doorsets.

The doorset will then be examined for any damage or deformation; then

- With the door leaf closed and locked and clamped at the position of the lockset the test will be repeated against both sides of the door leaf, three times, commencing with the opening face and with an impact energy of:
  - 40 Nm each time for kitchen and bathroom doorsets and;
  - 80 Nm each time for flat entrance and exit staircase doorsets.

The doorset will then be examined for any breakage.

- Refer to Figure 3 - heavy body, in Appendix COM5/I to this Worksection.

p. Test No. 11 - resistance to closing against an obstruction:

i. Mount for test:

- The doorset will be mounted vertically in a rigid rig, and fixed in accordance with the manufacturer's recommendations. A dry hardwood slip, 50 mm x 50 mm x 10 mm and of mass between 15 g and 20 g will be provided for the test.

ii. Test method:

- The door will be opened and the hardwood slip placed in the gap between the door leaf and the bottom of the hinge side jamb of the frame in order to hold the door ajar. The slip will be inserted from the closing face with its grain horizontal and its plane vertical and parallel to the plane of the door frame as shown in Figure 6 - "Arrangement of Hardwood slip for obstruction test", in Appendix COM5/I to this Worksection;
- A force will be applied, acting at right angles to the plane of the frame, increasing in 50 N increments to the lockside edge, at the handle height until it reaches 200 N.

q. Test No. 12 – endurance test of mechanical smoke seal

i. The drop seal sample will be installed securely to the timber door / panel set up in laboratory. The assembly of the timber door / panel set up will be similar to the recommended installation details indicated in the shop drawing;

ii. The door / panel will be closed such that the seal will be in fully dropped position and seal up the gap at bottom of the door / panel. Photos of the test sample will be taken at both closed and opened positions of the door / panel for record;

iii. Hydraulic jack / motor / pressure cylinder will be used to open and close the door with an opening angle of around 10 degrees to activate the mechanism of drop seal such that the seal will be lifted up when the door is opened and in fully dropped position when the door is closed. Each test cycle will be completed in 2 to 3 seconds;

iv. After completion of the first 50,000 test cycles in step (iii), the test sample will be examined for any distortion or breakage, and any abnormality of the dropping / lifting of the seal and any wear and tear of the seal observed will be recorded;

v. Step (iii) and (iv) will be repeated to a total of 500,000 test cycles;

vi. In case the mechanical operation of the drop seal fails during the test (i.e. the seal either cannot drop when the button / block is pushed or cannot be lifted up when the button / block is released), the test will be suspended and the failure condition will be recorded.

r. When the wooden doorsets are supplied for domestic blocks, standard of visual quality of doorsets shall be comparable with the benchmark samples maintained by the Housing Department.

3. On Site Delivery Verification:

a. At delivery stage, submit to the CM the following:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. A batch being the accumulative total of 1500 doorsets or part thereof delivered to Site;

iii. Delivery notes for all material delivered to Site;

iv. The Certificates of Origin and delivery notes for the doorsets from sustainable sources shall indicate the name and COC number of the doorset supplier / manufacturer and the certificate code of the independent certification scheme for the doorsets delivered.

b. Carry out X-ray scanning test as follows:

i. In an Approved Laboratory within two weeks from the delivery day of the representative batch of doorsets on Site to prove that the doorsets delivered is free from live insects and larvae infestation;

ii. Two specimens in one sample of doorsets to be selected by the CM from each batch of delivery for the test;

iii. Testing method in sequence shown below:

- Apply X-ray scanning to the whole door leaf;
- Select 10 spots from the X-ray scanning films;
- Remove the facing on one side of the door leaf for general inspection;
- Study in detail on the 10 selected spots including microscopic inspection (multiplication X20);
- Record the findings of the 10 selected spots including photographs of the whole leaf and individual selected spots.

iv. Remove the representative batch of doorsets off Site if the test results fail to meet the requirement stated in (b)(i), bear all associated costs, and no extension of time will be allowed.

c. Subsequent to each X-ray scanning test as per sub-clause (3)(b), verify the average density of the X-rayed solid core timber doorsets. Location for taking the specimens for the density test is to be selected by the CM. Carry out the test on one set of samples for each type of doorset by the same Approved Laboratory as follows:

i. Measure the density of 6 nos. of timber samples from one door leave and take average;

ii. Measure the density of 3 nos. of timber samples from one set of door frame and take average;

iii. Where the results fail to meet the requirement stated in COM5.M025, COM5.M030 and COM5.M035, either:

- Remove the representative batch of timber doorsets off Site; or
- When agreed by the CM, repeat verification in (c)(i) and (c)(ii) for three separate door leaves and door frames selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

d. Subsequent to each X-ray scanning test as per sub-clause (3)(b), open-up inspection shall be conducted by an Approved Laboratory using the same tested specimens. The specimens shall be the complete component as to be installed, including frame, door leaf, glazing, fire / smoke seals, all fixed parts, leaf, fastenings, and fixings necessary to ensure normal operation.

i. Method:

Inspection Items	Method	Acceptance Standards
Dimension and core construction of doorset	Dimension and layout check	Approved shop drawings; COM5.M015 and COM5.M210
Timber quality	Visual	COM5.M010
Doorset finishes	Dimension check	Approved shop drawings; COM5.M420 and COM5.M430

Moisture content	By moisture meters	COM5.M020
Identification tag	Visual	COM5.M070
Fire rated materials	Dimension and visual check	Approved shop drawings

ii. Where the results fail to meet the requirement stated in (d)(i), either:

- Remove the representative batch of doorsets off site; or
- When agreed by the CM, repeat the inspection (d)(i) on three separate samples of doorset selected by the CM from the same batch. One set of test sample consist of two specimens. In case of failure of any inspection to any one sample, remove the same type of doorsets from the representative batch off site, bear all associated costs, and no extension of time will be allowed.

e. Carry out and submit report on the following verifications for wooden doorsets upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Dimension Check	By measurement	COM5.M210
Holes or recesses to receive ironmongery	Visual and by measurement	COM5.M310
Surface Quality	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency, painting same as the CM's Approved sample.
Paint finish	Visual	COM5.M410 (3)(a)
Laminated plastic sheet door facing	Visual	COM5.M430
Screw for Hinges	Visual and by measurement	IRO1.M360
Ironmongery Check	Visual	Same as the CM's Approved sample and as per COM5.M510
Fire resistant glass	Visual	Identification mark same as the Approved sample
Intumescent strip	Visual	COM5.M080
Smoke seal	Visual	COM5.M090
Moisture Content	By moisture meters	COM5.M020

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Dimension Check	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site

Items	Sampling Frequency	Representative Batch
Holes or recesses to receive ironmongery	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site
Surface Quality	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site
Paint finish	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site
Laminated plastic sheet door facing	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site
Screw for Hinges	1 screw sample for every 1500 doorsets or part thereof	Same batch of material delivered to Site
Ironmongery Check	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site
Fire resistant glass	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site
Intumescent strip	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site
Smoke seal	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site
Moisture Content	1 sample for every 200 pieces or part thereof	Same batch of material delivered to Site

f. When any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM5.M050.9 DOORSET TYPE (PAINT FINISH)

Doorset to comprise of the following:

1. Solid core or skeleton flush door leaves with paint finish complete with ironmongeries and hinged to door frame;
2. Hardwood door frame with paint finish;
3. Hardwood or softwood architraves with paint finish;
4. Glazing beads with paint finish, fixing screws for glazing beads; and
5. Plastic pellets.

COM5.M060.9 DOORSET TYPE (TIMBER VENEER FINISH)

Doorsets to comprise of the following:

1. Solid core or skeleton flush door in timber veneer faced plywood finish sprayed with semi-gloss clear water based polyurethane paint or clear water based lacquer paint complete with ironmongeries and hinged to door frame;
2. Hardwood door frame to comprise a frame sprayed with semi-gloss clear water based polyurethane paint or clear water based lacquer paint;
3. Glazing beads sprayed with semi-gloss clear water based polyurethane paint or clear water based lacquer paint, fixing screws for glazing beads and matching wooden fillet.

COM5.M070.9 IDENTIFICATION

Supply RFID tags as specified in COM11 with a unique serial number and marked in an inconspicuous position on each doorset and its detached parts. Identify and record the date of manufacture.

COM5.M080.9 INTUMESCENT STRIP

1. Approved proprietary intumescent strip complying with the following requirements:
   a. Intumescent strip for fire protection only shall be tested to BS 476:Part 22:1987 or BS EN 1634:Part 1:2008;
   b. Intumescent strip for fire and smoke protection shall be tested to BS 476:Part 22:1987 or BS EN 1634:Part 1:2008, and BS EN 1634:Part 3:2004 for smoke control.
2. The fire sealing system shall be firmly fixed and its performance shall not be affected by moisture or dampness. For intumescent strip made of hygroscopic materials, the ends and the cut edges of the intumescent strip shall be properly protected and sealed with fire mastic to prevent deterioration through the absorption of atmospheric moisture;
3. Where the intumescent strip has to be used with a bedding liner made of hygroscopic materials underneath the glazing bead around the glazing panel, suitable means such as a continuous bead of sealant to prevent the bedding liner from deterioration through the absorption of atmospheric moisture shall be provided;
4. The use of intumescent strip and any details such as application of fire mastic or sealants shall be covered under a valid fire test report or the assessment report.

COM5.M090.9 SMOKE SEAL

1. Approved proprietary smoke seal tested at ambient temperature and medium temperature and demonstrated to comply with the smoke leakage rate criteria in accordance with BS EN 1634:Part 3:2004;
2. Smoke seal shall be covered under a valid smoke test report. The test specimen construction and finish shall be fully representative of that intended to be used in practice. When installed on Site, the bottom gap between the fire rated / smoke control door and the floor shall be not more than the designed values of such door specified in the fire or smoke test report;
3. When specified on Drawings or as required in accordance with the door manufacturer's fire rated door design, smoke seal installed at bottom of fire rated doors shall be a mechanical "drop-type" threshold smoke seal certified as tested to 500,000 cycles with test procedures to sub-clause 2(q) of COM5.M040;
4. For mechanical "drop-type" threshold smoke seal operated with an actuator hitting against the door jamb, the actuator shall be of non-ferrous metal and not in direct contact with the intumescent strip embedded at the door jamb, otherwise it may damage or affect the performance of the intumescent strip;
5. Other non-drop type smoke seal installed at door frame rebate shall be elastomeric fin(s) with self-adhesion backing;
6. The fire sealing system shall be firmly fixed and its performance shall not be affected by moisture or dampness.

COM5.M100.9 FIRE RESISTANT GLASS

Proprietary fire resistant laminated safety glass as per sub-clause (1) of COM4.M130.

DIMENSIONAL ACCURACY

COM5.M210.9 DOORSETS, DOOR LEAVES AND FRAMES GENERALLY

Comply with BS 4787:Part 1:1980 unless otherwise specified in Appendix H "Schedule of Tolerances" to this Specification.

PREFORMING AND DRILLING

COM5.M310.9 DOORSETS

Preformed with:

1. Holes or recesses to receive ironmongery as scheduled with the exception of overhead door closers and door stops and pre-drill screw fixing holes:
   a. For the purpose of fixing the door frames on to the sub-frames/linings or drywall partitions;
   b. On the door frames at 150 mm above finished floor level and at maximum 450 mm centres;
   c. Ensuring position of the ironmongery does not obstruct the predrilled fixing holes.
2. A cavity, where necessary, for the installation of wiring for the electrical locksets.

COM5.M320.9 EXPANDING ANCHOR FOR FIXING DOOR TO CONCRETE

1. Not less than 10 mm diameter proprietary expanding anchor, consisting of zinc electro-plated steel screw and zinc electro-plated steel sleeve. The anchor and sleeve shall be from the same manufacturer and packaged and supplied as a complete unit;
2. Minimum 30mm effective anchorage depth in concrete. Application and fixing shall be in strict compliance with the manufacturer's recommendations.

COM5.M330.9 EXPANDING ANCHOR FOR FIXING DOOR TO PANEL WALL

1. Not less than 10 mm diameter proprietary expanding anchor, consisting of zinc electro-plated steel screw and polyamide sleeve. The anchor and sleeve shall be from the same manufacturer and packaged and supplied as a complete unit;
2. Minimum 50mm effective anchorage depth in panel wall. Application and fixing shall be in strict compliance with the manufacturer's recommendations.

DOORSET FINISHES

COM5.M410.9 SURFACE FINISH

Ensure all timber doorsets, including top panels where applicable, frames and their parts are supplied in the following condition:

1. Door leaf surfaces: flat, true, smooth and jointless with no visible defects;
2. Inside of bathroom door leaf surfaces: finished with 1.0 mm plastic laminate;
3. Paint and decorative materials shall be as specified in FIN7 and generally in compliance with FIN7.M010:
   a. For doorsets with paint finish:
      i. Primed, undercoated and sprayed with wood paint of good adhesion and good resistance to fading (except sub-clause (2) above) as per FIN7.M585;
      ii. With backs of hardwood door frames treated with two coats of wood preservative as per FIN7.M140.

b. For doorsets with timber veneer finish:
   i. Sprayed with semi-gloss clear water based polyurethane paint or clear water based lacquer paint (except sub-clause (2) above) as per FIN7.M585;
   ii. With backs of hardwood door frames and veneer faced plywood treated with two coats of wood preservative as per FIN7.M140.

COM5.M420.A PLYWOOD FOR DOOR FACINGS

1. To BS EN 635 Part 1 to 3:1995, Grade II veneer in general or Grade I veneer if natural finish is required, 5 mm thick;
2. Plywood facings to be close grained and filled;
3. VOC data submission of adhesives used in the product shall comply with COM5.M525;
4. Formaldehyde emission of wood panels shall be of Class E1 under EN13986:2004+A1:2005:
5. Use sustainable timber as per COM5.M005;
6. Bonding adhesive as per TIM1.M310.

COM5.M430.A LAMINATED PLASTIC SHEET FOR BATHROOM DOOR FACINGS

To BS EN 438-1:2016, BS EN 438-2:2016+A1:2008 and BS EN 438-3:2016:

1. Class: VG
   a. “V” denotes “Vertical grade”;
   b. “G” denotes “General purpose or moderate use”.
2. Colour / sheen: matt texture with colour to Approval;
3. Thickness: 1.0 mm;
4. Back of sheet to be suitable for adhesive bonding to a substrate;
5. Submit samples for Approval;
6. VOC data submission of adhesives used in the product shall comply with COM5.M525;
7. Formaldehyde emission of wood panels shall be of Class E1 under BS EN 13986:2004+A1:2005:
8. All wood-based core materials for fixing laminated plastic sheets in compliance with TIM1.W160.

IRONMONGERY AND OTHER MATERIALS

COM5.M510.9 IRONMONGERY

Doorsets to be supplied with the following items of ironmongery:

1. Ironmongery supplied fitted:
   a. 'Magic Eye / Door Viewer' to IRO1.M1220 where scheduled;
   b. Hinges to IRO1.M210;
   c. Kicker plates to IRO1.M1150 where scheduled;
   d. Others as shown on the Drawings or scheduled.
2. Ironmongery supplied loose:
   a. Door closer to IRO1.M530 where scheduled;
   b. Locks and latches where scheduled;
   c. Push plates and pull handles to IRO1.M1150 where scheduled.

COM5.M520.9 WOOD SCREWS

1. For fixing glazing beads, architraves and other components of the timber doorset where applicable - as per TIM1.M630 and TIM1.M640;
2. For fixing door hinges – as per IRO1.M360 and IRO1.M370.

COM5.M525.9 ADHESIVES FOR WOOD

As TIM1.M710.

COM5.M530.9 FIRE RESISTANT LAMINATED SAFETY GLASS

As COM4.M130.

WORKMANSHIP

GENERALLY

COM5.W010.9 FRAME ASSEMBLY

1. For doorsets with paint finish:
   a. Construct door frames and door leaf framing with tight fitting joints ensuring framework is square after assembly.
2. For doorsets with timber veneer finish:
   a. Construct door frames, door leaf framing and patterns on veneer faced plywood with tight fitting joints ensuring framework is square after assembly.

COM5.W020.9 HEAD FIXING

Mid-span fix at the head.

COM5.W030.9 PELLETING

Plug pre-drilled fixing holes with nylon pellets.

COM5.W040.9 SPLAY EDGES

Provide splay edges to the lipping to enhance the operation of door leaves.

COM5.W050.9 JOINTS

1. For doorsets with paint finish:
   a. Provide 'V' joints at mitre joints of frames and of glazing beads, and at 'T' joint for transoms and frames to control the possible cracks of the paint finishes.
2. For doorsets with timber veneer finish:
   a. Provide 'V' joints at mitre joints of frames and of glazing beads, and at 'T' joint for transoms and frames. Provide the joints of the veneered faced plywood as shown in the standard drawings.

COM5.W060.9 SPREAD OF ADHESIVE

1. For doorsets with paint finish

   Provide sufficient and even spread of adhesive for gluing the plywood faces. This is indicated by a consistent bead of adhesive squeeze from the timber to plywood joint all around the perimeter of door leaves.
2. For doorsets with timber veneer finish

   Provide sufficient and even spread of adhesive for gluing the veneer and plywood faces. This is indicated by a consistent bead of adhesive squeeze from the plywood to veneer and from timber to plywood joint all around the perimeter of door leaves.

FIXING SEQUENCE

COM5.W110.9 INSTALLATION

Fix doorsets in formed openings in accordance with the manufacturer's recommendations and in the following sequence:

1. Install sub-frames/linings for fixing of door frames. Provide 5 mm thick plywood packs at every fixing position of door frame/sides panels. Provide means of attaching the door frames to sub-frames/linings or to panel partitions;

2. Fix door frames after the completion of all wet trade in the adjacent areas. Apply low modulus silicone sealant at joints between panel partitions/sub-frames and back of door frames;
3. Install ironmongery to the predrilled holes or recesses on the doorsets;
4. Ease and oil knobsets and other ironmongery;
5. Install vision panels, overpanels and side panels as specified in Worksection COM4.

TESTING

SURVEILLANCE TESTS FOR TIMBER DOORSETS

COM5.T1605.A SURVEILLANCE TESTS

1. Test Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or Direct Testing Contractor;
   b. Comply with the following pertaining to the surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Test Samples:
   a. For sub-clauses (3)(a) to (c), provide-one set of test samples from the batch of material delivered to Site (inclusive of door leaves, frames, ironmongery and other accessories sufficient for assembling the doorsets) under the delivery note as specified in COM5.M040 (3)(a) (hereinafter referred to as the "representative batch") or as instructed by the CM;
   b. Open-up inspection specified in sub-clause (3)(d) shall be conducted immediately after X-ray scanning specified in sub-clause COM5.M040 (3)(b) using the same tested specimens. The specimens shall be the complete component as to be installed, including frame, door leaf, glazing, fire / smoke seals, all fixed parts, leaf, fastenings and fixings necessary to ensure normal operation;
   c. Bear all cost for any replacement of samples.
3. Test methods:
   a. For Fire Resistance Test, as per COM5.M040 (2)(b)(i) or (2)(c)(i) as appropriate;
   b. For Smoke Control Test, as per COM5.M090 (1);
   c. For Functional Dimensions / Strength Test, as per COM5.M040 (2)(d);
   d. For Open Up Inspection, as per COM5.M040 (3)(d)(i):

Inspection Items	Method	Acceptance Standards
Dimension and core construction of doorset	Dimension and layout check	Approved shop drawings; COM5.M015 and COM5.M210
Timber quality	Visual	COM5.M010
Doorset finishes	Dimension check	Approved shop drawings; COM5.M420 and COM5.M430
Moisture content	By moisture meters	COM5.M020
Identification tag	Visual	COM5.M070
Fire rated materials	Dimension and visual check	Approved shop drawings

4. Non-compliance:

a. In the event that any of the testing samples fails to meet the test requirements in sub-clause (3), follow either one of the following actions:

i. Remove the representative batch off Site; or

ii. Apply to the CM for re-test / re-inspection as follows:

- For Fire Resistance Test or Smoke Control Test, re-test for the representative batch in accordance with the test methods as specified in sub-clause (3) by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for one separate set of samples selected by the CM from the representative batch;
- For Functional Dimensions / Strength Test, re-test for the representative batch in accordance with the test methods as specified in sub-clause (3) by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for three separate sets of samples selected by the CM from the representative batch;
- For Open Up Inspection, carry out re-inspection for the representative batch in accordance with the methods as specified in sub-clause (3) by the CM for three separate sets of samples selected by the CM from the representative batch.

  The CM shall have the discretion to approve or not the commissioning of the latter laboratory for the re-test. In case any one sample for the re-test fails, remove the representative batch off Site.

b. When the representative batch of doorsets is removed off Site, replace with another new batch (hereinafter referred to as the "replacement batch"). Apply to the CM for test in accordance with the test methods as specified in sub-clause (3) by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for one set of samples selected by the CM from the replacement batch. The CM shall have the discretion to approve or not the commissioning of the latter laboratory for the test. In case any one sample fails the test, follow action stated in sub-clause (4)(a);

c. Bear the costs of any failed surveillance tests and all associated costs for the test(s) and re-test(s) required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

COM5.T1610.A SURVEILLANCE TESTS FOR MECHANICAL SMOKE SEAL

1. Testing Arrangements:
   a. When instructed, surveillance tests shall be carried out by the CM or a Direct Testing Contractor;
   b. Comply with the following pertaining to surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified;
      iii. Set up the timber door/ panel and install the test sample as directed by the CM or as specified.
2. Testing Samples:
   a. Provide one set of test sample from the material delivered to Site as instructed by the CM;
   b. One set of test sample shall consist of one smoke seal and the associated accessories, fastenings and fixings necessary to ensure normal operation or as instructed by the CM.
3. Testing methods:
   As per sub-clause 2(q) of COM5.M040.

4. Non-compliance:
   a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch of mechanical smoke seal off Site; or
      ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch of mechanical smoke seal off Site.
   b. When the representative batch of mechanical smoke seal is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
   c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

APPENDIX COM5/I

COM5.APPEND1.9 TESTS FOR TIMBER DOORSETS

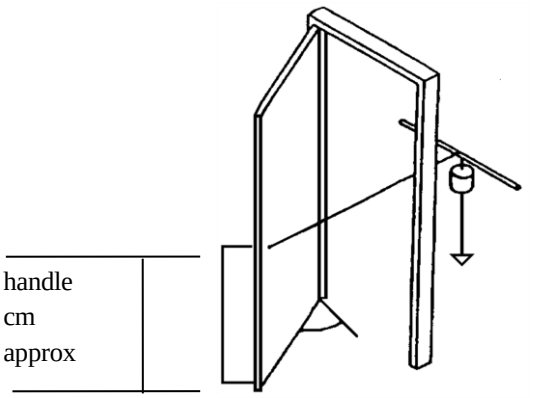


Fig. 1 - Slamming closed

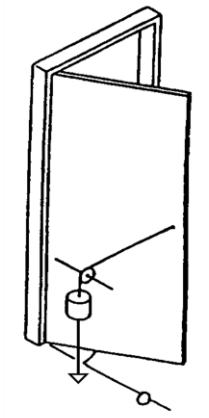


Fig. 2 - Slamming Open

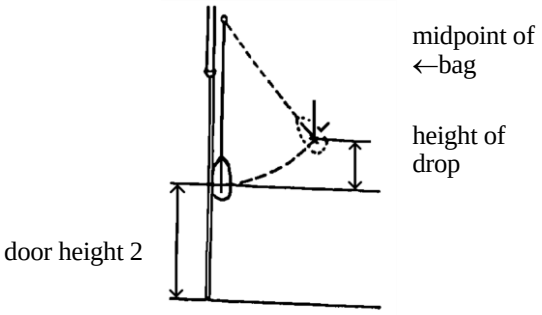


Fig. 3 - Heavy Body

X		X		X		X		X		← Mid-height of →	1		2		3		Y		4	
	X		X		X		X		X	specimen		4		1		2		Y		3
		X		X		X		X		↑	3		Y		4		1		2	
	X		X		X		X		X			Y		3		4		2		1
X		X		X		X		X			Y		3		2		4		1	
	X		X		X		X		X	| Main area 10		2		Y		1		3		4
X		X		X		X		X		equal divisions	2		4		1		3		Y	
	X		X		X		X		X			1		Y		3		4		2
X		X		X		X		X		↓	4		1		Y		2		3	
	X		X		X		X		X			Y		2		4		1		3
X	X	X	X	X							1	3	Y	4	2					
					X	X	X	X	X	↑ Base area 5						3	1	4	2	Y
X	X	X	X	X						equal divisions	2	4	1	3	Y					
					X	X	X	X	X	↓ totalling						Y	2	3	1	4
X	X	X	X	X						150 mm	Y	3	2	4	1					

15 rows 10 columns
<- potential aiming point
a) Principles of pattern construction

Y- retaining subareas
b) Four possible aiming patterns

Fig. 4 - Aiming patterns for hard body inpact test

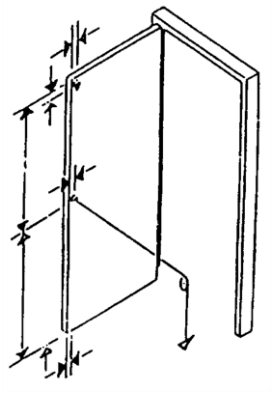


Fig. 5 - Torsion

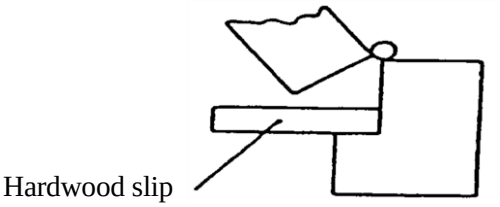


Fig. 6 Arrangement of Hardwood slip for obstruction test

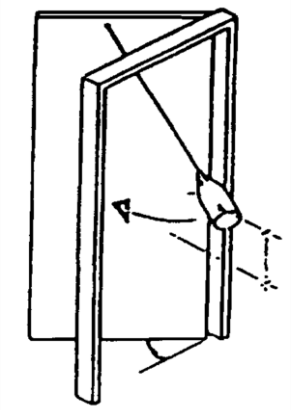


Fig. 7 Jarring

COM6 STEEL DOORS

DESIGN

GENERAL

COM6.D010.9 SPECIFICATION REQUIREMENTS

Instruct the Supplier to design, construct, fix and glaze steel doors and louvres in accordance with this Worksection and the relevant clauses of:

1. MET1 General Metalwork;
2. COM4 Glazing;
3. WAT5 Sealants.

COM6.D020.9 STEEL DOORS AND LOUVRES

Comply with BS 6510:1984 and including:

1. Fixings:
   a. Slotted adjustable lugs and screws necessary for building in steel doors and louvres with either:
      i. Lugs: projecting a minimum of 60 mm beyond the metal frame; or
      ii. Shot fixing lugs: at least 1.6 mm thick x 30 to 40 mm wide fixed at 300 to 400 mm centres with a minimum of one shot fixing to each and projecting a minimum of 50 mm beyond the metal frame; or
   b. Expansion bolts to MET1.M220.
2. Rolled steel, heavy channel section glazing beads, size as shown on the Drawings, mitred at the corners and fixed with galvanized, mild steel, flat headed countersunk screws at maximum centres of 225 mm and tap frames to receive screws.

COM6.D030.9 INSIDE GLAZING

Design steel doors for inside glazing unless otherwise shown on the Drawings.

SUBMISSION

COM6.D040.9 SHOP DRAWINGS AND STRUCTURAL CALCULATION

1. Submit structural calculation by RSE and shop drawings showing details of the members and the positions of fixings for CM's approval prior to the commencement of fabrication;
2. Submit details of equipotential bonding connection for steel doors and louvres in accordance with COM6.W030.

COM6.D050.9 SAMPLES

Submit samples of steel louvres, doors and ironmongery for the CM's approval prior to the commencement of fabrication.

DESIGN PARAMETERS

COM6.D110.9 WIND LOADING FOR EXTERNAL STEEL DOORS AND LOUVRES

When fixed in position and glazed, steel doors and louvres must withstand:

1. A wind load calculated in accordance with the current Code of Practice on Wind Effects, Hong Kong; and
2. The resultant resistance to wind loading of a minimum of:
   a. 3.0 kPa for non-domestic buildings such as schools, commercial centres etc.;
   b. 3.8 kPa for domestic buildings excluding ground floor or podium.

MATERIALS

STEEL MEMBERS AND FINISHES

COM6.M010.9 SECTIONS

Universal steel sections, hot rolled, cold straightened and:

1. Size: as shown on the Drawings;
2. Free from rolling defects;
3. With all manufacturer's fabrication holes sealed by welding prior to delivery to site.

COM6.M020.9 FRAMES

Must be:

1. Square and flat with mitred, welded corners;
2. With glazing bars machine tenoned and/or welded to frames;
3. With weatherbars for the complete width of the steel doors as shown on the Drawings.

COM6.M030.9 FINISH

1. All steel doors after fabrication must be hot dip galvanized as MET1.W330;
2. Any cutting, drilling or welding after galvanizing must be treated with an zinc rich primer on completion.

FIXINGS, FASTENING ETC

COM6.M110.9 SEALANT

As WAT5.M310.

COM6.M130.9 IRONMONGERY

Pull handle, striking plates, hinges, surface bolt, hasp and staple, padlock etc. as shown on the Drawings.

WORKMANSHIP

FABRICATION AND ASSEMBLY

COM6.W010.9 STEEL DOORS AND LOUVRES

Hang to open and fit with ironmongery as indicated on the Drawings.

COM6.W020.9 POSITIONING

Position steel doors plumb, level and square.

COM6.W030.9 EQUIPOTENTIAL BONDING TO STEEL DOORS AND LOUVRES

Unless otherwise specified on Drawings, provide equipotential bonding connection for steel doors and louvers as follows:

1. Louvres in public access areas:
   a. Provide a 20 mm x 1.5 mm thick steel plates earthing lug electroplated zinc galvanized to BS 1706:1990, class B and 13 μm to the outer frame of windows and louvres. The cut edges of earthing lug shall be painted with zinc phosphate primer;
   b. Fix one end of the earthing lug to the louvres with 2 No. M4 self-tapping stainless steel screws at 60 mm centres;
   c. Provide a 5 mm diameter hole at the other end for connection of the bonding conductor by the Nominated Sub-contractor for Electrical Installation;
   d. Ensure that full electrical continuity is maintained between all the component elements of louvres.
2. Doors and louvres for services rooms:
   a. Weld one end of 1.5 mm thick galvanised mild steel earthing lug(s) to the doors and louvres; and
   b. Form a 5 mm diameter hole at the other end of the earthing lug(s) for connection of the bonding conductor by the Nominated Sub-contractor fro Electrical Installation;
   c. Ensure that full electrical continuity is maintained between all the component elements of the steel doors and louvres.
3. As COM2.W465 (6).

COM6.W040.9 BEDDING MORTAR

Bed steel frames in waterproof mortar as MAS3.W180 leaving no gaps.

COM6.W050.9 POINTING TO PERIMETER OF STEEL DOORS AND LOUVRES

Where specified, point around external perimeter of steel louvres and door frames. Point in accordance with the Workmanship requirements of Worksection WAT5.

COM6.W060.9 PAINTING

Deliver steel doors and louvres to site unprimed and paint surfaces in accordance with Worksection FIN7.

TRANSPORTATION, HANDLING AND STORAGE

COM6.W110.9 STEEL DOORS AND LOUVRES

Keep upright during handling to prohibit sagging, stack off ground on levelled hard standing under cover, clear of mud and site traffic and avoid:

1. Distortion during handling and storage;
2. Distortion during vertical transportation to floors at high level.

TOLERANCES

COM6.W210.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

COM7 GATESETS

GENERAL

APPLICATION OF SPECIFICATION

COM7.G010.9 GATESETS

The gatesets specified in this Worksection are for use in domestic flats design and comprise the following:

1. Galvanized mild steel sliding type;
2. Galvanized mild steel swing type.

DESIGN

GENERAL

COM7.D010.9 DESIGN RESPONSIBILITY

Design and manufacture the gatesets based on the Drawings and in accordance with the requirements of this Worksection and Worksection MET1 as appropriate.

PERFORMANCE CRITERIA

COM7.D140.9 GATESET OPERATION

Ensure the operation of gateset is in a smooth and quiet manner.

MATERIALS

GALVANISED MILD STEEL GATESETS

COM7.M010.9 GALVANIZED MILD STEEL GATESETS

1. Submission Requirements:
   a. At sample submission and approval stage, submit one sample of the gateset showing complete fittings and accessories including typical section of members, track and guide rail, Approved steel roller, steel anchor bolts and lock for CM's approval together with all the following substantiation for CM's information:
      i. Job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Brand name of the lock case and key cylinder;
      v. Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

      vi. Submit a sample board similar to the one maintained by the Housing Department showing complete fittings and accessories including typical section of members, track and guide rail, Approved steel roller, steel anchor bolts and lock.

      When the gatesets are supplied for domestic blocks, submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works.

   b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clauses (2)(d) to (2)(g) and COM7.M080 for CM's information:
      i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;
      ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. Submit shop drawings for CM's approval, prior to the commencement of ordering of material. Drawings for each type of gateset shall include:

i. Materials in compliance with Drawings and Specifcation;

ii. Fixing details of metal gate to walls and floors;

iii. Positions of anchor bolts;

iv. Details of roller (with brand name if applicable), completed with lubricated bearings, threaded hangers and connection bars;

v. Welding details of components and parts;

vi. Details and sections to show sizes, profiles and fixings of assembling and concealed parts;

vii. Fixing details of equipotential bonding connection for the gateset;

viii. Proposed Radio Frequency Identification tag and the fixing method as specified in the Worksection COM11.

2. Quality Requirements:

a. Satisfy the requirements of the following tests. Record the test results as specified in sub-clause (2)(b) and follow the sequence for carrying out the test as sub-clause (2)(c).

<table>
<tr><td>Items</td><td>Methods</td><td colspan="2">Acceptance Standards</td></tr>
<tr><td></td><td>Sliding type / Swing type</td><td>Sliding type</td><td>Swing type</td></tr>
<tr><td>Operation Test</td><td>Refer sub-clause (2)(d)</td><td>Movement of gateset must be smooth and quiet; opening force ≤ 35 N.</td><td>Movement of gateset must be smooth and quiet; opening force ≤ 20 N.</td></tr>
<tr><td>Slamming Closed Test</td><td>Refer sub-clause (2)(e)</td><td colspan="2" rowspan="2">No damage, deformation or loosening of fixings or joints which would render it unfit for its purpose. No dislodgement or dangerous shattering of any component parts. After the test, the gateset must still meet the requirement of the Operation Test.</td></tr>
<tr><td>Slamming Open Test</td><td>Refer sub-clause (2)(f) (swing type only)</td></tr>
<tr><td>Heavy Body Impact Test</td><td>Refer sub-clauses (2)(g) & (2)(h)</td><td colspan="2">No visually unacceptable damage, deformation and functional defects at impact energy = 80 Nm, and gateset must remain fit for use. After the test, gateset must still meet the requirement of the Operation Test.
No breakage or functional defects must be found at impact energy = 240 Nm.</td></tr>
</table>

Resistance to torsion	Refer sub-clause (2)(i) (swing type only)	Not applicable	No damage, deformation or loosening of fixings or joints which would render it unfit for its purpose. No dislodgement or dangerous shattering of any component parts. No functional defects. The residual deformation must not exceed 1 mm. After the test, the gateset must still meet the requirement of the Operation Test.
Strength in the plane of the gateset leaf	Refer sub-clause (2)(j) (swing type only)	Not applicable	Movement of gateset must be smooth and quiet; opening force ≤ 35 N but the residual deformation must not exceed 1 mm.
Resistance to closing against obstruction	Refer sub-clause (2)(k) (swing type only)	Not applicable	No damage, deformation or loosening of fixings or joints which would render it unfit for its purpose. No dislodgement or dangerous shattering of any component parts. After the test, the gateset must still meet the requirement of the Operation Test.
Resistance to jarring and vibration	Refer sub-clause (2)(l) (swing type only)	Not applicable	
Endurance Performance Test	Refer sub-clause (2)(m)	No damage, deformation, functional defects or serious wear and tear to gateset must be found.	
Test on security by personnel loading	Refer sub-clause (2)(n) (swing type only)	Not applicable	Deflection ≤ 1.5 mm, maximum deformation ≤ 1 mm. No damage, breakage or function defects must be found. After the test, the gateset must still meet requirement of the Operation Test.

b. Record the following information in test reports:
   i. A detailed description and specification of the product with any necessary drawings and photographs, sufficient completely to identify the product and its fittings;
   ii. Description of each test undertaken and the performance of the gateset relative to the acceptance standards;

iii. Numerical test results expressed in the units prescribed for the appropriate test and supported by any other specified criteria, e.g. "no damage occurred" etc.. A graph of performance against increasing stress will be included where appropriate, as will diagrams or photographs of points of failure;

iv. Details of atmospheric conditions, prior to and during testing, where appropriate.

c. Carry out tests on two brand new samples for sliding type gateset and two brand new samples for swing type gateset:

i. First sample (Sample A) for the tests in the following order:

- Operation Test as in sub-clause (2)(d);
- Slamming Closed Test as in sub-clause (2)(e);
- Slamming Open Test as in sub-clause (2)(f);
- Heavy Body Impact Test as in sub-clauses (2)(g) & (2)(h);
- Resistance to torsion as in sub-clause (2)(i);
- Strength in the plane of the gateset leaf as in sub-clause (2)(j);
- Resistance to closing against obstruction as in sub-clause (2)(k);
- Resistance to jarring and vibration as in sub-clause (2)(l).

ii. Second sample (Sample B) for the tests in the following order:

- Endurance Performance Test as in sub-clause (2)(m);
- Security by personnel loading as in sub-clause (2)(n).

d. Operation Test:

i. Install the gateset with frame secured in a vertical position, according to actual construction details, in the laboratory;

ii. The gateset will be operated manually several times to ensure that it moves freely;

iii. The gateset will be tested in the state of lubrication in which it is supplied;

iv. For sliding type gateset, the force, acting at the position of the handle horizontally and in the direction of the travel of the gateset, required to open the gateset by 600 mm ± 30 mm from just open position (i.e. the side frame positioned 3 mm from the fixed frame) will be recorded to the nearest 0.5 N;

v. For swing type gateset, the force action at the position of the handle horizontally and in the direction of the travel of the gateset, required to open the gateset 60° ± 1° from just open position (i.e. the gate leaf positioned 10 mm from the fixed frame) will be recorded to the nearest 0.5 N.

e. Slamming Closed Test:

i. Secure the gateset and prepare the test as sub-clause (2)(d);

ii. For sliding type gateset, the gateset will be slammed closed from fully open position 20 times by a force of 15 kg ± 50 g action at the mid-height of the gate handle horizontally and in the direction of the travel of the gateset;

iii. For swing type gateset, conduct the test as follows:

- A light strong line will be arranged such that by it the gate leaf may be closed from 60 ± 1 degrees open by the descent of a weight of mass 15 kg ± 50 g. The line will be attached at some point within 150 mm of the lockside edge at the level of mid-height of the gate handle;

- The line is to pass horizontally from the gate leaf and then over a horizontal bar of smooth steel arranged with its axis parallel to the plane of the gate frame. The bar is to be of 25 ± 1 mm diameter, be 400 ± 5 mm from the gate leaf face when the gate leaf is closed and span the width of the swing gateset. The line is to descend vertically from the bar and carry the weight strikes a platform removing further tension from the line;
- The swing gate leaf will be opened to 60 ± 1 degrees and released. The gate leaf will be slammed shut by the action of the falling weight for 20 times.

f. Slamming Open Test:
   i. Secure the gateset and prepare the test as sub-clause (2)(d);
   ii. With the gate leaf fully opened, the gate leaf will be moved towards the closed position through an angle of 30 ± 1 degrees and allowed to open freely under the influence of a weight of mass 4 kg ± 5 g applied to a point 50 ± 1 mm form the lockside edge at level of mid-height of the gate handle and at right angles to the plane of the fully open door;
   iii. The gate leaf will be slammed open 10 times at a rate not exceeding 15 times per minutes against a floor mounted gate stop fixed at the 90 ± 1 degrees open position.

g. Heavy Body Impact Test for sliding type gateset:
   i. Secure the gateset and prepare the test as sub-clause (2)(d). The gate will be closed and locked;
   ii. The gateset will be struck by a spheroconical bag to BS EN 596:1995 Clause 6. The sand bag will strike the gateset normally with an impact energy of 80 Nm for three times at the following locations:
      - At the level of the handle and at the mid-width of the gateset;
      - At the centre of the upper infill grille panel;
      - At the centre of the lower infill grille panel.
   iii. The gateset will be examined for:
      - Any visually unacceptable damage, checking that the gateset can still operate in the normal manner. Repeat the test in sub-clause (2)(d);
      - Any breakage.
   iv. Repeat sub-clause (2)(g)(ii) but with an impact energy of 240 Nm once for the location at the level of the handle and at the mid-width of the gateset;
   v. The gateset will be examined for any breakage.

h. Heavy Body Impact Test for swing type gateset:
   i. A spheroconical bag to BS EN 596 Clause 6.2 will be hung as a pendulum capable of striking the gate leaf. The bag will be placed so that at rest it just contacts the surface of the gate leaf with its center of gravity at the level of the gate handle, such that when swung in a vertical plane normal to the gate leaf it will impact the gate leaf. The impact will be at mid-width of the gate leaf;
   ii. Mount the gateset vertically and install in accordance with the manufacturer's recommendations. The gate leaf will be closed and locked;
   iii. The test body will be swung against the gate leaf three times. This will be done to the closing face. The impact energy will be 80 Nm each time;

iv. The gateset will be examined for any breakage and / or any visually unacceptable damage; checking that the swing gateset can still operate in the normal manner. Test No. 2.6 will be repeated. Maximum deformation will be measured;

v. The test will be repeated with impact energy of 240 Nm once. Any breakage will be examined.

i. Resistance to torsion:

i. Mount the swing gateset vertically and install in accordance with the manufacturer's recommendations. The gate leaf is then to be held open at 90 ± 1 degrees by means of a clamp to top lockside corner. Means is to be provided to apply force normal to the plane of the gate leaf at its mid-height. The force will be applied at the lockside edge of the gate leaf. Deflection normal to the plane of the gate leaf will be measured at the lower lockside corner;

ii. A force of 200 ± 3 N will be carefully applied to the attachment point in increments not exceeding 100 N, the force acting at right angles to the gate leaf. The force will be removed in the same incremental stages as in the loading procedure. The position of the lockside lower corner will be noted as datum for deflection measurements;

iii. A force of 400 ± 3 N will then be applied in increments not exceeding 100 N, the force acting at right angles to the gate leaf. The deflection will be measured after the gate leaf has stabilized at each increment, the movement of the dial gauge being less than 0.02 mm per minute. After recording the deflection under maximum force the reverse procedure will be adopted to remove the load, the final residual deflection being recorded at least 1 hour after all force has been removed.

j. Test on strength in the plane of the gateset leaf:

i. Same test specimen for sub-clause (2)(i), resistance to torsion will be used;

ii. This test will follow the resistance to torsion test. The swing type gateset will remain in the rig in the position as previously described in sub-clause (2)(i) (clamp at the top lockside corner must not restrict the gate leaf to move along its plane). The force, acting vertically downwards in plane of the gate leaf, is to be applied at mid-height of the gate leaf near the handle. The point of measurement will be on the center line of the underside of the gate leaf and 10 ± 1 mm from the bottom lockside corner;

iii. The initial and final readings of the dial gauge will be taken when the downward force of 50 ± 3 N is applied to the gate leaf (including the weight of the rope). The downward vertical force will then be increased to 1000 ± 5 N at increments of 50 N;

iv. The final force will be maintained for 5 minutes when the maximum deformation is recorded. The reverse procedure will be adopted and the residual deformation will be measured one hour after the downward force has been decreased to 50 ± 3 N.

k. Test on resistance to closing against an obstruction:

i. Mount the swing type gateset vertically in a rigid rig, installed by the method recommended by the gateset manufacturer. A dry hardwood slip, 50 mm x 10 mm and of mass between 15 g and 20 g is required for the test;

ii. The gateset will be opened and the hardwood slip placed in the gap between the gate leaf and the bottom of the hinge side jamb of the frame so as to hold the gate leaf ajar;

iii. The slip will be inserted from the closing face with its grain horizontal and its plane vertical and parallel to the plane of the gateset frame. A force will be applied increasing in 50 N increments to the lockside edge at mid-height of the gate handle until it reaches 200 ± 3 N. The force will act at right angles to the plane of the frame.

l. Test on resistance to jarring and vibration:

i. Mount the swing type gateset vertically in a rigid rig and install in accordance with the manufacturer's recommendations. A spheroconical bag to BS EN 596 Clause 6.2 will be hung from an independent support at about the same height as the top of the gate leaf as a pendulum capable of striking the closing face of the gate leaf. The bag will be hung so that at rest with the gateset open at 45 ± 1 degrees it just contacts the surface of the gate leaf with its center of gravity at mid-leaf width and at level of the mid-height of the gate handle;

ii. The gate leaf will be opened from the closed position through an angle of 45 ± 1 degrees. Provide a floor mounted gate stop at the 90 ± 1 degrees open position;

iii. The sand bag will be drawn away from the gate leaf in a vertical plane normal to the gate frame through an arc of 250 ± 5 mm vertical height then released to strike the gate leaf. This will be repeated 99 times.

m. Endurance Performance Test:

i. Ensure that the gateset is installed and secured as sub-clause (2)(d);

ii. The gateset will be operated manually to ensure that it moves freely. The sample will be tested in the state of lubrication in which it is supplied;

iii. The test is performed as sub-clause (2)(d);

iv. Either the inside or outside gate handle will be connected to a mechanical system capable of producing a uniform back and forth movement of the gateset;

v. The gateset will then be moved backwards and forwards over a distance equal to at least 90% of the full travel distance of the gate leaf, from the closed position, for 60,000 operations at such a speed as will ensure free impact with the frame at each operation;

vi. The specimen will be checked for damage and examined for, and a record made of, the wear and tear condition after 5,000, 10,000 and 20,000 operations and thereafter every 20,000 operations;

vii. The test as sub-clause (2)(d) will then be repeated.

n. Test on security by personnel loading:

i. After performing sub-clause (2)(k), the swing gateset will be subject to an outward load of 50 ± 3 N normal to the opening face of gate leaf at mid-point of the highest 30 x 10 mm box section of the bottom panel of grills. Width of load will be 100 ± 5 mm. The gateset will be closed and locked when performing the test;

ii. The initial measurement will be taken at positions normal to the plane of the gate leaf at bottom lockside corner of the gateset (10 mm from both edges) and under the load;

iii. The load will be taken to 700 ± 5 N, and the maximum deflection measured at these positions 15 minutes after the load is applied;

iv. The load will be decreased to 50 ± 3 N, and the deformation recorded at these positions one hour later;

v. The load will be removed and the gateset examined for any visually unacceptable damage, breakage and functional defects;

vi. The test as sub-clause (2)(d) will then be repeated.

o. Standard of quality of gatesets shall be comparable with the benchmark samples maintained by the Housing Department.

3. On Site Delivery Verification:

a. At delivery stage, submit to the CM the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under the sub-clause (1)(a);

ii. Original or certified true copy of Certificate of Origin for every batch of delivery. A batch being the accumulative total of 500 metal gatesets or part thereof delivered to Site;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for gatesets upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Dimension Check	By measurement	Approved shop drawings
Surface Quality	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency. Colour as per Approved sample
Coating thickness	Hand held dry film thickness measuring equipment	COM7.M070
Ironmongery Check	Visual	Same as the CM's Approved sample
Lockset and Key cylinder	Visual	COM7.M080 and same as the CM's Approved sample
Pull Handle	Visual and by measurement	COM7.M090 and same as the CM's Approved sample

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Dimension Check	1 sample for every 100 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note

Surface Quality and Coating Thickness	1 sample for every 100 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Ironmongery , Lockset and Pull handle Check	1 sample for every 100 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM7.M020.9 SAMPLES

Keep the Approved sample and sample board available for inspection on Site until completion of the installation work of all the gatesets.

COM7.M030.9 DIMENSIONAL ACCURACY

1. See Appendix H of this Specification for permissible tolerances;
2. Maximum gap size to be generally 0.5 mm between connecting parts;
3. Critical dimensions to be maintained as shown on the Drawings.

COM7.M040.9 CONSTRUCTION

Manufacture gatesets from the following materials:

1. Mild steel sections:
   a. Chemical composition and mechanical properties: to BS EN 10025-Part 1 – Part 6:2004;
   b. Section size and thickness: as shown on Drawings;
   c. Zinc electroplated component parts, except rolled sections, to BS 1706:1990 Class A 0.025 mm thick.
2. Rolled sections formed from metal sheets:
   a. 1 mm, 1.2 mm and 1. 5 mm thick slit coils to grade Z27 of JIS G3302-1994 or coating designation Z275 of BS EN 10346:2009;
   b. Electrically galvanized except parts made of plastic, nylon or brass.
3. Fixing rivets: stainless steel.

COM7.M050.9 CONSTRUCTION (STAINLESS STEEL PARTS)

1. Stainless steel parts: to BS EN 10095:1995:
   a. Section size and thickness: as shown on Drawings;
   b. Grade: Grade 304 in accordance with MET1.M060;
   c. Finish: as shown on Drawings.
2. Anchors and fixing bolts as MET1.M220.

COM7.M060.9 GATESET ASSEMBLY

1. Construct component parts for assembly without welding unless otherwise approved by the CM or as indicated on Drawings;
2. All welding points are to be polished, free of rusting and pre-treated as appropriate before application of the electrostatic powder coating;
3. Assembled gatesets must be capable of receiving Approved steel rollers and ironmongery as specified in Worksection IRO1;

4. Carry out quality tests in accordance with the requirements of this Worksection when gateset are re-designed on project basis, as required by the CM.

COM7.M070.9 GATESET FINISH

Electrostatic powder coating of epoxy and polyester resin mix with hammer or plain finish applied by electrostatic spray by either manual or automatic methods. Apply finish in accordance with the finish manufacturer's recommended method of operation. Finish and application must meet the following requirements:

1. Performance properties:
   a. Nominal thickness: 70 microns - 150 microns;
   b. Cross-cut test (BS EN ISO 2409: 2007): Classification = 1;
   c. Salt spray (ASTM B117): - no discernible change after 1000 hours of test.
2. Colour and finish of the electrostatic powder coating to be submitted to the CM for approval;
3. Pretreatment: pretreat metal surfaces with phosphate treatment or other alternative pretreatment process to the CM's approval prior to application of powder coating;
4. Extent: treat and finish all exposed steel and galvanized steel surfaces, including portions of the component parts forming moveable joints, pre-drilled screw holes, hinges, handles and welds as specified in Worksection MET1.

COM7.M080.9 LOCKSET

In compliance with IRO1.M750. Lock case and lock cylinder with brand name and / or logo engraved.

COM7.M090.9 PULL HANDLE

To be 25mm diameter stainless steel grade 304 securely fixed with recessed type screws.

WORKMANSHIP

INSTALLATION OF GATESETS

COM7.W005.9 SAMPLES AND SHOP DRAWING APPROVAL

Do not commence fabrication until all samples and shop drawings have been Approved and all shop drawings have been checked on Site to suit all flat entrance sizes and conditions (with or without wall recess) for each flat.

COM7.W010.9 CLEANING AND PROTECTION

1. After installation, clean gatesets to remove any surface dirt, grime, oily substances etc;
2. Protect the installed components to prevent damage from subsequent works until completion of the works;
3. Enclose in corrugated carton paper and polythene wrapped with moulded polystyrene as transportation protection against damp and scratching. Avoid premature delivery to site;
4. Return to site on completion of the building works and carefully remove wrapping.

COM7.W015.A EQUIPOTENTIAL BONDING TO GATESETS

1. When the gatesets are installed before the Occupation Permit for the domestic block is issued, comply with the following:
   a. Provide equipotential connection for gateset by the following:
      i. Weld one end of the hot dip galvanized steel earthing lug to GMS track or jamb for gateset;
      ii. Form a 5 mm diameter hole at the other end of the earthing lug for connection of bonding conductor by Nominated Sub-contractor for Electrical Installation.
   b. As COM2.W465 (6).
2. When the gatesets are installed after the Occupation Permit for the domestic block is issued, comply with the following:
   a. Provide equipotential connection for gateset by the following:
      i. Weld one end of the hot dip galvanized steel earthing lug to GMS track or jamb for gateset;
      ii. Form a 5 mm diameter hole at the other end of the earthing lug for connection of bonding conductor;
      iii. Connect earthing lug of gateset to earthing terminal of door bell with provided bonding conductor.
   b. Ensure that the bonding for metal gateset is electrical sound and the result complies with the CoP for the Electricity (Wiring) Regulation and BS 7671 by proper measurement with records at good time. Rectify as early as possible those parts of equipotential bonding system that are found to be not electrical conductive.

COM7.W020.9 GATESET ASSEMBLY

1. The horizontal alignment at the top level of Approved steel rollers of the bottom hangers should be levelled (p.d.±1 mm). The size of the rolled top rail including the opening width should be consistent particularly at he position of the open end;

2. The size of the rolled grille bars should be consistent particularly at the gap position and the acceptable gap dimensions at the junction between vertical and horizontal grille bars is 0.5 mm each on both top and bottom faces of the vertical / horizontal grilles;
3. All moulding residues of plastic or nylon part should be neatly trimmed or cut before fixing;
4. Only stainless steel rivets are allowed for fixing and should be closely fixed onto the grilles bars to ensure no protrusion;
5. No concavity at the position of punching slots of any surfaces should be ensured;
6. Bulking at stainless steel striking plate is not acceptable;
7. All holes for screw fixing shall be sealed with sealant before installation of screws;
8. All parts and accessories, such as stainless steel thumbturn cover, should be ground to smooth edge.

TOLERANCES

COM7.W110.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification taking into account that any tolerance application permissible under this Specification should not in any case jeopardize the installation requirements and design intent of the gateset in accordance with the standard Drawings.

MOCK UP

COM7.W200.9 MOCK UP

Provide full scale mock up for different types of gatesets at flat entrance of sample flats as instructed by the CM and obtain Approval prior to proceeding with the installation work.

TESTING

SURVEILLANCE TESTS FOR GALVANIZED MILD STEEL GATESETS

COM7.T010.A SURVEILLANCE TESTS

1. Testing Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in COM7.M010 (3)(a) or as instructed by the CM;
   b. One set of test sample shall consist of two representative gateset specimens. Sample shall be completed with fittings and accessories as to be installed, including typical section of members, track and guide rail, stainless steel roller, steel anchor bolts and lock to ensure normal operation. Bear all cost for any replacement of samples.
3. Testing methods:
   a. As per COM7.M010 (2)(a);
   b. Annex A of BS EN 10327:2004 for zinc coating mass.
4. Non-compliance:
   a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch off Site; or
      ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.
   b. When the representative batch of gatesets is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
   c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

ON SITE VERIFICATION TEST FOR GATESET LOCK

COM7.T020.9 VERIFICATION TEST ON NO REPEAT OF KEY CHANGES

1. Testing Arrangements:

a. Random verification tests shall be carried out by the CM to ensure that the individual key changes will not repeat for the gatesets of domestic units in the Works as specified in sub-clause (7) of IRO1.M750. The verification test shall be witnessed by the gateset supplier / manufacturer;

b. Comply with the following pertaining to the tests:

i. Produce keys for the gatesets installed as directed by the CM;

ii. Provide attendance on the Site.

2. Testing Samples:

a. One set of test sample shall consist of three representative installed gatesets completed with locks selected by the CM, with one gateset from each of the high, mid and low zones of a domestic block, a total of three selected gatesets per block. The representative batch implies the locks of all the gatesets installed in the block.

3. Testing method:

a. After all gatesets are installed, randomly select 60 keys not designated to open the lock of the three selected gatesets. Divide the keys into three lots of 20 keys for each of the three zones. At each zone, insert the 20 keys individually into the gateset lock to check all of them cannot open the lock. After testing, check the gateset lock is in working order using its own set of key.

Gateset test sample	Key for testing *	Acceptance Standards
1 no. for high-zone	20 nos.	All the randomly selected keys cannot open the lock of the gateset test sample
1 no. for mid- zone	20 nos.	
1 no. for low-zone	20 nos	

* Use different set of randomly selected keys not designated to open the lock of the selected gateset test sample for each zone.

b. Repeat the test for all domestic blocks of the Works.

4. Non-compliance:

a. In the event that any selected lock fails to meet the acceptance standard as specified in sub-clause (3)(a);

i. Submit remedial proposal for CM's approval to remove and replace the gateset locks; or

ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) on three separate sets of samples selected by the CM from the representative batch for each failed lock;

iii. In the event that all the re-test passed, remove and replace the failed locks;

iv. In the event that any selected lock of the re-test fails to meet the acceptance standard as specified in sub-clause (3)(a), submit remedial proposal for CM's approval to remove and replace all the gateset locks.

b. When the locks of the representative batch of gatesets are removed and replaced in accordance with sub-clause (4)(a), carry out test in accordance with the testing methods as specified in sub-clause (3) for one set of samples selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

COM8 ROLLER SHUTTERS AND DOORS

DESIGN

GENERAL

COM8.D010.9 CONTRACTOR'S RESPONSIBILITY

Take responsibility for the detail design of roller shutters specified in this Worksection and their installation, employing either:

1. The roller shutters manufacturer; or
2. An installation sub-contractor approved by the roller shutter manufacturer.

COM8.D020.9 GENERAL DESCRIPTION

Roller shutter comprising horizontal slats interlocking throughout their entire length, forming a continuous hinge and:

1. In accordance with Drawings;
2. Shutter type: open grille or solid slate or insulated as specified on the Drawings;
3. Basic material: hot dip zinc coated steel, aluminium, stainless steel, plastic or other materials as specified on the Drawings;
4. Operating mechanism: self-closing as COM8.D040 or manually operated as COM8.D050 or electrically operated as COM8.D060 as specified on the Drawings;
5. Finishes: hot dip zinc coated or anodised or powder coated as specified on the Drawings;
6. Features and fittings: as specified on the Drawings;
7. Equipotential bonding: provide earthing lug(s) for equipotential bonding connection of the roller shutter and doors.

COM8.D030.9 MATERIALS AND WORKMANSHIP

1. Comply with the relevant provisions of Worksection MET1 in respect of all materials and workmanship;
2. As COM2.W465 (6).

OPERATING MECHANISM

COM8.D040.9 SELF CLOSING SHUTTERS

Manually operated through an internal self-closing mechanism, opened and shut using lifting handles or a pole and hook and with an adjustable mechanism to control the effort required to raise or lower the door.

COM8.D050.9 MANUALLY OPERATED SHUTTERS

Operated by means of an endless chain fitted with a spur or worm reduction gear to prevent the shutter falling or rising without manual operation of the chain.

COM8.D060.9 ELECTRICALLY OPERATED SHUTTERS

1. Remote controlled, opened by an electric motor;
2. Comply with the "Code of Practice for Installation of Electrically Operated Sliding Gates, Sliding Glass Doors and Roller Shutters" published by the Electrical and Mechanical Services Department;

3. Design installation complete with:
   a. Electric motors;
   b. Associated overload protections;
   c. Gearing drive mechanism;
   d. Gear box;
   e. Open and close limit switches;
   f. Emergency stop;
   g. Any other control devices or mechanisms recommended by the shutter manufacturer.
4. Provide full details of:
   a. Motors;
   b. Gearing;
   c. Drive mechanism;
   d. Control mechanism.
5. Totally enclosed three phase motors are preferred, with accessible motors, driving gears, limit switches and control mechanism for inspection and servicing;
6. An isolating switch provided by others with an adequate power supply, to allow for the isolation of electricity supply during inspection and servicing;
7. Provide auxiliary manually operating gear. Ensure change over is easily effected without climbing up to the gearing drive mechanism to engage or disengage manual operation;
8. Provide an interlock switch to prevent locked roller shutters from operating electrically. Mount the interlock switch on a stationary part of the door (such as guide rails) not on any moving part of the shutters.

CONSTRUCTION

COM8.D110.9 WIND LOAD

Design and construct external shutters, gear and fastenings to withstand a wind load as required in the current Code of Practice on Wind Effects, Hong Kong.

COM8.D120.9 STEEL SLATS

Fit ends of alternate hot dip zinc coated steel slats with a malleable iron end stop riveted on to prevent lateral movement and protect the shutter against wear.

COM8.D130.9 HORIZONTAL BARREL FOR CARRYING SHUTTER CURTAIN

Ensure:

1. Barrel is of sufficient diameter and strength to resist deflection;
2. There are enough counter balance springs to enable the shutter to be balanced correctly in all positions;
3. Barrel is rust proofed steel.

COM8.D140.9 BARREL SUPPORT

Shutter and barrel support to provide sufficient bearing. Provide brackets with appropriate fixings for attaching to the soffit, face or side of opening.

COM8.D150.9 VERTICAL GUIDES

Vertical channel guides to be:

1. Of adequate size and depth as COM8.D110;

2. Provided with appropriate fixings for attaching to the soffit, face, jamb or side openings or base and apex in the case of movable mullions;
3. Manufactured from hot dip zinc coated steel, anodised aluminium, stainless steel or other materials as shown on the Drawings.

COM8.D160.9 HOODS AND CASINGS

1. Fully braced and supported to prevent sagging or distortion;
2. With access doors or plates as appropriate to allow routine inspection and servicing;
3. Manufactured from hot dip zinc coated steel, anodised aluminium, stainless steel or other materials as shown on the Drawings.

COM8.D170.9 LOCKING DEVICE

Design shutters with a locking device and two malleable iron shoot bolts of an Approved type. Fit shoot bolts to the bottom bar at either end of all shutters to assist holding the shutter under high wind conditions.

COM8.D180.9 FITTINGS AND FIXINGS

Ensure screws, bolts and fixing lugs are supplied as necessary for the assembling and fixing of the roller shutters.

COM8.D190.9 RUST PROOFING

Ensure all ungalvanized steel is painted with one coat of zinc phosphate primer before despatch to Site.

FIRE RESISTING DOORS AND SHUTTERS

COM8.D210.9 STANDARD

Comply with the requirements of BS 476:Part 22:1987 for roller shutters for the period of fire resistance specified.

COM8.D220.9 PERFORMANCE

Fire resisting roller shutters and doors must be self-closing, activated by fusible links, electronic heat or smoke detectors. Provide certificates of tests.

SUBMISSION

COM8.D310.9 SHOP DRAWINGS

Provide and obtain Approval of shop drawings before manufacturing.

COM8.D320.9 INSTRUCTION MANUALS

Provide two instruction manuals giving detailed operating and maintenance instructions that include:

1. Wiring and schematic drawings where applicable;
2. Schedule of component parts;
3. Price list of recommended spares.

COM9 COOKING BENCH / SINK UNITS

DESIGN

SUBMISSION

COM9.D110.9 SHOP DRAWINGS

Submit shop drawings to CM for approval prior to the commencement of fabrication and ordering of materials.

MATERIALS

GENERAL

COM9.M010.A COOKING BENCH / SINK UNIT

1. Submission Requirements:
   a. At sample submission and approval stage, submit one sample of the cooking bench / sink unit for CM's approval together with all the following substantiation for CM's information:
      i. Job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If the cooking bench and sink unit are not manufactured in the same plant, the certification is required for all manufacturing plants. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

      v. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports for polymer resin worktop showing full compliance with the requirements in COM9.M150 for CM's information:
         - The date of the test shall be generally within five years prior to the notified date for commencement of the Works;
         - The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a) above, or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a) below;
         - In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be granted.
      vi. Installation procedure of the cooking bench / sink unit;
      vii. Confirmation in writing with a declaration from the cooking bench / sink unit supplier / manufacturer that the bonding agent used for bonding stainless steel to concrete components are in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation;

viii. Submit a sample board similar to the one maintained by the Housing Department showing the quality and accessories for the proposed cooking bench / sink unit. When the cooking bench / sink unit are supplied for domestic blocks, submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works.

2. Quality Requirements:
   a. Cooking bench / sink unit comprising:
      i. A polymer resin worktop cooking bench with bullnosed front edge and coved back upturn as specified in COM9.M120;
      ii. A reinforced concrete sink top with a single bowl stainless steel sink with overflow fittings for connection to drain outlet with stainless steel basket strainer;
      iii. Reinforced concrete supporting legs finished with epoxy paint to all exposed surfaces;
      iv. Stainless steel earthing lugs for stainless steel supporting frames and sink unit;
      v. All necessary fixing accessories including concrete inserts, galvanized mild steel angle brackets, fixing bolts, stainless steel supporting frames, stainless steel screw caps etc..
   b. Standard of quality of the cooking bench / sink units shall be comparable with the benchmark samples maintained by the Housing Department.
3. On Site Delivery Verification
   a. At delivery stage, submit to the CM the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under the sub-clause (1)(a);
      ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for cooking bench / sink unit upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Delivery Note	Document Check	Complete with information of serial number as COM9.M020
Dimension Check	By measurement	As shown on Drawings; to Approved sample and COM9.M040
Surface Quality	Visual	No damage, no staining, no blemish
Sink unit	Visual and by measurement	COM9.M110 and as per Approved sample
Stainless steel supporting frame	Visual and by measurement	COM9.M115 and as per Approved sample

Polymer resin worktop	Visual and by measurement	COM9.M120 and as per Approved sample

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Dimension Check	1 sample for every 100 pieces or part thereof	Same batch of material delivered to Site under one Delivery Note
Surface Quality	1 sample for every 100 pieces or part thereof	
Sink unit	1 sample for every 100 pieces or part thereof	
Stainless steel supporting frame	1 sample for every 100 pieces or partthereof	
Polymer resin worktop	1 sample for every 100 pieces or part thereof	

c. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

COM9.M020.9 SERIAL NUMBER

Print on the bottom of each unit and on each of its detached parts a unique serial number. Repeat the serial number on all packaging. Keep a separate sheet record identifying the date of manufacture.

COM9.M030.9 SAMPLES

Keep the Approved sample available for inspection on Site until completion of the cooking bench/sink unit installation work.

COM9.M040.9 DIMENSIONAL ACCURACY

See Appendix H of this Specification for permissible tolerances in major dimensions of the cooking bench/ sink units.

STAINLESS STEEL SHEET

COM9.M110.9 STAINLESS STEEL SHEET FOR SINK UNIT

To BS EN 10095:1999:

1. Grade 304 in accordance with MET1.M060;
2. Finish No 2R;
3. Minimum thickness of 0.8 mm.

STAINLESS STEEL SUPPORTING FRAME

COM9.M115.9 STAINLESS STEEL SUPPORTING FRAME FOR COOKING BENCH

To BS EN 10095:1999:

1. Grade 304 in accordance with MET1.M060;
2. Section size and thickness: as shown on Drawings.

POLYMER RESIN WORKTOP

COM9.M120.9 POLYMER RESIN WORKTOP FOR COOKING BENCH

1. Colour: white solid colour;
2. Thickness: 12 mm to maximum 13 mm;
3. The quality requirements for the polymer resin worktop are as follows:

Items	Test Method	Acceptance Standards
i. Resistance to Mechanical Damage - Impact test - Cross-cut test	BS 3962:Part 6:1980	Impact test: Rating 5 – no surface cracking Cross-cut test: Rating 5 – cuts are smooth, no finish removed, except for small chips at the intersections of the cuts and an occasional small chip along the cut
ii. Light Resistance	NEMA LD3-2005 Cl. 3.3	Slight effect – a change in colour or surface finish visible only at certain angles and directions
iii. Boiling Water Resistance	NEMA LD3-2005 Cl. 3.5	No effect - no change in colour or surface finish
iv. High Temperature Resistance	NEMA LD3-2005 Cl. 3.6	No effect - no change in colour or surface finish
v. Ball Impact Resistance	NEMA LD3-2005 Cl. 3.8	No fracture by the polished stainless steel ball dropped from vertical height of 900 mm
vi. Coefficient of Linear Thermal Expansion	ASTM D696-03	Not more than 3.02×10^{-5} / ºC
vii. Resistance to fungi	ASTM G21-96 (Reapproved 2002)	Observed fungal growth on specimens: None (Rating 0)
viii. Flame Spread Index	ASTM E84-12b	Class A of NFPA 101: Flame Spread Index 0 - 25
ix. Smoke Developed Index	ASTM E84-12b	Class A of NFPA 101: Smoke Developed Index 0 - 450
x. Water Absorption	ASTM D570-98 (Reapproved 2010)	24 hour immersion: not more than 0.08%

xi. Wear and Cleanability	ANSI Z124.6-2007 Cl. 5.3	Wear Test - Surface finish shall not be worn through in the middle third of the specimen. Cleanability Test - Each specimen, after 10,000 cycles, shall pass the cleanibility test with an absolute percentage loss of white-light reflectance of not more than 5% after the cleaning with standard liquid detergent - If the average absolute percentage loss of white-light reflectance is greater than 2% but less than 5%, absolute percentage loss of white-light reflectance of not more than 2% after additional cleaning with abrasive slurry
xii. Stain Resistance	ANSI Z124.6-2007 Cl. 5.2	Maximum stain resistance rating shall be 64 Maximum allowable thickness of material removed to eliminate stain shall be 0.127 mm

FIXING AND POINTING MATERIALS

COM9.M210.9 ANCHORS AND FIXING BOLTS

For supporting legs and frames of cooking bench/sink units:

1. For concrete block/concrete walls: proprietary type of stainless steel fixing bolts to Approval;
2. For proprietary types of partition walls, use fixings as recommended by partition manufacturer.

COM9.M220.9 BONDING AGENT

1. For bonding stainless steel to concrete components: proprietary type of bonding agent to Approval;
2. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

COM9.M230.9 SILICONE SEALANT

1. In compliance with WAT5.M110;
2. Silicone sealant to BS 5889:1989, Type B (non-acidic type).

COM9.M240.9 CEMENT MORTAR

For bedding concrete support legs to floors: cement : sand mix with water : cement : sand ratio of 0.5:1:3 and produced in accordance with the requirements of Worksection MAS3.

COM9.M250.9 EARTHING LUG

25 mm x 1.5 mm thick stainless steel earthing lug for equipotential bonding connection, or otherwise as indicated on Drawings.

WORKMANSHIP

SUPPORTING LEGS

COM9.W010.9 CRACK REPAIR IDENTIFICATION AND RESPONSIBILITY

1. In accordance with clause 58(2) of the Conditions of Contract, all visual cracks discovered within the hardened concrete at any time prior to the issue of the final certificate will be regarded as defective. In this respect the provision of BS 8110:1985 relating to the permitted calculated maximum crack width will not apply;
2. Take responsibility and liability for any such crack defect as sub-clause (1), other imperfection or fault under clause 58(2) of the Conditions of Contract, unless such cracks are proved to be due to the Authority's design fault. Where cracks are proven to be due to the design fault of the Authority any expense incurred by the Contractor for investigation and remedial work will be paid in accordance with clause 58(3) of the Conditions of Contract;
3. Where directed by the CM, investigate and repair visual cracks in accordance with the procedures and methods as specified in this sub-section. Notwithstanding the above provision, where Instructed replace sink units found to be defective.

COM9.W020.9 CLASSIFICATION AND REMEDIAL REPAIR OF CRACKS

1. Crack width classification:
   a. Fine: maximum width at any point 0.3 mm or less;
   b. Coarse: maximum width at any point greater than 0.3 mm;
2. Determine crack width at the surface of the concrete with either the aid of a transparent sheet marked with lines of different widths or, by examining the crack with a low powered microscope incorporating a measuring graticule;
3. Determine crack depth by one of the following procedures:
   a. Where the line of the crack on one surface can be traced on another surface parallel to the first surface, or where the crack can be seen to transverse two adjacent surfaces in different planes, it is deemed to be a through crack;
   b. Where a crack follows an irregular pattern on one surface of an element only and is branched at a minimum of two points, it is deemed to be a non-through crack;
4.
   a. Prior to commencement of repairs submit a method statement of the materials and the method to be used for Approval;
   b. Use the following methods for rectifying cracks:
      i. Fine non-through crack: brush into crack cement grout or a mixture of cement and water until the crack appears to be filled;
      ii. Coarse non-through crack: cut a V-groove and fill with proprietary repair mortar;
      iii. Through cracks: seal by arranging for a low viscosity polymer resin to flow under the influence of gravity or injection into the crack to fill it and harden therein.

POLYMER RESIN WORKTOP

COM9.W050.9 MINOR REPAIR TO POLYMER RESIN WORKTOP

Seek CM's approval for repair minor visual scratch and other imperfection to the quality of the Approved sample. Notwithstanding the above provision, replace defective polymer resin worktop where Instructed.

INSTALLATION

COM9.W110.9 FIXING COOKING BENCH/SINK UNITS

1. Check units have no missing or dislodged concrete inserts, and components are free from scratches, cracks, dents, voids and other damage;
2. Assemble and set units correctly in relation to position on plan and height above finished floor level;
3. Fix units using stainless steel supporting frames, brackets and bolts specified and as indicated on the Drawings;
4. Apply cement mortar bedding between support leg and floor;
5. Seal joints between top and wall and between sink leg and unit with silicone sealant applied in accordance with Worksection WAT5;
6. Protect units from damage and maintain protective film intact.

COM9.W120.9 EQUIPOTENTIAL BONDING TO COOKING BENCH/SINK UNITS

1. Provide equipotential bonding connection for stainless steel supporting frames of cooking bench and sink units by:
   a. Weld one end of the earthing lug to sink and stainless steel supporting frames; and
   b. Form a 5 mm diameter hole at the other end of the earthing lug for connection of bonding conductor by the Nominated Sub-contractor for Electrical Installation.
2. As COM2.W465 (6).

ACCURACY AND TOLERANCES

COM9.W210.9 ERECTION ACCURACY

Refer to Appendix H, "Schedule of Tolerances" to this Specification.

PROTECTION

COM9.W310.9 PROTECTION OF FINISHES

1. Protect sink stainless steel surface and polymer resin worktop with removable adhesive film;
2. Remove protective film on 5% of installed sinks for inspection;
3. Remove all protection before completion of the Works unless approved by the CM.

COM10 GLASS PANELS

DESIGN

GENERAL

COM10.D010.9 SPECIFICATION REQUIREMENTS

Design, construct, fix and glaze the glass panel balustrades or fire resistant glazing system in accordance with this Worksection and the relevant clauses of:

1. MET1 General Metalwork;
2. COM4 Glazing;
3. WAT5 Sealants.

COM10.D020.9 SHOP DRAWINGS

When proprietary design of glass panel balustrades or fire resistant glazing system is used by Contractor:

1. Provide shop drawings with technical substantiation for construction showing details of the members and fixings of glass panel and obtain Approval prior to commencement of fabrication of the elements;
2. For glass panel balustrades, appoint a Registered Structural Engineer registered with the Building Authority of the Government of the Hong Kong Special Administrative Region for the design of the glass protective barrier. The Registered Structural Engineer shall certify and sign all shop drawings and technical substantiation including calculations.

COM10.D030.9 METHOD STATEMENT

Submit method statement detailing the installation procedure (including procedure for reglazing and torque of fixing bolts) and obtain Approval prior to starting fabrication.

COM10.D040.9 SAMPLES

Submit samples of each type of glass, sealants, distance pieces and setting blocks and obtain Approval prior to starting fabrication.

COM10.D050.9 MOCK UP

Provide full scale mock up for glass panel balustrade and obtain Approval prior to proceeding with the installation work.

COM10.D060.9 FIRE RESISTANCE PERFORMANCE OF THE FIRE RESISTANT GLAZING SYSTEM

1. Fire resistant glazing systems consisting of one or more transparent or translucent panes shall be designed with a suitable method of mounting, such as frames, seals and fixing materials, capable of satisfying the specified fire resistance criteria;
2. To BS 476 Parts 20 : 1987 and 22 : 1987, or BSEN 1363-1: 2012 and 1364-1 : 2014.

DESIGN PARAMETERS

COM10.D110.9 GENERAL

The design parameters specified in COM10.D120 to COM10.D150 apply when the Contractor is required to submit shop drawings and valid fire resistance test reports for the proprietary design of glass panel balustrades or fire resistant glazing systems.

COM10.D120.9 MINIMUM HORIZONTAL IMPOSED LOADS

Calculate to demonstrate the glass panel balustrade or fire resistant glazing system must resist the following, whichever shall produce the more adverse effects:

1. The minimum horizontal imposed loads as specified in accordance with the Building (Construction) Regulations for the following when separately applied:
   a. Areas where crowd load is not expected;
   b. Places of assembly and all panic barriers.
2. Wind load where applicable.

COM10.D130.9 DEFLECTION LIMITS

1. Design glass panel balustrade or fire resistant glazing systems to resist the most unfavourable combination of imposed and wind loads with an adequate margin of safety against collapse and without unacceptable deflections or distortions;
2. For glass panel balustrades, draw particular attention to the following deflection limits which are in addition to any recommendations for limiting deflection under full load given in the appropriate structural codes for the material to be used and in which event, apply the most onerous limit:
   a. Horizontal displacement of any part of the glass panel balustrade: not exceed 25 mm;
   b. For bolt fixing of glass barriers under the design loads, design the barrier such that the relative in-plane movement of the bolted connections in the same glass panel do not exceed 2 mm;
   c. When the glass components are subjected to half the most unfavourable combination of imposed and wind loads, the horizontal displacement of any point of the glass component, relative to its fixings, shall not exceed the following:
      i. The smaller of 12.5 mm or L/125 for infill panels, where L is the longest dimension of the glass for fully framed infill panels; or the span between the supporting frames for two-edge framed infill panels; or the maximum space between support points for clipped infill panel; or the span between the bolt connectors for point supports infill panels;
      ii. 10 mm for free-standing glass panel balustrade.

COM10.D140.9 FIXING

1. Design fixings, the frame section of the glass panel balustrade, the clips, the bolted connectors and their fixings or connections to the main frame to withstand the design loads transferred through the glass infill panels;
2. Design all joints to provide the full strength of the members being joined. Take into account particularly the material into which the fixing is placed, the spacing between fixings, the edge distance, and the position of reinforcement in the concrete;
3. Refer to manufacturer's recommendation when using proprietary fixing products.

COM10.D150.9 HANDRAIL ATTACHMENT FOR FREE-STANDING GLASS PANEL BALUSTRADE

Calculate to demonstrate handrail attached to free-standing glass panel balustrade must behave in the following manner should a glass panel fracture:

1. Remain in position;
2. Do not fail if the design load is applied across the resulting gap.

MATERIALS

COM10.M010.9 METALWORKS

As specified in Worksection MET1.

COM10.M020.9 GLASS

1. As specified in COM4.M010 to COM4.M130;
2. Comply with the impact test requirements for safety glazing materials given in recognised testing standards. The type of glass shall achieve impact resistance not inferior to the impact class A of BS 6206:1981 when the free path is greater than 1500 mm. Submit test certificates from the manufacturer of the glass material to prove its impact resistance.

COM10.M030.9 SETTING BLOCKS

Rot-proof, non-absorbent and load bearing, capable of maintaining the requisite edge clearance without presenting local areas of stress to the glass though being non-compressible or non-resilient and as COM4.M420.

COM10.M040.9 DISTANCE PIECES

Resilient, non-absorbent, generally of plasticized PVC complying with BS 2571:1990 softness number 35 to 45:

1. Length: 25 mm minimum;
2. Thickness: equal to the front and back clearance, thus retaining the glass firmly in the frame so that it cannot be displaced;
3. Depth: giving 3 mm minimum cover of sealant.

COM10.M050.9 SEALANTS

1. As specified in WAT5.M110 to WAT5.M170 for glass balustrades;

2. In compliance with glass manufacturer's instructions for installation at fire resistant glazing systems to satisfy the specified fire resistance criteria.

WORKMANSHIP

GENERAL

COM10.W010.9 STANDARD

Comply with BS 6180:1995 and BS 6262:1982 unless specified otherwise.

COM10.W020.9 DELIVERY

Ensure glass is kept dry and clean during delivery.

COM10.W030.9 STORAGE

Store glass vertically in a well-ventilated location, protected from condensation and other moisture.

COM10.W040.9 FIRE RESISTANT LAMINATED SAFETY GLASS

Install in accordance with the manufacturer's recommendations to satisfy the specified fire resistance criteria.

FIXING GLASS GENERALLY

COM10.W110.9 EDGE COVER

Provide a minimum 15 mm edge cover with sealant for glass infill panels.

COM10.W120.9 CLIP FIXING OF GLASS INFILL PANEL

For clipped infill panel, position the clips around the periphery of the infill panel at a maximum spacing of 600 mm. Each clip shall be not less than 50 mm in length and give a minimum depth of cover of 25 mm to the glass panel.

COM10.W130.9 BOLT FIXING OF GLASS INFILL PANELS

1. Use toughened glass where glass is supported by bolt connections through holes in the glass;
2. Surround bolts through holes in the glass with incompressible bushes 2 mm to 3 mm thick, and use 1 mm thick incompressible fibre gaskets under clamping plates;
3.
    a. Clamping plates and gaskets on both sides of the glass provide a minimum of 50 mm diameter cover to the glass;
    b. Clamping plates: not less than 6 mm thick in steel or 10 mm thick in other suitable metals.

COM10.W140.9 FREE-STANDING GLASS PANEL BALUSTRADE

Depth of clamping at base fixing of free-standing glass panel balustrade that does not rely on bolts through glass: not less than 75 mm.

COM10.W150.9 BOLT FIXING OF FREE-STANDING GLASS PANEL BALUSTRADE

1. Point fixing clamps:
    a. Fixing clamps on each side: not less than 100 mm x 150 mm and minimum 12 mm thick;
    b. Fixing clamps for every 1 m length of balustrade: not less than two;
2. Continuous fixing clamps:

a. Fixing clamps on each side of the glass: not less than 100 mm wide and minimum 12 mm thick;
b. Clamps: continuous for the entire length of the glass pane and have a maximum bolt spacing of 500 mm.

COM10.W160.9 POSITIONING SETTING BLOCKS

Position the setting blocks as near to the quarter points as possible. Where it is necessary to avoid undue deflection of the frame section, position the setting blocks as follows:

1. Not less than 30 mm from the corner of the glass;
2. In positions to coincide with the frame section fixing points, if these are between 30 mm from the corner and the quarter points.

COM10.W170.9 POSITIONING DISTANCES PIECES

1. Position distance pieces as follows:
   a. First distance piece: at approx. 50 mm from the corner;
   b. Remainder: at approx. 300 mm centres or less.
2. Never coincide a distance piece with a setting block position.

COM10.W180.9 SILICONE SEALANT

Where specified, seal the joint between the glass and bead with an Approved silicone sealant.

FINISHING

COM10.W210.9 BROKEN OR DAMAGED GLAZING

Replace glass or fixing materials broken or damaged before completion of the works and make good the adjoining areas.

COM11 RADIO FREQUENCY IDENTIFICATION AND WEB-BASED DATABASE SYSTEM FOR BUILDING COMPONENTS

DESIGN

GENERAL

COM11.D010.9 RADIO FREQUENCY IDENTIFICATION (RFID) SYSTEM

1. Provide, operate, and maintain a RFID System for the following building components in accordance with this Worksection and COM11.APPEND1 to COM11.APPEND5 and other relevant Worksections of this Specification:
   a. Precast Concrete Facades (CON5 and CON7);
   b. Aluminium Windows and Louvres (COM2);
   c. Timber Doorsets (COM5);
   d. Gatesets (COM7);
   e. Volumetric Precast Bathrooms (VPB) including Combined VPB components (CON8);
   f. Volumetric Precast Kitchen (VPK) including Combined VPK and Combined VPB and VPK components (CON8).
2. Install approved RFID tags to the respective building components at the place of manufacture to record the manufacturing process, the logistics in delivery and the installation detail of the building components as indicated in COM11.APPEND1 to COM11.APPEND5. The workflow and data fields specified in COM11.APPEND1 to COM11.APPEND5 may be subject to amendments to suit the manufacturing processes proposed by the Contractor and agreed by CM.

COM11.D020.9 MAIN COMPONENTS OF THE RADIO FREQUENCY IDENTIFICATION (RFID) SYSTEM

Provide all required facilities and services for the RFID System to support the operation of the RFID System, including but not limited to:

1. RFID tags;
2. RFID readers: at least two numbers for each manufacturing factory of building components specified in COM11.D010 and at least …… numbers on site;
3. RFID Web-based Database System as specified in COM11.D050;
4. Middleware for the readers;
5. Networking infrastructure, equipment and services connecting the RFID devices and workstations (wired or wireless);
6. Internet connection for all locations involved in the workflow;
7. Servers and workstations for all RFID devices, including web and application servers, database servers;
8. Security facility for all RFID devices; and

9. All other resources to ensure the operation of the RFID System meet the service level requirements.

COM11.D030.9 OUTLINE OF THE OPERATION OF THE RADIO FREQUENCY IDENTIFICATION (RFID) SYSTEM

The RFID System provided shall follow the workflow outlined in COM11.APPEND1 to COM11.APPEND5 which shall include but not limit to following sequences:

1. Provide and install RFID tags in building components as specified in COM11.D010;
2. During the manufacturing, record the date and time for each tagged building components via RFID readers at locations / steps specified and then upload these data to the RFID Web-based Database System as specified in COM11.D050;
3. During the delivery and on site installation, record the date and time for each tagged building components via the RFID reader at locations / steps specified and then upload these data to the RFID Web-based Database System as specified in COM11.D050;
4. Through the RFID Web-based Database System via internet, authorized users can be able to view, search, sort and identify logistics workflow in the manufacturing, delivery and installation of every building component with RFID tags installed and follow the workflow as specified in COM11.APPEND1 to COM11.APPEND5.

COM11.D040.9 SUPPLY OF RFID TAGS AND RFID READERS

Make available all approved RFID tags and approved RFID readers and other equipment according to COM11.APPEND10 at a date not more than …… days after the notified date for commencement of the Works.

COM11.D050.9 RFID WEB-BASED DATABASE SYSTEM

1. Provide, operate and maintain a RFID System from a date not more than …… days after the notified date for commencement of the Works until the expiry of Maintenance Period, in the manufacturing, delivery and installation processes for building components as specified in COM11.D010. The RFID Web-based Database System shall comply with COM11.APPEND1 to COM11.APPEND5;
2. Prepare, record and submit production data at the RFID Web-based Database System via internet in accordance with COM11.M210.

SUBMISSIONS

COM11.D110.9 PROVISIONAL APPROVAL

Submit the following items to the CM for provisional approval as specified in COM11.D010 at a date not more than …… days after the notified date for commencement of the Works:

1. One sample of each type of RFID tag to be used in the RFID System;
2. Fixing method of RFID tags;
3. RFID tags shall be embedded in building components as specified in COM11.D010. Where embedment of RFID tag in the building component is not feasible, alternative fixing method shall be submitted to the CM for approval;
4. Shop drawings of building components showing location of RFID tags in each type of building component;
5. The proposed RFID Web-based Database System as specified in COM11.M210;
6. The proposed RFID Reader to be used in the RFID System; and
7. The CV of the proposed RFID Project Coordinator as specified in COM11.D210.

COM11.D120.9 PROGRAMME

Indicate the installation programme of RFID tags, including the duration for the verification of proper functioning of all tags by RFID readers, in the manufacturing programme of building components as required in other Worksections of this Specification.

RESOURCES

COM11.D210.9 RFID PROJECT COORDINATOR

1. The Contractor shall appoint one full time RFID Project Coordinator to deliver the services including but not limited to, the provision of operation, support and maintenance service of all RFID related works including the RFID Web-based Database System. The RFID Project Coordinator is responsible for monitoring/controlling data input, and various related processes in the on-going support and delivery of the services;
2. The RFID Project Coordinator shall liaise with the vendors for the provision of the RFID Web-based Database System and the Contractor shall provide necessary IT support for the RFID Project Coordinator to ensure the proper and effective operation/maintenance of the whole System;
3. A RFID Project Coordinator shall have:
    a. Level 2/Grade E or above in five subjects including Mathematics in the Hong Kong Certificate of Education Examination (HKCEE), or equivalent (the five subjects include Chinese Language and English Language);
    b. met the language proficiency requirements of Level 2 or above in Chinese Language and English Language in HKCEE, or equivalent ("Grade E" in Chinese Language and English Language (Syllabus B) in previous HKCEE is accepted as comparable to "Level 2" in Chinese Language and English Language in the 2007 HKCEE and henceforth);
    c. good knowledge in Chinese and English word processing and in the application of common business software (including Microsoft Word and Excel); and
    d. a minimum two years' working experience in the application of common business software.

MATERIALS

RADIO FREQUENCY IDENTIFICATION TAGS

COM11.M010.9 STANDARD

1. RFID tag shall:
   a. Comply with ISO 18000:2004, Part 6B or Part 6C, or relevant standards when other frequency range is proposed by the Contractor and approved by CM;
   b. Be of 'passive' type with all inlays protected by outlays;
   c. Be pre-bagged with a print out record or a soft copy showing the unalterable serialized Tag Identifier (TID) of each tag inside.
2. RFID tags embedded in the building components shall be capable of withstanding all induced stresses arising from the manufacturing process and transportation and site operations and shall remain functional after the installation of the building components on Site. In addition, it shall exhibit:
   a. Good durability for environment and conditions during the manufacturing process after it was embedded in the building components;
   b. Good abrasion resistance; and
   c. Good chemical resistance.
3. Tag number including TID and user-defined serial number of all RFID tags to be used in the Contract shall be registered in the RFID Web-based System prior to the commencement of manufacturing process of building components. The registered tag number list shall be delivered to CMR for information and record.

COM11.M020.9 TECHNICAL PERFORMANCE

RFID tags shall be capable of achieving the following performance:

1. Good functional conditions for serving the temperature, conditions and environment anticipated during the manufacturing process of the building components;
2. Sufficient storage capacity for all the data indicated in COM11.APPEND1 to COM11.APPEND6; being able to protect memory;
3. When embedded in the proposed locations in the building components:
   a. Free from interferences by metal;
   b. Detectable to facilitate data transfer by the RFID reader at a reasonable distance during the quality control inspections, delivery and when installed.
4. Unalterable serialized Tag Identifier (TID) exists;
5. Protected by write-proof and kill-proof password.

RADIO FREQUENCY IDENTIFICATION READERS

COM11.M110.9 STANDARD

RFID readers shall:

1. Comply with the exemption requirements under the Telecommunication (Telecommunications Apparatus) (Exemption from Licensing) (Amendment) Order 2005, under the Telecommunication Ordinance (Cap. 106); and
2. Be of portable handheld type.

COM11.M120.9 MIDDLEWARE FOR DATA TRANSFER WITH RFID TAGS

1. Submit to demonstrate to the CM the performance of all RFID supporting software complying with workflows as specified in COM11.APPEND1 to COM11.APPEND5 for data preparation, capture and submission amongst RFID tags, RFID readers and the RFID Web-based Database System specified in COM11.D010 at a date not more than …… days after the notified date for commencement of the Works;
2. RFID reader program shall have the following function:
   a. Multiple tags scanning for input of data, including but not limited to delivery date and site arrival date of scanned building component tags specified in COM11.D010;
   b. Displays on screen to show a list of scanned tags with RFID tag number and building component type and the accumulated number of scanned tags of one selected building component type in each scan;
   c. Batch input to enable user to select one authorized workflow checkpoint for applying one data entry to all scanned building components.

COM11.M130.9 TECHNICAL PERFORMANCE

RFID readers shall be compatible with RFID tags using in the project and capable of achieving and performing functions specified and/or required in the supporting RFID Web-based Database System.

RADIO FREQUENCY IDENTIFICATION (RFID) WEB-BASED DATABASE SYSTEM

COM11.M210.9 RADIO FREQUENCY IDENTIFICATION (RFID) WEB-BASED DATABASE SYSTEM

1. Provide, operate and maintain a RFID Web-based Database System for uploading all RFID data as specified in COM11.D030 and to prepare relevant tabulated data. The Contractor shall submit the details of RFID Web-based Database System to the CM as specified in COM11.D110 for approval at a date not more than …… days after the notified date for commencement of the Works. The RFID Web-based Database System shall be:
   a. Website readily accessible on internet by CMRs and authorized users with proper security measures, including but not limited to individual user accounts and passwords. Users account shall be locked after a pre-defined number (configurable) of unsuccessful logon attempts. The system must provide facilities to monitor unsuccessful logon attempts. Reports shall be available for analysis of such attempts;
   b. All RFID data and specified information shall be uploaded within the time schedule for submission specified in this specification;
   c. All data shall be uploaded to Housing Authority's system when instructed by the CM;
   d. A user logon session shall be logged off automatically by the System if it is unattended for a certain period of time;
   e. Logical access to the applications and system utilities shall be restricted to authorized users and the type of access rights granted to them shall be governed by the individual user account and password.
2. Requirements on website
   a. All data and information shall be made available for viewing and downloadable by Project Officers or authorized users;
   b. Data and related information shall be shown in chronological order of the manufacturing time of the building components or as instructed by the CM;

c. Change control: The date of any data uploaded on to the website shall be included in each report for change control. Any amendment to the data shall be notified and carried out by authorized personnel of the Contractor with proper version control;

d. Performance:

Indices to the data and information to be retrieved from the RFID Database System via internet shall be shown within 30 seconds and be shown in the order of the RFID tag number, chronological order of the manufacturing date, or other similar criteria as requested via the web site by the CM or authorized users.

i. Retrieval of the selected report shall be completed within about 30 seconds;

ii. The RFID Database website shall be able to support at least 20 concurrent users.

e. Availability: The RFID Web-based Database System shall be available at all time around the clock, and availability of the System shall not be less than 98% within the hours from 7:00 am to 10:00 pm, and shall not be less than 95% during other hours. The Contractor shall report its RFID Web-based Database System availability to the CM upon request;

f. Search: Search facilities shall be provided to search data and reports by RFID tag number, building component serial number, manufacturing date, component type, delivery date, installation date, installed location in blocks, floors, and flat number or other similar criteria as instructed by the CM;

g. Browser support: The System shall support Internet Explorer version 7.0 or above;

h. Security:

i. Website shall only be accessible to authorized users with individual User ID and password;

ii. The System shall require users to change passwords within a specific range of time agreed by the CM and support users to change their password as required. All passwords shall be encrypted and invisible on the screen when type in;

iii. The Contractor shall maintain, update a list of the User IDs and Passwords, and report to the CM whenever there is a change;

iv. Data shall be encrypted and secured when transmitted over the internet;

v. The Contractor shall maintain a logging of the browsers of the website, and have it readily available for inspection;

vi. The System shall be protected by reliable antivirus software with the latest virus definition updated.

i. RFID Alert Function: The system shall have alert and reporting function as specified in COM11.APPEND9.

3. The Contractor shall submit typical user-interface layouts to the CM for approval. The user-interface shall be easy-to-use and selections by mouse click are used as far as possible. The user-interface layout sequence is as follows:

a. Prompt and authenticate user ID and password to enter RFID data and information;

b. Prompt and authenticate user ID to enter into Project reports;

c. Select type of building component;

d. Browse / download data, information, or reports;

e. Exit website by a logout process.

4. When instructed by the CM, for each building component as specified in COM11.D010, the Contractor shall produce electronic data file on RFID data, information, reports and / or test reports, and transmit to a Housing Authority web based system. The input formats of each type of RFID tagged building component are given in COM11.APPEND1 to COM11.APPEND5 to the Specification;
5. The user-interface of the RFID-Web-based Database System shall follow the layout as specified at COM11.APPEND6. The Contractor may submit alternative design to the CM for approval;
6. When instructed by the CM, submit summary report to demonstrate the performance of the RFID-Web-based Database System to fulfil the requirements stipulated in the above sub-clause 2;
7. The Contractor shall review and report the performance of the RFID Web-based Database System monthly or at intervals agreed by the CM. The review shall include:
   a. Achievement of the performances as stated at above clauses;
   b. Feedback received and remedial and follow-up actions as raised;
   c. Results of planned / random inspections on the performance of the System;
   d. Nonconformities, including but not limited to missing entries and incorrect timestamp, and the corresponding remedial proposal;
   e. Other relevant information.

COM11.M220.9 BACKUP AND RECOVERY OF PROGRAMME AND DATA

1. Back up regularly the System, including configuration files and all data, in a full-scale and centralized approach. Appropriate system/ application/ system data files backups are required every time when there is change of system, change of application or change of system data files;
2. Periodically archive all data and information in the RFID Web-based Database System into removable media (e.g. DVD-RW) and deliver to CM. The period is defined by CM.

COM11.M230.9 INTEGRITY OF DATA

1. Take reasonable precautions to preserve the integrity of data in the RFID Web-based Database System and to prevent any corruption or loss;
2. Take such steps as are necessary to ensure that, in the event of any corruption or loss of Data howsoever caused, it is in a position to restore or procure the restoration of Data; and
3. At the request by CM in the event of any corruption or loss of Data and without prejudice to any other remedies that may be available to it either under the Contract or otherwise, restore or procure the restoration of Data to its state immediately prior to the said corruption or loss.

COM11.M240.9 HANDLING OF DATA

1. All data, information and related document in the RFID Web-based Database System for the Contract are properties of HA. The Contractor shall not disclose, transmit, copy any of them to other parties in any form without the approval from CM;
2. Upon the expiry of the RFID System or as instructed by CM, the Contractor shall copy all data, and information in the database of the RFID Web-based Database System into removable media (e.g., DVD-RW) and submit to CM.

COM11.M250.9 REMOVAL OF EQUIPMENT AND DATA UPON COMPLETION

1. Upon the expiry of the RFID System or as instructed by CM, unless otherwise approved by CM, remove the RFID devices and associated equipment installed in the site. The removal shall be carried out with method and procedures as approved by CM;

2. Upon the expiry of the RFID System or as instructed by CM, unless otherwise approved by CM, delete all data and information of the contract from the RFID Web-based Database System. The removal shall be carried out with method and procedures as approved by CM.

WORKMANSHIP

INSTALLATION OF RFID TAGS

COM11.W010.9 INSTALLATION OF RFID TAGS

Install RFID tags at the locations detailed in COM11.APPEND7, by using the approved fixing method during the manufacturing process of building components. Alternative RFID tags installation locations may be proposed to CM for approval.

COM11.W020.9 REPLACEMENT OF INSTALLED TAGS

In the event that a RFID tag fails to be detected by the RFID reader or becomes damaged after installation to the building component, replace the non-functional/damaged tag immediately. When replacement of RFID tag in the building component is not feasible, alternative remedial measures shall be submitted to CM for approval.

DATA TRANSFER

COM11.W110.9 DAILY UPLOADING OF DATA AND RECORDS

1. Upload daily all data, records and information of building components installed with RFID tags to the RFID Web-based Database System as indicated in COM11.APPEND1 to COM11.APPEND5 via internet;
2. Unless otherwise instructed by CM, complete daily uploading:
   a. At the casting yard or place of manufacturing of the respective building components for daily productions and testing;
   b. At the Site after installation of the respective building components.

COM11.W120.9 CORRECTNESS OF DATA

1. Check the correctness of data each time after uploading of data to the RFID Web-based Database System as indicated in COM11.APPEND1 to COM11.APPEND5;
2. Inform CM immediately of any non-matching data.

COM11.W130.9 VIEWING OF RECORDS

1. Make available the data, record and information uploaded to the RFID Web-based Database System for viewing and downloading by the CM and his representatives if required;
2. All reports and colour photographs including those taken by digital cameras if provided in the RFID Web-based Database System shall be legible.

DATA FORMAT

COM11.W210.9 DOCUMENT FORMAT

The data, record and information uploaded to the RFID Web-based Database System shall be in unalterable format such as Adobe "Portable Document Format" (PDF) or other similar format approved or specified by CM.

COM11.W220.9 SECURITY

1. Access to the RFID Web-based Database System shall be via internet and shall be restricted and secured by individual user ID and password;

2. The Contractor shall only allow authorized users to access the RFID Web-based Database System.

COM11.W230.9 CHANGE CONTROL

1. The date of the data, record and information uploaded to the RFID Web-based Database System shall be included for change control purposes;
2. Any amendment to the database shall be notified and carried out by the Contractor's authorized person with proper change control in line with the hard copy records.

COM11.W240.9 HARDWARE AND SOFTWARE

The Contractor shall provide his own computer hardware and software for the development and access to the RFID Web-based Database System.

COM11.W250.9 TAG STRUCTURE

The encoding structure for the data to be stored in the RFID tags shall be in accordance with COM11.APPEND8.

TESTING

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM

COM11.T010.9 SYSTEM ACCEPTANCE TEST

1. Carry out System Acceptance Tests with the CM or his representatives. The Contractor shall set up the environments for the System Acceptance Tests and prepare test plan and testing data for such acceptance test;
2. Provide guidelines for the operation of the System; and
3. Carry out the System Acceptance Test before the field trial as specified in COM11.T020 and the manufacturing of the building components as specified in COM11.D010. The System Acceptance Test shall demonstrate:
    a. The functions in website, including but not limit to, single search, multiple search, export to excel file and multiple fill as specified in COM11.APPEND6;
    b. The Alert Function as specified in COM11.M210;
    c. The capability of RFID reader program to scan and show proper RFID Tag number and User Information as specified in COM11.APPEND8.

COM11.T020.9 FIELD TRIAL AND DEMONSTRATION

1. Prepare field trial of the RFID System on receipt of the provisional approval specified in COM11.D110;
2. Carry out field trial to demonstrate:
    a. The proper data transfer in the RFID Web-based Database System at the casting yard or place of manufacturing and on Site and complete in good time before the commencement of tag installation to the building components;
    b. The proper multiple scan and batch input functions as specified in COM11.M120;
3. Further field trials shall be made until the CM is satisfied with the performance of the RFID system before Approval.

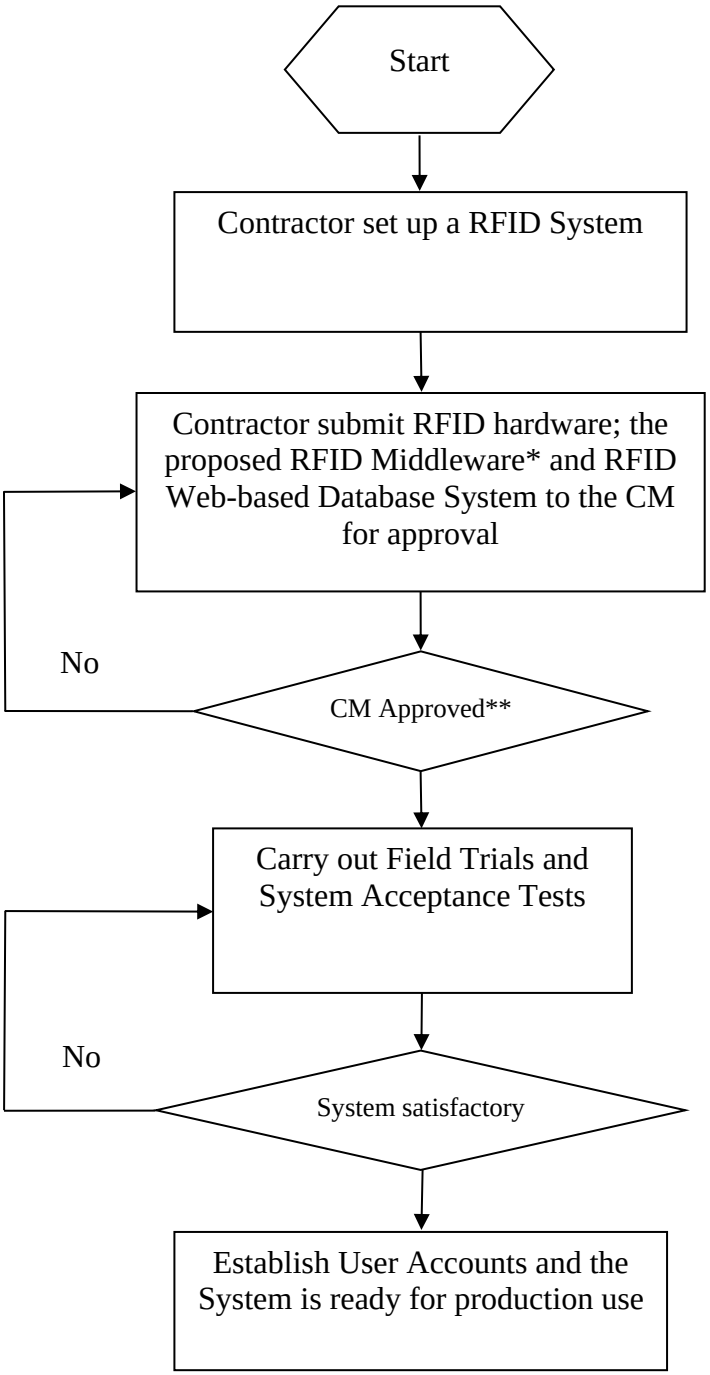
COM11.T030.9 PROCEDURE

1. A test sample for field trial shall comprise RFID tag, RFID reader, RFID supporting software, the RFID Web-based Database System, computer hardware and software necessary for the data transfer in the RFID system;
2. Unless otherwise agreed by CM, provide one test sample for each type of building components;
3. Perform data preparation, capture and submission to the RFID Web-based Database System at the casting yard or place of manufacturing and on Site and verify the correctness of data in the RFID System.

APPENDIX COM11/I

COM11.APPEND1.9CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM - PRECAST CONCRETE FAÇADE

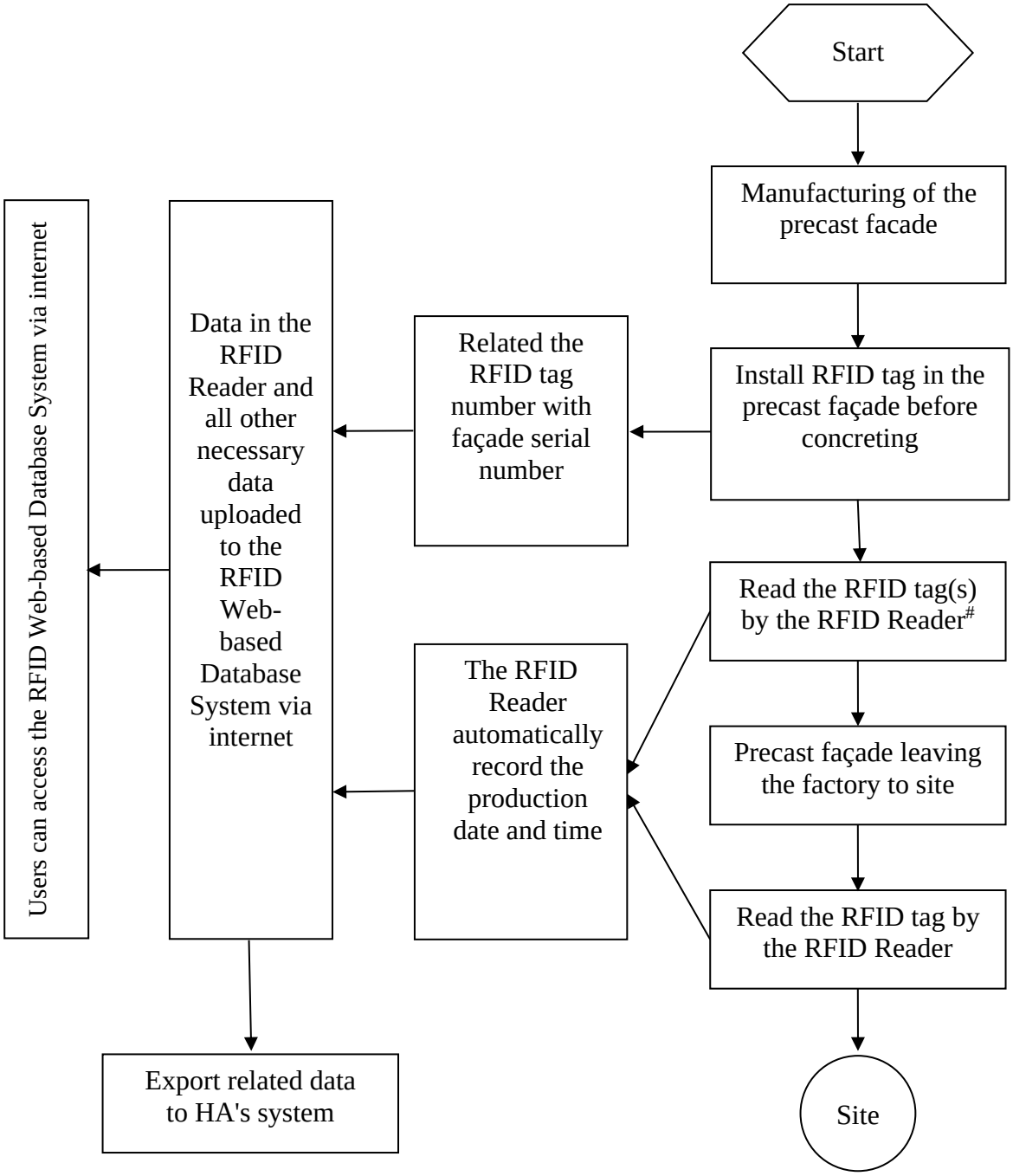
SYSTEM SET UP



* Middleware = Software for the communication/data transfers amongst RFID tags, RFID Readers/ and the RFID Web-based Database System.

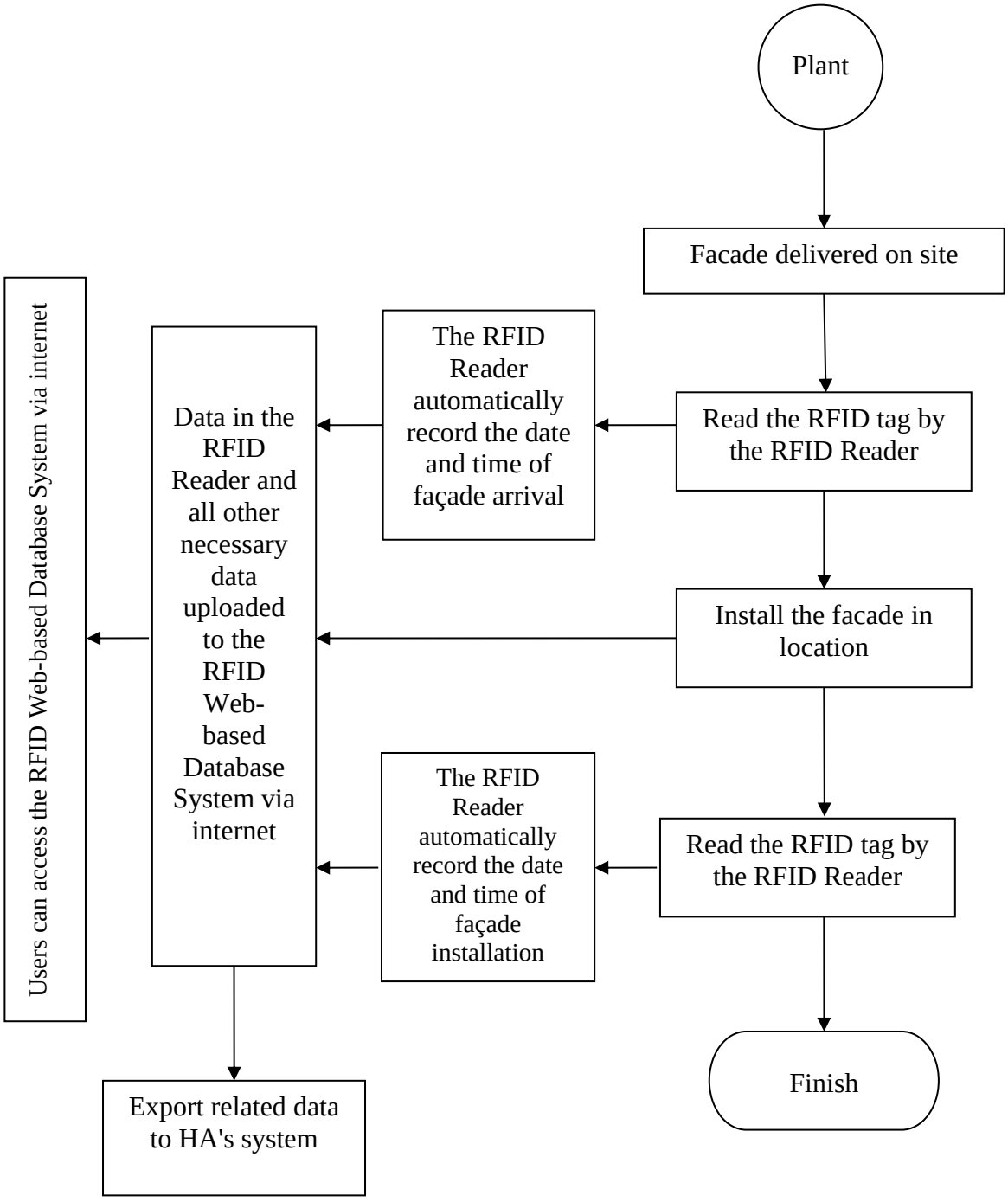
** The provisional approval from CM as per COM11.D110.

PLANT



If alumimium window(s) to be installed in the precast elements (e.g. precast façade, volumetric precast bathroom, etc.), read also the RFID tag(s) of respective aluminium window(s) to record the installation date and time.

SITE


Plant
Facade delivered on site
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the date and time of façade arrival
Install the facade in location
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the date and time of façade installation
Finish
Data in the RFID Reader and all other necessary data uploaded to the RFID Web-based Database System via internet
Users can access the RFID Web-based Database System via internet
Export related data to HA's system

Data Fields for data to be stored and maintained in the RFID Web-based Database System and RFID tags installed in Precast Concrete Façade

Seq	Column Name	Format	Stored in Tags	Stored in the database	Remarks
1.	Type of Building Component	Characters(3)	Yes	PCF	Note (1)
2.	Tag Identifier (TID)	Note (6)	Yes	Yes	
3.	RFID tag no.	EPC	Yes	Yes	Note (7)
4.	Precast Façade Serial no.	Char(20)		Yes	
5.	Contract Number	Char(12)	Yes	Yes	Note (1)
6.	Contract Description	Char(20)		Yes	
7.	Contractor	Char(15)	Yes	Yes	Note (1)
8.	Manufacturer	Char(50)		Yes	
9.	Manufacturer's Address	Char(100)		Yes	
10.	Facade Type	Char(12)		Yes	
11.	Casting Date	ddmmyyyy		Yes	Note (2)
12.	Delivery Date	ddmmyyyy		Yes	Note (2)
13.	Site Arrival Date	ddmmyyyy		Yes	Note (2)
14.	Installation Date	ddmmyyyy		Yes	Note (2)
15.	Block Number	Char(2)		Yes	Note (3)
16.	Floor Number	Char(2)		Yes	Note (3)
17.	Flat Number	Char(2)		Yes	Note (3)
18.	Concrete Grade	Char(10)		Yes	
19.	RS Inspection Date	ddmmyyyy		Yes	Notes (2,4)
20.	RS Company	Char(50)		Yes	
21.	Remarks	Char(50)		Yes	Note (5)

The Contractor may make use of the System to record other data such as Finishes, Tile adhesive, Tile Grout, Aluminum Window, Conduit and etc. (All optional)

Note

(1) This field of data to be stored in the user memory of RFID tags installed;

(2) Real time record with reference to the built-in clock inside the reader or other date definition agreed by the CM;

(3) Data to be input after the building component is installed in its final location;

(4) Resident Supervisor (RS) inspection to be carried out before the concreting of the precast façade;

(5) The "Remarks" field is to record any other information related to the component, e.g. any relevant tests carried out to the component;

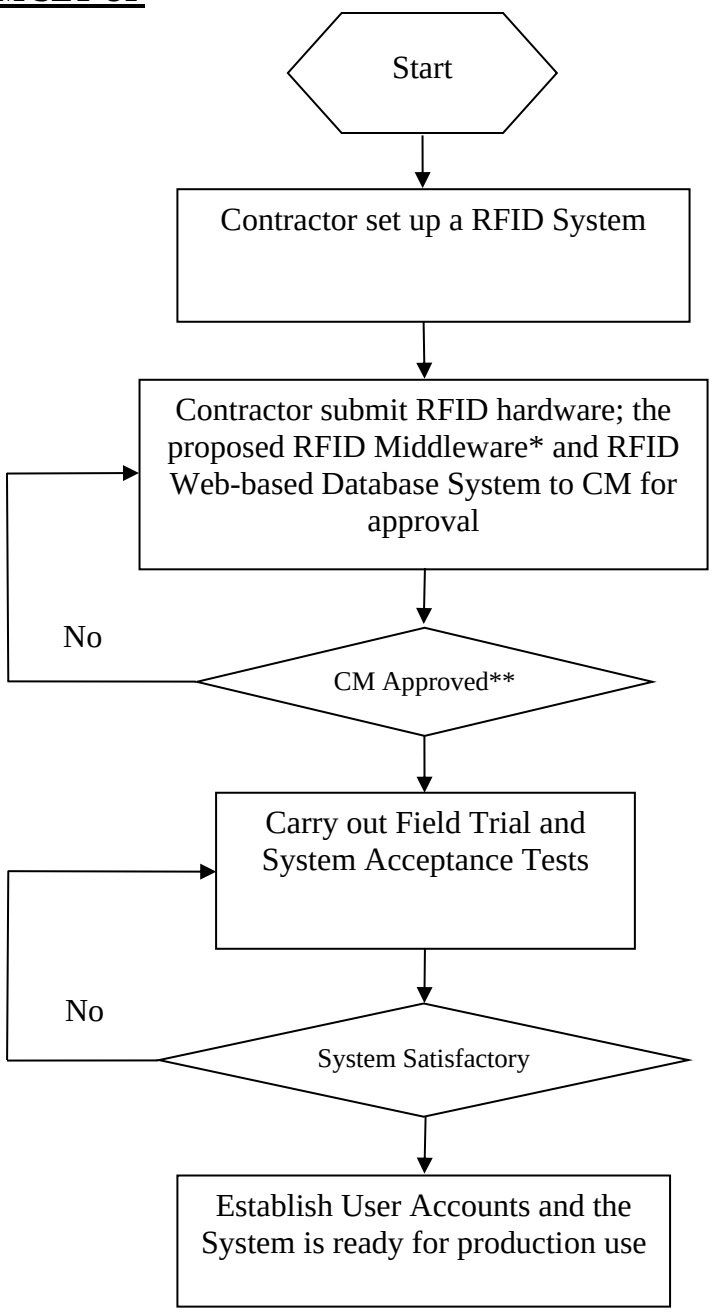
(6) Unalterable unique TID is assigned by the manufacturer of RFID tags;

(7) RFID tag no. to be stored in the format of Electronic Product Code (EPC).

APPENDIX COM11/II

COM11.APPEND2.9CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM - ALUMINIUM WINDOW

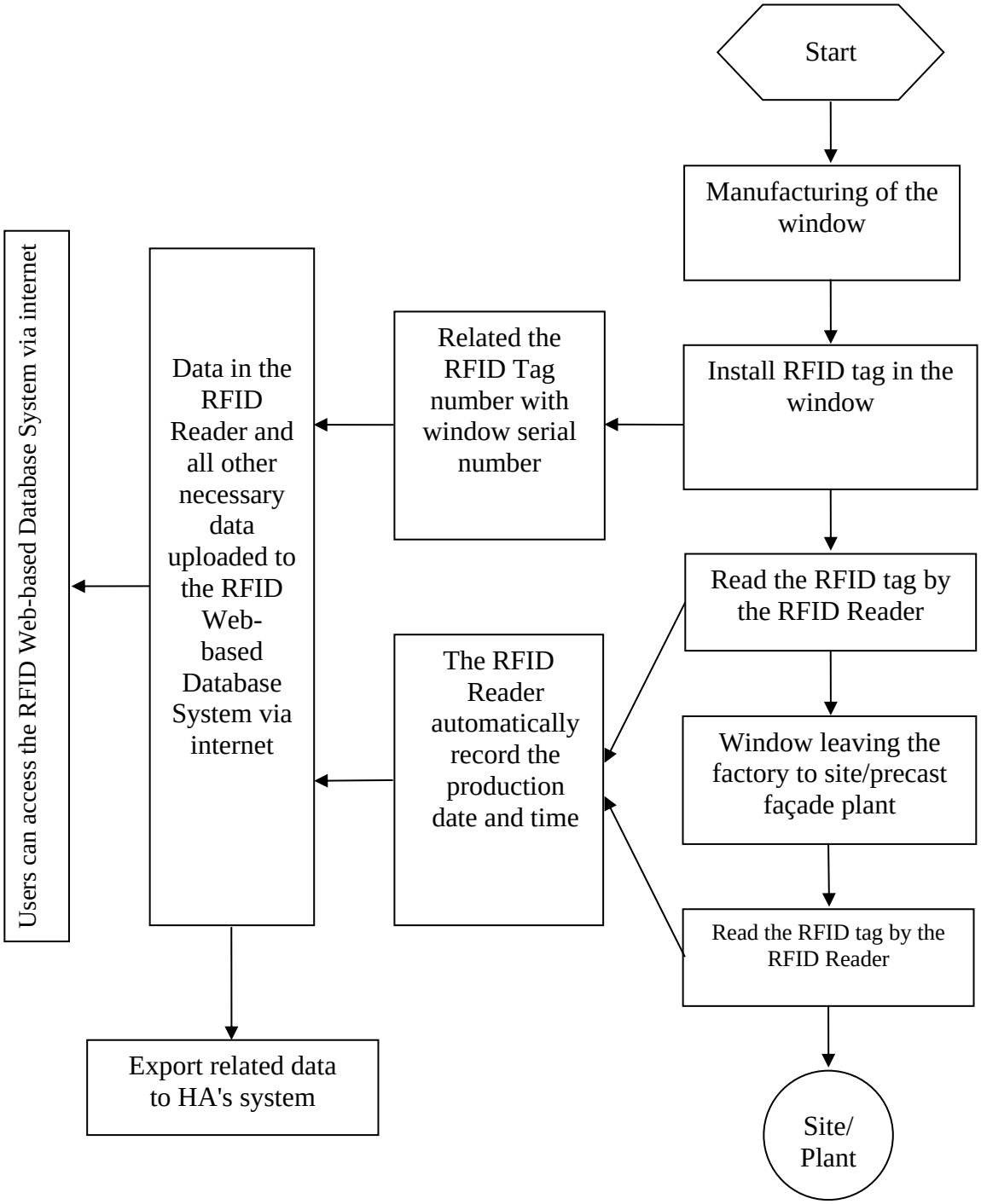
SYSTEM SET UP



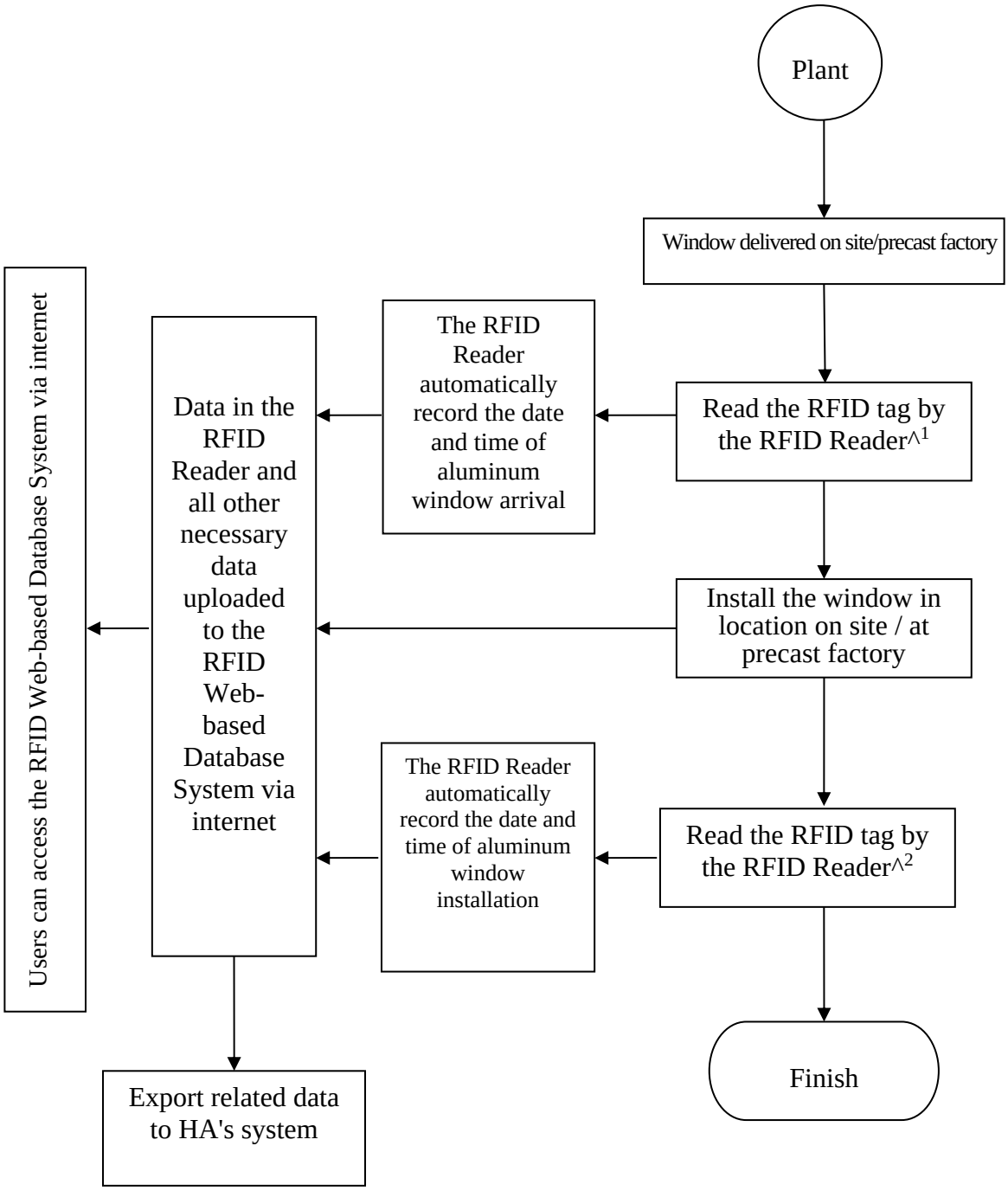
* Middleware = Software for the communication/data transfers amongst RFID tags, RFID Readers/ and the RFID Web-based Database System.

** The provisional approval from CM as per COM11.D110.

PLANT


Start
Manufacturing of the window
Install RFID tag in the window
Related the RFID Tag number with window serial number
Data in the RFID Reader and all other necessary data uploaded to the RFID Web-based Database System via internet
Users can access the RFID Web-based Database System via internet
Export related data to HA's system
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the production date and time
Window leaving the factory to site/precast façade plant
Read the RFID tag by the RFID Reader
Site/ Plant

SITE



^1 For aluminium windows to be installed in precast elements (e.g. precast façade, volumetric precast bathroom, etc.), read the RFID tag to record the date and time of aluminium window arrival to precast factory and store the data in the datafield of "Site Arrival Date".

^2 For aluminium windows to be installed in precast elements, read the RFID tag before concreting the related precast element to record the casting date of the precast element as the date and time of installation of aluminium window.

Data Fields for data to be stored and maintained in the RFID Web-based Database System and RFID tags installed in Aluminum Window

Seq	Column Name	Format	Stored in Tags	Stored in the database	Remarks
1.	Type of Building Component	Characters(3)	Yes	ALW	Note (1)
2.	Tag Identifier (TID)	Note (5)	Yes	Yes	
3.	RFID tag no.	EPC	Yes	Yes	Note (6)
4.	Window Serial no.	Char(20)		Yes	
5.	Contract Number	Char(12)	Yes	Yes	Note (1)
6.	Contract Description	Char(20)		Yes	
7.	Contractor	Char(15)	Yes	Yes	Note (1)
8.	Manufacturer	Char(50)		Yes	
9.	Manufacturer's Address	Char(100)		Yes	
10.	Window Type	Char(12)		Yes	
11.	Manufacturing Date	ddmmyyyy		Yes	Note (2)
12.	Delivery Date	ddmmyyyy		Yes	Note (2)
13.	Site Arrival Date	ddmmyyyy		Yes	Note (2,7)
14.	Installation Date	ddmmyyyy		Yes	Note (2,8)
15.	Block Number	Char(2)		Yes	Note (3)
16.	Floor Number	Char(2)		Yes	Note (3)
17.	Flat Number	Char(2)		Yes	Note (3,9)
18.	Brand name of four bar hinge	Char(10)		NA	
19.	(NA)	ddmmyyy		NA	
20.	(NA)	Char(50)		NA	
21.	Remarks	Char(50)		Yes	Note (4)

The Contractor may make use of the system to record other data such as test reports, mill certificates, shop drawings and etc. (All optional)

Note

(1) This field of data to be stored in the user memory of RFID tags installed;

(2) Real time record with reference to the built-in clock inside the reader or other date definition agreed by the CM;

(3) Data to be input after the building component is installed in its final location;

(4) The "Remarks" field is to record any other information related to the component, e.g. any glazing pre-installed;

(5) Unalterable unique TID is assigned by the manufacturer of RFID tags;

(6) RFID tag no. to be stored in the format of Electronic Product Code (EPC);

(7) For aluminium window to be installed in precast elements, date of arrival to precast factory to be stored in the data field for "Site Arrival Date";

(8) For aluminium window to be installed in precast elements, date of casting for the respective precast element to be stored in the data field for "Installation Date";

(9) For aluminium window to be installed in common areas, the following abbreviation to be stored in the data field of "Flat Number":

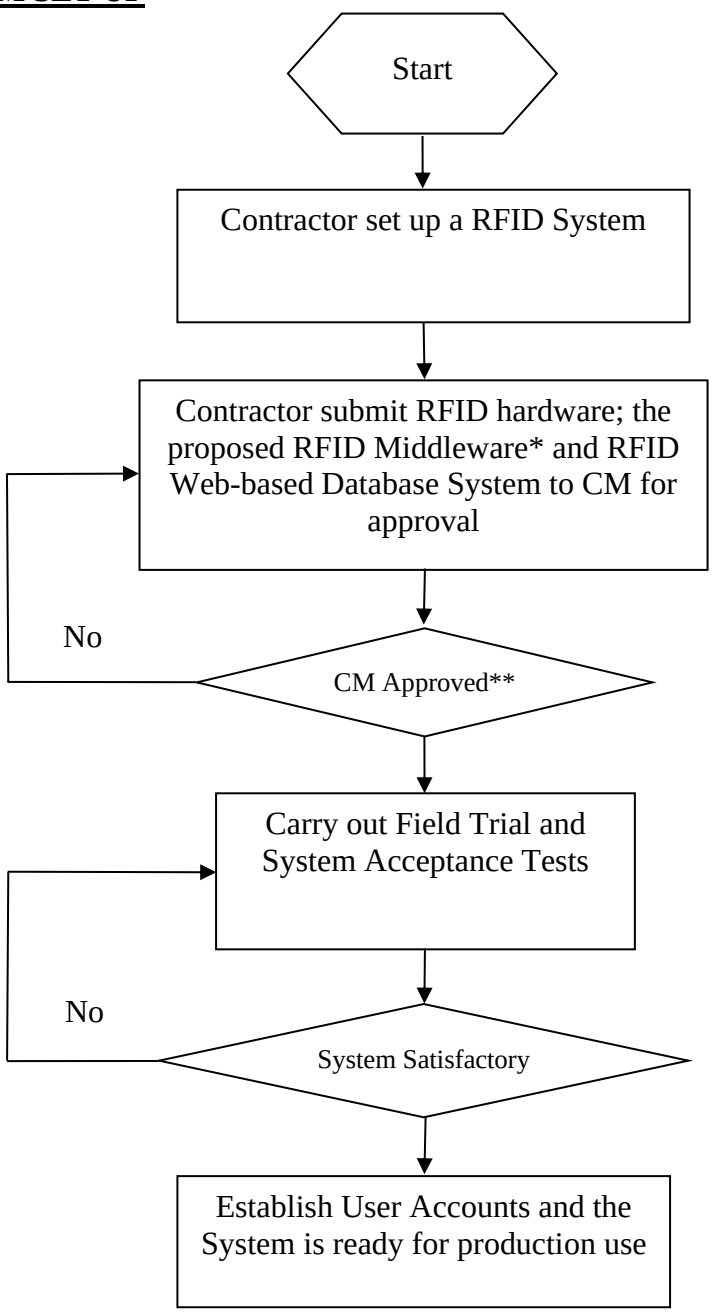
ST – Staircase	EM – Electrical Meter Room	TB – T.B.E Room
PD – Pipe Duct Room	SW – Switch Room	CD – Cable Duct Room
FS – FS Pump Room	SR – Store Room	WC - Toilet

LM – Lift Machine Room CO – Corridor LL – Lift Lobby
RS – Refuse Storage & Material Recovery Room
For other areas, abbreviation to be proposed by the Main Contractor for CMR's agreement.

APPENDIX COM11/III

COM11.APPEND3.9CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM - TIMBER DOOR

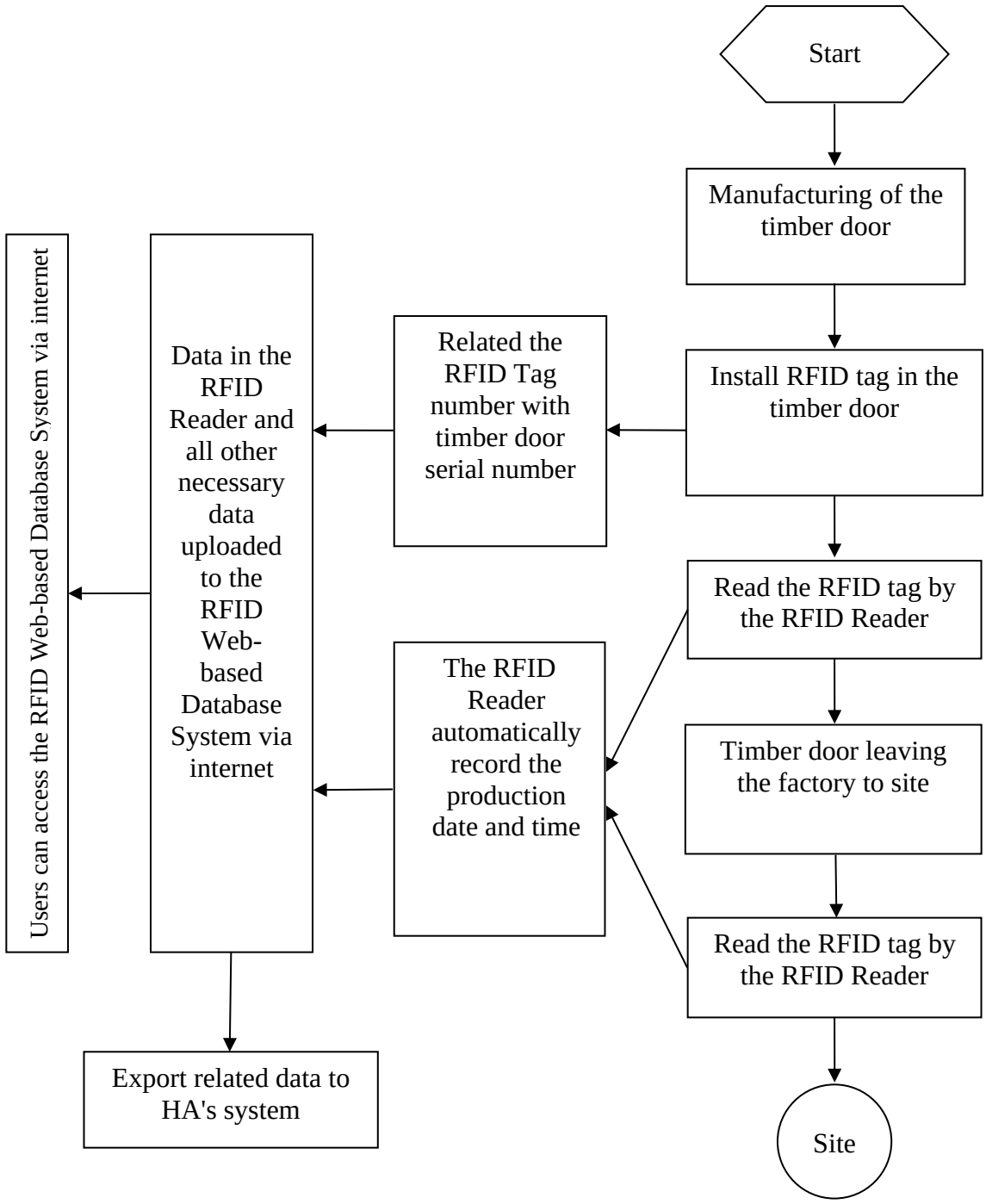
SYSTEM SET UP



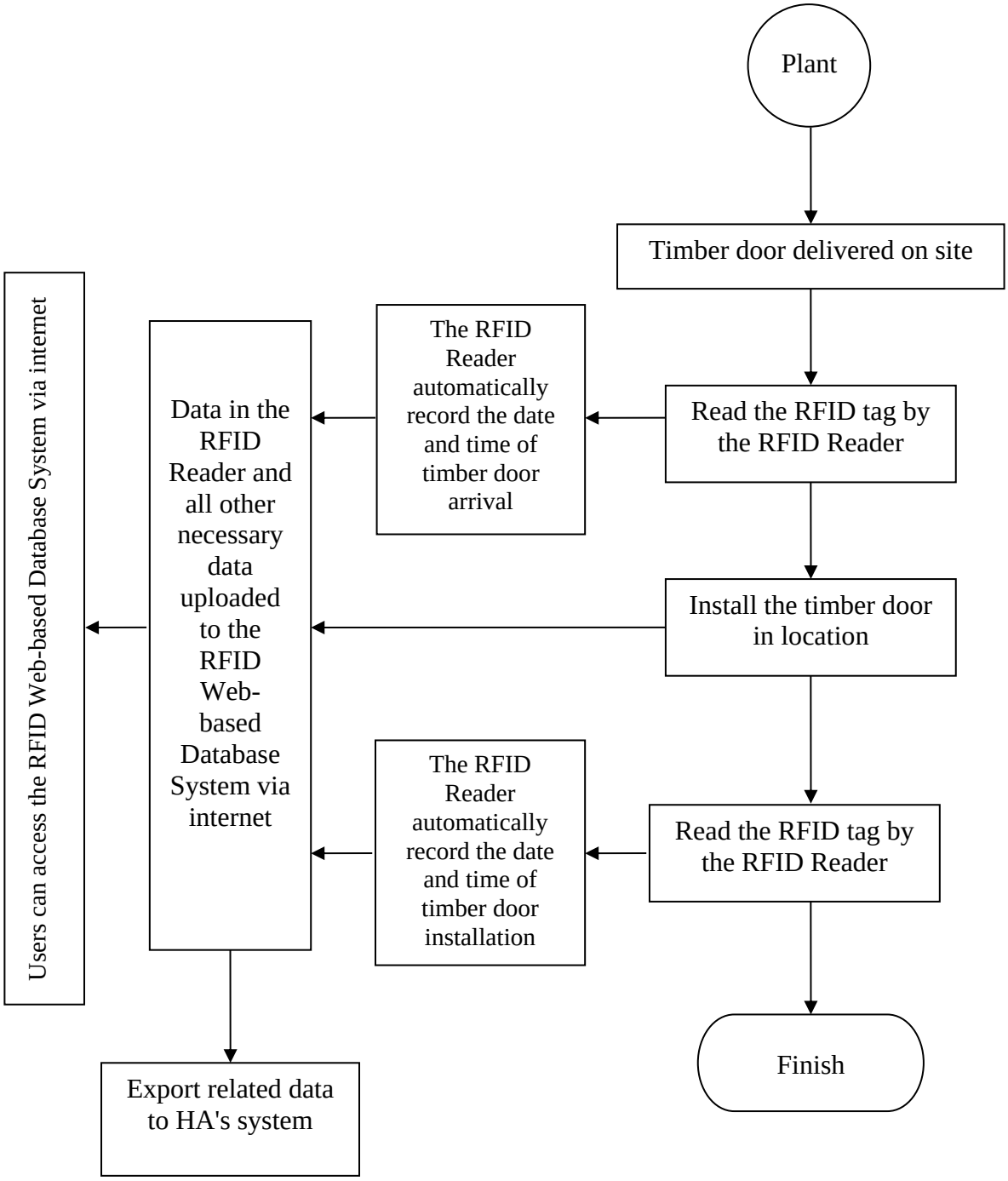
* Middleware = Software for the communication/data transfers amongst RFID tags, RFID Readers/and the RFID Web-based Database System.

** The provisional approval from CM as per COM11.D110.

PLANT


Start
Manufacturing of the timber door
Install RFID tag in the timber door
Related the RFID Tag number with timber door serial number
Data in the RFID Reader and all other necessary data uploaded to the RFID Web-based Database System via internet
Users can access the RFID Web-based Database System via internet
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the production date and time
Timber door leaving the factory to site
Read the RFID tag by the RFID Reader
Site
Export related data to HA's system

SITE


Plant
Timber door delivered on site
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the date and time of timber door arrival
Install the timber door in location
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the date and time of timber door installation
Finish
Data in the RFID Reader and all other necessary data uploaded to the RFID Web-based Database System via internet
Users can access the RFID Web-based Database System via internet
Export related data to HA's system

Data Fields for data to be stored and maintained in the RFID Web-based Database System and RFID tags installed in Timber Door

Seq	Column Name	Format	Stored in Tags	Stored in the database	Remarks
1.	Type of Building Component	Characters(3)	Yes	TID	Note (1)
2.	Tag Identifier (TID)	Note (5)	Yes	Yes	
3.	RFID tag no.	EPC	Yes	Yes	Note (6)
4.	Timber Door Serial no.	Char(20)		Yes	
5.	Contract Number	Char(12)	Yes	Yes	Note (1)
6.	Contract Description	Char(20)		Yes	
7.	Contractor	Char(15)	Yes	Yes	Note (1)
8.	Manufacturer	Char(50)		Yes	
9.	Manufacturer's Address	Char(100)		Yes	
10.	Door Type	Char(12)		Yes	
11.	Manufacturing Date	ddmmyyyy		Yes	Note (2)
12.	Delivery Date	ddmmyyyy		Yes	Note (2)
13.	Site Arrival Date	ddmmyyyy		Yes	Note (2)
14.	Installation Date	ddmmyyyy		Yes	Note (2)
15.	Block Number	Char(2)		Yes	Note (3)
16.	Floor Number	Char(2)		Yes	Note (3)
17.	Flat Number	Char(2)		Yes	Note (3,7)
18.	(NA)	Char(10)		NA	
19.	(NA)	ddmmyyy		NA	
20.	(NA)	Char(50)		NA	
21.	Remarks	Char(50)		Yes	Note (4)

The Contractor may make use of the System to record other data such as test reports, materials certificates, shop drawings and etc. (All optional)

Note

(1) This field of data to be stored in the user memory of RFID tags installed;

(2) Real time record with reference to the built-in clock inside the reader;

(3) Data to be input after the building component is installed in its final location;

(4) The "Remarks" field is to record any other information related to the component, e.g. any door furniture installed;

(5) Unalterable unique TID is assigned by the manufacturer of RFID tags;

(6) RFID tag no. to be stored in the format of Electronic Product Code (EPC);

(7) For timber door to be installed in common areas, the following abbreviation to be stored in the data field of "Flat Number":

ST – Staircase EM – Electrical Meter Room TB – T.B.E Room

PD – Pipe Duct Room SW – Switch Room CD – Cable Duct Room

FS – FS Pump Room SR – Store Room WC - Toilet

LM – Lift Machine Room CO – Corridor LL – Lift Lobby

RS – Refuse Storage & Material Recovery Room

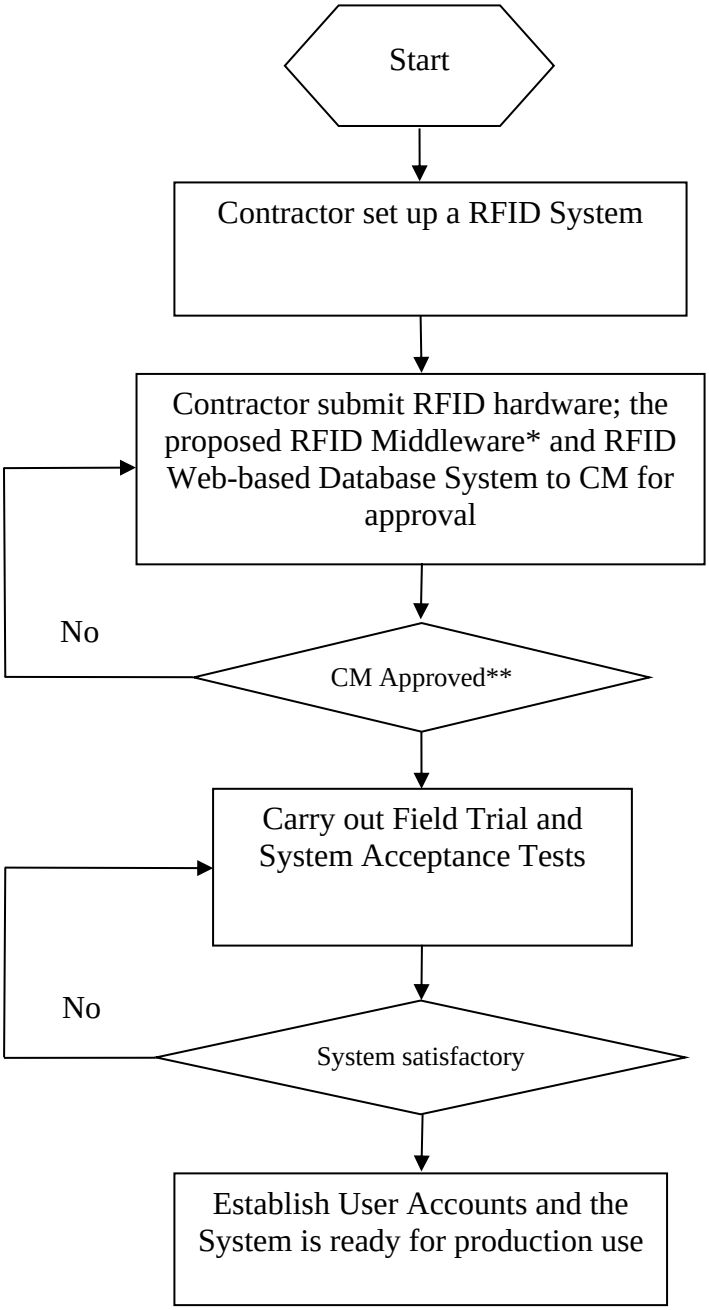
For other areas, abbreviation to be proposed by the Main Contractor for CMR's agreement.

DELETED

APPENDIX COM11/IV

COM11.APPEND4.9CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM - METAL GATESET

SYSTEM SET UP



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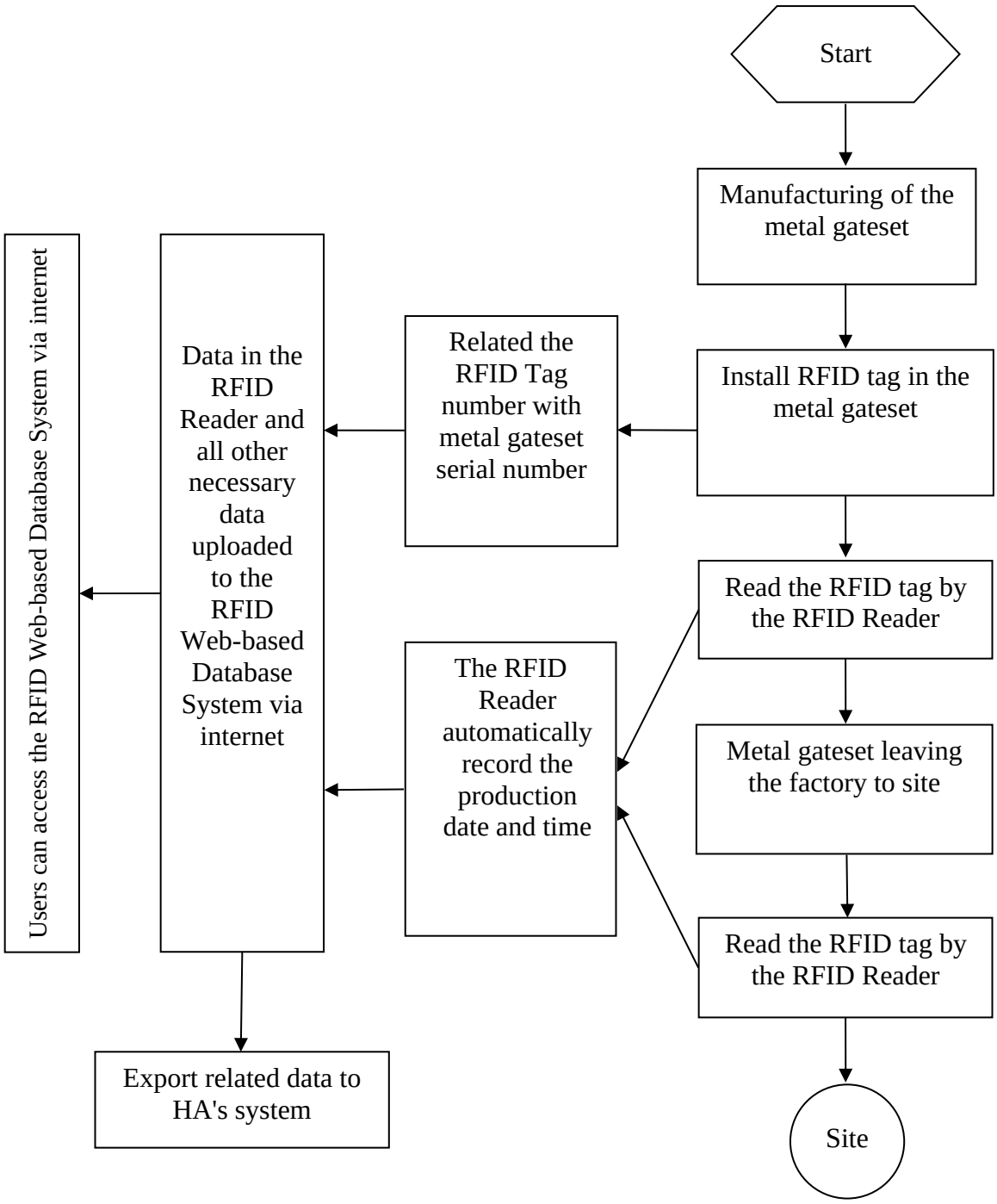
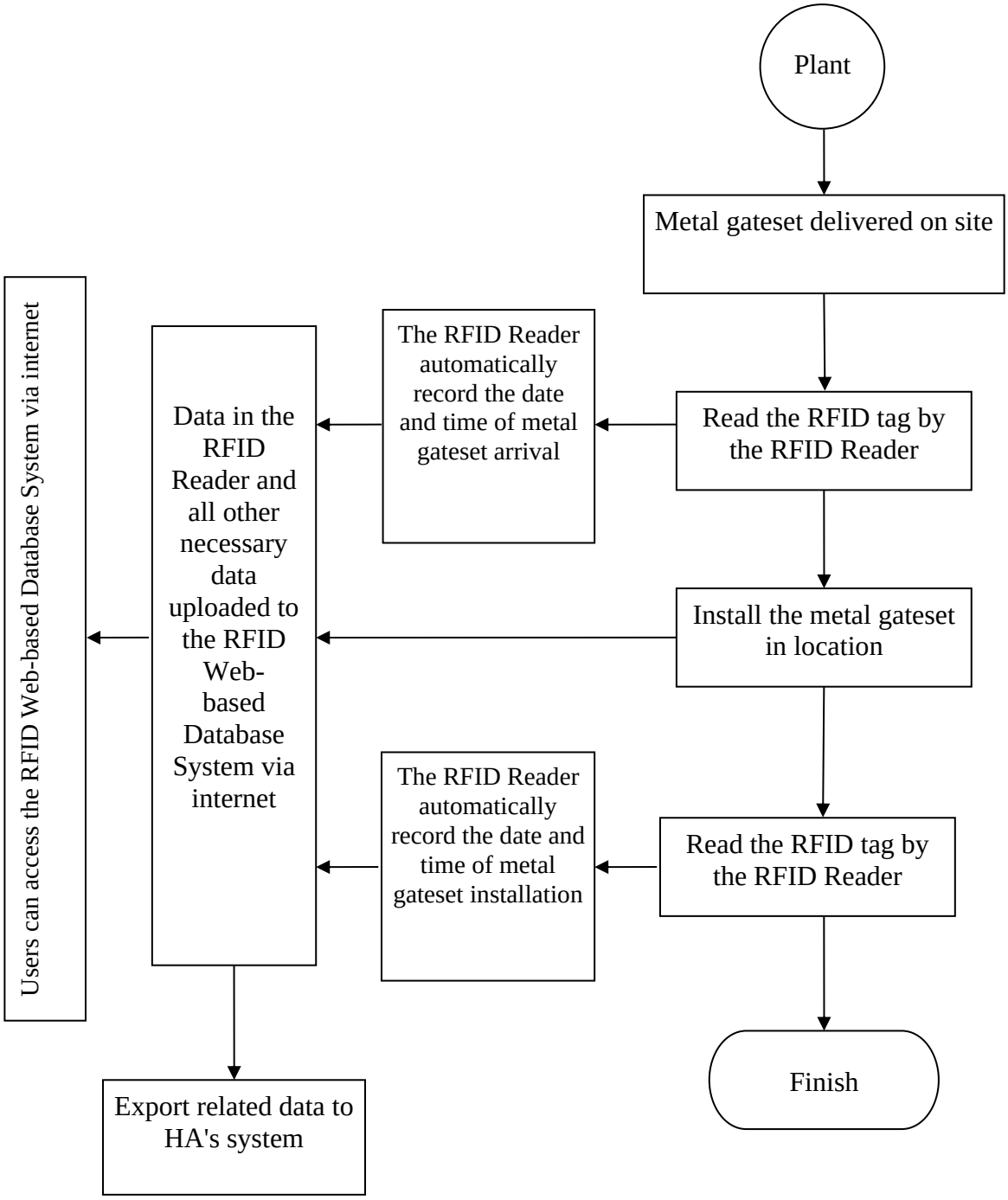
* Middleware = Software for the communication/data transfers amongst RFID tags, RFID Readers/ and the RFID Web-based Database System.

** The provisional approval from CM as per COM11.D110.

PLANT


Start
Manufacturing of the metal gateset
Install RFID tag in the metal gateset
Related the RFID Tag number with metal gateset serial number
Data in the RFID Reader and all other necessary data uploaded to the RFID Web-based Database System via internet
Users can access the RFID Web-based Database System via internet
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the production date and time
Metal gateset leaving the factory to site
Read the RFID tag by the RFID Reader
Site
Export related data to HA's system

SITE


Plant
Metal gateset delivered on site
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the date and time of metal gateset arrival
Install the metal gateset in location
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the date and time of metal gateset installation
Finish
Data in the RFID Reader and all other necessary data uploaded to the RFID Web-based Database System via internet
Users can access the RFID Web-based Database System via internet
Export related data to HA's system

Data Fields for data to be stored and maintained in the RFID Web-based Database System and RFID tags installed in Metal Gateset

Seq	Column Name	Format	Stored in Tags	Stored in the database	Remarks
1.	Type of Building Component	Characters(3)	Yes	MEG	Note (1)
2.	Tag Identifier (TID)	Note (5)	Yes	Yes	
3.	RFID tag no.	EPC	Yes	Yes	Note (6)
4.	Metal Gateset Serial no.	Char(20)		Yes	
5.	Contract Number	Char(12)	Yes	Yes	Note (1)
6.	Contract Description	Char(20)		Yes	
7.	Contractor	Char(15)	Yes	Yes	Note (1)
8.	Manufacturer	Char(50)		Yes	
9.	Manufacturer's Address	Char(100)		Yes	
10.	Gateset Type	Char(12)		Yes	
11.	Manufacturing Date	ddmmyyyy		Yes	Note (2)
12.	Delivery Date	ddmmyyyy		Yes	Note (2)
13.	Site Arrival Date	ddmmyyyy		Yes	Note (2)
14.	Installation Date	ddmmyyyy		Yes	Note (2)
15.	Block Number	Char(2)		Yes	Note (3)
16.	Floor Number	Char(2)		Yes	Note (3)
17.	Flat Number	Char(2)		Yes	Note (3)
18.	(NA)	Char(10)		NA	
19.	(NA)	ddmmyyy		NA	
20.	(NA)	Char(50)		NA	
21.	Remarks	Char(50)		Yes	Note (4)

The Contractor may make use of the System to record other data such as test reports, mill certificates, shop drawings and etc. (All optional)

Note

(1) This field of data to be stored in the user memory of RFID tags installed;

(2) Real time record with reference to the built-in clock inside the reader;

(3) Data to be input after the building component is installed in its final location;

(4) The "Remarks" field is to record any other information related to the component, e.g. door lock installed;

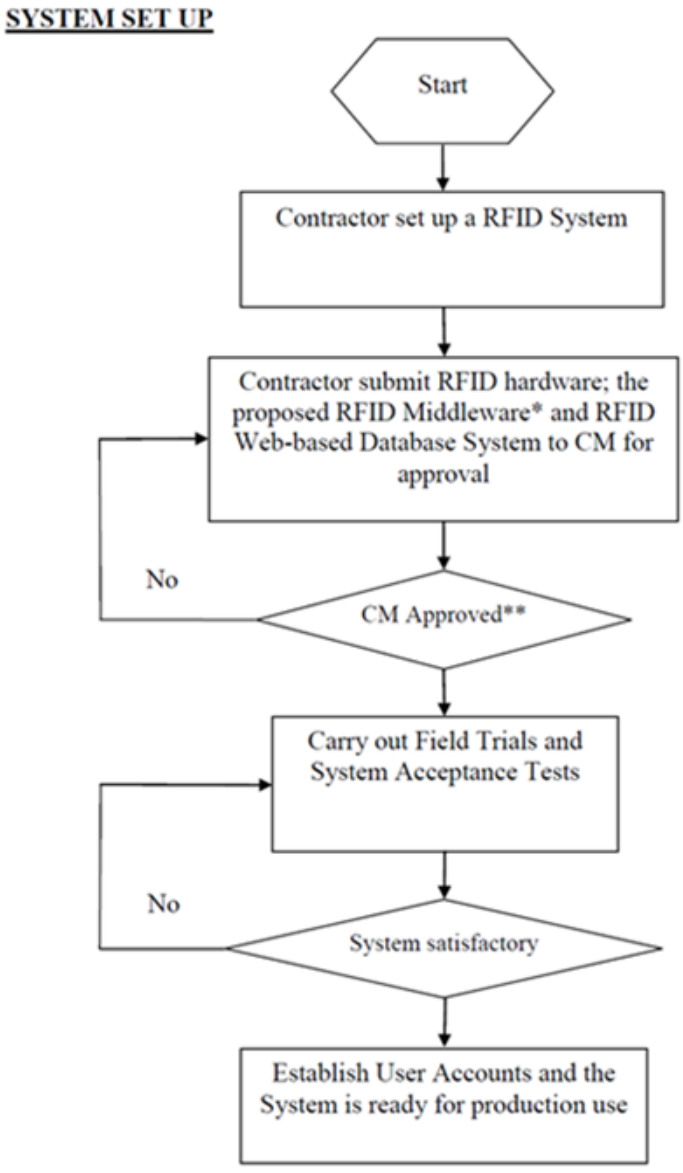
(5) Unalterable unique TID is assigned by the manufacturer of RFID tags;

(6) RFID tag no. to be stored in the format of Electronic Product Code (EPC).

APPENDIX COM11/V

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM

COM11.APPEND5.9 CONCEPTUAL WORKFLOW FOR THE RFID SYSTEM – VOLUMETRIC PRECAST BATHROOM (VPB) AND VOLUMETRIC PRECAST KITCHEN (VPK)

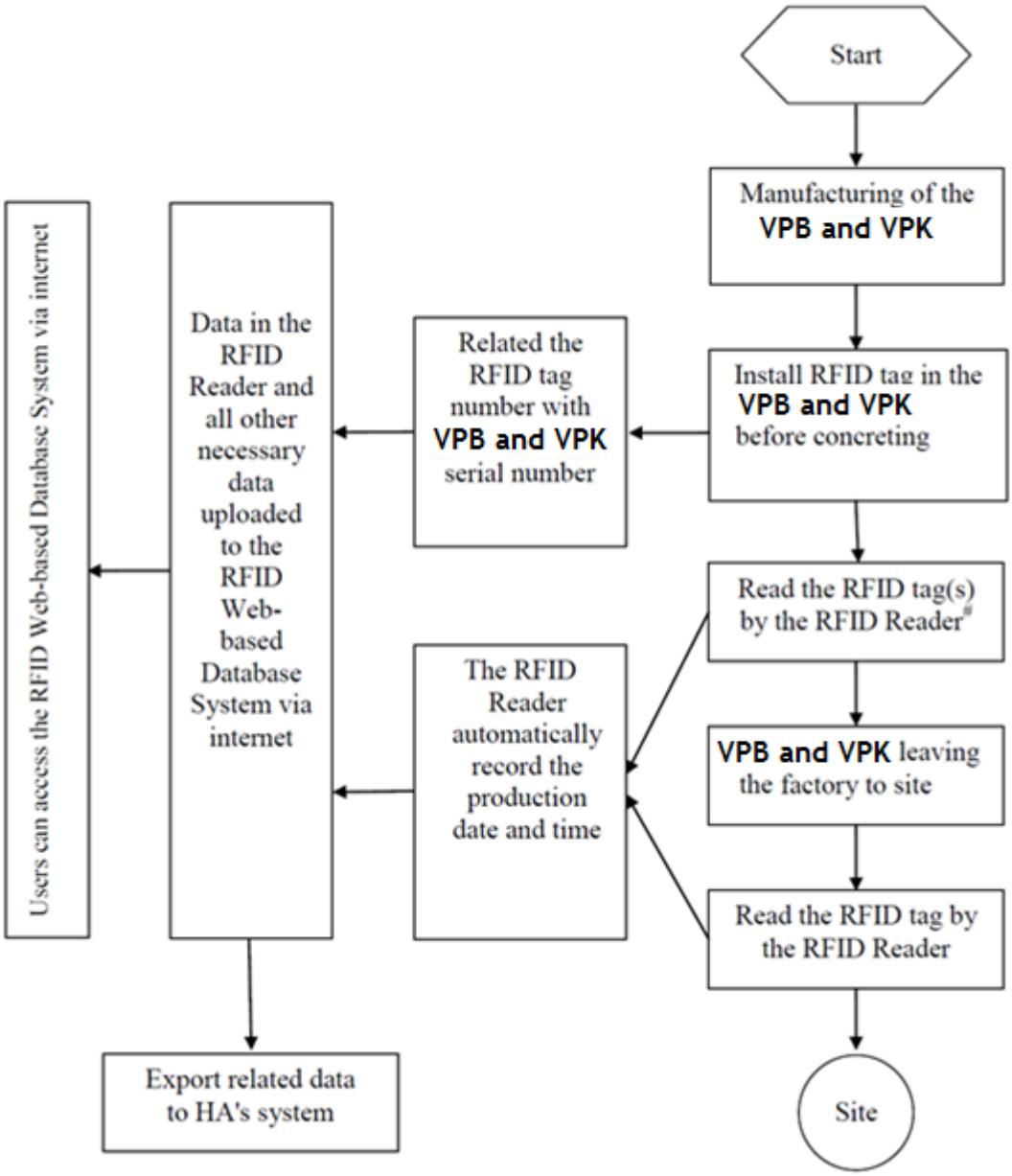


* Middleware = Software for the communication / data transfers amongst RFID tags, RFID Readers / and the RFID Web-based Database System.

** The provisional approval from the CM as per COM11.D110.

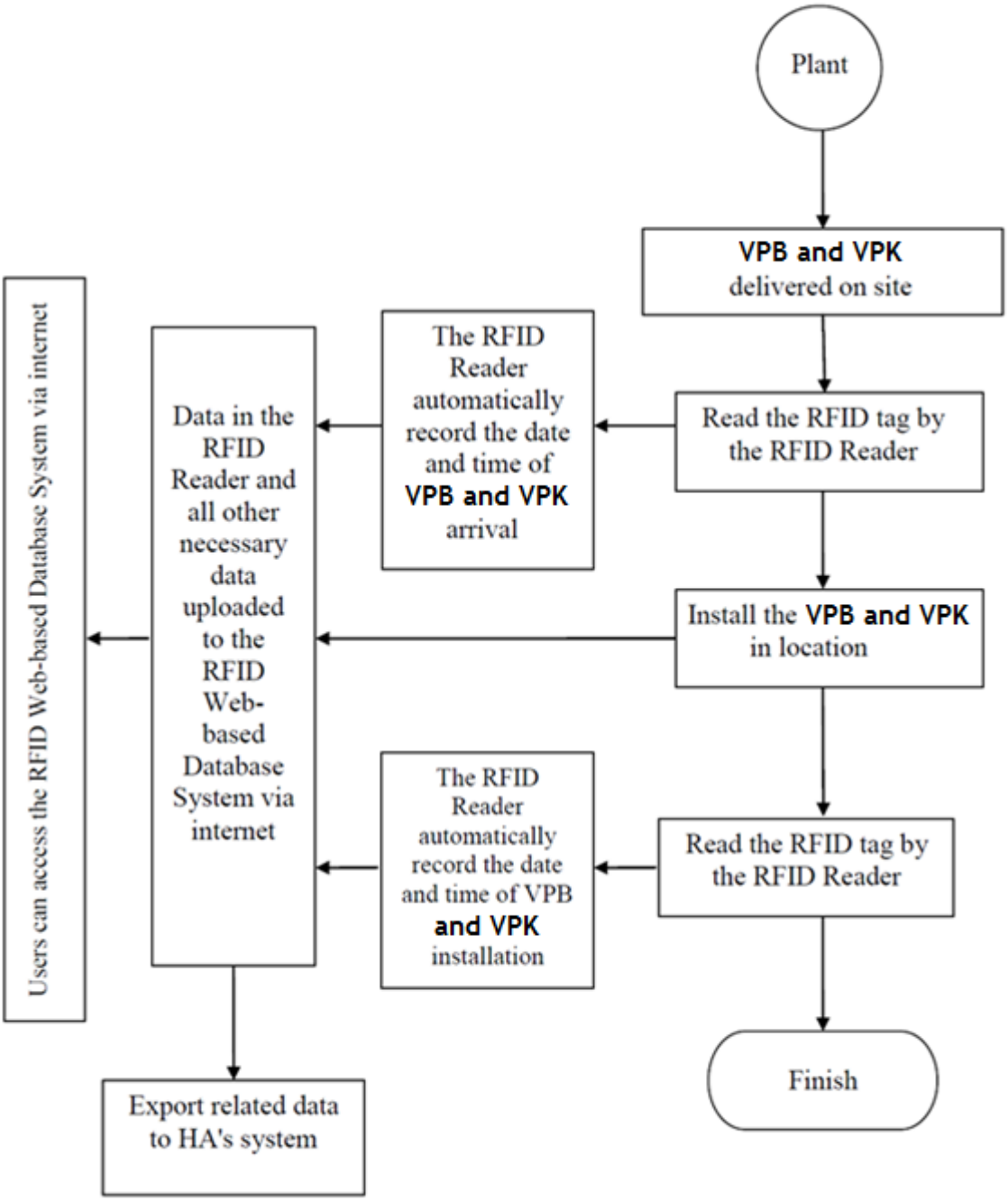
Note: All VPB, Combined VPB, VPK, Combined VPK, Combined VPB and VPK components shall follow RFID system and the RFID tags shall be installed at the location specified in COM11.APPEND7.A (E) and (F).

PLANT



If alumimium window(s) to be installed in the precast elements (e.g. precast façade, volumetric precast bathroom, volumetric precast kitchen etc.), read also the RFID tag(s) of respective aluminium window(s) to record the installation date and time.

SITE


Plant
VPB and VPK delivered on site
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the date and time of VPB and VPK arrival
Data in the RFID Reader and all other necessary data uploaded to the RFID Web-based Database System via internet
Users can access the RFID Web-based Database System via internet
Install the VPB and VPK in location
Read the RFID tag by the RFID Reader
The RFID Reader automatically record the date and time of VPB and VPK installation
Finish
Export related data to HA's system

Data Fields for data to be stored and maintained in the RFID Web-based Database System and RFID tags installed in Volumetric Precast Bathrorom (VPB) and Volumetric Precast Kitchen (VPK)

Seq	Column Name	Format	Stored in Tags	Stored in the database	Remarks
1.	Type of Building Component	Characters(3)	Yes	VPB	Note (1)
2.	Tag Identifier (TID)	Note (6)	Yes	Yes	
3.	RFID tag no.	EPC	Yes	Yes	Note (7)
4.	VPB and / or VPK Serial no.	Char(20)		Yes	
5.	Contract Number	Char(12)	Yes	Yes	Note (1)
6.	Contract Description	Char(20)		Yes	
7.	Contractor	Char(15)	Yes	Yes	Note (1)
8.	Manufacturer	Char(50)		Yes	
9.	Manufacturer's Address	Char(100)		Yes	
10.	VPB and / or VPK Type	Char(12)		Yes	
11.	Casting Date 1	ddmmyyyy		Yes	Note (2)
12.	Casting Date 2*	ddmmyyyy		Yes	Note (2)
13.	Waterproofing Installation Date	ddmmyyyy		Yes	Note (2)
14.	Delivery Date	ddmmyyyy		Yes	Note (2)
15.	Site Arrival Date	ddmmyyyy		Yes	Note (2)
16.	Installation Date	ddmmyyyy		Yes	Note (2)
17.	Block Number	Char(2)		Yes	Note (3)
18.	Floor Number	Char(2)		Yes	Note (3)
19.	Flat Number	Char(10)		Yes	Note (3)
20.	Concrete Grade	Char(10)		Yes	
21.	RS Inspection Date	ddmmyyyy		Yes	Notes (2,4)
22.	RS Company	Char(50)		Yes	
23.	Remarks	Char(50)		Yes	Note (5)

The Contractor may make use of the System to record other data such as Finishes, Tile adhesive, Tile Grout, Aluminum Window, Conduit and etc. (All optional)

Note

(1) This field of data to be stored in the user memory of RFID tags installed;

(2) Real time record with reference to the built-in clock inside the reader or other date definition agreed by the CM;

(3) Data to be input after the building component is installed in its final location;

(4) Resident Supervisor (RS) inspection to be carried out before the concreting of the precast façade;

(5) The "Remarks" field is to record any other information related to the component, e.g. any relevant tests carried out to the component;

(6) Unalterable unique TID is assigned by the manufacturer of RFID tags;

(7) RFID tag no. to be stored in the format of Electronic Product Code (EPC).

* Applicable if casting of VPB and / or VPK are separated in two days.

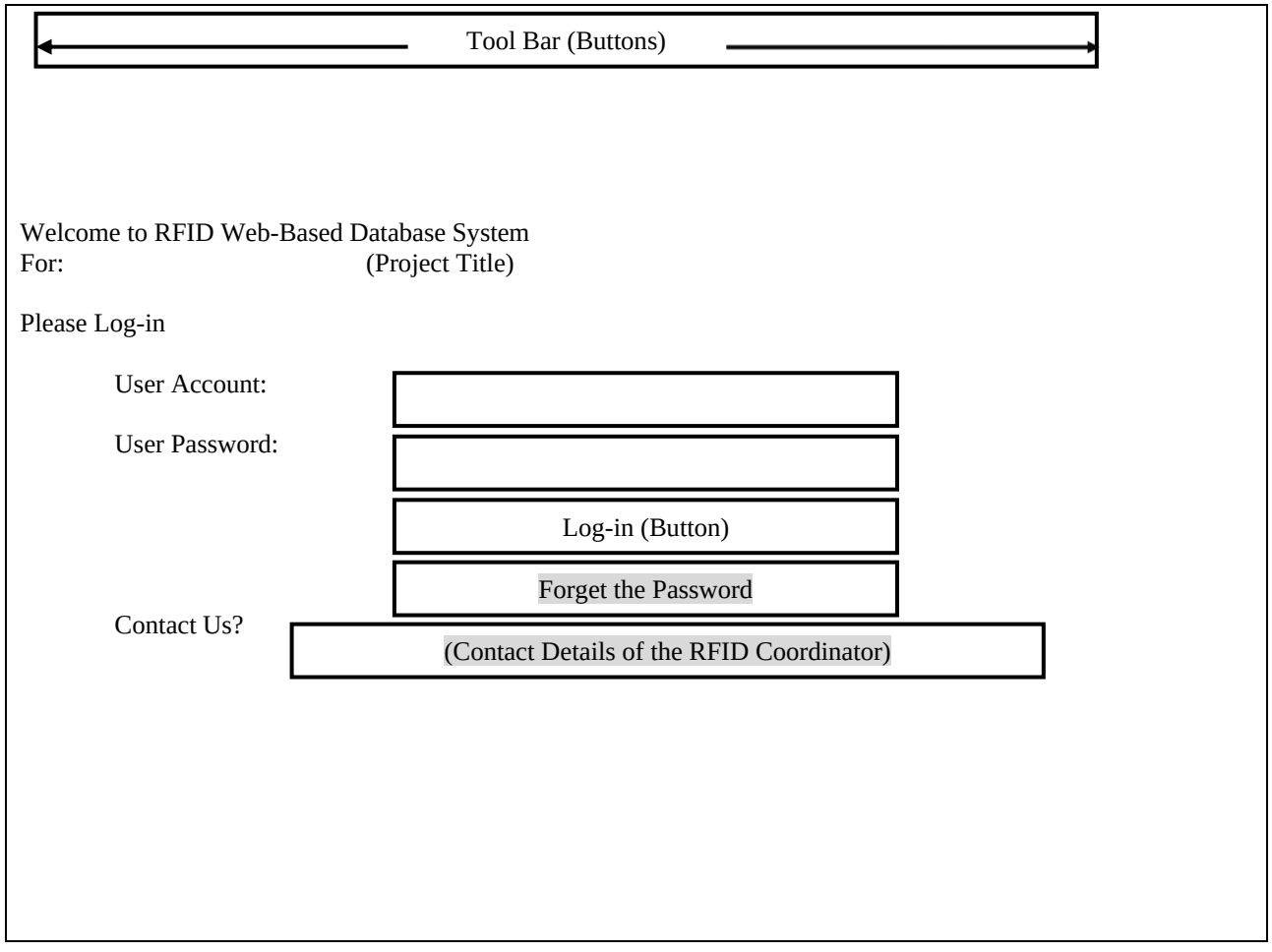
APPENDIX COM11/VI

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM

COM11.APPEND6.9SUGGESTED USER-INTERFACE LAYOUT FOR THE RFID WEB-BASED DATABASE SYSTEM

Suggested User-Interface Layout for the RFID Web-Based Database System

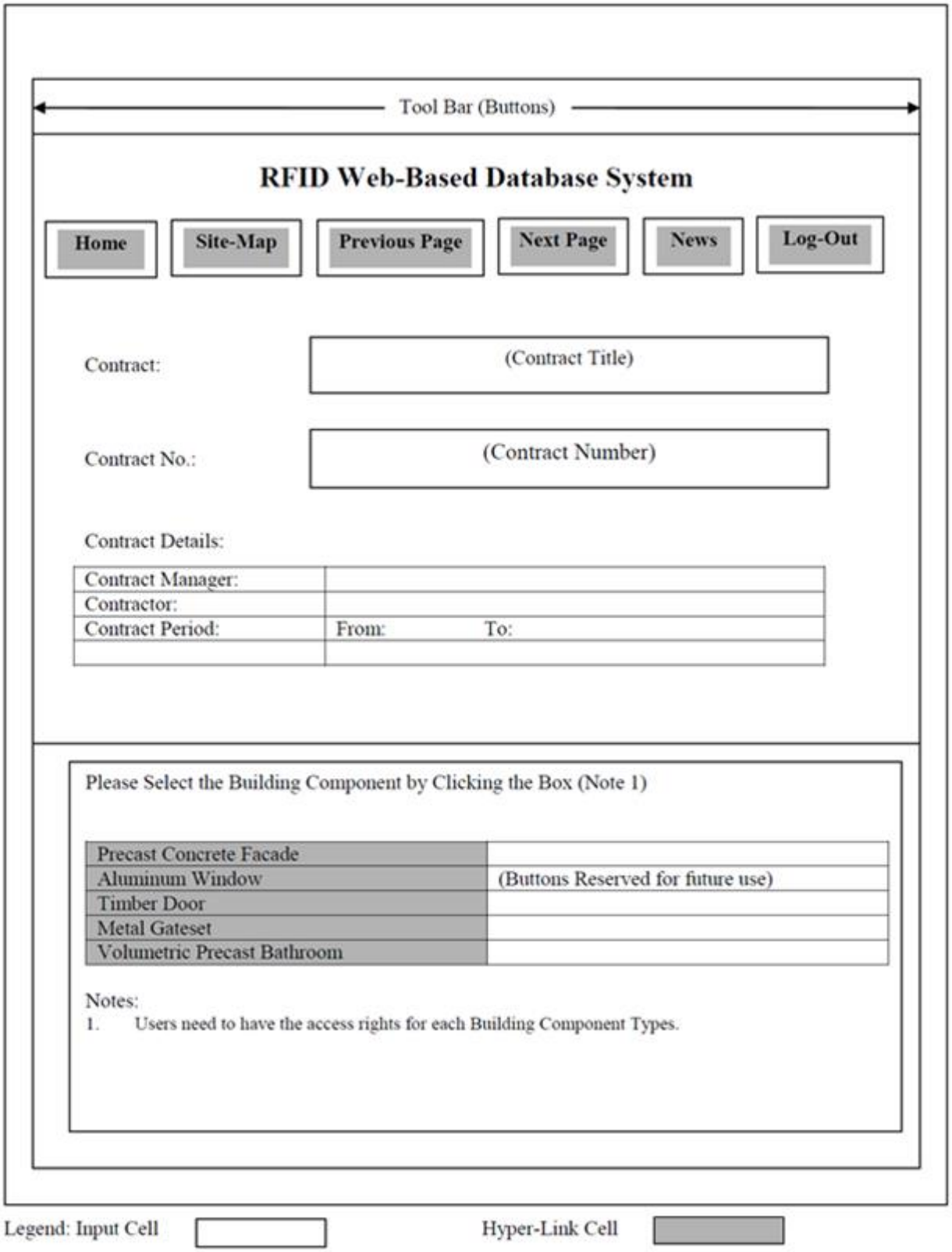
Log-in Page



Legend: Input Cell Hyper-Link Cell

Suggested User-Interface Layout for the RFID Web-Based Database System

(B) Home Page



Suggested User-Interface Layout for the RFID Web Based Database System
(C) Precast Facade

Tool Bar (Buttons)

RFID Web-Based Database System
Precast Concrete Facade

Home | **Site-Map** | **News** | **Report (Note 3)** | **Log-out**

Previous Page | **Next Page**

Summary Report:

	This Month	This Week	Cumulative
No. of Facades tagged			
No. of Facades cast			
No. of Facades arrived at Site			
No. of Facades installed			

Searching Information

Single Search (Input RFID Tag No.) OR (Input Serial No.) Click here to Search

Multiple Search

	Criteria (Note 1)			Searching Details (Note 2)	
1		▼			▼
2		▼			▼
3		▼			▼
4		▼			▼
5		▼			▼

Click here to Search

Notes:
1) Criteria will pop-out by clicking the arrow and then select any one to all for searching (RFID tag no., Precast Façade Serial no., Facade Type, Casting Date, Delivery Date, Site Arrival Date, Installation Date, Block no., Floor no., Flat no., Concrete Grade, RS inspection Date).
2) Key in or select the searching range (For example, a casting period, etc.). A pop-out menu for selection (Type) shall be provided.
3) Missing entries search according to RFID Alert Function as specified in COM11.APPEND9.

Legend: Input Cell

Suggested User-Interface Layout for the RFID Web Based Database System
(D) Aluminum Window

Tool Bar (Buttons)

RFID Web-Based Database System
Aluminum Window

Home | **Site-Map** | **News** | **Report (Note 3)** | **Log-out**

Previous Page | **Next Page**

Summary Report:

	This Month	This Week	Cumulative
No. of Windows tagged			
No. of Windows completed & in the factory			
No. of Windows to be installed to precast elements arrived at precast factory			
No. of Windows installed to precast elements			
No. of In-situ Windows arrived at site			
No. of In-situ Windows installed			

Searching Information

Single Search (Input RFID Tag No.) OR (Input Serial No.) Click here to Search

Multiple Search

	Criteria (Note 1)			Searching Details (Note 2)	
1		▼			▼
2		▼			▼
3		▼			▼
4		▼			▼
5		▼			▼

Click here to Search

Notes:
1) Criteria will pop-out by clicking the arrow and then select any one to all for searching (RFID tag no., Window Serial no., Window Type, Manufacturing Date, Delivery Date, Site Arrival Date, Installation Date, Block no., Floor no., Flat no).
2) Key in or select the searching range (For example, a manufacturing period, etc.). A pop-out menu for selection (Type) shall be provided.
3) Missing entries search according to RFID Alert Function as specified in COM11.APPEND9.

Legend: Input Cell

Suggested User-Interface Layout for the RFID Web Based Database System
(E) Timber Door

Tool Bar (Buttons)

RFID Web-Based Database System
Timber Door

Home **Site-Map** **News** **Report (Note 3)** **Log-out**

Previous Page **Next Page**

Summary Report:

	This Month	This Week	Cumulative
No. of Doors tagged			
No. of Doors completed & in the factory			
No. of Doors arrived at site			
No. of Doors installed			

Searching Information

Single Search (Input RFID Tag No.) OR (Input Serial No.) Click here to Search

Multiple Search

	Criteria (Note 1)			Searching Details (Note 2)	
1		▼			▼
2		▼			▼
3		▼			▼
4		▼			▼
5		▼			▼

Click here to Search

Notes:
1) Criteria will pop-out by clicking the arrow and then select any one to all for searching (Tag Identifier (TID), RFID tag no., Timber Door Serial no., Door Type, Manufacturing Date, Delivery Date, Site Arrival Date, Installation Date, Block no., Floor no., Flat no.).
2) Key in or select the searching range (For example, a manufacturing period, etc.). A pop-out menu for selection (Type) shall be provided.
3) Missing entries search according to RFID Alert Function as specified in COM11.APPEND9.

Legend: Input Cell

Suggested User-Interface Layout for the RFID Web Based Database System
(F) Metal Gateset

Tool Bar (Buttons)

RFID Web-Based Database System
Metal Gateset

Home | **Site-Map** | **News** | **Report (Note 3)** | **Log-out**

Previous Page | **Next Page**

Summary Report:

	This Month	This Week	Cumulative
No. of Gatesets tagged			
No. of Gatesets completed & in the factory			
No. of Gatesets arrived at site			
No. of Gatesets installed			

Searching Information

Single Search (Input RFID Tag No.) OR (Input Serial No.) Click here to Search

Multiple Search

	Criteria (Note 1)			Searching Details (Note 2)	
1		▼			▼
2		▼			▼
3		▼			▼
4		▼			▼
5		▼			▼

Click here to Search

Notes:
1) Criteria will pop-out by clicking the arrow and then select any one to all for searching (RFID tag no., Metal Gateset Serial no., Gateset Type, Manufacturing Date, Delivery Date, Site Arrival Date, Installation Date, Block no., Floor no., Flat no.).
2) Key in or select the searching range (For example, a manufacturing period, etc.). A pop-out menu for selection (Type) shall be provided.
3) Missing entries search according to RFID Alert Function as specified in COM11.APPEND9.

Legend: Input Cell H

Suggested User-Interface Layout for the RFID Web Based Database System
(G) Volumetric Precast Bathroom and Volumetric Precast Kitchen

Tool Bar (Buttons)

RFID Web-Based Database System
Volumetric Precast Bathroom (VPB) and Volumetric Precast Kitchen (VPK)

Home | **Site-Map** | **News** | **Report (Note 3)** | **Log-out**

Previous Page | **Next Page**

Summary Report:

	This Month	This Week	Cumulative
No. of VPB and / or VPK tagged			
No. of VPB and / or VPK cast			
No. of VPB and / or VPK arrived at site			
No. of VPB and / or VPK installed			

Searching Information

Single Search (Input RFID Tag No.) OR (Input Serial No.) Click here to Search

Multiple Search

	Criteria (Note 1)			Searching Details (Note 2)	
1		▼			▼
2		▼			▼
3		▼			▼
4		▼			▼
5		▼			▼

Click here to Search

Notes:
1) Criteria will pop-out by clicking the arrow and then select any one to all for searching (RFID tag no., VPB and / or VPK Serial no., VPB and / or VPK Type, Casting Date 1, Casting Date 2, Waterproofing Installation Date, Delivery Date, Site Arrival Date, Installation Date, Block no., Floor no., Flat no., Concrete Grade, RS Inspection Date).
2) Key in or select the searching range (For example, a casting period, etc.). A pop-out menu for selection (Type) shall be provided.
3) Missing entries search according to RFID Alert Function as specified in COM11.APPEND9.

Legend: Input Cell

Suggested User-Interface Layout for the RFID Web Based Database System
(H) Example of a Search Request Page

Tool Bar (Buttons)

RFID Web-Based Database System
Selected Criteria of Search Request Report

Home **Site-Map** **News** **Report** **Log-out**

Previous Page **Next Page**

Building Component:
(Type of the Building Component)

Export to Excel File (Note 1)

Searching Criteria

	Criteria			Searching Details	
1		▼			▼
2		▼			▼
3		▼			▼

Asset List:

Checkboxes	No.	RFID No.	Serial No.	Type					
☐	1								
☐	2								
☐	3								
☐	4								
☐	5						(All other data in table form)		
☐	6						(Click No. for more information)		

Multiple Fill (Note 2)

Total _____ nos. found

Page 1, 2, 3, 4, 5…… (More)

Notes:
1) The exported Excel File includes all search criteria values and the list of building component with serial no., RFID tag no., and Type.
2) By clicking the multiple fill button, a new page for selective data fields in either one authorized workflow checkpoint shall be provided. Successful single entry applies to those checkboxes ticked building components.

Legend: Input Cell Hyper-Link Cell

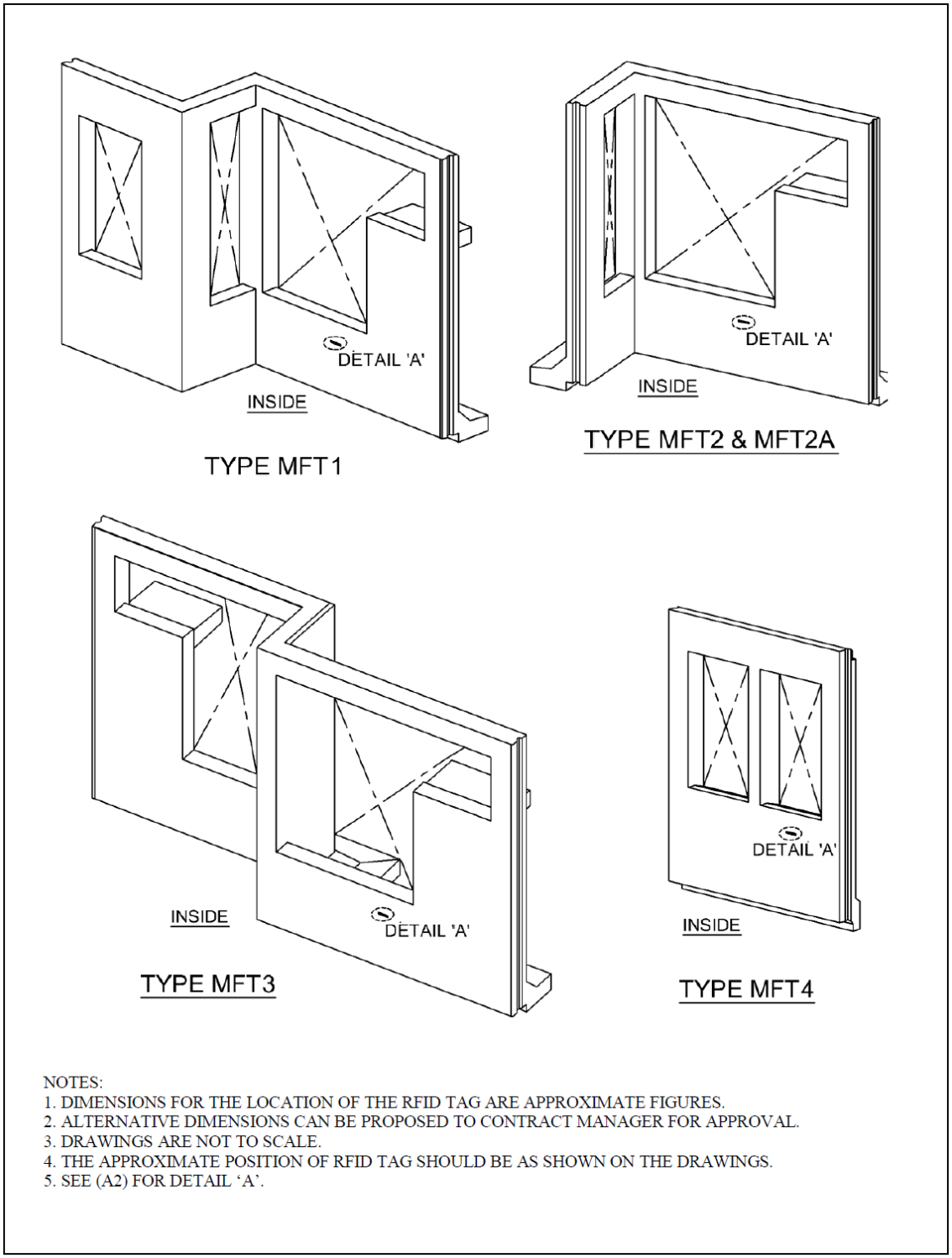
APPENDIX COM11/VII

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM

COM11.APPEND7.9 LOCATIONS OF RFID TAGS

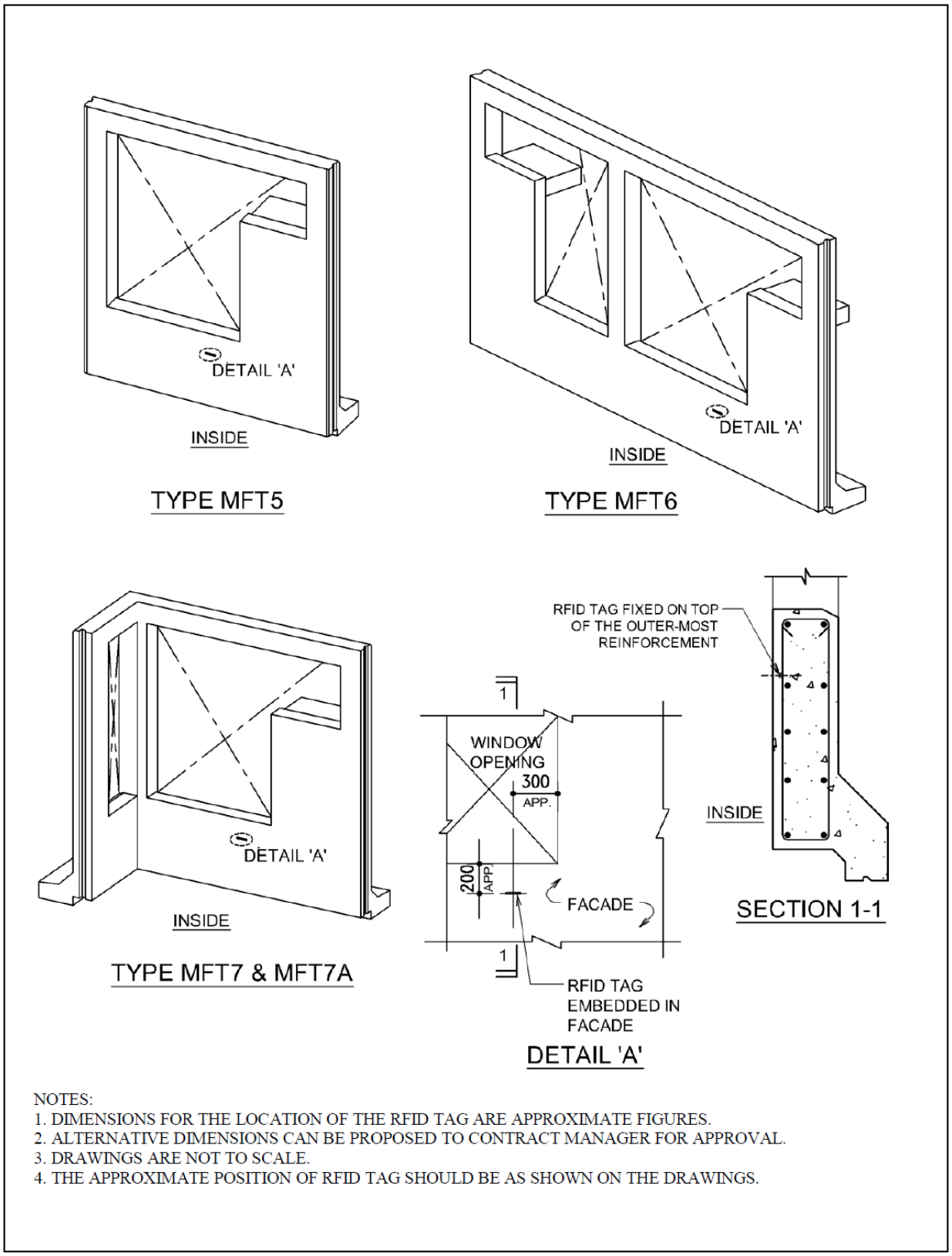
Location of RFID Tags:

(A1) Precast Facade



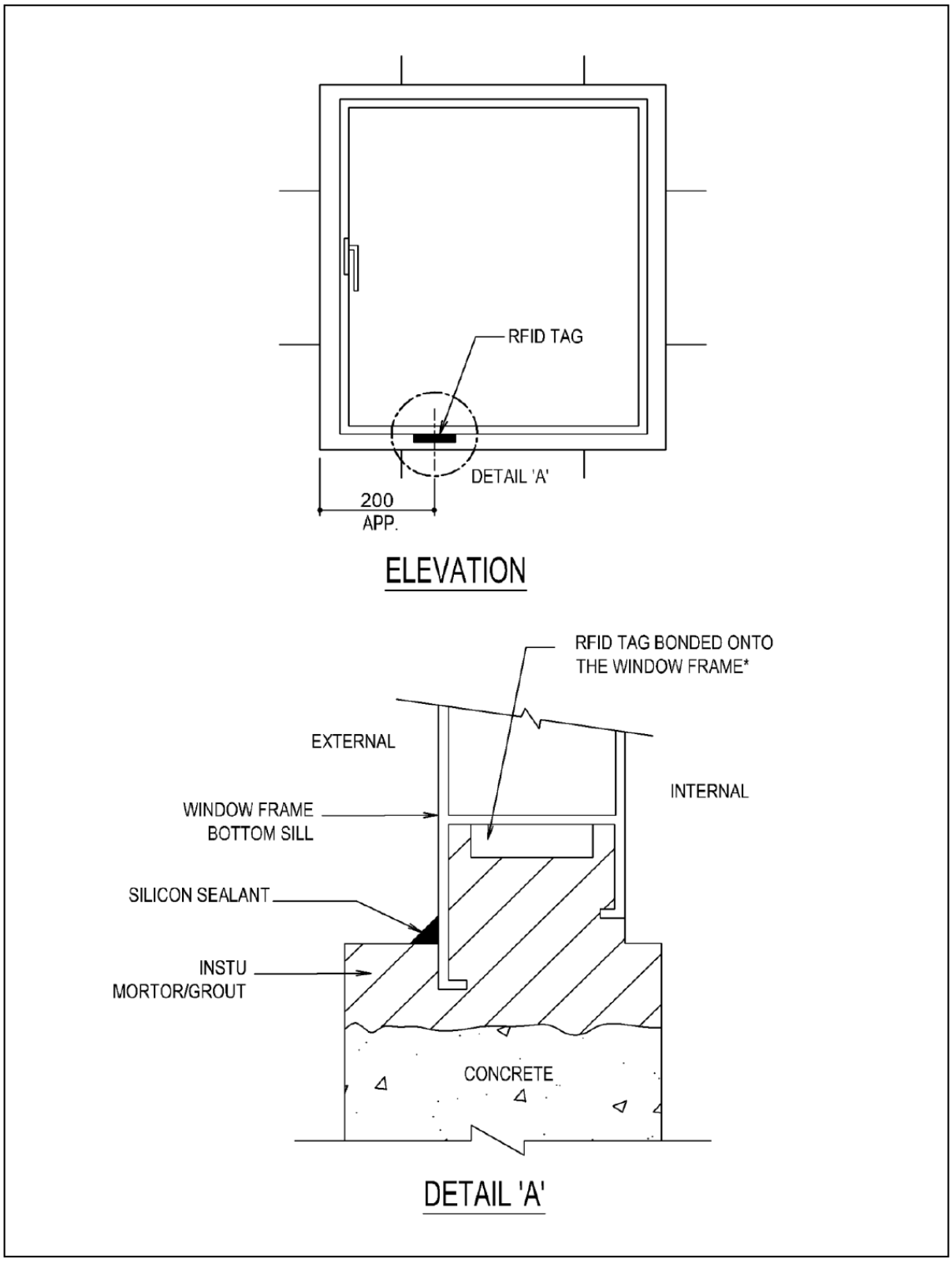
NOTES:
1. DIMENSIONS FOR THE LOCATION OF THE RFID TAG ARE APPROXIMATE FIGURES.
2. ALTERNATIVE DIMENSIONS CAN BE PROPOSED TO CONTRACT MANAGER FOR APPROVAL.
3. DRAWINGS ARE NOT TO SCALE.
4. THE APPROXIMATE POSITION OF RFID TAG SHOULD BE AS SHOWN ON THE DRAWINGS.
5. SEE (A2) FOR DETAIL 'A'.

Location of RFID Tags:
(A2) Precast façade



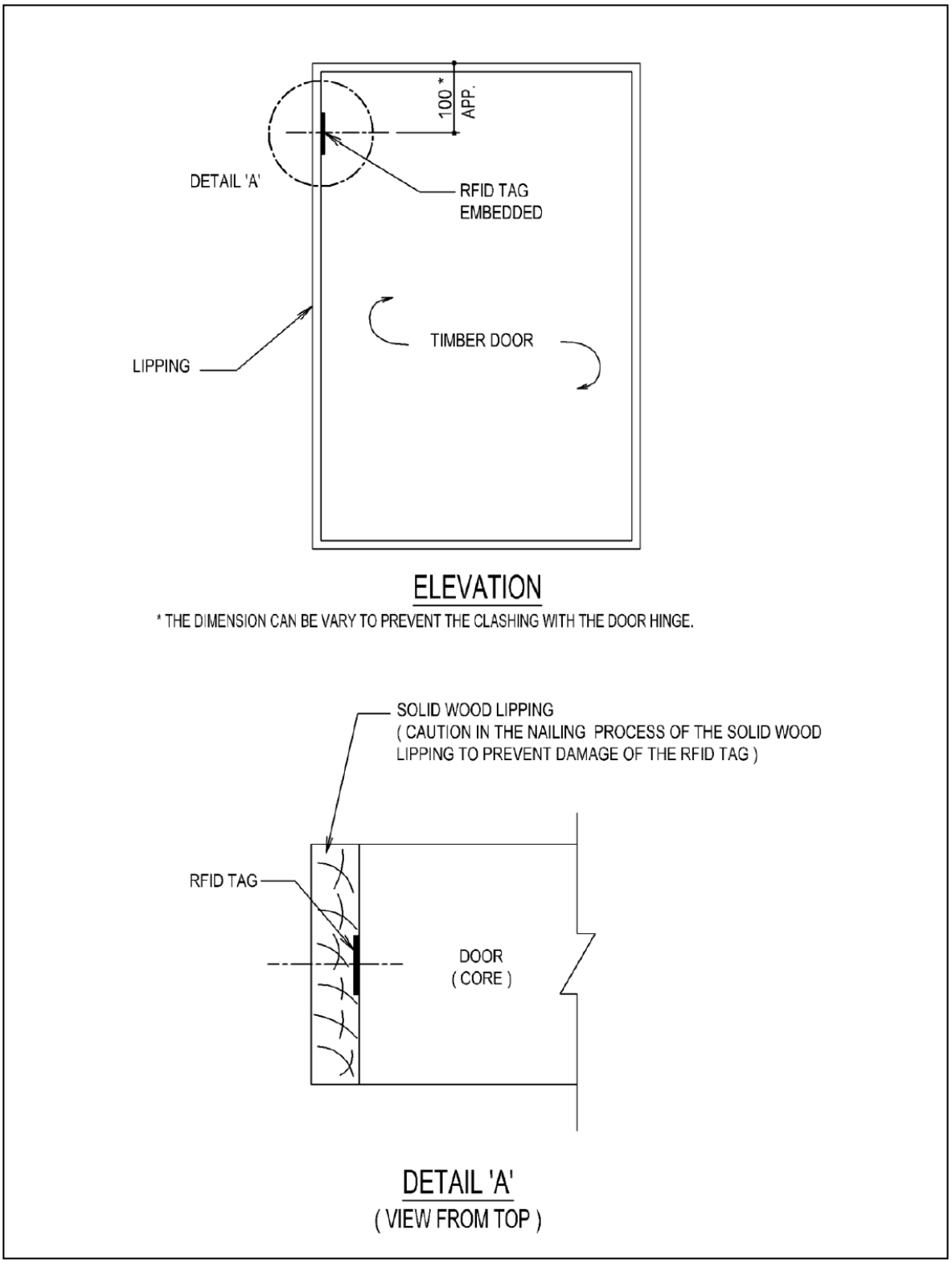
NOTES:
1. DIMENSIONS FOR THE LOCATION OF THE RFID TAG ARE APPROXIMATE FIGURES.
2. ALTERNATIVE DIMENSIONS CAN BE PROPOSED TO CONTRACT MANAGER FOR APPROVAL.
3. DRAWINGS ARE NOT TO SCALE.
4. THE APPROXIMATE POSITION OF RFID TAG SHOULD BE AS SHOWN ON THE DRAWINGS.

Location of RFID Tags:
(B) Aluminum Window

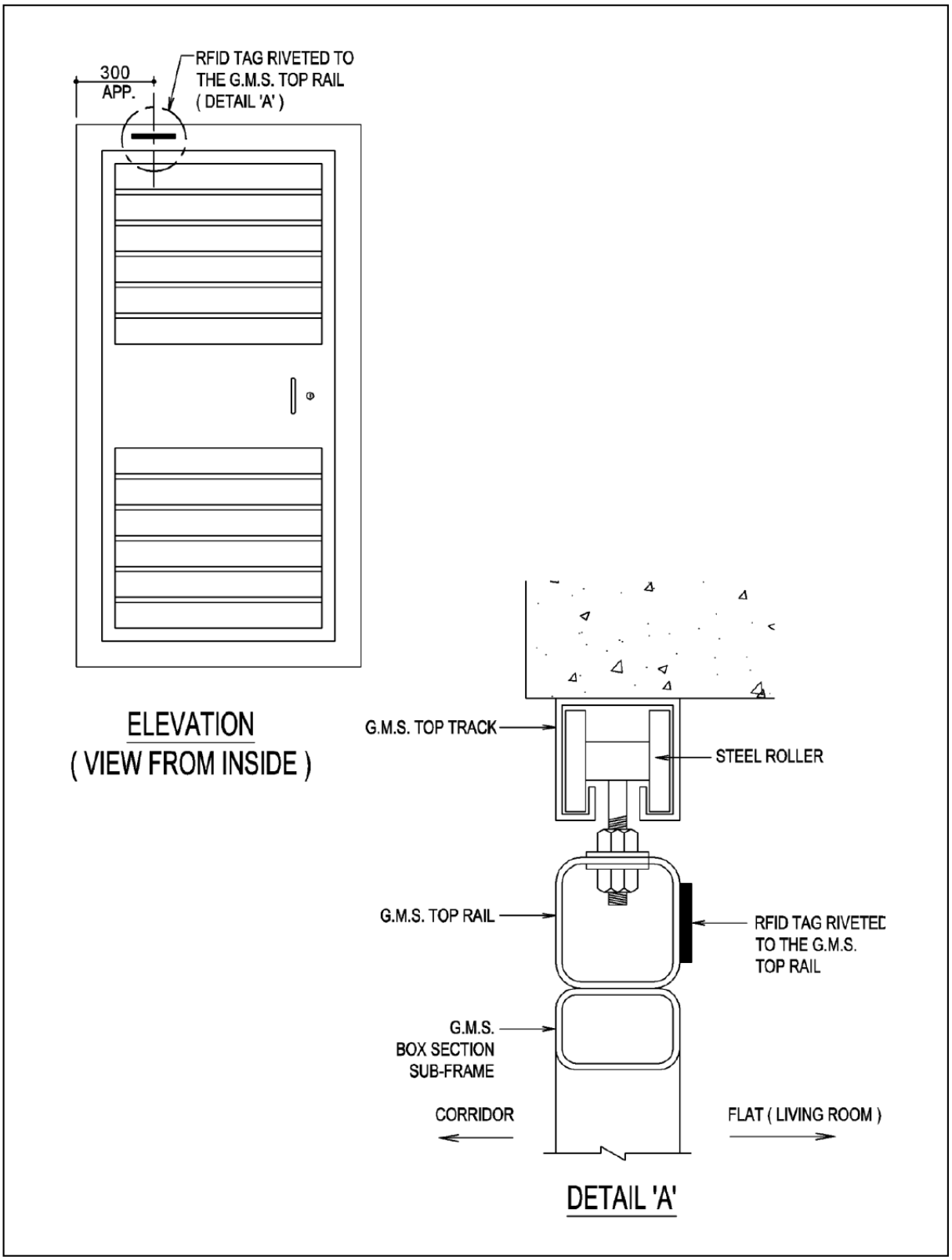


Location of RFID Tags:

(C) Timber Door

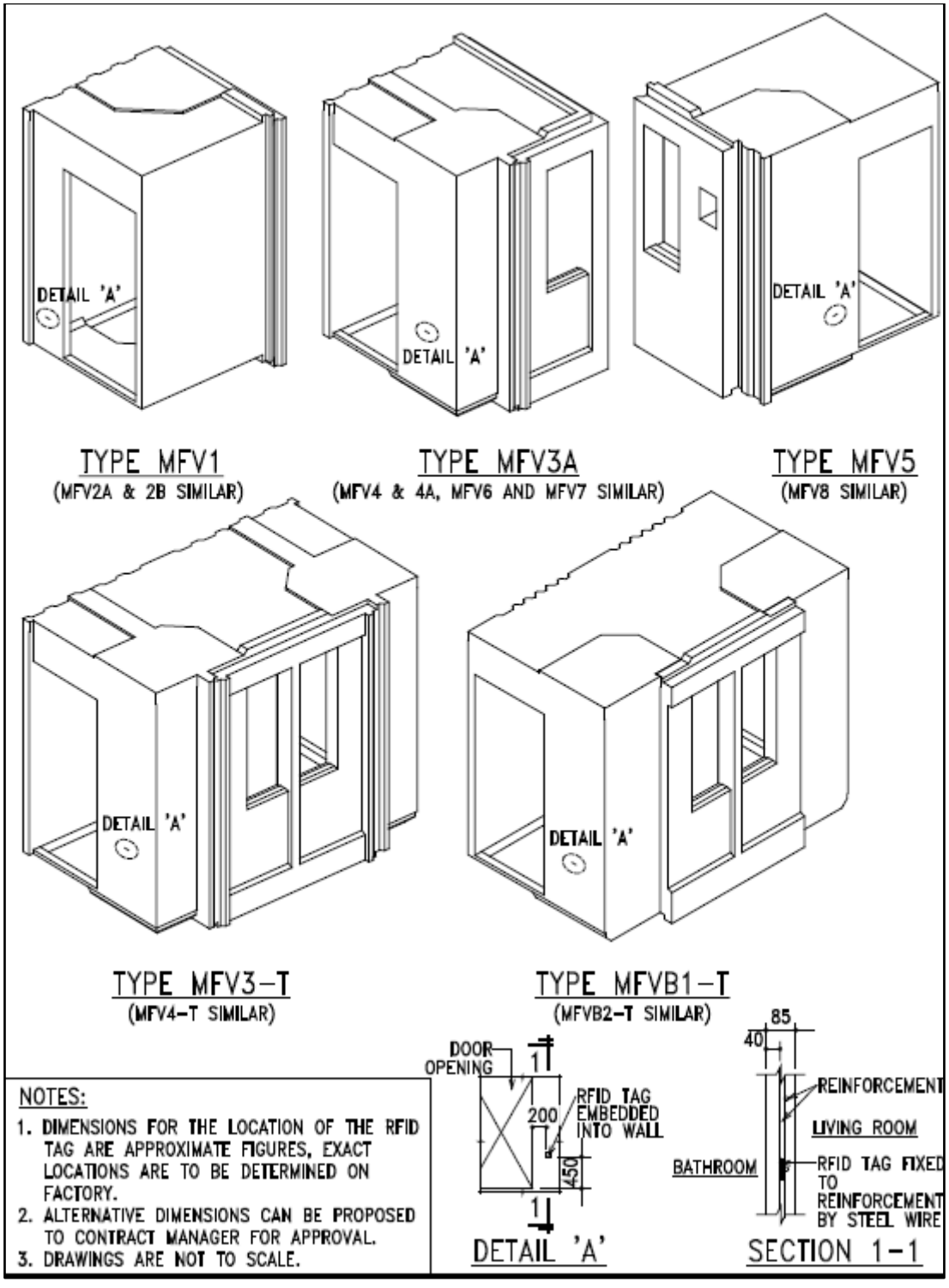


Location of RFID Tags:
(D) Metal Gateset

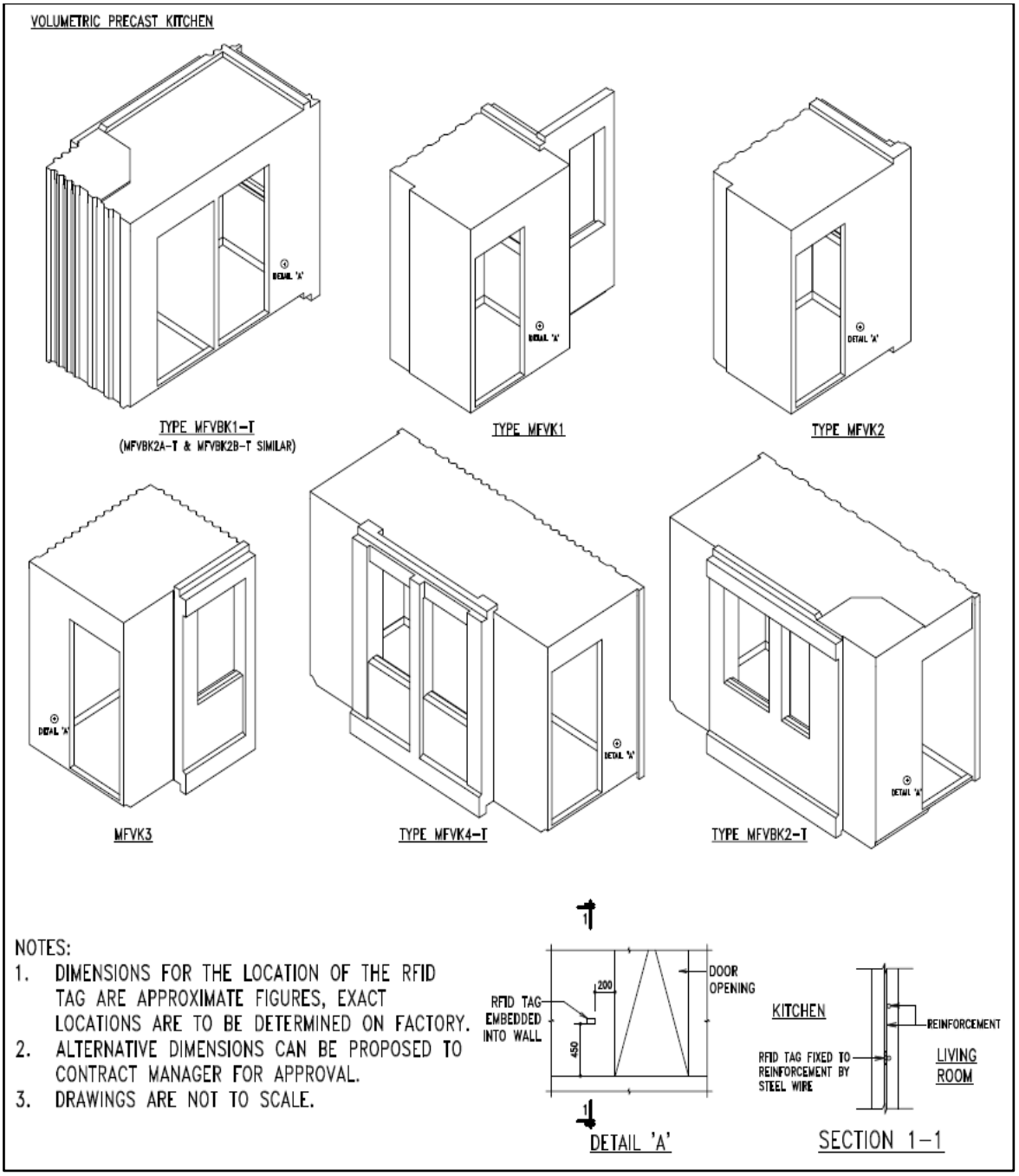


Location of RFID Tags:

(E) Volumetric Precast Bathroom



Location of RFID Tags:
(F) Volumetric Precast Kitchen



APPENDIX COM11/VIII

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM

COM11.APPEND8.9 RFID TAG STRUCTURE

The encoding structure for data to be stored in RFID tags should be as follows:

Unique Tag Identifier (TID) assigned by Tag Manufacturer (Unalterable)	User-defined Serial Number – RFID Tag Number stored in the form of Electronic Product Code (EPC) (Write-protected)						User Information (Write-protected)
	Company Prefix			Individual Asset Reference			
	MC Prefix	Version	Reserved	Product ID	Contract Number	Building Component (B.C.) System Serial Number	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	

e.g.

RFID Tag Number stored in the form of EPC in hexadecimal: **<u>341800230101171234000001</u>**

34180	02	3	0	101	171234	000001
	(i)	(ii)	(iii)	(iv)	(v)	(vi)

Unique Tag Identifier (TID): Each RFID Tag shall have a unique TID assigned by Tag manufacturer. The TID must be unique for the same manufacturer. This TID is unalterable. At least 20-bit shall be provided.

User-defined Serial Number: The user-defined serial number is a GIAI number in accordance with GS1 EPC GIAI-96 standard and shall be used as the RFID tag number. The GIAI number shall be stored in EPC number area in the form of Electronic Product Code. The GIAI number shall comprise of company prefix and individual asset reference of which at least 82-bit shall be provided. The user-defined serial number should be at the beginning blocks of the EPC memory for tags with more than 96-bit memory.

Company Prefix: Company prefix shall comprise the data of MC prefix , version and memory reserved for future extension.

MC Prefix (i): The MC prefix shall denote the Contractor. The coding number of the Contractor shall be in accordance with the information provided by the CM. At least 8-bit shall be provided.

Version (ii): The version of EPC scheme shall be defined by the Contractor. At least 4-bit shall be provided.

Reserved (iii): At least 4-bit reserved memory shall be provided for future extension.

Individual Asset Reference:	Individual asset reference shall comprise the data of product ID and serial number in system of the building component.
Product ID (iv):	The product ID shall denote the type of building components. The coding number of the type of building components shall be in accordance with the information provided by the CM. At least 10-bit shall be provided.
Contract Number (v):	The HA's Contract Number in the RFID web-based system. For example, Contractor Number 20171234 will be shown as 171234 in the RFID Tag Number. At least 24-bit shall be provided.
B.C. System Serial Number (vi):	A serial number shall be defined and assigned by the Contractor or the building components manufacturer for each building component to be used in the Contract. The serial number shall not be repeated. At least 24-bit shall be provided.
User Information:	The information specified in APPENDIX COM11/I to /V including Contract Number, Contractor and Type of Building Component shall be stored in the user memory in the following sequence:

e.g.

User Information: 20171234-ABCDEFG-PCF

20171234 – ABCDEFG – PCF

(1) (2) (3)

(1) HA's Contract Number (Maximum 8 characters)

(2) Name of the Contractor (Maximum 7 characters) * Abbreviation shall be in accordance with the information provided by the CM

(3) Type of Building Components (Maximum 3 characters)

* e.g.
- PCF for Precast Façade
- ALW for Aluminium Window
- TID for Timber Door
- MEG for Metal Gateset
- VBK for Volumetric Precast Bathroom and / or Volumetric Precast Kitchen

Remarks:

(i) Each data field shall be separated by dash " – " or a space.

APPENDIX COM11/IX

FIELD TRIAL AND SYSTEM ACCEPTANCE TEST OF RFID SYSTEM

COM11.APPEND9.9RFID ALERT FUNCTION

1. Data Accuracy Alert: The system shall issue alert to RFID Project Coordinator for follow-up action when the following situations are triggered (the following criteria can be set as default and can be altered subject to the CM's agreement):
   a. Missing entries in certain conditions:
      i. Whenever the Manufacturing / Casting Date is input according to COM11.APPEND1 to COM11.APPEND5, any missing entries listed below shall automatically trigger Alert Category I:

	Entry Name according to COM11.APPEND1 to COM11.APPEND5
(1)	Type of Building Component
(2)	Tag Identifier (TID)
(3)	RFID Tag No.
(4)	Contract Number
(5)	Contract Description
(6)	Contractor
(7)	Manufacturer
(8)	Manufacturer's Address

      ii. Whenever the Delivery Date is input according to COM11.APPEND1 to COM11.APPEND5, any missing entries listed below shall automatically trigger Alert Category II:

	Entry Name according to COM11.APPEND1 to COM11.APPEND5
(1)	Serial No of Building Component

      iii. Whenever any of latter workflow checkpoint's data field according to the sequence stated in sub-clause (b)(i) below is input but the former one is missing, the system shall automatically trigger Alert Category III.
   b. Doubtful timestamps: Alert Category IV shall be automatically triggered if the following situations happen:
      i. Reverse timestamp: Whichever two of the following dates have been input according to COM11.APPEND1 to COM11.APPEND5, the occurrence of improper date reversing the latter sequence:

Sequence	Entry Name
Precast Concrete Facade according to COM11.APPEND1	
(1)	RS Inspection Date
(2)	Casting Date
(3)	Delivery Date
(4)	Site Arrival Date

(5)	Installation Date
Sequence	Entry Name
Aluminium Window according to COM11.APPEND2	
(1)	Manufacturing Date
(2)	Delivery Date
(3)	Site Arrival Date
(4)	Installation Date
Timber Door according to COM11.APPEND3	
(1)	Manufacturing Date
(2)	Delivery Date
(3)	Site Arrival Date
(4)	Installation Date
Metal Gateset according to COM11.APPEND4	
(1)	Manufacturing Date
(2)	Delivery Date
(3)	Site Arrival Date
(4)	Installation Date
Volumetric Precast Bathroom (VPB) and / or Volumetric Precast Kitchen (VPK) according to COM11.APPEND5	
(1)	RS Inspection Date
(2)	Casting Date 1
(3)	Casting Date 2*
(4)	Waterproofing Installation Date
(5)	Delivery Date
(6)	Site Arrival Date
(7)	Installation Date

* Applicable if casting of VPB and / or VPK are separated in two days.

ii. Unreasonable timestamp: Whichever the following dates have been input according to COM11.APPEND1 to COM11.APPEND5 and if they are the same:

Group	the dates in the same Group below shall not be the same
Precast Concrete Facade according to COM11.APPEND1	
(1)	Casting Date & Delivery Date
(2)	Site Arrival Date & Installation Date
Aluminium Window according to COM11.APPEND2	
(1)	Manufacturing Date & Delivery Date
(2)	Site Arrival Date & Installation Date
Group	the dates in the same Group below shall not be the same

Timber Door according to COM11.APPEND3	
(1)	Manufacturing Date & Delivery Date
(2)	Site Arrival Date & Installation Date
Metal Gateset according to COM11.APPEND4	
(1)	Manufacturing Date & Delivery Date
(2)	Site Arrival Date & Installation Date
Volumetric Precast Bathroom (VPB) and / or Volumetric Precast Kitchen (VPK) according to COM11.APPEND5	
(1)	Casting Date 1 & Casting Date 2*
(2)	Casting Date 1 (or Casting Date 2*) & Waterproofing Installation Date
(3)	Waterproofing Installation Date & Delivery Date
(4)	Site Arrival Date & Installation Date

* Applicable if casting of VPB and / or VPK are separated in two days.

iii. Unreasonable long period: If the Delivery Date and Site Arrival Date have been input according to COM11.APPEND1 to COM11.APPEND5 and if they lapse more than 7 days.

2. Reporting System:
   a. Data Accuracy Alerts to RFID Project Coordinator:
      i. In case the situation mentioned in sub-clause (1) above is triggered, the system automatically generates email of alert sending to RFID Project Coordinator's delegated email address for follow-up actions;
      ii. The email of alert shall contain the list of inaccurate cases generated by the system the date before the issuance of email of alert;
      iii. The list of the inaccurate cases reported shall be provided in excel format as attachment to the email of alert. The details of the subject building component as indicated in COM11.APPEND1 to COM11.APPEND5 and information triggering the alert shall be shown.
   b. Alert Summary Report for Outstanding Inaccurate Cases:
      i. The system can allow RFID Project Coordinator or authorized users to generate an Alert Summary Report which show and preview the up-to-date outstanding inaccurate cases;
      ii. The Alert Summary Report shall be provided in excel format. The details of the subject building component as indicated in COM11.APPEND1 to COM11.APPEND5, total number of each type of building component tagged, total number of each type of building component offending inaccurate cases and the breakdown of each type of Alert Category shall be shown.

APPENDIX COM11/X

COM11.APPEND10.9 RFID DEVICE REQUIREMENTS

The RFID tags and RFID readers shall meet the following requirements:

Part	Requirement
Hard Tag	
Standards supported	UHF EPC Class 1 Gen 2 compatible
Memory	≥ 96 bit EPC
Read range (Note 1)	Inside concrete at least 40cm Aluminum window frame inside concrete at least 5cm On timber door at least 15cm On metal gateset at least 20cm
Ingress Protection (IP) Rating	IP67 or above according to IEC 60529 (not applicable to RFID tag for timber door)
RFID Reader	
Standard supported / Air Interface Protocol	UHF EPC Class 1 Gen 2 (ISO 18000-6C) protocol
Frequency	902 – 928 MHz – FCC (US)
Nominal Read Range[1]	Up to 3m
Nominal Write Range	Up to 1m
Field	150° forward facing (approx.) measured from front of device
Operating system	Win CE or Android
Internal Memory	Minimum 256 MB RAM / 4GB iNAND Flash
External Storage	Support up to 32GB Memory Card
Wireless LAN	IEEE802.11b/g
Ingress Protection (IP) Rating	IP64 according to IEC 60529
Embedded Antenna	
Polarization	Circularly polarized (R.H.C.P);
Handheld Program (Supplied by Device Manufacturer)	
UHF Module Testing Software	Able to read User Memory and to display User Memory in character format

Note 1 Read range depends on the tag IC, used frequency band, tagged object, reader configuration, reader power, and the environmental conditions (moisture content, temperature, etc.)

COM12 PLASTIC FOLDING DOORS

MATERIALS

PLASTIC FOLDING DOORS

COM12.M010.9 PLASTIC FOLDING DOORS

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed plastic folding door for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name / model name and job reference of the product;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Shop drawings and installation methods.
   b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for the CM's information:
      i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to the CM's consideration on the track records as maintained by the Housing Department;
      ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material to Site;
      iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
2. Quality Requirements:
   a. Extruded plastic folding doors of robust design and smooth sliding and folding operation shall comprise of the following:
      i. Double ply door leaves with rigid joint;
      ii. Caps at top and bottom of door leaves and stiles;
      iii. Vertical twin rollers securely connected to the door leaves. For leading door leaf, two nos. vertical twin rollers shall be provided;
      iv. Plastic top rail;
      v. Closure channel for lead side and closure channel with hooks for end side;
      vi. Magnetic catch;
      vii. Plastic lock with plastic or corrosion resisting metal latch and with door handles on both sides. The lock shall be operated from inside bathroom without key. In case of emergency, the lock can be released by coin operated emergency bolt action or similar operation from outside.
   b. The quality and performance requirements are as follows:

Items	Test Method	Acceptance Standards
Endurance Test	To move the plastic folding door repeatedly backwards and forwards over a distance equal to at least 90% of the full travel distance of the plastic folding door from the closed position for 60,000 cycles with 7 second per cycle. The operation rest for one hour at 5,000 cycle interval.	No damage, crack, deformation and serious wear and tear

WORKMANSHIP

PLASTIC FOLDING DOORS

COM12.W010.9 PLASTIC FOLDING DOORS

1. Install the plastic folding doors in accordance with manufacturers' instructions;
2. The clear door width shall not be less than 750 mm after the installation of the plastic folding door.

TESTING

SURVEILLANCE TESTS

COM12.T010.A SURVEILLANCE TESTS FOR PLASTIC FOLDING DOORS

1. Testing Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM.
2. Testing Samples:
   a. Provide one set of test sample from the batch of material delivered to Site;
   b. One set of test sample shall consist of one plastic folding door. Sample shall consist of the complete set of components as to be installed to ensure normal operation. Bear all cost for any replacement of samples.
3. Testing methods:
   a. As per COM12.M010 (2)(b).
4. Non-compliance:
   a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch off Site; or
      ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) above in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case any one sample fails the re-test, remove the representative batch off Site.
   b. When the representative batch of plastic folding doors is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) above in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
   c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

FIN FINISHINGS

FIN1 PLASTERED AND RENDERED FINISHES 18

MATERIALS 18

CEMENT AND LIME 18

FIN1.M010.9 CEMENT 18
FIN1.M020.9 LIME 19
FIN1.M030.9 LIME PUTTY 20

GYPSUM PLASTERS 20

FIN1.M110.9 UNDERCOAT FOR SOLID BACKGROUNDS 20
FIN1.M120.9 UNDERCOAT FOR METAL LATHING 20
FIN1.M130.9 FINISH COAT 20

ACOUSTIC PLASTER 20

FIN1.M210.9 ACOUSTIC PLASTER 20

WATER 22

FIN1.M310.A WATER 22

AGGREGATES 22

FIN1.M402.9 SAND GENERALLY 22
FIN1.M405.9 MANUFACTURED SAND 22
FIN1.M410.9 SAND OTHER THAN MANUFACTURED SAND 27
FIN1.M420.9 GRADING OF SAND FOR MIXES WITHOUT LIME 27
FIN1.M430.9 GRADING OF SAND FOR MIXES WITH LIME 28
FIN1.M440.9 EXPOSED AGGREGATE RENDER/SHANGHAI PLASTER 28
FIN1.M450.9 PAPER PULP 28
FIN1.M460.9 READY-MIXED (DRY) MORTARS AND READY-TO-USE (WET) MORTARS FOR RENDERING AND PLASTERING 28

RENDERS 31

FIN1.M510.9 UNDERCOATS GENERALLY 31
FIN1.M520.9 RENDERS FOR TILE AND MOSAIC FINISHES 31
FIN1.M530.9 FINISH COAT FOR INTERIOR PAINT FINISHES 31
FIN1.M540.9 FINISH COAT FOR EXTERIOR PAINT FINISHES 31
FIN1.M550.9 FINISH COAT FOR EXPOSED AGGREGATE RENDER/SHANGHAI PLASTER 31
FIN1.M560.9 PFA IN CEMENTITIOUS RENDERS 31

LIME PLASTERS 31

FIN1.M610.9 UNDERCOATS FOR SOLID BACKGROUNDS 31
FIN1.M620.9 UNDERCOATS FOR METAL LATHING 32
FIN1.M630.9 FINISHING COAT 32
FIN1.M640.9 PAPER PULP PLASTER 32

SPECIALIST RENDERS 32

FIN1.M710.9 DECORATIVE FINISHES 32

ADMIXTURES FOR CEMENTITIOUS RENDERS 32

FIN1.M810.9 GENERAL 32
FIN1.M820.9 PIGMENTS FOR PORTLAND CEMENT AND PORTLAND CEMENT PRODUCTS 32
FIN1.M830.A ACCELERATING ADMIXTURES 32
FIN1.M840.A RETARDING ADMIXTURES 32
FIN1.M850.A WATER REDUCING ADMIXTURES 32
FIN1.M860.A SUPERPLASTICISERS 32
FIN1.M870.A WATER RESISTING ADMIXTURE 32
FIN1.M880.9 WATER RESISTING ADMIXTURE FOR TANKS FOR POTABLE WATER 32

ANCILLARY MATERIALS 33
FIN1.M910.9 SPATTERDASH 33
FIN1.M920.9 BONDING AGENT 33
FIN1.M930.A PLAIN EXPANDED METAL LATHING 33
FIN1.M940.A RIBBED EXPANDED METAL LATHING 33
FIN1.M950.9 BEADS AND STOPS 33
FIN1.M970.9 WIRE NETTING 33
FIN1.M980.9 STAPLES 34
FIN1.M990.9 TYING WIRE 34
FIN1.M995.9 COMPRESSIBLE JOINT FILLER 34

WORKMANSHIP 35
GENERAL 35
FIN1.W010.9 STANDARD 35
FIN1.W020.9 CONSTRUCTION MOCK-UP 35
FIN1.W030.9 READY-MIXED (DRY) MORTAR AND READY-TO-USE (WET) MORTAR FOR PLASTERING AND RENDERING APPLICATION 35
FIN1.W040.9 MOVEMENT JOINTS 35
FIN1.W050.9 HANDLING AND STORAGE OF GYPSUM PLASTERS 35
FIN1.W060.9 ADMIXTURES 35
BACKGROUND PREPARATION FOR PLASTER AND RENDERING 35
FIN1.W110.9 GENERAL 35
FIN1.W120.9 CONCRETE BACKGROUNDS GENERALLY 36
FIN1.W130.9 PREPARING HARDENED CONCRETE TO RECEIVE CEMENTITIOUS RENDERS 36
FIN1.W140.9 PREPARING HARDENED CONCRETE TO RECEIVE GYPSUM PLASTERS 36
FIN1.W150.9 JUNCTIONS BETWEEN DISSIMILAR SOLID BACKGROUNDS 36
FIN1.W160.9 JUNCTIONS BETWEEN PANEL WALL PARTITIONS AND OTHER BACKGROUNDS 36
FIN1.W170.9 DUBBING OUT 36
APPLYING SPATTERDASH TO NEW CONCRETE 36
FIN1.W210.9 APPLYING SPATTERDASH 36
FIN1.W240.9 JOINT INSPECTION TO SPATTERDASH 37
FIXING STEEL LATHING 37
FIN1.W310.9 FIXING METHODS 37
FIN1.W320.9 LAPS 37
FIN1.W330.9 CUT ENDS 37
MIXING PLASTERS AND RENDERS 37
FIN1.W410.9 GAUGE BOXES 37
FIN1.W420.9 MIXING RENDERS 37
FIN1.W430.9 MIXING GYPSUM PLASTERS 38
FIN1.W440.9 LIMITS ON USE OF MIXED MATERIAL 38
FIN1.W450.9 USE OF SUPERPLASTICIZERS 38
APPLYING RENDER 38
FIN1.W510.9 KEYING UNDERCOATS 38
FIN1.W520.9 RENDER FOR TILE OR MOSAIC FINISH 38
FIN1.W530.9 RENDER FOR PAINT FINISH 39
FIN1.W540.9 WATERPROOF RENDERING FOR STANDARD DOMESTIC 39
FIN1.W550.9 EXPOSED AGGREGATE RENDER/SHANGHAI PLASTER 39
APPLYING LIME PLASTERS 39
FIN1.W610.9 KEYING UNDERCOATS 39
FIN1.W620.9 SOLID BACKGROUNDS 39

FIN1.W630.9 METAL LATHING INTERNALLY 39
FIN1.W640.9 EXTERNAL ANGLES 40
APPLYING GYPSUM PLASTER 40
FIN1.W710.9 KEYING UNDERCOATS 40
FIN1.W720.9 SOLID BACKGROUNDS 40
FIN1.W730.9 METAL LATHING 40
ARRISES, BEADS, STOPS AND CORNICES 40
FIN1.W810.9 ARRISES 40
FIN1.W820.9 FIXING BEADS AND STOPS 40
FIN1.W830.9 CORNICES 40
SURFACE FINISHES 40
FIN1.W905.9 GENERAL 40
FIN1.W910.9 SMOOTH FINISH 40
FIN1.W920.9 WOOD FLOAT FINISH 40
FIN1.W930.9 TEXTURED FINISH 41
FIN1.W940.9 ROUGH CAST FINISH 41
FIN1.W950.9 MACHINE APPLIED, TEXTURED FINISH 41
ACOUSTIC PLASTER 41
FIN1.W1010.9 MIXING AND APPLYING 41
SPECIALIST RENDERS 41
FIN1.W1110.9 APPLICATION 41
DRYING OUT AND CURING 41
FIN1.W1210.9 UNDERCOATS 41
FIN1.W1220.9 PREMATURE DRYING 41
ACCURACY AND TOLERANCES 41
FIN1.W1310.9 GENERAL 41
PROTECTION AND CLEANLINESS 41
FIN1.W1410.9 PROTECTION OF EXISTING WORK 41
FIN1.W1420.9 PROTECTION OF NEW FINISHES 41
FIN1.W1430.9 CLEANLINESS 42
TESTING 43
SURVEILLANCE TESTS 43
FIN1.T010.A SURVEILLANCE TESTS FOR READY-MIXED (DRY) MORTA FOR PLASTERING AND RENDERING 43
FIN2 PLASTERBOARD 44
MATERIALS 44
PLASTERBOARD 44
FIN2.M005.9 SUBMISSIONS 44
FIN2.M010.9 GYPSUM PLASTERBOARD 44
STUDDING 44
FIN2.M110.9 TIMBER STUDDING 44
FIN2.M120.9 STEEL STUDDING 44
FIRE RATED BOARDS 45
FIN2.M130.9 FIRE RESISTANCE RATED ENCLOSURE SYSTEM 45
FIXING AND JOINTING MATERIALS 47
FIN2.M210.9 NAILS FOR FIXING PLASTERBOARD 47
FIN2.M220.9 JOINT REINFORCEMENT 47
FIN2.M230.9 BEADS AND STOPS 47
FIN2.M240.9 SCREWS FOR FIXING TO STEEL STUDDING 47

FINISHING PLASTER **47**
FIN2.M310.9 BOARD FINISH PLASTER 47

WORKMANSHIP **48**

HANDLING AND STORAGE **48**
FIN2.W010.9 PLASTERBOARD 48
FIN2.W020.9 GYPSUM PLASTER 48

FIXING PLASTERBOARD **48**
FIN2.W110.9 GENERAL 48
FIN2.W120.9 FIXING TO TIMBER BEARERS 48
FIN2.W130.9 FIXING TO STEEL STUDDING 48
FIN2.W140.9 JOINTING 48
FIN2.W150.9 ACCURACY AND TOLERANCES 48

FINISHING **49**
FIN2.W210.9 PREPARATION 49
FIN2.W220.9 APPLYING BOARD FINISHING PLASTER 49
FIN2.W230.9 FIXING BEADS AND STOPS 49
FIN2.W240.9 ARRISES 49
FIN2.W250.9 PROTECTION 49

FIN3 SCREEDS **50**

MATERIALS **50**

GENERAL **50**
FIN3.M010.9 STANDARDS 50

CEMENT AND AGGREGATES **50**
FIN3.M110.9 CEMENT 50
FIN3.M120.A PFA IN SCREED MIXES 50
FIN3.M130.9 SAND GENERALLY 50
FIN3.M140.9 GRADING OF SAND FOR SCREEDS 50
FIN3.M150.9 LIGHTWEIGHT AGGREGATES 50
FIN3.M160.9 COARSE AGGREGATE FOR SCREEDS 48 MM THICK AND OVER 50
FIN3.M170.9 READY-MIXED (DRY) MORTARS AND READY-TO-USE (WET) MORTARS FOR SCREEDS 50

WATER **52**
FIN3.M210.9 WATER 52

SCREEDS **53**
FIN3.M310.9 SCREEDS BETWEEN 25 MM AND 48 MM THICK 53
FIN3.M320.9 SCREEDS 48 MM THICK AND OVER 53
FIN3.M330.9 LIGHTWEIGHT AGGREGATE SCREEDS FOR ROOFS 53
FIN3.M340.9 LIGHTWEIGHT AGGREGATE SCREEDS FOR FLOORS 53
FIN3.M350.9 AIR ENTRAINED SCREEDS 53
FIN3.M360.9 TOPPING FOR LIGHTWEIGHT SCREEDS 53

ANCILLARY MATERIALS **53**
FIN3.M410.A ADMIXTURES 53
FIN3.M420.9 BONDING AGENT 53
FIN3.M430.A AIR ENTRAINING ADMIXTURE FOR LIGHTWEIGHT SCREEDS 53
FIN3.M440.9 VAPOUR BARRIER 53
FIN3.M450.9 MOVEMENT JOINTS 53
FIN3.M460.9 WATER RESISTING ADMIXTURE 53
FIN3.M470.9 WATER RESISTING ADMIXTURE FOR TANKS FOR POTABLE WATER 53

SELF-LEVELLING SCREEDS **54**
FIN3.M510.N POLYURETHANE RESIN / EPOXY RESIN SELF-LEVELLING SCREEDS 54
FIN3.M520.N CEMENTITIOUS SELF-LEVELLING SCREEDS 55

WORKMANSHIP **57**
BASE PREPARATION **57**
FIN3.W010.9 GENERAL 57
FIN3.W020.9 PREPARATION OF HARDENED OR EXISTING CONCRETE 57
MIXING SCREED MORTARS **57**
FIN3.W110.9 GENERAL 57
FIN3.W120.9 MIXING 57
FIN3.W130.9 LIMITS ON USE OF MIXED MATERIAL 57
FIN3.W140.9 READY-MIXED MORTARS AND READY-TO-USE MORTARS FOR SCREEDS 57
THICKNESSES OF SCREEDS **58**
FIN3.W210.9 BONDED TO HARDENED CONCRETE 58
FIN3.W220.9 UNBONDED 58
FIN3.W230.9 FLOATING SCREEDS 58
FIN3.W240.9 LIGHTWEIGHT SCREEDS 58
FIN3.W250.9 TOPPING FOR LIGHTWEIGHT SCREEDS 58
LAYING SCREEDS **58**
FIN3.W310.9 GENERAL 58
FIN3.W320.9 MECHANICAL APPLICATION 58
FIN3.W330.9 LAYING SCREEDS 58
FIN3.W336.9 VERIFICATION OF BONDED SCREED 59
FIN3.W340.9 LAYING LIGHTWEIGHT SCREEDS 59
FIN3.W345.N POLYURETHANE RESIN / EPOXY RESIN SELF-LEVELLING SCREEDS 59
FIN3.W350.9 VAPOUR BARRIER 59
FIN3.W360.9 ADMIXTURES 59
FINISHES **59**
FIN3.W410.9 GENERAL 59
FIN3.W420.9 SMOOTH FINISH 59
FIN3.W430.9 WOOD FLOAT FINISH 59
FIN3.W440.9 TEXTURED FINISH 59
FIN3.W450.9 SURFACES FOR FLEXIBLE SHEET AND TILE FINISHES 59
FIN3.W460.9 SCREEDS FOR RIGID TILE AND SLAB TILE FINISHES 60
MOVEMENT JOINTS **60**
FIN3.W510.9 GENERAL 60
FIN3.W520.9 MECHANICAL MOVEMENT JOINTS 60
ROOF SCREEDS PENETRATED BY PIPES **60**
FIN3.W610.9 SCREEDS PENETRATED BY PIPES LESS THAN 50 MM IN DIAMETER 60
DRYING OUT AND CURING **60**
FIN3.W710.9 CURING SCREEDS 60
PROTECTION AND CLEANLINESS **60**
FIN3.W810.9 PROTECTING EXISTING WORK 60
FIN3.W820.9 CLEANLINESS 60
FIN3.W830.9 PROTECTING NEW SCREEDS 60
TOLERANCES **60**
FIN3.W910.9 GENERAL 60

FIN4 INSITU WALL AND FLOOR FINISHES 61

MATERIALS 61

CEMENT 61

FIN4.M010.9 CEMENT 61

AGGREGATES 61

FIN4.M110.9 SAND GENERALLY 61
FIN4.M120.9 GRADING OF SAND 61
FIN4.M130.9 STONE 61
FIN4.M140.9 READY-MIXED MORTARS AND READY-TO-USE MORTARS 61

WATER 61

FIN4.M210.9 WATER 61

MIX PROPORTIONS 61

FIN4.M310.9 CEMENT AND SAND OR GRANITE FINES 61
FIN4.M320.9 GRANOLITHIC 61
FIN4.M330.9 TERRAZZO 62

ANCILLARY MATERIALS 62

FIN4.M410.9 PIGMENTS FOR CEMENT 62
FIN4.M420.9 BONDING AGENT 62
FIN4.M430.9 SURFACE HARDENER 62
FIN4.M440.9 HARDENING ADMIXTURE 62
FIN4.M450.9 METAL DIVIDING STRIP 62
FIN4.M460.9 PLASTIC DIVIDING STRIP 62
FIN4.M470.9 NON-SLIP COMPOUND INSERT 62
FIN4.M480.9 NON-SLIP INSERT STRIPS 63

WORKMANSHIP 64

GENERAL 64

FIN4.W010.9 STANDARD 64
FIN4.W020.9 CONSTRUCTION MOCK-UP 64
FIN4.W030.9 MECHANICAL APPLICATION 64
FIN4.W040.9 MOVEMENT JOINTS GENERALLY 64
FIN4.W050.9 MECHANICAL MOVEMENT JOINTS 64

BASE PREPARATION 64

FIN4.W110.9 GENERAL 64
FIN4.W120.9 JUNCTIONS BETWEEN DISSIMILAR BACKGROUNDS 64
FIN4.W130.9 HARDENED OR EXISTING CONCRETE 64

MIXING MORTARS AS A FINISH 65

FIN4.W170.9 SITE MIX MORTAR 65
FIN4.W180.9 READY-MIXED MORTARS AND READY-TO-USE MORTARS 65

APPLYING FINISHES GENERALLY 65

FIN4.W210.9 ACCURACY AND TOLERANCES 65
FIN4.W220.9 LEVELS AND FALLS 65
FIN4.W225.9 LAYING CEMENT AND SAND OR GRANITE FINES FINISH 65
FIN4.W230.9 FINISHING FLOORING 65
FIN4.W240.9 DIVIDING STRIPS 65
FIN4.W250.9 NON-SLIP COMPOUND INSERT 65
FIN4.W260.9 NON-SLIP INSERT STRIPS 65

APPLYING GRANOLITHIC AND TERRAZZO 65

FIN4.W310.9 THICKNESSES 65
FIN4.W315.9 LAYING GRANOLITHIC FLOOR 66
FIN4.W320.9 COLOURED GRANOLITHIC AND TERRAZZO 66
FIN4.W330.9 TROWELLED FINISH GRANOLITHIC 66

FIN4.W340.9 RUBBED FINISH GRANOLITHIC 66
FIN4.W350.9 WASHED FINISH GRANOLITHIC 67
FIN4.W360.9 APPLYING TERRAZZO 67
APPLYING COLOURED CEMENT AND SAND OR GRANITE FINES 67
FIN4.W410.9 APPLYING TWO COAT COLOURED FINISH 67
DRYING OUT AND CURING 67
FIN4.W510.9 WALL FINISHES 67
FIN4.W520.9 CURING FLOOR FINISHES 67
PROTECTION AND CLEANLINESS 67
FIN4.W610.9 PROTECTION 67
FIN4.W620.9 PROTECTION OF EXISTING WORK 68
FIN4.W630.9 CLEANLINESS 68
FIN4.W640.9 PROTECTING NEW FINISHES 68

FIN5 FLOOR AND WALL TILES AND SLABS 69

GENERAL 69
WALL TILING WORKS IN BUILDINGS OR STRUCTURES 69
FIN5.G010.9 PERFORMANCE REQUIREMENTS 69
FIN5.G020.9 CONTRACTOR'S DESIGN AND BUILD TILE FIXING SYSTEM OF THE WALL TILING WORKS 69
SLIP RESISTANCE REQUIREMENTS 70
FIN5.G050.9 SLIP RESISTANCE OF FLOOR SURFACE MATERIALS 70

MATERIALS 72
GENERAL 72
FIN5.M005.9 SUBMISSION AND DELIVERY VERIFICATION REQUIREMENTS 72
CERAMIC TILES GENERALLY 73
FIN5.M010.9 STANDARD 73
FIN5.M020.9 CONSISTENT SUPPLY 73
FIN5.M030.N CERAMIC TILES COMPOSITION 73
CERAMIC FLOOR TILES 73
FIN5.M110.9 SPECIALS AND SPECIAL FITTING TILES 73
FIN5.M120.9 FLOOR TILES AND NOSING TILES 73
FIN5.M130.9 CLAY QUARRY TILES 74
FIN5.M140.9 NON-SLIP TILES 74
FIN5.M150.9 CANTON TILES 74
FIN5.M160.9 NON-SLIP TACTILE HOMOGENEOUS FLOOR TILES 74
FIN5.M170.9 NON-SLIP HOMOGENEOUS FLOOR TILES 75
CERAMIC WALL TILES 76
FIN5.M210.9 GLAZED CERAMIC WALL TILES 76
FIN5.M220.9 HOMOGENEOUS WALL TILES 77
FIN5.M230.9 EXTERNAL FACING TILES 77
FIN5.M240.9 HOMOGENEOUS COVED SKIRTING TILES 78
CERAMIC AND VITREOUS MOSAIC TILES 79
FIN5.M310.9 GLAZED CERAMIC MOSAIC TILES 79
FIN5.M320.9 UNGLAZED VITREOUS MOSAIC WALL TILES 79
GLASS MOSAIC TILES 79
FIN5.M330.9 GLASS MOSAIC TILES 79
TERRAZZO 81
FIN5.M510.9 TERRAZZO FLOOR TILES 81
NATURAL AND RECONSTITUTED STONE 81
FIN5.M610.9 MARBLE SLABS 81

FIN5.M620.9 GRANITE SLABS ... 81
FIN5.M625.9 MARBLE AND GRANITE WALL TILES ... 82
FIN5.M630.9 NON-SLIP ARTIFICIAL GRANITE AND AGGLOMERATED MARBLE TILES ... 82

CONCRETE TILES ... 82
FIN5.M710.9 CONCRETE FLOOR TILES ... 82

BEDDING AND JOINTING MATERIALS ... 82
FIN5.M810.9 CEMENT ... 82
FIN5.M820.9 WATER ... 82
FIN5.M830.9 SAND GENERALLY ... 82
FIN5.M840.9 GRADING OF SAND ... 82
FIN5.M860.9 CEMENT SLURRY ... 83
FIN5.M865.9 SEMI-DRY MIX ... 83
FIN5.M870.9 MORTAR FOR CEMENT SAND MORTAR BEDDING FIXING ... 83
FIN5.M880.9 BEDDING FOR MARBLE AND GRANITE FLOOR SLABS ... 83
FIN5.M890.9 PLASTERS FOR MARBLE AND GRANITE WALL TILES ... 83
FIN5.M900.9 FIXINGS FOR MARBLE AND GRANITE WALL SLAB ... 83
FIN5.M920.9 POINTING FOR MARBLE AND GRANITE FLOOR SLABS ... 83
FIN5.M930.9 POINTING FOR MARBLE AND GRANITE WALL TILES ... 83
FIN5.M940.9 GROUT FOR FLOOR TILING ... 84
FIN5.M950.9 GROUT FOR MOSAIC TILING ... 84
FIN5.M960.9 GROUT FOR GLAZED WALL TILING ... 84
FIN5.M970.9 GROUT FOR EXTERNAL FACING TILES ... 84
FIN5.M980.9 PROPRIETARY GROUT ... 84
FIN5.M990.9 BONDING AGENT ... 84
FIN5.M995.9 MOVEMENT JOINTS FOR MARBLE AND GRANITE WALL TILES AND FLOOR SLABS ... 84

TILE ADHESIVES AND GROUTING ... 84
FIN5.M1010.A TILE ADHESIVES AND TILE GROUT ... 84
FIN5.M1020.9 EPOXY BASED TILE ADHESIVE ... 91

CEMENT SAND MORTAR WITH LATEX ... 91
FIN5.M1050.9 CEMENT SAND MORTAR WITH LATEX FOR DIRECT APPLICATION OF TILING ON CONCRETE SURFACES ... 91

ANCILLARY MATERIALS ... 95
FIN5.M1110.9 NON-SLIP SURFACE ... 95
FIN5.M1120.9 MOVEMENT JOINTS FOR CERAMIC AND MOSAIC TILES ... 95

WORKMANSHIP ... 96

GENERAL ... 96
FIN5.W010.9 STANDARD ... 96
FIN5.W020.9 PREPARATION OF CONCRETE SURFACES FOR DIRECT APPLICATION OF TILING ... 96
FIN5.W025.9 CUTTING TILES ... 96
FIN5.W030.9 CLEANLINESS ... 96
FIN5.W040.9 CUT MITRES ETC ... 96
FIN5.W050.9 CONSTRUCTION MOCK-UP ... 96
FIN5.W060.9 TILE JOINT TREATMENT ... 97
FIN5.W070.9 TILING WORKS ADJOINING FRAMES OF TIMBER DOOR AND HOSE REEL CABINETS ... 97

LAYING FLOOR TILES ... 97
FIN5.W120.9 CEMENT : SAND MORTAR BEDDING METHOD ... 97
FIN5.W130.9 CEMENT-BASED ADHESIVE BEDDING METHOD ... 98
FIN5.W140.9 SEMI-DRY METHOD ... 98

FIN5.W150.9 LAYING TACTILE HOMOGENEOUS FLOOR TILES 98
FIN5.W160.9 TRAFFIC ON NEWLY LAID FLOORS 98
FIXING WALL TILES 98
FIN5.W210.9 CEMENT : SAND MORTAR BEDDING METHOD 98
FIN5.W220.9 CEMENT-BASED ADHESIVE BEDDING METHOD 98
FIN5.W230.9 FIXING TO PANEL WALL PARTITIONS 99
FIN5.W240.9 FIXING TO BLOCKWORK OR CONCRETE 99
FIN5.W250.9 DIRECT APPLICATION OF TILING ON CONCRETE SURFACE WITH CEMENT SAND MORTAR MIXED WITH LATEX BEDDING 99
FIXING MOSAIC TILES 100
FIN5.W310.9 FIXING TO FLOOR BY CEMENT SAND MORTAR BEDDING METHOD 100
FIN5.W315.9 FIXING TO FLOOR BY CEMENT-BASED ADHESIVE BEDDING METHOD 100
FIN5.W320.9 FIXING TO WALLS BY CEMENT SAND MORTAR BEDDING METHOD 100
FIN5.W330.9 FIXING TO WALLS BY CEMENT-BASED ADHESIVE BEDDING METHOD 100
FIN5.W340.9 FIXING TO WALLS BY CEMENT SLURRY BEDDING METHOD 100
FIN5.W350.9 FIXING TO PANEL WALL PARTITIONS 101
FIN5.W360.9 FIXING GLASS AND GLAZED MOSAIC TO PRECAST FACADE 101
MARBLE AND GRANITE SLAB OR TILE FINISHES 101
FIN5.W405.9 APPLY PLASTERS FOR MARBLE AND GRANITE WALL TILES 101
FIN5.W410.9 LAYING MARBLE AND GRANITE FLOOR SLABS 101
FIN5.W420.9 FIXING MARBLE AND GRANITE WALL SLABS 101
FIN5.W430.9 FIXING MARBLE AND GRANITE WALL TILES 102
FIN5.W440.9 SHOP DRAWINGS 102
FIN5.W450.9 FINISHING 102
FIN5.W460.9 PROTECTION 102
TOLERANCES 102
FIN5.W610.9 GENERAL 102
TESTING 103
MATERIAL VERIFICATION TEST FOR TILE ADHESIVE 103
FIN5.T105.A MATERIAL VERIFICATION TEST FOR TILE ADHESIVE DELIVERED TO SITE 103
FIN5.T106.A MATERIAL VERIFICATION TEST FOR LATEX DELIVERED TO SITE 104
FIN5.T108.A MATERIAL VERIFICATION TEST FOR TILE ADHESIVE DELIVERED TO MANUFACTURER'S FACTORY OF PRECAST CONCRETE COMPONENTS 105
FIN5.T109.A MATERIAL VERIFICATION TEST FOR LATEX DELIVERED TO MANUFACTURER'S FACTORY OF PRECAST CONCRETE COMPONENTS 106
SURVEILLANCE TESTS 107
FIN5.T110.A SURVEILLANCE TEST FOR TILE GROUT 107
FIN5.T130.A SURVEILLANCE TEST FOR FLOOR SURFACE MATERIALS 108
ON-SITE VERIFICATION TESTS 109
FIN5.T150.A IN-SITU PULL-OFF TESTS ON COMPLETED TILES 109
VERIFICATION TEST FOR FLOOR SURFACE MATERIALS 112
FIN5.T180.A VERIFICATION TEST FOR SLIP RESISTANCE OF FLOOR SURFACE MATERIALS 112

FIN6 FLEXIBLE SHEET AND TILE FINISHES 114

MATERIALS 114

GENERAL 114

FIN6.M010.A QUALITY GENERALLY 114
FIN6.M020.9 SAMPLES 114
FIN6.M030.9 SLIP RESISTANCE 114

PVC TILES AND SHEET 114

FIN6.M110.A SEMI-FLEXIBLE TILES 114
FIN6.M120.A UNBACKED FLEXIBLE TILES 114
FIN6.M130.A UNBACKED FLEXIBLE SHEET 114
FIN6.M140.A FOAM BACKED SHEET 114
FIN6.M150.9 COVED SKIRTINGS 114

LINOLEUM 114

FIN6.M210.A SHEET AND TILES 114

RUBBER 115

FIN6.M310.A SHEET AND TILES 115
FIN6.M320.9 NON-SLIP TACTILE SYNTHETIC RUBBER FLOOR TILES 115

ANCILLARY MATERIALS 115

FIN6.M410.9 ADHESIVE 115
FIN6.M415.9 ADHESIVE FOR FIXING TACTILE SYNTHETIC RUBBER FLOOR TILE 115
FIN6.M420.9 PVC WELDING RODS 115
FIN6.M430.9 POLISH 115

WORKMANSHIP 116

GENERAL 116

FIN6.W010.A GENERAL 116
FIN6.W020.9 DAMAGED MATERIALS 116
FIN6.W030.9 PREPARATION OF LAYING SURFACE 116

LAYING SHEET AND TILES 116

FIN6.W110.9 GENERAL 116
FIN6.W120.9 PRE-HEATED TILES 116
FIN6.W130.9 APPLYING ADHESIVE 116
FIN6.W140.9 JOINTING AND CUTTING 116
FIN6.W150.9 JOINTING PVC SHEET 116
FIN6.W160.9 FIXING TACTILE SYNTHETIC RUBBER FLOOR TILES 116
FIN6.W170.9 DEFECTIVE AREAS 117

FINISHING 117

FIN6.W210.9 CLEANING 117
FIN6.W220.9 POLISHING 117
FIN6.W230.9 PROTECTION 117

TOLERANCES 117

FIN6.W310.9 GENERAL 117

FIN7 PAINTING 118

MATERIALS 118

GENERAL 118

FIN7.M010.B PAINTS AND DECORATIVE MATERIALS 118
FIN7.M015.9 WATER BASED PAINTS 118
FIN7.M016.9 SOLVENT BASED PAINTS 118
FIN7.M020.9 UNIFORM SUPPLY 119

PESTICIDES AND PRESERVATIVES 119
FIN7.M110.9 RUST INHIBITOR 119
FIN7.M120.9 ANTI-MOULD LIQUID 119
FIN7.M130.9 PESTICIDAL COATING 119
FIN7.M140.9 WOOD PRESERVATIVE 119
FIN7.M150.9 WATER REPELLENT LIQUID 119
PRIMING PAINTS AND SEALERS 119
FIN7.M210.9 WOOD PRIMERS 119
FIN7.M220.9 METAL PRIMERS 119
FIN7.M230.9 PRIMERS FOR GALVANIZED SURFACES 120
FIN7.M240.9 METAL PRIMERS FOR POLYURETHANE FINISHES 121
FIN7.M250.9 SEALERS FOR PLASTER, MASONRY ETC 121
FIN7.M260.9 FLOOR SEALER 121
PAINTS 121
FIN7.M340.A ANTI-MOULD INTERNAL EMULSION PAINT 121
FIN7.M350.9 TEXTURED EMULSION PAINT 124
FIN7.M370.A ANTI-MOULD EXTERNAL EMULSION PAINT 124
FIN7.M380.9 MULTI-COLOUR PAINT 129
FIN7.M400.9 EXTERNAL TEXTURED PAINT 129
FIN7.M410.9 FIRE RETARDANT PAINT 129
FIN7.M420.9 COLD CURE EPOXY PAINT 129
FIN7.M430.9 POLYURETHANE PAINT 129
FIN7.M440.9 CHLORINATED RUBBER PAINT 129
FIN7.M450.9 MICACEOUS IRON OXIDE PAINT 129
FIN7.M460.9 BLACK BITUMASTIC PAINT 129
FIN7.M470.9 BLACK BITUMEN COATING SOLUTION 129
FIN7.M480.9 FLUORESCENT PAINT 130
FIN7.M490.9 REFLECTING PAINT 130
FIN7.M500.9 METALLIC PAINT 130
FIN7.M510.9 HEAT RESISTING PAINT 130
FIN7.M520.9 ACID RESISTING PAINT AND THINNER 130
FIN7.M530.9 BLACK ENAMEL 130
FIN7.M560.9 CHALKBOARD PAINT 130
FIN7.M570.A SYNTHETIC PAINT 130
FIN7.M580.A MULTI-LAYER ACRYLIC PAINT 133
FIN7.M584.N ACRYLIC PAINT FOR INTERNAL STAINLESS STEEL PIPE BRACKETS 138
FIN7.M585.9 DOORSET PAINT 139
FIN7.M590.9 TEXTURED SPRAYED PAINT COATING 139
FIN7.M600.N VARNISH, STAIN AND WAX POLISH COMPOSITION 140
CLEAR WOOD TREATMENTS 141
FIN7.M610.9 LINSEED OIL 141
FIN7.M620.9 STAINS FOR VARNISHING OR POLISHING 141
FIN7.M630.9 SELF FINISHED STAINS 141
FIN7.M640.9 COPAL VARNISH 141
FIN7.M650.9 SYNTHETIC VARNISH 141
FIN7.M660.9 POLYURETHANE VARNISH 141
FIN7.M670.9 WAX POLISH 141
FIN7.M680.9 CELLULOSE LACQUER 141
ANCILLARY MATERIALS 141
FIN7.M710.9 KNOTTING FOR METAL 141
FIN7.M720.9 KNOTTING FOR WOOD 141
FIN7.M730.9 STOPPING FOR INTERNAL WOODWORK 141

FIN7.M740.9 STOPPING FOR EXTERNAL WOODWORK 141
FIN7.M750.9 FILLER FOR PLASTER SURFACES 141
FIN7.M760.9 SURFACE FILLER FOR WOOD 142
FIN7.M770.9 WHITE SPIRIT 142
FIN7.M780.9 STONE CLEANER AND SEALER 142
FIN7.M790.9 SKIM COAT FOR PAINT FINISHES 142

WORKMANSHIP 146

GENERAL 146

FIN7.W010.9 STANDARD 146
FIN7.W020.9 HEALTH AND SAFETY 146
FIN7.W030.9 HANDLING AND STORAGE 146
FIN7.W040.9 PROTECTION OF EXISTING SURFACES 146
FIN7.W050.9 CLEANLINESS 146
FIN7.W060.9 COLOURS 146
FIN7.W070.9 SAMPLE OF FINISHED WORK FOR CONSTRUCTION MOCK-UP 146
FIN7.W080.9 DISPOSAL OF TINS 146

PREPARATION - DEFINITION OF TERMS 146

FIN7.W110.9 PAINTING 146
FIN7.W120.9 WASH DOWN 147
FIN7.W130.9 BROOM DOWN 147
FIN7.W140.9 SCRAPE 147
FIN7.W150.9 WIRE BRUSH 147
FIN7.W160.9 STRIP 147
FIN7.W170.9 STOP (PLASTER) 147
FIN7.W180.9 STOP (WOODWORK) 147
FIN7.W190.9 KNOT (METAL PIPES) 147
FIN7.W200.9 KNOT (WOODWORK) 147
FIN7.W210.9 RUB DOWN 147
FIN7.W220.9 FILL 148

PREPARATION - UNDECORATED SURFACES 148

FIN7.W310.9 GENERAL 148
FIN7.W320.9 PLASTERED AND RENDERED SURFACES 148
FIN7.W325.9 INTERNAL FAIR-FACED CONCRETE, PLASTERED SURFACES AND PANEL WALL PARTITIONS TO DOMESTIC BLOCKS 148
FIN7.W330.9 CONCRETE, MASONRY AND ROOF TILES 148
FIN7.W340.9 STRUCTURAL STEELWORK 148
FIN7.W350.A UNCOATED IRON AND STEEL 148
FIN7.W360.9 ZINC COATED IRON AND STEEL 148
FIN7.W370.9 COATED IRON AND STEEL PIPES 148
FIN7.W380.9 COPPER 148
FIN7.W390.9 WOODWORK TO RECEIVE PAINT 148
FIN7.W400.9 WOODWORK TO RECEIVE PRESERVATIVES AND PESTICIDES 148
FIN7.W410.9 WOODWORK TO RECEIVE LINSEED OIL 148
FIN7.W420.9 WOODWORK TO RECEIVE CLEAR FINISHES 148
FIN7.W430.9 WOODWORK TO RECEIVE CHALKBOARD PAINT 148
FIN7.W440.9 ABSORBENT FIBRE BASED BOARDS 149
FIN7.W450.9 FIBRE CEMENT 149
FIN7.W460.9 SURFACES TO RECEIVE POLYURETHANE OR COLD-CURE EPOXY PAINTS 149

PREPARATION - DECORATED SURFACES 149

FIN7.W510.9 GENERAL 149
FIN7.W520.9 SURFACES SUBJECT TO MOULD GROWTH 149
FIN7.W530.9 LIMEWASHED OR WHITENED SURFACES 149

FIN7.W540.9 WASHABLE AND NON-WASHABLE DISTEMPERS....149
FIN7.W550.9 EMULSION PAINTED SURFACES....149
FIN7.W560.9 SYNTHETIC PAINTED SURFACES OTHER THAN METAL AND WOOD....149
FIN7.W570.9 BLACK BITUMINOUS COATED SURFACES....149
FIN7.W580.9 UNGALVANIZED IRON AND STEEL....149
FIN7.W590.9 PAINTED, ZINC COATED IRON AND STEEL....149
FIN7.W600.9 SYNTHETIC PAINTED WOODWORK....150
FIN7.W610.9 POLYURETHANE OR EPOXY PAINTED WOODWORK....150
FIN7.W620.9 VARNISHED WOODWORK....150
FIN7.W630.9 WAXED AND LACQUERED WOODWORK....150
FIN7.W640.9 WAXED FLOORS....150
FIN7.W650.9 STRIPPING EXISTING DECORATIONS....150

APPLYING PAINTS GENERALLY....150
FIN7.W710.9 AMBIENT CONDITIONS....150
FIN7.W720.9 SURFACE CONDITION....150
FIN7.W730.9 IRONMONGERY AND HARDWARE....150
FIN7.W740.9 MIXING AND APPLYING....151
FIN7.W750.9 THINNING....151
FIN7.W760.9 BRUSH APPLICATION....151
FIN7.W770.9 THICKNESSES OF COATS....151
FIN7.W780.9 SUCCESSIVE COATS....151
FIN7.W790.9 APPLICATION BY ROLLERS, CLOTHS AND GLOVES....151
FIN7.W800.9 MECHANICAL APPLICATION....151
FIN7.W810.9 SURFACES LIKELY TO BECOME INACCESSIBLE....151
FIN7.W820.9 WEATHERSTRIPPING....151
FIN7.W830.9 TOUCHING UP....151
FIN7.W840.9 CLEANLINESS....151
FIN7.W850.9 PROTECTION OF NEWLY COATED SURFACES....151

APPLYING PRIMERS....152
FIN7.W910.9 GENERAL....152
FIN7.W920.9 METAL SURFACES....152
FIN7.W930.9 WASH AND ETCH PRIMERS....152
FIN7.W940.9 REBATES, GLAZING BEADS AND PUTTY....152

APPLYING UNDERCOATS AND FINISHING COATS....152
FIN7.W1010.9 UNDERCOATING....152
FIN7.W1020.9 FINISHING COATS GENERALLY....152
FIN7.W1030.9 TWO FINISHING COATS....152

WATER REPELLENT LIQUID....152
FIN7.W1110.9 APPLICATION....152

EXTERNAL TEXTURED PAINT....152
FIN7.W1310.9 APPLICATION....152

PESTICIDES AND PRESERVATIVES....153
FIN7.W1410.9 APPLYING PESTICIDAL COATINGS....153
FIN7.W1420.9 TIMBER PRESERVATIVE TREATMENT....153

BLACK BITUMEN COATING SOLUTION....153
FIN7.W1510.9 APPLYING COATINGS TO RECEIVE PLASTERS AND RENDERS....153

BLACK ENAMEL....153
FIN7.W1610.9 APPLICATION....153

REFLECTING PAINT....153
FIN7.W1710.9 APPLYING REFLECTIVE AGGREGATE....153

CLEAR WOOD TREATMENTS 153
FIN7.W1810.9 LINSEED OIL 153
FIN7.W1820.9 WAX POLISH ON JOINERY 153
FIN7.W1830.9 WAX POLISH FLOOR FINISHES 153
FIN7.W1840.9 CELLULOSE LACQUER 153

SIGNWRITING 154
FIN7.W1910.9 PAINTING LETTERS, CHARACTERS AND FIGURES 154

MULTI-LAYER ACRYLIC PAINT 154
FIN7.W2010.9 GENERAL 154

PAINTING TO KITCHEN, BATHROOM, FLAT ENTRANCE AND EXIT STAIRCASE DOORSETS IN DOMESTIC 154
FIN7.W2110.9 GENERAL 154
FIN7.W2120.9 SAMPLES OF FINISHED WORK 154
FIN7.W2130.9 COLOURS 154
FIN7.W2140.9 SURFACE PREPARATION 154
FIN7.W2150.9 AMBIENT CONDITIONS 154
FIN7.W2160.9 APPLICATION OF PAINT 155
FIN7.W2170.9 DRYING AND PACKAGING 155

PAINTING TO GALVANIZED SURFACES 155
FIN7.W2180.9 PAINTING TO GALVANIZED SURFACES 155

SCHEDULES OF PAINT TYPES AND NUMBERS OF COATS 155
FIN7.W2210.9 GENERAL 155
FIN7.W2220.9 NEW PLASTER, RENDER, CONCRETE, MASONRY AND SIMILAR SURFACES 155
FIN7.W2230.9 NEW STRUCTURAL STEEL SURFACES 156
FIN7.W2250.9 NEW METAL SURFACES 156
FIN7.W2270.9 NEW WOOD SURFACES 156
FIN7.W2290.9 NEW BUILDING BOARDS AND ROOF COVERINGS 157

PIPEWORK AND MACHINERY 157
FIN7.W2405.9 GENERAL 157
FIN7.W2410.9 INSULATED PIPES 157
FIN7.W2420.9 UNINSULATED PIPES 157
FIN7.W2430.9 PAINTING MACHINERY 157
FIN7.W2460.9 CAST IRON PIPES 158
FIN7.W2465.9 GALVANIZED PIPES 158
FIN7.W2470.9 REFRIGERANT PIPES 158
FIN7.W2475.9 PAINTING UPVC PIPES 158
FIN7.W2480.9 METALWORK IN REFRIGERATOR SPACES 158
FIN7.W2490.A PIPELINE IDENTIFICATION 158
FIN7.W2500.9 PIPELINE IDENTIFICATION SCHEDULE 158
FIN7.W2510.9 UNDERGROUND SUPPLY PIPELINE IDENTIFICATION SCHEDULE 159
FIN7.W2520.9 PAINTING TO PIPEWORK AND EXPOSED METALWORK TO BUILDING SERVICES INSTALLATIONS 160

TESTING 161

SURVEILLANCE TESTS FOR PAINTS 161
FIN7.T050.A SURVEILLANCE TESTS 161

INSPECTION OF EXTERNAL WALLS OF DOMESTIC BLOCKS WITH SMALL UNMANNED AIRCRAFT 162
FIN7.T110.N SCOPE 162
FIN7.T120.N SUBMISSION REQUIREMENTS 162
FIN7.T130.N SUA INSPECTION 163
FIN7.T140.N INSPECTION REPORT 163

APPENDIX FIN7/I 164
FIN7.APPEND1.9 ACCELERATED TESTS FOR RESISTANCE TO FUNGAL AND ALGAL GROWTH OF PAINT 164

APPENDIX FIN7/II 170
FIN7.APPEND2.9 PIPE IDENTIFICATION 170
FIN7.APPEND3.N LABELLING FOR HA PIPES PASSING THROUGH NON-HA PREMISES 171

FIN8 PROPRIETARY SUSPENDED CEILINGS 173

DESIGN 173

GENERAL 173

FIN8.D010.9 DRAWINGS AND SCHEDULES 173
FIN8.D020.A STANDARD 173
FIN8.D030.9 CEILINGS SUBJECT TO EXTERNAL CONDITIONS 173
FIN8.D040.9 ACCESS 173
FIN8.D050.A SERVICES 173
FIN8.D060.9 SHOP DRAWINGS 173
FIN8.D070.9 CERTIFICATION 174

MATERIALS 175

GENERAL 175

FIN8.M010.9 COMPONENT MATERIALS 175

PANEL SYSTEM 175

FIN8.M110.A SUSPENDED CEILING 175
FIN8.M120.9 SAMPLES 175

ALUMINIUM CELL SYSTEM 175

FIN8.M210.A SUSPENDED CEILING 175
FIN8.M220.9 SAMPLES 176
FIN8.M230.X DELETED 176

ANCILLARY MATERIALS 176

FIN8.M310.9 CAVITY BARRIERS AND FIRE STOPPING 176
FIN8.M320.9 INSULATION 176
FIN8.M330.9 SOFFIT FIXINGS 176

WORKMANSHIP 177

GENERAL 177

FIN8.W010.9 APPROVED FIXING SUB-CONTRACTOR 177

INSTALLING CEILINGS 177

FIN8.W110.A GENERAL 177
FIN8.W120.9 HANDLING AND STORAGE 177
FIN8.W130.9 INSTALLATION CONDITIONS 177
FIN8.W140.9 SETTING OUT 177
FIN8.W150.9 FIXING TRIMS 177
FIN8.W160.9 CAVITY BARRIERS 177
FIN8.W170.9 ELECTRICAL CONTINUITY AND EARTH BONDING 178
FIN8.W180.9 PROTECTION 178

ACCURACY AND TOLERANCES 178

FIN8.W210.9 GENERAL 178

FIN1 PLASTERED AND RENDERED FINISHES

MATERIALS

CEMENT AND LIME

FIN1.M010.9 CEMENT

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name, and job reference of the material;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. When the material is supplied, plain or prebagged, for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
         - Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS;
         - For ordinary cement in grey colour, submit also original or a certified true copy of the product conformity certificate to the "Product Conformity Certification Scheme For Cement Products" published by the Hong Kong Concrete Institute. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM.
   b. A summary of the test results under the audit testing of the "Product Conformity Certification Scheme For Cement Products". The summary shall be prepared by the accredited laboratory carried out the testing or the certified manufacturer. If so directed by the CM, submit a full set of the audit test reports to the CM for record;
   c. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2) for CM's information unless the test requirements are covered by the scope of the "Product Conformity Certification Scheme For Cement Products":
      i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as per sub-clause (1)(a), or at a time not later than the delivery of the material as per sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:
   a. Cement to be Portland cement type CEM I in BSEN 197-1:2000;
   b. Strength class to be 52.5N, unless otherwise specified or approved by the CM.
3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a); one batch being the material quantity covered under each delivery note;
      ii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for cement upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Delivery note	Document Check	Information recorded in the delivery notes to be same as the material delivered.
Material and packaging	Visual	To Approved sample
Expiry Date	Check information printed on the packaging	Minimum 6 months from the date of delivery

      ii. Frequency:

      Carry out verification for one packaged bag per every delivery of the material made to Site under each delivery note submitted in sub-clause (3)(a).

   c. Where any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site and one batch being the material quantity covered under each delivery note; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

FIN1.M020.9 LIME

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name, and job reference of the material;
      ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer.

b. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2) for the CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:
   a. Hydrated lime to BS 890:1995;
   b. In sealed bags bearing the manufacturer's name or brand.
3. On Site Delivery Verification:
   a. As per FIN1.M010 (3).

FIN1.M030.9 LIME PUTTY

Prepared in accordance with BS 5492:1990, by adding hydrated lime to water and mixing to a thick, creamy consistency, allow to stand for a minimum of 16 hours before use.

GYPSUM PLASTERS

FIN1.M110.9 UNDERCOAT FOR SOLID BACKGROUNDS

Retarded hemihydrate gypsum browning plaster to BS 1191:Part 1:1973, Class B, Type a1, mixed with sand, 1 : 2.

FIN1.M120.9 UNDERCOAT FOR METAL LATHING

Retarded hemihydrate gypsum lathing plaster to BS 1191:Part 1:1973, Class B, Type a2, mixed with sand, 1 : 1.5.

FIN1.M130.9 FINISH COAT

Retarded hemihydrate gypsum finish plaster to BS 1191:Part 1:1973, Class B, Type b1, with or without lime putty to a maximum of 25%.

ACOUSTIC PLASTER

FIN1.M210.9 ACOUSTIC PLASTER

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name, and job reference of the material;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. The manufacturer’s confirmation in writing that the plaster is asbestos free.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) and (2)(c) for CM's information:
   i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;
   ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material to Site;
   iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. Submit the manufacturer's method statement of application.

2. Quality Requirements:
   a. A proprietary plaster including all ancillary materials shall be an approved proprietary brand to suit the specified acoustic performance;
   b. Absorption coefficients and Noise Reduction Coefficient (NRC) rating with test conducted according to ASTM C423;
   c. Fire and safety requirements:
      i. Non-inflammable and shall not sustain any combustion;
      ii. Achieve, within the cavity, Class 1 classifications when tested in accordance with BS 476-7 and an index of Performance (1) not exceeding 12 and a sub-index (i) not exceeding 6 when tested in accordance with BS 476-6.
   d. Asbestos free;
   e. Resistant to bacteria, mold and mildew;
   f. Comply with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation;
   g. Applied by an applicator authorized by the supplier or manufacturer.
3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1);
      ii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following checking for materials upon delivery on Site. Prior to carrying out the checking, inform the CM who may present to witness the checking:
      i. Method:

Checking Items	Method	Acceptance Standards
Delivery note	Document Check	Information recorded in the delivery notes to be same as the material delivered
Material and packaging	Visual	To Approved sample
Expiry Date	Check information printed on the delivery notes	Minimum 6 months from the date of delivery

      ii. Frequency:

Carry out checking for one packaged bag per every delivery of materials made to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the checking failed to meet the acceptance standards, remove the delivery off Site.

WATER

FIN1.M310.A WATER

Provide water in accordance with PRE.B10.1210 to PRE.B10.1260. The water shall be of quality deemed suitable for concrete when tested by the methods in BS EN 1008:2002.

AGGREGATES

FIN1.M402.9 SAND GENERALLY

1. Use manufactured sand in compliance with FIN1.M405 for local production of cement mortar for use in plastering, rendering, floor screeding, insitu wall and floor finishes and tiling works under Worksections FIN1, FIN3, FIN4 and FIN5. Cement mortar shall include but not be limited to:
   a. Locally produced cement mortar (wet); and
   b. Locally manufactured pre-mixed mortar (dry).
2. Manufactured sand is defined as crushed fine aggregates processed to improve the particle shape and grading for enhancing the performance of the material. The processing applied to the crushed fine aggregate may include grinding, screening and cleaning;
3. Should there be genuine difficulties in using manufactured sand, e.g. supply shortages, submit justification and seek the CM's approval for substitution of manufactured sand. If the CM is satisfied that there is genuine difficulty in procuring manufactured sand and upon the CM's approval, clean natural sand complying with the technical specifications and other associated requirements as per FIN1.M410 shall be adopted. Bear all additional cost incurred and no extension of time will be granted;
4. For avoidance of doubt, the requirement for use of manufactured sand is not applicable to pre-mixed mortar (dry) which is factory-produced in the Mainland or other countries by weighted combination of plaster raw materials and chemicals, and is supplied to construction sites in bags.

FIN1.M405.9 MANUFACTURED SAND

1. Submission Requirements:
   a. At sample submission and approval stage, submit sample(s) of the proposed manufactured sand used for site mixing, or used as aggregates in factory produced cement mortar, for the CM's approval together with all the following substantiation for the CM's information:
      i. Source of supply of the material;
      ii. Name, address and contact person of the supplier;

iii. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance of the manufactured sand with the physical and chemical properties set out in sub-clauses (2)(c), (2)(d), (2)(e) & (2)(f). The date of the test report shall not be earlier than one year prior to the notified date for commencement of the Works. Samples shall be taken in accordance with the procedures described in Section 8 of CS3:2013, or as agreed with the CM.

2. Quality Requirements:

a. Manufactured sand shall be crushed fine aggregates processed to improve the particle shape and grading to enhance the performance of the crushed fine aggregates. The process applied to the crushed fine aggregates may include grinding, screening and cleaning. Recycled aggregates may be used for production of manufactured sand subject to the prior approval of the CM. Aggregates from marine source and all-in aggregates shall not be used;

b. Manufactured sand shall be:

i. Clean, hard, durable and obtained from an Approved source;

ii. Having an oven-dried particle density not less than 2,000kg/m³. Lightweight aggregates and heavyweight aggregates are not applicable.

c. Geometrical Requirements:

i. Aggregate size

Manufactured sand for cement mortar is limited to fine aggregates with an upper sieve size of not larger than 5.0 mm. Depending on the thickness of mortar application and the surface finish specified, select upper sieve size of aggregates between 5.0 mm and 2.36 mm. Do not use coarse aggregates unless approved otherwise;

ii. Grading

- The grading of the manufactured sand; i.e. C (coarse graded), M (medium graded) or F (fine graded), as determined in accordance with Section 10 of CS3:2013, shall be declared and documented by the manufactured sand producer or supplier. This grading shall comply with both the overall limits and the limits for the declared grading given in Table 1 and Table 2 below for fine aggregates of size 0/5.0 mm and 0/2.36 mm respectively. Not more than one in ten consecutive samples shall have a grading outside the limits for the declared grading;

Table 1 - Grading test of manufactured sand of size 0/5.0 mm

Sieve size	Percentage by mass passing test sieves (%)			
	Overall limits	Limits for declared grading		
		C	M	F
10 mm	100	-	-	-
5 mm	89-100	-	-	-
2.36 mm	60-100	60-100	65-100	80-100
1.18mm	30-100	30-90	45-100	70-100
600 µm	15-100	15-54	25-80	55-100
300 µm	5-70	5-40	5-48	5-70
150 µm	0-20	-	-	-

Table 2 - Grading test of manufactured sand of size 0/2.36 mm

Sieve size	Percentage by mass passing test sieves (%)			
	Overall limits	Limits for declared grading		
		C	M	F
5 mm	100	-	-	-
2.36 mm	89-100	-	-	-
1.18mm	60-100	60-100	65-100	80-100
600 µm	30-100	30-90	45-100	70-100
300 µm	15-100	15-54	25-80	55-100
150 µm	5-70	5-40	5-48	5-70
75 µm	0-14	-	-	-

- Manufactured sand for cement mortar not incorporating lime shall conform to the grading limits set out in Table 1, whilst manufactured sand for cement mortar incorporating lime shall conform to the grading limits set out in Table 2. Lime shall be hydrated lime to BS EN 459-1, delivered in sealed bags bearing the manufacturer's name or brand;
- Manufactured sand of grading C (coarse graded) shall not be used unless prior approval from the CM is obtained.

iii. Fines content

The amount of material passing the 75 µm test sieve, as determined in accordance with Section 10 of CS3:2013, shall not exceed the quantities given in Table 3;

Table 3 - Limit for fines content

Fines content class	Maximum percentage by mass passing 75 µm test sieve (%)
F5	5

iv. Foreign Materials Content

The maximum content of foreign materials in the manufactured sand, as determined by manual sorting in accordance with BRE Digest 433, shall not exceed the quantities given in Table 4;

Table 4 - Limits for foreign materials in the manufactured sand

Type of foreign materials	Maximum percentage by mass (%)
Wood and other material less dense than water.	0.5
Other foreign materials (e.g. shell, metals, plastics, clay lumps, asphalt and tar etc.)	1.0

v. Angularity

The shape of manufactured sand shall be sub-angular, sub-rounded or rounded. Angular manufactured sand is unacceptable.

d. Physical Requirements:

i. Particle Density

The oven-dried particle density of manufactured sand, as determined in accordance with Section 17 of CS3:2013, shall not be less than 2,000 kg/m³;

ii. Durability

- Drying Shrinkage

  The drying shrinkage of the manufactured sand, as determined in accordance with Section 20 of CS3:2013, shall not exceed 0.075%;

- Alkali-silica Reactivity

  The linear expansion of mortar-bars immersed in NaOH solution at elevated temperature, as determined in accordance with Section 22 of CS1:2010, shall be evaluated using Equation 22-1 of CS1:2010. The potential alkali-reactivity of manufactured sand can then be obtained from Table 10 of CS1:2010. Alternatively, the concrete prism test in accordance with Section 23 of CS1:2010 may also be used and the potential alkali-reactivity of manufactured sand can then be obtained from Table 13 of CS1:2010. Manufactured sands that fall into the alkali "Reactive" category shall not be used unless prior approval of the CM is obtained.

e. Chemical Requirements:

i. Chlorides - Water-soluble Chloride Ion Content

- The water-soluble chloride ion content of natural aggregates of the manufactured sand shall be determined in accordance with Cl. 21.3 of Section 21 of CS3: 2013;
- Acid-soluble Chloride Ion Content

  The acid-soluble chloride ion content of recycled aggregates of the manufactured sand shall be determined in accordance with Cl. 21.4 of Section 21 of CS3: 2013;

- Chloride Ion Content

  The total chloride ion contents of natural aggregates and recycled aggregates of manufactured sand shall not exceed 0.03% by mass.

ii. Sulphur Containing Compounds

- Acid-Soluble Sulphate Content;
- The acid-soluble sulphate content of natural aggregates of manufactured sand, as determined in accordance with Clause 21.5 of Section 21 of CS3:2013, shall not exceed 0.8% by mass;
- The acid-soluble sulphate content of recycled aggregates of manufactured sand, as determined in accordance with Clause 21.5 of CS3:2013, shall not exceed 1.0% by mass;
- Total Sulphur Content

  The total sulphur content of natural aggregates of manufactured sand, as determined in accordance with Cl. 21.6 of Section 21 of CS3:2013, shall not exceed 1.0% by mass.

f. Other constituents:

i. Manufactured sand shall be clean and free of organic substances. The manufactured sand supplier or mortar producer shall demonstrate that the supplied manufactured sand is clean and free of organic substances or alternatively the presence of organic substances does not affect the stiffening or hardening of the mortar;

ii. The presence of organic substances in the form of humus shall be determined in accordance with Cl.21.7 of Section 21 of CS3:2013. Where the test result under Cl.21.7 is negative, the manufactured sand shall be considered to be free of organic substances. Otherwise, the manufactured sand shall be further tested in accordance with Section 22 of CS3:2013 to assess the effect of organic substances on the stiffening time and compressive strength of mortar. The organic substances to be of such proportion that:

- the stiffening time of mortar test specimens does not increase by more than 120 minutes; and
- the 28-day compressive strength of mortar test specimens does not decrease by more than 20%.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample(s) submitted under sub-clause (1);

ii. Delivery notes for all material delivered to Site;

iii. Reports giving test results for the physical and chemical properties of manufactured sand as set out in sub-clauses (2)(c)(ii), (2)(d) and (2)(e), to be submitted every three months starting from the first delivery of manufactured sand, or mortars produced with manufactured sand as aggregates, unless agreed otherwise by the CM. The issue date of test reports shall be within three months for grading and six months for other properties counting from the date of submission;

iv. In the event that no test report as required in sub-clause (3)(a)(iii) has been submitted when materials are delivered to Site, or any of the test results fail to meet the specified requirement, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

b. Submit the following document for verification upon delivery on Site:

i. Method

Verification Items	Method	Acceptance Standards
Supplier's Certificate of Origin and delivery note	Check information printed on the delivery notes	Supplier same as the supplier declared as per sub-clause (1)(a)(ii)
Reports for manufactured sand as per sub-clause (3)(a)(iii)	Document check	Compliance with sub-clauses (2)(d)(ii), (2)(e) and (2)(f)

ii. Frequency

Carry out one set of verification for the delivery of manufactured sand or mortar containing manufactured sand as aggregate to Site under a delivery note submitted in sub-clause (3)(a) as follows:

Verification Items	Frequency
Supplier's Certificate of Origin and delivery note	Every batch
Reports for manufactured sand as per sub-clause (3)(a)(iii)	Once every three months starting from the first delivery of manufactured sand or mortar

c. Where any of the verifications fail to meet the acceptance standards, remove the delivery off Site.

FIN1.M410.9 SAND OTHER THAN MANUFACTURED SAND

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
      i. Source of supply of the material;
      ii. Name, address and contact person of the supplier.
   b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2) for the CM's information:
      i. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material to Site;
      ii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
2. Quality Requirements:
   a. Clean, hard, durable crushed rock, gravel or clean sand; free from salt and its quality shall comply with the "quality of sand" as stated in BS 1199:1976 Amendment No.3;
   b. The quantity of clay, fine silt and fine dust present, when determined in accordance with BS812: Section 103.1:1985, must not exceed 10% by weight.
3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1);
      ii. Delivery notes for all material delivered to Site.
   b. Submit the following document for verification upon delivery on Site:
      i. Method:

Verification Items	Method	Acceptance Standards
Supplier's Certificate of Origin and delivery note	Document Check	Source of origin in the Certificate of Origin and delivery note are the same

      ii. Frequency:

      Carry out verification for every delivery of materials made to Site under each delivery note submitted in sub-clause (3)(a).
   c. Where any of the verifications fail to meet the acceptance standards, remove the delivery off Site.

FIN1.M420.9 GRADING OF SAND FOR MIXES WITHOUT LIME

1. When manufactured sand is used as aggregates, comply with the grading requirements of manufactured sand under FIN1.M405 (2)(c) for mixing with other constituents;
2. When sand other than manufactured sand is used;

a. The grading of sand shall comply with Type A under Table 1 of BS 1199:1976 Amendment No.3;

b. Sand other than 6.30 mm in size, whose grading falls outside the limits as set out in the table stated in sub-clause (2a) above by a total amount of not exceeding 5% will be accepted.

FIN1.M430.9 GRADING OF SAND FOR MIXES WITH LIME

1. When manufactured sand is used as aggregates, comply with the grading requirements of manufactured sand under FIN1.M405 (2)(c) for mixing with other constituents;
2. When sand other than manufactured sand is used;
   a. The grading of sand shall comply with Type B as stated under Table 1 of BS 1199:1976 Amendment No.3;
   b. Sand other than 6.30 mm in size, whose grading falls outside the limits as set out in the table as stated in sub-clause (2a) above by a total amount of not exceeding 5% will be accepted.

FIN1.M440.9 EXPOSED AGGREGATE RENDER/SHANGHAI PLASTER

1. Shanghai plaster shall be applied in two coats, each 10 mm thick;
2. The base coat shall consist of cement and sand in the proportions 1:3 by volume;
3. The finishing coat shall consist of cement and granite, white stone or marble chippings in the proportions 1:1 by volume. The chippings shall be:
   a. Graded from 3 mm to 5 mm;
   b. Free from dust;
   c. In the proportions given in the following table for the colour of finish required:

Proportions of Chippings						
Colour	Cement	Stone Chippings			Marble Chippings	
		Dark Grey %	Light Grey %	White %	Black %	White %
Dark	Ordinary	70		20	10	
Medium	White	60	20	20		
Light	White	5	75			20
White	White					100

FIN1.M450.9 PAPER PULP

Do not use.

FIN1.M460.9 READY-MIXED (DRY) MORTARS AND READY-TO-USE (WET) MORTARS FOR RENDERING AND PLASTERING

1. Terminology:
   a. Ready-mixed mortar refers to dry bagged mortar which is ready mixed only requiring the addition of water for applications where flexibility of supply is demanded;
   b. Ready-to-use mortar refers to factory produced mortar which is supplied ready for use.
2. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
   i. Catalogue, brand name, and job reference of the material;
   ii. Name, address and contact person of the local supplier;
   iii. Name, address and contact person of the manufacturer;
   iv. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
      - Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant for the CM's inspection. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (3) for the CM's information:
   i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to the CM's consideration on the track records as maintained by the Housing Department;
   ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (4)(a);
   iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. Manufacturer's written confirmation for the CM's information providing the Declared Value for the workable life for the ready-to-use (wet) mortar, all as defined under BS EN 998-1;

d. When the ready-mixed or ready-to-use mortars for use in plastering, rendering and other architectural finishing works are locally produced, manufactured sand in lieu of river sand shall be used. Comply with the submission requirements for manufactured sand as per FIN1.M405 (1);

e. Ready-mixed mortar used as lining materials for water tanks in direct contact with potable water shall comply with the relevant submission requirement as per PLU1.M1110.

3. Quality Requirements:

a. To BS EN 998-1:2003, including requirements of "Evaluation of conformity" on Initial type tests and Factory Production Control;

b. The properties and performance requirements shall be type GP (General purpose rendering / plastering mortar) for hardened mortar as specified in BS EN 998-1: 2003 when used internally:

Item	Method of Test	Requirements
Compressive strength	EN 1015-11	> 6 N/mm²
Dry bulk density	EN 1015-10	Self-declared by manufacturer (kg/m³)

Tensile Adhesion Strength	EN 1015-12	Self-declared by manufacturer, min. 0.5 N/mm²
Reaction to Fire	EN 13501-1	Self-declared by manufacturer on the mass or volume fraction of homogeneously distributed organic materials and reaction to fire class
Durability	-	Self-declared by manufacturer to the provisions valid in the intended place of use of the mortar

c. Mortar for structures for potable water shall be non-toxic, shall not promote microbial growth, shall not impart a taste, odour, cloudiness or discolouration to the water after disinfection and washing out at completion stage, in compliance with the requirements of the Water Authority;

d. Ready-mixed mortar used as lining materials for water tanks in direct contact with potable water shall comply with the relevant quality requirement as per PLU1.M1110.

4. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (2);

ii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Delivery note	Document Check	Material information recorded in the delivery notes to be same as the material delivered
Ready-mixed mortar		
Material and packaging	Visual	To Approved sample
Expiry Date	Check information printed on packaging	Minimum 6 months from the date of delivery
Ready-to-use mortar		
The date & time of final mixing & specified working life	Check information printed on the delivery notes	Not expired

ii. Frequency:

- For ready-mixed mortar, one set of verification should be carried out for one packaged bag per every delivery of ready-mixed mortar made to Site under each delivery note submitted in sub-clause (4)(a);

- For ready-to-use mortar, one set of verification should be carried out for the delivery of mortar by mixer truck to Site in a day under the delivery note submitted in sub-clause (4)(a).

c. Where any of the verifications fail to meet the acceptance standards, remove the delivery off Site;

d. When the ready-mixed or ready-to-use mortars for use in plastering, rendering and other architectural finishing works are locally produced, manufactured sand in lieu of river sand shall be used. Comply with the on site delivery verification requirements for manufactured sand as per FIN1.M405 (3).

RENDERS

FIN1.M510.9 UNDERCOATS GENERALLY

Cement and sand or granite fines, 1 : 3.

FIN1.M520.9 RENDERS FOR TILE AND MOSAIC FINISHES

To BS 5385:Part 2:1991, cement and sand or granite fines, 1 : 3.

FIN1.M530.9 FINISH COAT FOR INTERIOR PAINT FINISHES

Cement, lime and sand or granite fines, 1 : 3 : 6.

FIN1.M540.9 FINISH COAT FOR EXTERIOR PAINT FINISHES

Cement and sand or granite fines, 1 : 3.

FIN1.M550.9 FINISH COAT FOR EXPOSED AGGREGATE RENDER/SHANGHAI PLASTER

Cement and stone chippings, 1 : 1:

1. Colour: as shown on Drawings;
2. Cement: colour as appropriate for required finish colour (see table to clause FIN1.M440).

FIN1.M560.9 PFA IN CEMENTITIOUS RENDERS

Cementitious render mixes containing a blend of Ordinary Portland Cement and Pulverized Fuel Ash may be offered as a substitute for those specified in this Worksection provided that:

1. PFA complies with BS 3892:Part 1:1997 and PPFAC complies with BS 6588:1996;
2. Not more than 25% by weight of the cementitious content of the proposed mix comprises PFA;
3. The physical properties and workability of the proposed mix can be demonstrated to be equivalent to or better than those of the specified mixes to the CM's satisfaction;
4. Setting and hardening times will not be so affected as to compromise the construction programme;
5. The PFA cement mortar is a manufactured product pre-mixed off-site and delivered in bulk by mixer trucks to Site;
6. No site mixing is allowed and storage of PFA on Site is not permitted.

LIME PLASTERS

FIN1.M610.9 UNDERCOATS FOR SOLID BACKGROUNDS

Cement, lime, sand, 1 : 1: 4.

FIN1.M620.9 UNDERCOATS FOR METAL LATHING

Cement, lime, sand, 1 : 2: 6.

FIN1.M630.9 FINISHING COAT

Cement, lime and sand, 1 : 1 : 4.

FIN1.M640.9 PAPER PULP PLASTER

Do not use.

SPECIALIST RENDERS

FIN1.M710.9 DECORATIVE FINISHES

Proprietary products obtained from Approved manufacturers.

ADMIXTURES FOR CEMENTITIOUS RENDERS

FIN1.M810.9 GENERAL

Ensure that the chloride ion content of admixtures for renders containing embedded metal does not exceed 2% by mass of the admixture or 0.03% by mass of the cement, whichever is the less.

FIN1.M820.9 PIGMENTS FOR PORTLAND CEMENT AND PORTLAND CEMENT PRODUCTS

A proprietary product to BS EN 12878:1999.

FIN1.M830.A ACCELERATING ADMIXTURES

A proprietary product to BS EN 934-2:2009+A1:2012.

FIN1.M840.A RETARDING ADMIXTURES

A proprietary product to BS EN 934-2:2009+A1:2012.

FIN1.M850.A WATER REDUCING ADMIXTURES

A proprietary product to BS EN 934-2:2009+A1:2012.

FIN1.M860.A SUPERPLASTICISERS

A proprietary product to BS EN 934-2:2009+A1:2012.

FIN1.M870.A WATER RESISTING ADMIXTURE

1 A proprietary product to BS EN 934-2:2002+A1:2012;

2. The water resisting admixture shall comply with the following:
   a. Do not cause any hazard or injury to the operatives;
   b. Compatible with all other contacting materials.
3. Materials for construction of components in contact with potable water shall be non-toxic, shall not promote microbial growth and shall not impart a taste, odour, cloudiness or discolouration to the water after disinfection and washing out at completion stage in compliance with the requirements of the Water Authority.
4. Store the material in a cool, well ventilated and covered storage accommodation.

FIN1.M880.9 WATER RESISTING ADMIXTURE FOR TANKS FOR POTABLE WATER

1. Water resisting admixture used as lining materials for water tanks in direct contact with potable water shall comply with:

a. Quality requirements as FIN1.M870; and
b. Relevant quality requirement as per PLU1.M1110.

2. Submit manufacturer's written confirmation to declare that the admixture is safe for use for construction of components in contact with potable water, and comply with relevant submission requirement as per PLU1.M1110.

ANCILLARY MATERIALS

FIN1.M910.9 SPATTERDASH

1. For concrete substrate that has been set and cured, the spatterdash shall be cement and coarse sand or granite fines, 1:2, mixed with an Approved proprietary bonding agent in accordance with the manufacturer's recommendations for the application;
2. When a proprietary surface applied bond coat is proposed by the Contractor as an alternative to replace the spatterdash bonding compound in sub-clause (1) and approved by the CM, its application procedures as recommended by the manufacturer must be strictly followed. Take extreme care during application and inspection of the work.

FIN1.M920.9 BONDING AGENT

An Approved proprietary product:

1. Compatible with both the background and the subsequent application;
2. Designated as suitable for internal or external use;
3. Either for surface application or integral mixing;
4. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

FIN1.M930.A PLAIN EXPANDED METAL LATHING

To BS EN 13658-1:2005:

1. Reference number: L, expanded metal lath Z275;
2. Size: minimum 5 mm across short way of mesh;
3. Weight: not less than 1.6 kg/m² ± 15%;
4. Coating: zinc.

FIN1.M940.A RIBBED EXPANDED METAL LATHING

To BS EN 13658-1:2005:

1. Reference number: RL, ribbed lath Z275;
2. Size: minimum 7 mm across short way of mesh;
3. Weight: not less than 2.25 kg/m² ± 15%;
4. Coating: zinc.

FIN1.M950.9 BEADS AND STOPS

1. Stainless steel corner beads, plaster stops and movement joint stops with expanded metal wings and obtained from an Approved manufacturer;
2. As an alternative to sub-clause (1) above, proprietary plastic beads or stops for use in internal areas may be proposed subject to CM's approval.

FIN1.M970.9 WIRE NETTING

To BS 1485:1983 and:

1. Mesh size: 25 mm;
2. Wire designation: 19;

3. Galvanized.

FIN1.M980.9 STAPLES

Galvanized steel wire staples to BS 1494: Part 1:1964.

FIN1.M990.9 TYING WIRE

1.22 mm diameter annealed steel wire, galvanized to BS 443:1982.

FIN1.M995.9 COMPRESSIBLE JOINT FILLER

As CON6.M010 or CON6.M020.

WORKMANSHIP

GENERAL

FIN1.W010.9 STANDARD

Generally comply with the following:

1. BS 5262:1991 in respect of external rendering;
2. BS 5492:1990 in respect of internal plastering.

FIN1.W020.9 CONSTRUCTION MOCK-UP

Construct a Construction Mock-up of around 5 m² as PRE.B9.440 for each different type of plastered and rendered surfaces showing the workmanship of each construction layer including background preparation through to the installation of finishes, including E&M works and accessories etc., as directed by CM.

FIN1.W030.9 READY-MIXED (DRY) MORTAR AND READY-TO-USE (WET) MORTAR FOR PLASTERING AND RENDERING APPLICATION

1. Submit method statement detailing the application procedure of ready-mixed and ready-to-use plaster or render finishes including preparation of the substrate for receiving plaster or render finishes for Approval;
2. Demonstrate the application method at the Construction Mock Up in accordance with FIN1.W020 before use.

FIN1.W040.9 MOVEMENT JOINTS

1. Construct movement joints as shown on the Drawings and as specified in Worksection CON6;
2. Ensure the joint cavity all the way back to the concrete substrate is free from mortar and incompressible material;
3. Ensure the movement joints extend through the combined depth of the tiles, tile bedding and render substrate.

FIN1.W050.9 HANDLING AND STORAGE OF GYPSUM PLASTERS

Ensure that gypsum plaster is delivered to Site in sealed containers and:

1. Store in weathertight structures with a raised floor;
2. Store different types of consignments separately;
3. Use plaster in the order of delivery.

FIN1.W060.9 ADMIXTURES

Mix and apply admixtures in accordance with manufacturer's instructions.

BACKGROUND PREPARATION FOR PLASTER AND RENDERING

FIN1.W110.9 GENERAL

To BS 5385:1995 and BS 8000:Part 10:1995 and comply with the following:

1. Use high pressure water jet to remove efflorescence, laitance, oil, formwork release agent, grease, dirt and loose materials from the concrete surfaces prior to application of subsequent finishes;

2. Allow minimum 4 weeks continuous drying out for new concrete wall after curing before cement sand plastering / rendering commence;
3. Allow additional 2 weeks drying out after application of cement sand plastering / rendering to concrete wall before tiling. Extend drying time in damp weather conditions and adjust programme to ensure satisfactory installation;
4. Protect the prepared concrete surfaces from the weather and contamination from concreting run-offs.

FIN1.W120.9 CONCRETE BACKGROUNDS GENERALLY

Hack off extraneous concrete projections.

FIN1.W130.9 PREPARING HARDENED CONCRETE TO RECEIVE CEMENTITIOUS RENDERS

Either:

1. Prepare surface by:
   a. Shortly before applying the finish, thoroughly hacking the concrete surface to remove any laitance or, where Approved, with an electric spade;
   b. Thoroughly cleaning and wetting the surface as required, to adjust its suction, before applying finish and remove surplus water;
   c. Brushing neat cement slurry into the damp surface immediately before applying the finish; or
2. Apply bonding agent in accordance with the manufacturer's recommendations.

FIN1.W140.9 PREPARING HARDENED CONCRETE TO RECEIVE GYPSUM PLASTERS

Apply bonding agent in accordance with the manufacturer's recommendations.

FIN1.W150.9 JUNCTIONS BETWEEN DISSIMILAR SOLID BACKGROUNDS

At junctions between different backgrounds, like concrete and blockwork, or where the same finish is to be applied to surfaces in differing planes, fix a strip of steel lathing as FIN1.W310.

FIN1.W160.9 JUNCTIONS BETWEEN PANEL WALL PARTITIONS AND OTHER BACKGROUNDS

As MAS1.W1140.

FIN1.W170.9 DUBBING OUT

When necessary to correct inaccuracies in the background, dub out:

1. In layers of a maximum thickness of 10 mm;
2. In the same mix as the first coat;
3. Allowing each coat to dry out before applying the next;
4. Cross scratching each coat to provide a key for the next;
5. To a total thickness not exceeding 25 mm.

APPLYING SPATTERDASH TO NEW CONCRETE

FIN1.W210.9 APPLYING SPATTERDASH

1. Apply spatterdash to concrete vertical surfaces and soffits immediately after striking formwork;
   a. Throw on spatterdash to give an overall coverage of thin coating of rough texture such that;
      i. Uncovered areas do not exceed 0.01 m²;

ii. Spacing between strokes is less than 50 mm;

iii. Uncovered area at wall edges is less than 50 mm.

b. After hardening and curing, use high pressure water jet to clean off dust and loose particles before applying subsequent finishing coat.

2. Use spatterdash as late-applied mechanical key to concrete with bonding agent if late application of spatterdash is proposed by the Contractor and subject to satisfaction of the CM.

FIN1.W240.9 JOINT INSPECTION TO SPATTERDASH

1. Carry out joint inspection with the CM or his representatives to minimum 10% of spatterdash on floor to floor basis;
2. After hardening and curing, check the adhesion of the spatterdash coat by brushing with a stiff wire brush;
3. Where spatterdash is easily removed, completely remove loosened spatterdash. Re-apply and re-inspect after 7 days;
4. Do not start subsequent works on any affected area until re-inspection is to CM's satisfaction.

FIXING STEEL LATHING

FIN1.W310.9 FIXING METHODS

Fix taut, with the long dimension of mesh running at right angles to the supports where provided, and:

1. To concrete, brickwork, blockwork or cement-sand backfilling, with 40 mm long nails or staples or with explosive cartridges when agreed by the CM or his representatives at 300 mm centres staggered and fitted with appropriate sized washers;
2. To timber, with staples at not more than 100 mm centres;
3. To steelwork, with tying wire at not more than 100 mm centres;
4. Extend at least 150 mm to either side of the junction with the fixing methods as above at junctions between dissimilar solid backgrounds or discontinuous constructions.

FIN1.W320.9 LAPS

Secure laps with tying wire at 75 mm centres and lap:

1. 25 mm minimum, generally;
2. 50 mm where end laps occur between supports.

FIN1.W330.9 CUT ENDS

Apply one coat of bituminous paint or zinc rich primer to cut ends.

MIXING PLASTERS AND RENDERS

FIN1.W410.9 GAUGE BOXES

Measure constituents by volume, using clean gauge boxes of sizes to suit the volumes required.

FIN1.W420.9 MIXING RENDERS

To BS 8000:Part 10:1995:

1. By mechanical mixer or, where Approved, by hand on a clean, close-boarded platform;

2. Cement: manufactured sand ratio of 1:3 by volume in general unless otherwise specified;
3. Avoid too strong or too wet render mix which will increase the render drying shrinkage;
4. Without over-mixing renders containing plasticizers;
5. Dry constituents before mixing with lime putty or water;
6. Mixing render shall be in accordance with BS 8000: Part 10: 1995. Too strong or too wet render mix that will increase the render drying shrinkage should be avoided;
7. Using the minimum amount of water to achieve the required consistency and workability; making due allowance for the moisture content of manufactured sand (or sand). The water: cement ratio should be not more than 3:5 by volume.

FIN1.W430.9 MIXING GYPSUM PLASTERS

To BS 8000:Part 10:1995:

1. Mix plasters for hand application by hand unless otherwise Approved;
2. Allow for the moisture content of sand in sanded mixes;
3. Do not use admixtures.

FIN1.W440.9 LIMITS ON USE OF MIXED MATERIAL

1. Use within one hour of mixing, with the exception of those added with retarding admixture, and:
   a. Do not use after the initial set has taken place; and
   b. Do not reconstitute material.
2. Submit compatibility report and method statement if use of pulverised fuel ash is proposed.

FIN1.W450.9 USE OF SUPERPLASTICIZERS

Use strictly in accordance with the manufacturer's recommendations and adjust the mix proportions of the render accordingly.

APPLYING RENDER

FIN1.W510.9 KEYING UNDERCOATS

Cross scratch undercoats to provide key for each subsequent coat.

FIN1.W520.9 RENDER FOR TILE OR MOSAIC FINISH

To BS 5385:Part 1:1995 and BS 5385:Part 2:1991 with particular attention to the following:

1. For render applied in a single coat:
   a. For manual application, to a maximum thickness of 10 mm; for mechanical applications, comply with manufacturer's recommendations;
   b. Where localized undulation is greater than 10 mm, apply in two coats as specified in sub-clause (2) below for manual applications.
2. For render applied in more than one coat adopting manual application:
   a. Undercoat not exceeding 10 mm thick;
   b. Second coat not exceeding 10 mm thick and should not be thicker than the undercoat;
   c. Comb undercoat to provide the key for the second coat, and allow undercoat to harden and dry out as stated in FIN1.W1210;

d. When the total thickness exceeds 20 mm, add metal lathing in the undercoat to CM's approval.

3. For subsequent tile finishes with cement sand bedding, comb the top coat of the render lightly to form the key; and for tile finishes with cementitious adhesive bedding, provide the top coat with wood float finish;
4. For subsequent mosaic finishes with cement sand bedding or cementitious adhesive bedding, provide the top coat of the render with float finish by polystyrene or wood to form the key.

FIN1.W530.9 RENDER FOR PAINT FINISH

Apply in two coats as follows:

1. Undercoat not exceeding 10 mm thick scratched to form key;
2. Finish coat to be one of the following as specified in Drawings:
   a. Finish coat for interior paint finishes as FIN1.M530, 5 mm thick trowelled smooth;
   b. Finish coat for exterior paint finishes as FIN1.M540, not exceeding 10 mm thick trowelled smooth in accordance with clause FIN1.W910.

FIN1.W540.9 WATERPROOF RENDERING FOR STANDARD DOMESTIC

Incorporate water resisting admixture into render strictly in accordance with the manufacturer's recommendations and apply in two coats as follows:

1. Undercoat not exceeding 10 mm thick;
2. Finish coat:
   a. Not exceeding 10 mm thick with the surface lightly scratched to form a key where tiles are to be fixed; or
   b. As FIN1.M540, 5 mm thick trowelled smooth where paint is to be applied.

FIN1.W550.9 EXPOSED AGGREGATE RENDER/SHANGHAI PLASTER

Apply in two coats, as follows:

1. Undercoat 10 mm thick;
2. Finish coat 10 mm thick;
3. Before the finish coat has set, scrub off the surface to expose the aggregate.

APPLYING LIME PLASTERS

FIN1.W610.9 KEYING UNDERCOATS

Cross scratch undercoats to provide a key for subsequent coats.

FIN1.W620.9 SOLID BACKGROUNDS

1. Apply in two coats on walls as follows:
   a. Undercoat not exceeding 10 mm thick;
   b. Cement, lime, sand finishing coat, 5 mm thick.
2. Apply in one coat to soffits as FIN1.M630 not exceeding 10 mm.

FIN1.W630.9 METAL LATHING INTERNALLY

Apply in three coats to a total thickness not exceeding 13 mm measured from the face of the lathing as follows:

1. First and second undercoats to a thickness not exceeding 8 mm;
2. Finish coat of cement, lime, sand, 5 mm thick, or of gypsum plaster gauged with lime, 5 mm thick, and brought to a smooth finish.

FIN1.W640.9 EXTERNAL ANGLES

Finish external angles, except those to beam soffits, with returns 50 mm wide in Keene's cement, on a cement sand render backing as FIN1.M510, with a slightly rounded arris.

APPLYING GYPSUM PLASTER

FIN1.W710.9 KEYING UNDERCOATS

Cross scratch undercoats to provide a key for subsequent coats.

FIN1.W720.9 SOLID BACKGROUNDS

Apply in two coats to a total thickness not exceeding 10 mm, as follows:

1. Undercoat;
2. Finish coat trowelled to a smooth finish.

FIN1.W730.9 METAL LATHING

Apply in three coats to a total thickness not exceeding 13 mm, measured from the outer face of the lathing, as follows:

1. First and second undercoats;
2. Finish coat trowelled to a smooth finish.

ARRISES, BEADS, STOPS AND CORNICES

FIN1.W810.9 ARRISES

Form arrises to be square or pencil round as shown on Drawings.

FIN1.W820.9 FIXING BEADS AND STOPS

Fix corner beads, plaster stops and movement joint stops with nails, staples or plaster dabs and trowel the finish coat flush with the outer edge of the beads or stops to manufacturer's recommendations.

FIN1.W830.9 CORNICES

Form coved or moulded cornices either:

1. With a backing of cement, sand render, 1 : 3 and a finish coat identical to that used on the adjacent wall, finished with a steel template, to a smooth finish; or
2. With pre-formed sections, fixed in accordance with the manufacturer's recommendations.

SURFACE FINISHES

FIN1.W905.9 GENERAL

Finish plaster and render the surfaces as shown on the Drawings and in accordance with the following clauses in this sub-section to the same standard of workmanship as Approved in the Construction Mock-up specified in PRE.B9.440.

FIN1.W910.9 SMOOTH FINISH

Finish with a steel trowel to a smooth surface, free of blemishes.

FIN1.W920.9 WOOD FLOAT FINISH

Finish with a dry wood float to give an overall even surface.

FIN1.W930.9 TEXTURED FINISH

Finish by stippling, scraping, brushing with a stiff brush or other means to produce an Approved textured surface.

FIN1.W940.9 ROUGH CAST FINISH

Throw a wet mix of aggregate and cementitious material onto the undercoat.

FIN1.W950.9 MACHINE APPLIED, TEXTURED FINISH

Apply in accordance with the manufacturer's recommendations.

ACOUSTIC PLASTER

FIN1.W1010.9 MIXING AND APPLYING

Mix and apply by special spray equipment:

1. In accordance with the manufacturer's recommendations;
2. Number of coats and total thickness: as shown on Drawings.

SPECIALIST RENDERS

FIN1.W1110.9 APPLICATION

Employ an Approved firm for the application of all resin, epoxy, urethane and acrylic based decorative finishes.

DRYING OUT AND CURING

FIN1.W1210.9 UNDERCOATS

Allow undercoats to dry out for 7 days before the application of a subsequent coat.

FIN1.W1220.9 PREMATURE DRYING

Prevent excessively rapid or localised drying out of wall or ceiling finishes by an Approved means.

ACCURACY AND TOLERANCES

FIN1.W1310.9 GENERAL

Comply with the requirements of Appendix H "Schedule of Tolerances" to this Specification and:

1. Finish wall and ceiling finishes to a true plane and to the correct line and level;
2. Ensure angles are true right angles unless otherwise required, with walls and reveals plumb and square.

PROTECTION AND CLEANLINESS

FIN1.W1410.9 PROTECTION OF EXISTING WORK

Protect existing work with boards, dust sheets and the like. Clean any droppings on existing work off immediately.

FIN1.W1420.9 PROTECTION OF NEW FINISHES

Prevent all finishes from discolouration or damage until completion.

FIN1.W1430.9 CLEANLINESS

Keep plant and tools clean and free from all traces of previous mixes.

TESTING

SURVEILLANCE TESTS

FIN1.T010.A SURVEILLANCE TESTS FOR READY-MIXED (DRY) MORTA FOR PLASTERING AND RENDERING

1. Test Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as specified or as directed by the CM.
2. Testing Samples:
   a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in FIN1.M460 (3)(a) or as instructed by the CM. One batch being the material quantity covered under each delivery note;
   b. One set of test sample shall consist of one packaged bag of ready-mixed mortar.
3. Testing methods:
   As per FIN1.M460 (2)(b).
4. Non-compliance:
   a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch off Site; or
      ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.
   b. When the representative batch of ready-mixed mortar is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
   c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

FIN2 PLASTERBOARD

MATERIALS

PLASTERBOARD

FIN2.M005.9 SUBMISSIONS

1. An Approved proprietary plasterboard system;
2. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed materials for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name, and job reference of the materials;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer.
   b. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant for the CM's inspection. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS;
   c. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the specified quality requirements for the CM's information. The date of the test shall be generally within five years prior to the notified date for commencement of the Works;
   d. Submit shop drawings of the plasterboard System, including fixing and jointing details, and method statement for Approval six months prior to fabrication.

FIN2.M010.9 GYPSUM PLASTERBOARD

1. To BS 1230:Part 1:1985 with square edges;
2. Thickness: as shown on Drawings.

STUDDING

FIN2.M110.9 TIMBER STUDDING

1. Timber quality as Worksection TIM1;
2. Design partition width: as shown on Drawings;
3. Size and arrangement of studding as per manufacturer's recommendations.

FIN2.M120.9 STEEL STUDDING

Galvanized steel support system to BS 7364:1990:

1. Design partition width: as shown on Drawings;
2. Minimum thickness of steel in studs: 0.55 mm;
3. Stud profile: 'C' 'I' or 'Z';
4. Size and arrangement of studding as per manufacturer's recommendations.

FIRE RATED BOARDS

FIN2.M130.9 FIRE RESISTANCE RATED ENCLOSURE SYSTEM

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of materials including all accessories of the proposed enclosure system for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name, and job reference of the materials;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv Details with illustration / photos of packaging of the fire resistance rated board upon delivery to site.
   b. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant for CM's inspection. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS;
   c. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test report and assessment report, if applicable, showing full compliance with the applicable requirements at sub-clause (2) for CM's information.
      i. The date of fire test report to be either –
         - Generally within five years prior to the notified date for commencement of the Works when the manufacturing plant at sub-clause (1)(b) is certified with a third party product conformity scheme such as CE Marking (CE), FM Approvals, Underwriters Laboratories (UL), Certifire, or an equivalent scheme; or
         - Generally within three years prior to the notified date for commencement of the Works.
      ii. The date of assessment report to be within five years prior to the notified date for commencement of the Works.
   d. Job reference of minimum five local projects installed with the system and completed within five years prior to the notified date for commencement of the Works;
   e. Six months prior to installing the enclosure system at either internal or external areas, submit the following for approval –
      i. Shop drawings showing the board dimensions, thickness, supporting member size, maximum fixing spacing, joint and corner details, maintenance access locations complete with signage, access opening details, etc.;
      ii. Installation method statement;

(Guidance Note: Project team to specify the design wind load for checking the fire resistance rated enclosure system)

      iii. For installation at ceiling of non-enclosed area with wind load of ….. kPa, submit structural calculations on the fire resistance rated enclosure system, including the enclosure board, supporting frame and all associated fixings in accordance with the relevant Code of Practice. Structural calculation shall be prepared, endorse and submitted by RSE.

2. Quality Requirements:

a. An Approved proprietary fire resistance rated enclosure system comprising of fire resistance rated panel or board, supporting structure and accessories;
b. Fire resistance rating of the system shall meet the project requirements as shown on Drawings;
c. Comply with the following requirement standards or equivalent international standards:
    i. BS 476 Part 4 : 1970 - Non-combustible;
    ii. BS 476 Part 7 : 1997 - Class 1 on surface spread of flame;
    iii. BS 1902: 1990 - Less than 15 x 10-6K-1 for coefficient of thermal expansion;
    iv. BS 476 Parts 20&22 : 1987 when installed at vertical non-load bearing partition and ceiling.
d. The Fire Resistance Rated Enclosure System installed at ceiling of non-enclosed areas to meet the structural requirements at sub-clause (1)(e)(iii);
e. General requirements:
    i. Not affected by temperature and humidity;
    ii. Does not contain asbestos or formaldehyde, benzene or harmful radioactive elements;
    iii. Does not produce smoke or toxic substance in case of fire;
    iv. Resistant to rot, fungus and vermin attack;
    v. Apply finishes in accordance with the manufacturer's recommendations;
    vi. Co-ordinate and provide access openings with signs.
f. Metallic Fire Resistance Rated Enclosure System –
    i. A system of composite panels fixed to galvanized steel supports; composite panel to comprise of fibre reinforced cement core mechanically bonded to min. 0.5mm thick punch hole galvanized steel sheets on both outer surfaces;
    ii. Comply with the following requirement standards or equivalent international standards:
        - BS 5669 Part 1 : 1989 or BS EN 310 : 1993 – Flexural strength min. 180N/mm^2 (Uniform Distributed Load);
        - BS EN 12467 : 2000 – Flexural strength min. 80MPa (Point Load);
        - ASTM C518: 1991 - Less than 0.130W/m^{o}K at 20^{o}C for thermal conductivity.
g. Non-metallic Fire Resistance Rated Enclosure System –
    i. A system of either fibre reinforced cement or calcium silicate boards fixed to metal supports;
    ii. Comply with the following requirement standards or an equivalent international standard:
        - BS 5669 Part 1 : 1989 or BS EN 310 : 1993 – Flexural strength min. 7.0N/mm^2 (longitudinal) and 5.0 N/mm^2 (transverse) (Uniform Distributed Load);
        - ASTM C518: 1991 - Less than 0.250W/m^{o}K at 40^{o}C for thermal conductivity.

3. On Site Delivery Verification:
    a. At delivery stage, submit the following documents:
        i. Written confirmation that the material delivered to Site conforms to the Approved sample submitted under sub-clause (1);

ii. Delivery notes for all material delivered to Site;

iii. Written confirmation from the supplier in sub-clause (1)(a)(ii) stating the Batch or Lot number of the fire rated resistance panel or board.

b. Submit the following document for verification upon delivery on Site:

i. Method:

Verification Items	Method	Acceptance Standards
Supplier's Certificate of Origin and delivery note	Document Check	Source of origin stated in the Certificate of Origin and delivery note are the same
Batch or Lot number of panels or boards delivered to Site	Document Check	Batch or Lot number stated in Supplier's confirmation letter is same as that of the boards delivered to Site.
Packaging	Visual	Same as submission at sub-clause (1)(a)(iv)

ii. Frequency:

Carry out verification for every delivery of materials made to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the acceptance standards, remove the representative batch of material off Site.

FIXING AND JOINTING MATERIALS

FIN2.M210.9 NAILS FOR FIXING PLASTERBOARD

2.65 mm galvanized steel nails with jagged shanks, to BS 1202:Part 1:1974 and

1. 30 mm long for plasterboard not exceeding 12.7 mm thick;
2. 40 mm long for plasterboard not exceeding 19 mm thick;
3. Fixing arrangement as per manufacturer's recommendations.

FIN2.M220.9 JOINT REINFORCEMENT

1. Jute scrim cloth, not less than 90 mm wide;
2. As recommended by manufacturer of plasterboard.

FIN2.M230.9 BEADS AND STOPS

1. As FIN1.M950;
2. Proprietary plastic beads and stops as per manufacturer's recommendations.

FIN2.M240.9 SCREWS FOR FIXING TO STEEL STUDDING

1. Self-drilling, self-tapping, plated, cross-head, countersunk screws, as recommended by the studding system manufacturer;
2. Screws for fixing to steel studding as per manufacturer's recommendations.

FINISHING PLASTER

FIN2.M310.9 BOARD FINISH PLASTER

Retarded hemihydrate gypsum plaster to BS 1191:Part 1:1973, Class B, Type 'b2'.

WORKMANSHIP

HANDLING AND STORAGE

FIN2.W010.9 PLASTERBOARD

1. Carry plasterboard on edge;
2. Stack plasterboard inside a building, flat, on a level surface and clear of the floor;
3. Keep the plasterboard dry and free of mould growth, programming deliveries to ensure that storage on site is kept to a minimum during periods of high humidity.

FIN2.W020.9 GYPSUM PLASTER

Ensure that gypsum plaster is delivered to Site in sealed containers and:

1. Store in weather-tight structures with a raised floor;
2. Store different types of consignments separately;
3. Use plaster in the order of delivery.

FIXING PLASTERBOARD

FIN2.W110.9 GENERAL

1. Comply with BS 8000:Part 8:1989.
2. In accordance to the approved method statement.

FIN2.W120.9 FIXING TO TIMBER BEARERS

Nail boards:

1. At each support;
2. At 150 mm centres;
3. At a minimum of 15 mm from the edge of each board;
4. Leaving a gap of 3 mm to 5 mm between the edges of the boards.

FIN2.W130.9 FIXING TO STEEL STUDDING

Erect studding and fix plasterboard, all to the studding manufacturer's sitework instructions and:

1. Screw fix plasterboard sheets generally at 300 mm centres;
2. Screw fix plasterboard to 200 mm centres to all external angles.

FIN2.W140.9 JOINTING

1. Fill joints with board finish plaster;
2. Press strips of reinforcement into the plaster, trowel flat and allow to set but not to dry before general plastering commences.

FIN2.W150.9 ACCURACY AND TOLERANCES

Comply with the requirements of Appendix H "Schedule of Tolerances", to this Specification and:

1. Finish wall and ceiling finishes to a true plane and to the correct line and level;
2. Ensure angles are true right angles unless otherwise required, with walls and reveals plumb and square.

FINISHING

FIN2.W210.9 PREPARATION

Fill all nail and screw heads and other imperfections with board finish plaster and allow to set but not to dry before general plastering commences.

FIN2.W220.9 APPLYING BOARD FINISHING PLASTER

Apply gypsum plaster as one finishing coat:

1. To a thickness not exceeding 3 mm;
2. Trowelled to a smooth surface using as little water as possible.

FIN2.W230.9 FIXING BEADS AND STOPS

As FIN1.W820.

FIN2.W240.9 ARRISES

Finish arrises to be square or pencil round as specified in Drawings.

FIN2.W250.9 PROTECTION

Protect all finishes from discolouration or damage until completion of the Works.

FIN3 SCREEDS

MATERIALS

GENERAL

FIN3.M010.9 STANDARDS

Unless otherwise specified in this Worksection, supply materials for and lay screeds in accordance with the relevant provisions of:

1. BS 8204:Part 1:1999;
2. BS 5385:Part 3:1989.

CEMENT AND AGGREGATES

FIN3.M110.9 CEMENT

As FIN1.M010.

FIN3.M120.A PFA IN SCREED MIXES

Screed mixes containing a blend of Ordinary Portland Cement and Pulverized Fuel Ash may be offered as a substitute for those specified in this Worksection provided that:

1. PFA complies with BS 3892:Part 1:1997 and PPFAC complies with BS 6588:1996;
2. Not more than 25% by weight of the cementitious content of the proposed mix comprises PFA;
3. The physical properties and workability of the proposed mix can be demonstrated to be equivalent to or better than those of the specified mixes to the CM's satisfaction;
4. Setting and hardening times will not be so affected as to compromise the construction programme.

FIN3.M130.9 SAND GENERALLY

As FIN1.M402, FIN1.M405 and FIN1.M410.

FIN3.M140.9 GRADING OF SAND FOR SCREEDS

As FIN1.M420.

FIN3.M150.9 LIGHTWEIGHT AGGREGATES

Either:

1. 5 mm exfoliated vermiculite to BS 3797:1990; or
2. Lightweight beads or granules of Approved proprietary manufacture.

FIN3.M160.9 COARSE AGGREGATE FOR SCREEDS 48 MM THICK AND OVER

Aggregate graded from 10 mm down with at least 75% being retained on a 5mm BS Test Sieve, as determined by the particle size distribution method in accordance with BS 812:Section 103.1:1985.

FIN3.M170.9 READY-MIXED (DRY) MORTARS AND READY-TO-USE (WET) MORTARS FOR SCREEDS

1. Terminology:

a. Ready-mixed mortar refers to dry bagged mortar which is ready mixed only requiring the addition of water for applications where flexibility of supply is demanded;

b. Ready-to-use mortar refers to wet mortar which is factory produced and supplied ready for use.

2. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name, and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant for CM's inspection. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (3) for CM's information:

i. The date of the test for the mortar shall be generally within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (4)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. When the ready-mixed or ready-to-use mortars for use in screeding works are locally produced, manufactured sand in lieu of river sand shall be used. Comply with the submission requirements for manufactured sand as per FIN1.M405 (1).

3. Quality Requirements:

a. To requirements of:

i. BS 4721:1981; or

ii. BS EN 13813:2002, including requirements of "Evaluation of conformity" on Initial type tests and Factory Production Control.

b. The properties and performance requirements shall comply with the class achieving:

Item	Method of Test	Requirements
Compressive strength	EN 1015-11	> 25 N/mm²

c. When the ready-mixed or ready-to-use mortars for use in screeding works are locally produced, manufactured sand in lieu of river sand shall be used. Comply with the quality requirements for manufactured sand as per FIN1.M405 (2).

4. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (2);

ii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Delivery note	Document Check	Material information recorded in the delivery notes to be same as the material delivered
Ready-mixed mortar		
Material and package	Visual	To Approved sample
Expiry Date	Check information printed on package	Minimum 6 months from the date of delivery
Manufactured sand (if used)	See FIN1.M405 (3)	See FIN1.M405 (3)
Ready-to-use mortar		
Manufactured sand (if used)	See FIN1.M405 (3)	See FIN1.M405 (3)

ii. Frequency:

- For ready-mixed mortar, one set of verification should be carried out for one packaged bag per every delivery of ready-mixed mortar made to Site under each delivery note submitted in sub-clause (4)(a);
- For ready-to-use mortar, one set of verification should be carried out for the delivery of mortar by mixer truck to Site in a day under the delivery note submitted in sub-clause (4)(a).

c. Where any of the verifications fail to meet the acceptance standards, remove the delivery off Site;

d. When the ready-mixed or ready-to-use mortars for use in screeding works are locally produced, manufactured sand in lieu of river sand shall be used. Comply with the on site delivery verification requirements for manufactured sand as per FIN1.M405 (3).

WATER

FIN3.M210.9 WATER

As FIN1.M310.

SCREEDS

FIN3.M310.9 SCREEDS BETWEEN 25 MM AND 48 MM THICK

Consisting of cement and sand or granite fines, 1 : 3, mixed with the minimum of water consistent with workability.

FIN3.M320.9 SCREEDS 48 MM THICK AND OVER

Comprising a fine concrete mix of cement, sand or granite fines and coarse aggregate, 1 : 1.5 : 3.

FIN3.M330.9 LIGHTWEIGHT AGGREGATE SCREEDS FOR ROOFS

Consisting of cement and lightweight aggregate, 1 : 8 unless otherwise indicated by the manufacturer's recommendations.

FIN3.M340.9 LIGHTWEIGHT AGGREGATE SCREEDS FOR FLOORS

Consisting of cement and lightweight aggregate, 1 : 6 unless otherwise indicated by the manufacturer's recommendations.

FIN3.M350.9 AIR ENTRAINED SCREEDS

Having a maximum dry density of 1200kg/m³.

FIN3.M360.9 TOPPING FOR LIGHTWEIGHT SCREEDS

Consisting of cement and sand 1 : 4.

ANCILLARY MATERIALS

FIN3.M410.A ADMIXTURES

1. Chloride ion content to FIN1.M810;
2. Accelerating admixtures: A proprietary product to BS EN 934-2:2009+A1:2012;
3. Retarding admixtures: A proprietary product to BS EN 934-2:2009+A1:2012;
4. Water reducing admixtures: A proprietary product to BS EN 934-2:2009+A1:2012;
5. Superplasticisers: A proprietary product to BS EN 934-2:2009+A1:2012.

FIN3.M420.9 BONDING AGENT

As FIN1.M920.

FIN3.M430.A AIR ENTRAINING ADMIXTURE FOR LIGHTWEIGHT SCREEDS

An Approved proprietary product to BS EN 934-2:2009+A1:2012 capable of producing a screed of the required density.

FIN3.M440.9 VAPOUR BARRIER

80 microns thick polyethylene sheet.

FIN3.M450.9 MOVEMENT JOINTS

As CON6.

FIN3.M460.9 WATER RESISTING ADMIXTURE

As FIN1.M870.

FIN3.M470.9 WATER RESISTING ADMIXTURE FOR TANKS FOR POTABLE WATER

As FIN1.M880.

SELF-LEVELLING SCREEDS

FIN3.M510.N POLYURETHANE RESIN / EPOXY RESIN SELF-LEVELLING SCREEDS

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name, and job reference of the material;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
         - Original or certified true copies of certification to ISO 9001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

   b. Test reports showing full compliance with the requirements of sub-clause (2) for the CM's information:
      i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;
      ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);
      iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and the extra time required;
      iv. Method statement including the repair method for the bond strength test area.
   c. Relevant information to be provided for the CM’s consideration:
      i. Construction details, such as edges, joints and skirtings etc;
      ii. Bay construction - including bay sizes and joints locations;
      iii. Tolerances and surface regularity;
      iv. Allowance for surface covering, if required;
      v. Falls and slope gradient allowed, with eventual finish to comply the surface drainage requirements;
      vi. Protection and curing;
      vii. Installation method statement from the screed manufacturer or supplier;
2. Quality requirements:
   a. A proprietary product to BS EN 13813:2002 and BS 8204-6:2008+A1:2010 type 5 or 7 with due consideration to the usage and traffic;
   b. Two-component resin flooring: one part base resin, one part reactive hardener or catalyst;

c. One or more parts fillers of sand or aggregates and pigments subject to manufacturer's recommendation;

d. Mixing ratio, pot-life, curing time strictly in accordance with manufacturer's recommendations;

e. Minimum bond strength of 1.5 N/mm^2 when tested in accordance with BS EN 13892-8:2002;

f. Surface regularity to Class SR1 of BS 8204-6:2008+A1:2010 Table 2 and to be tested in accordance with BS 8204-1:2003 Annex C;

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a); one batch being the material quantity covered under each delivery note;

ii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for self-levelling screeds upon delivery on Site. Prior to carrying out the verifications, inform the CM's or his representatives who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Delivery note	Document Check	Information recorded in the delivery notes to be same as the material delivered.
Material and packaging	Visual	To Approved sample
Expiry Date	Check information printed on the packaging	Minimum 6 months from the date of delivery

ii. Frequency:

Carry out verification for one packaged bag per every delivery of the material made to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site and one batch being the material quantity covered under each delivery note; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and the extra time required.

FIN3.M520.N CEMENTITIOUS SELF-LEVELLING SCREEDS

1. Submission Requirement as FIN3.M510 sub-clause (1);

2. Quality Requirement:

a. Thin or thick bed cementitious self-levelling screed to BS EN 13813:2002 with due consideration to the usage and traffic;

b. Blended cements, aggregates, polymers and additives;

c. Compressive strength (1 day): minimum 8 N/mm^2 to BS EN 13892-2:2002; and compressive strength (28 days) minimum 25 N/mm^2 to BS EN 13892-2:2002;

d. Suitable for the type of floor finishes specified;

e. Surface regularity to Class SR1 of BS 8204-6:2008+A1:2010 Table 2 and to be tested in accordance with BS 8204-1:2003 Annex C;

3. On site delivery verification as FIN3.M510 sub-clause (3).

WORKMANSHIP

BASE PREPARATION

FIN3.W010.9 GENERAL

1. Remove efflorescence, laitance, oil, grease, all traces of release agents, dirt and loose material by dry brushing and scraping;
2. Protect surfaces from the weather and ensure they are completely compatible with the finish to be applied before starting work.

FIN3.W020.9 PREPARATION OF HARDENED OR EXISTING CONCRETE

Either:

1. Prepare surface by:
   a. Shortly before applying the finish, thoroughly hacking the concrete surface to remove any laitance and to expose the aggregate;
   b. Thoroughly cleaning and wetting the surface as required, to adjust its suction before applying screed and remove surplus water;
   c. Brushing neat cement slurry into the damp surface immediately before applying the finish; or
2. Apply bonding agent in accordance with the manufacturer's recommendations.

MIXING SCREED MORTARS

FIN3.W110.9 GENERAL

1. Measure constituents by volume, using clean gauge boxes of sizes to suit the volumes required;
2. Make an appropriate allowance for bulking. The proportions given in this Worksection allow for the use of dry sand.

FIN3.W120.9 MIXING

Mix:

1. By mechanical mixer or, where Approved, by hand on a clean, closeboarded platform;
2. Without overmixing mortars containing plasticizers;
3. Dry constituents before mixing with water;
4. Using the minimum amount of water to achieve the required consistency and workability; making due allowance for the moisture content of manufactured sand (or sand). The water: cement ratio should be not more than 3:5 by volume.

FIN3.W130.9 LIMITS ON USE OF MIXED MATERIAL

Use within one hour of mixing and do not:

1. Use screed mortar after the initial set has taken place;
2. Reconstitute screed mortar.

FIN3.W140.9 READY-MIXED MORTARS AND READY-TO-USE MORTARS FOR SCREEDS

Mix to BS 4721:1981 and use strictly in accordance with manufacturer's recommendations for screeds.

THICKNESSES OF SCREEDS

FIN3.W210.9 BONDED TO HARDENED CONCRETE

Lay screed to the level shown on the Drawings in a layer normally up to 40 mm thick and with a minimum thickness of 25 mm at any point. Thickness of the screed may be increased to above 40 mm as and when indicated on the Drawings.

FIN3.W220.9 UNBONDED

Lay screeds not fully bonded to the base to the levels shown on the drawings in a layer up to and exceeding 70 mm thick and with a minimum thickness of 50 mm at any point, excluding the applied tile finish unless otherwise specified in the drawings.

FIN3.W230.9 FLOATING SCREEDS

Lay screed to the level shown on the Drawings in a layer up to and exceeding 90 mm thick and with a minimum thickness of 65 mm at any point, excluding the applied tile finish.

FIN3.W240.9 LIGHTWEIGHT SCREEDS

Lay screed to the level shown on the Drawings in a layer up to and exceeding 90 mm thick and with a minimum thickness of 65 mm at any point, excluding the toping.

FIN3.W250.9 TOPPING FOR LIGHTWEIGHT SCREEDS

Finish lightweight screeds with a topping of 15 mm minimum thickness.

LAYING SCREEDS

FIN3.W310.9 GENERAL

To BS 8000:Part 9:1989, lay and compact screeds level or to falls as shown on the Drawings or as otherwise required.

FIN3.W320.9 MECHANICAL APPLICATION

Submit method statement for mechanical method of applying screeding for Approval before use.

FIN3.W330.9 LAYING SCREEDS

Lay screeds to BS 8204:Part 1:1999 with particular attention to the following:

1. In areas of 24 m²and larger:
   a. Not greater than 3 to 4 m width and 5 to 6 m length for screed of all thickness; and the joints of the bays shall follow any movement joints of the base slab;
   b. With the length of each bay not greater than 1.5 times its width;
   c. In a chequerboard pattern.
2. In areas or rooms smaller than 24 m²:
   a. To whole area or room, or as sub-clauses (1)(a) and (1)(b); and
   b. Form a construction joint at door openings, or along the shortest distance across the area or room.
3. In corridors:
   a. To the full corridor width;
   b. In alternating bays not exceeding 6 m in length, and the joints of the bays shall follow any movement joint of the base slab.
4. Allowing a minimum of 12 hours to elapse between the laying of screeds in adjoining bays, connecting areas or rooms, or alternate bays;

5. As an alternative to sub-clause (4) above, the Contractor may propose to lay screeds in adjoining bays, connecting areas or rooms, and alternate bays with appropriate removable joint filler boards. Submit proposal with method statement to CM for approval.

FIN3.W336.9 VERIFICATION OF BONDED SCREED

To BS 8204:Part 1:1999 with particular attention to the following:

1. Arrange CM to select verification locations when the maximum effect of drying shrinkage of screed has taken place and before applying tile;
2. Perform one set of verification for every 10 floors or part thereof on floor to floor basis;
3. Verify the screed bonding by tapping or dragging a rod or a mallet on the surface. Hollow sound and when accompanied by lifting of bay edges or at cracks, or when not to the satisfaction of CM, propose remedial method(s) and make good the unsatisfactory areas to the satisfaction of CM;
4. Make reference to the Construction Mock-up as per PRE.B9.440 for surface roughness;
5. Record the verifications, together with the date, location reference and any other relevant information and submit two copies of the completed record to the CM.

FIN3.W340.9 LAYING LIGHTWEIGHT SCREEDS

Lay topping monolithically with the screed.

FIN3.W345.N POLYURETHANE RESIN / EPOXY RESIN SELF-LEVELLING SCREEDS

Apply polyurethane resin / epoxy resin self-levelling screeds in strict accordance with method statement provided by the manufacturer or authorised supplier.

FIN3.W350.9 VAPOUR BARRIER

Loose lay a vapour barrier under lightweight roof screeds, lapping 150 mm at joints.

FIN3.W360.9 ADMIXTURES

Mix and apply admixtures in accordance with manufacturer's instructions.

FINISHES

FIN3.W410.9 GENERAL

Apply screeds on the surfaces as shown on the Drawings and in accordance with the following clauses in this sub-section to the same standard of workmanship as approved in the Construction Mock-up specified in PRE.B9.440.

FIN3.W420.9 SMOOTH FINISH

Finish with a steel trowel to a smooth surface, free of blemishes.

FIN3.W430.9 WOOD FLOAT FINISH

Finish with a dry wood float to give an even overall surface.

FIN3.W440.9 TEXTURED FINISH

Finish by stippling, scraping, brushing with a stiff brush or other means to produce an Approved textured surface.

FIN3.W450.9 SURFACES FOR FLEXIBLE SHEET AND TILE FINISHES

Finish with a smooth surface as specified in FIN3.W420.

FIN3.W460.9 SCREEDS FOR RIGID TILE AND SLAB TILE FINISHES

Finish screeds to receive rigid tile or slab finishes with a wood float finish in accordance with FIN3.W430.

MOVEMENT JOINTS

FIN3.W510.9 GENERAL

Construct movement joints as shown on the Drawings and as specified in Worksection CON6.

FIN3.W520.9 MECHANICAL MOVEMENT JOINTS

Install in accordance with the Drawings and with the manufacturer's recommendations.

ROOF SCREEDS PENETRATED BY PIPES

FIN3.W610.9 SCREEDS PENETRATED BY PIPES LESS THAN 50 MM IN DIAMETER

Form a surround of cement and sand or granite fines, 1 : 3, 150 mm × 150 mm around the pipe sleeve, projecting 150 mm above the finished roof level and:

1. Finish the top to a slope;
2. Form combined surrounds for groups of pipes.

DRYING OUT AND CURING

FIN3.W710.9 CURING SCREEDS

Where exposed to direct wind and sunlight, immediately after laying, protect surface of screed as follows:

1. Cover the surface as soon as it is sufficiently hardened, with canvas, waterproof sheeting, mats or a layer of damp sand;
2. Keep these covering layers constantly wet for a minimum period of 7 days.

PROTECTION AND CLEANLINESS

FIN3.W810.9 PROTECTING EXISTING WORK

Protect existing work with boards, dust sheets and the like. Clean off any droppings on existing work immediately.

FIN3.W820.9 CLEANLINESS

Keep plant and tools clean and free from all traces of previous mixes.

FIN3.W830.9 PROTECTING NEW SCREEDS

Protect screeds from wear and other damage until the final floor finish is laid.

TOLERANCES

FIN3.W910.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

FIN4 INSITU WALL AND FLOOR FINISHES

MATERIALS

CEMENT

FIN4.M010.9 CEMENT

As FIN1.M010.

AGGREGATES

FIN4.M110.9 SAND GENERALLY

As FIN1.M402, FIN1.M405 and FIN1.M410.

FIN4.M120.9 GRADING OF SAND

As FIN1.M420.

FIN4.M130.9 STONE

Crushed grey granite or white stone to BS 882:1992, graded from 10 mm to 3 mm and free from dust.

FIN4.M140.9 READY-MIXED MORTARS AND READY-TO-USE MORTARS

As FIN1.M460 for in-situ wall finish.

As FIN3.M170 for in-situ floor finish.

WATER

FIN4.M210.9 WATER

As FIN1.M310.

MIX PROPORTIONS

FIN4.M310.9 CEMENT AND SAND OR GRANITE FINES

Cement and sand or granite fines in the proportion 1 : 3.

FIN4.M320.9 GRANOLITHIC

1. Mix granolithic in the proportions shown in the following table, relating to the types of finish shown or scheduled on the Drawings:

Granolithic Finishes						
Type	Cement	Granite Fines or Sand	Granite Aggregate	White/ Coloured Stone	Surface Finish	Suggested location
A	1	1	2		Trowelled or Rubbed	Floor
B	1	1		2		
C	1		2		Washed	

D	1			2		
E	2	2	3		Trowelled, Rubbed or Washed	Wall, Skirting, Treads or Risers
F	2	2		3		

2. Add minimum amount of water to give sufficient workability for laying and compacting.

FIN4.M330.9 TERRAZZO

1. First coat cement and sand or granite fines 1:3;
2. Finishing coat in one of the proportions shown in the following table:

Terrazzo Finishes			
Type	Coloured Cement	Marble Aggregate	Grade of Aggregate (mm)
A	1	2	5 to 3
B	1	2.5	10 to 5
C	1	3	10

ANCILLARY MATERIALS

FIN4.M410.9 PIGMENTS FOR CEMENT

As FIN1.M820.

FIN4.M420.9 BONDING AGENT

As FIN1.M920.

FIN4.M430.9 SURFACE HARDENER

A proprietary liquid hardener and dust proofer to Approval.

FIN4.M440.9 HARDENING ADMIXTURE

1. A proprietary product to Approval;
2. In compliance with the prescribed limit of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

FIN4.M450.9 METAL DIVIDING STRIP

1. Material: brass, stainless steel or aluminium as shown on Drawings;
2. Thickness: as shown on Drawings;
3. Size: to the full depth of the finish.

FIN4.M460.9 PLASTIC DIVIDING STRIP

1. Colour: as shown on Drawings;
2. Thickness: as shown on Drawings;
3. Size: to the full depth of the finish.

FIN4.M470.9 NON-SLIP COMPOUND INSERT

A compound of cement and carborundum dust in the proportion, 1 : 1, for filling into a pre-formed groove.

FIN4.M480.9 NON-SLIP INSERT STRIPS

An Approved proprietary insert strip:

1. Size: as shown on Drawings;
2. Colour: as shown on Drawings;
3. Slightly rounded on the top.

WORKMANSHIP

GENERAL

FIN4.W010.9 STANDARD

Comply with the relevant provisions of BS 8204:Part 1:1999, BS 8204:Part 2:2002 and BS 8204:Part 4:1993 as appropriate.

FIN4.W020.9 CONSTRUCTION MOCK-UP

Construct a Construction Mock-up of around 5 m² as PRE.B9.440 for each different type of in-situ wall and floor finishes showing the workmanship of each construction layer including background preparation through to the installation of finishes, including E&M works and accessories etc. as directed by the CM.

FIN4.W030.9 MECHANICAL APPLICATION

1. Do not use mechanical method of application without Approval for finishes other than cement sand or granite fine finish;
2. Submit method statement for mechanical method of applying finishes for Approval before use.

FIN4.W040.9 MOVEMENT JOINTS GENERALLY

Construct movement joints as shown on the Drawings and as specified in Worksection CON6.

FIN4.W050.9 MECHANICAL MOVEMENT JOINTS

Install in accordance with the Drawings and with the manufacturer's recommendations.

BASE PREPARATION

FIN4.W110.9 GENERAL

1. Remove efflorescence, laitance, oil, grease, all traces of release agents, dirt and loose material by dry brushing and scraping;
2. Protect surfaces from the weather and ensure they are completely compatible with the finish to be applied before starting work.

FIN4.W120.9 JUNCTIONS BETWEEN DISSIMILAR BACKGROUNDS

At backgrounds in the same plane or where the same finish is to be applied to surfaces in differing planes, fix a strip of steel lathing as FIN1.W310.

FIN4.W130.9 HARDENED OR EXISTING CONCRETE

1. Prepare surface by:
    a. Thoroughly hacking the concrete surface to remove any laitance and to expose the aggregate shortly before applying the finish;
    b. Thoroughly cleaning and wetting the surface as required, to adjust its suction, shortly before applying the finish;
    c. Brushing neat cement slurry into the damp surface immediately before applying the finish; or
2. Apply bonding agent in accordance with the manufacturer's recommendations.

MIXING MORTARS AS A FINISH

FIN4.W170.9 SITE MIX MORTAR

As FIN3.W110 to FIN3.W130 for in-situ floor finish;

As FIN1.W420 for in-situ wall finish.

FIN4.W180.9 READY-MIXED MORTARS AND READY-TO-USE MORTARS

As FIN3.W140 for in-situ floor finish;

As FIN1.W030 for in-situ wall finish.

APPLYING FINISHES GENERALLY

FIN4.W210.9 ACCURACY AND TOLERANCES

Refer to and comply with the requirements of Appendix H "Schedule of Tolerances" to this Specification and:

1. Finish wall and ceiling finishes to a true plane and to the correct line and level;
2. Ensure angles are true right angles unless otherwise required, with walls and reveals plumb and square.

FIN4.W220.9 LEVELS AND FALLS

Lay and compact finishes level or to falls and currents as shown on the Drawings or as otherwise required.

FIN4.W225.9 LAYING CEMENT AND SAND OR GRANITE FINES FINISH

As FIN3.W310 and FIN3.W330.

FIN4.W230.9 FINISHING FLOORING

Finish surfaces as specified for individual materials as soon as compaction is completed, and:

1. Do not bring excessive laitance to the surface, removing any which appears;
2. Do not wet the surface;
3. Repeat the trowelling process or power floating at least three times at intervals within ten hours of laying.

FIN4.W240.9 DIVIDING STRIPS

Bed the dividing strip through the whole thickness of the finishing coat from top of finish to concrete wall or floor and do not haunch them prior to laying the base.

FIN4.W250.9 NON-SLIP COMPOUND INSERT

Fill the compound into the pre-formed grooves, slightly round the top and project from the finished surface by 3 mm.

FIN4.W260.9 NON-SLIP INSERT STRIPS

Bed the strip into the pre-formed grooves and project from the finished surface by 3 mm.

APPLYING GRANOLITHIC AND TERRAZZO

FIN4.W310.9 THICKNESSES

Apply granolithic and terrazzo to the minimum thicknesses given in the following table:

Location	Granolithic Thicknesses		Terrazzo Thicknesses	
	First Coat (mm)	Finishing Coat (mm)	First Coat (mm)	Finishing Coat (mm)
Floors in one coat		minimum 20 maximum 40		
Floors in two coats	minimum 20	minimum 20	minimum 25	15
Walls and dadoes	10	10	10	10
Treads	-	20	10	15
Risers	-	15	10	10
Skirting	-	minimum 15	10	10

FIN4.W315.9 LAYING GRANOLITHIC FLOOR

1. To BS 8204:Part 2:2002 with particular attention to the following:
   a. Prepare concrete base in accordance with FIN4.W130;
   b. Brush a thin layer of neat cement grout into the surface of concrete base. A proprietary bonding agent may be added to the cement grout;
   c. Divide granolithic floor into panels with each bay not exceeding 15 m², and the length of each bay not greater than 1.5 times its width for bonded construction;
   d. Daywork joints between bays should be straight untreated vertical butt joint;
   e. Form contraction joints by sawing through the finish within 7 days of laying at 6 to 8 m in both directions;
   f. Expansion joints may be necessary subject to the location, and especially where it is exposed to weather.
2. Comply also with the following:
   a. Lay two coats if the total thickness is greater than 40 mm;
   b. Minimum thickness of first and finishing coat as FIN4.W310 for bonded construction;
   c. The finishing coat shall not be thicker than the first coat; neither coat shall be less than 20 mm thick;
   d. Both coats shall have the same mix proportions, place the finishing coat immediately on the first coat when compacted thoroughly;
   e. No pipe or conduit shall be laid in the granolithic floor finish.

FIN4.W320.9 COLOURED GRANOLITHIC AND TERRAZZO

Mix using pigmented cement and apply the second coat after the first has set.

FIN4.W330.9 TROWELLED FINISH GRANOLITHIC

Where a trowelled finish is shown or scheduled on the Drawings, either:

1. Finish with a steel trowel to a smooth surface, free of blemishes; or
2. Finish with a dry wood float to give an even overall surface.

FIN4.W340.9 RUBBED FINISH GRANOLITHIC

Where a rubbed finish is shown or scheduled on the Drawings, bring to a trowelled finish and after the granolithic has set, rub down with fine carborundum stone to form a smooth surface and to expose the aggregate.

FIN4.W350.9 WASHED FINISH GRANOLITHIC

Where a washed finish is shown or scheduled on the Drawings, bring to a trowelled finish and before the granolithic has set, brush off the surface to expose the aggregate.

FIN4.W360.9 APPLYING TERRAZZO

To BS 8204:Part 4:1993 with particular attention to the following:

1. Minimum thickness of first and finishing coat as FIN4.W310;
2. Unless specified in Drawings, divide terrazzo work into panels not exceeding 1 m²., with the length of each panel not greater than 3 times its width and separated by dividing strips while the screed is still in a workable condition;
3. Prepare concrete base in accordance with FIN4.W130;
4. Lay first coat of cement sand screed in accordance with FIN3.W330;
5. Lay finishing coat of terrazzo on the screed within 2 days after curing;
6. Grind surface to expose aggregate and produce a smooth finish after completion of laying for a minimum of 4 days;
7. Fill any voids with matching cement;
8. Apply one coat of wax polish to all wall finishes;
9. Do not highly polish or wax polish floor finishes.

APPLYING COLOURED CEMENT AND SAND OR GRANITE FINES

FIN4.W410.9 APPLYING TWO COAT COLOURED FINISH

Where coloured cement and sand or granite fines is shown or scheduled on the Drawings, lay in two coats as follows:

1. First coat using ordinary cement to a minimum thickness of 10 mm and lightly scratch to form a key;
2. Finishing coat using pigmented cement, to a minimum thickness of 5 mm, applied after the first coat has set.

DRYING OUT AND CURING

FIN4.W510.9 WALL FINISHES

Prevent excessively rapid or localised drying out of wall finishes by an Approved method.

FIN4.W520.9 CURING FLOOR FINISHES

Where exposed to direct wind and sunlight immediately after laying, protect surface of finish as follows:

1. Cover the surface as soon as it is sufficiently hardened, with canvas, waterproof sheeting, mats or a layer of damp sand;
2. Keep these covering layers constantly wet for a minimum period of 7 days.

PROTECTION AND CLEANLINESS

FIN4.W610.9 PROTECTION

Protect all finishes from discolouration or damage until completion.

FIN4.W620.9 PROTECTION OF EXISTING WORK

Protect existing work with boards, dust sheets and the like. Clean any droppings, on existing work, off immediately.

FIN4.W630.9 CLEANLINESS

Keep plant and tools clean and free from all traces of previous mixes.

FIN4.W640.9 PROTECTING NEW FINISHES

Protect finishes from wear and other damage until completion.

FIN5 FLOOR AND WALL TILES AND SLABS

GENERAL

WALL TILING WORKS IN BUILDINGS OR STRUCTURES

FIN5.G010.9 PERFORMANCE REQUIREMENTS

1. Design, install and test individual components and materials of the tile fixing system of the wall tiling works to fulfil the following:
   a. No disintegration of the wall tiling works such as visible de-bonding, de-lamination or bulging out of the wall tiles and the like;
   b. No damage of the tiling surfaces;
   c. Plane of adjacent tiles and alignment of joints shall be within the tolerance as specified in TOL.FIN5; and
   d. No growth of mould and no peeling off of the grouting. No discolouration of the proprietary or coloured grouting.
2. Comply with the acceptance standards for the Pull-off tests specified in FIN5.T150 (3)(c).

FIN5.G020.9 CONTRACTOR'S DESIGN AND BUILD TILE FIXING SYSTEM OF THE WALL TILING WORKS

1. Design and build a tile fixing system complying with the following requirements:
   a. In full compliance with the performance requirements as specified in FIN5.G010;
   b. Do not alter the types, profiles, dimensions, pattern, colour, texture and appearance of the wall tiles and grout as specified in the Specification and as shown in the Drawings;
   c. Do not alter construction of the reinforced concrete walls, panel wall partitions, brick and block walls;
   d. Do not alter the clear width of the passageway and the doorway;
   e. Do not induce mismatched junction assembling details of the adjoining components and finishes;
   f. Compatible with the installation of waterproofing system where required;
   g. Do not lower the quality standard of the original design as shown on Drawings;
   h. Meet all prevailing regulations and standards;
   i. Allow for any additional components, materials, fixing systems, changes to interfacing details etc. which are required for achieving the performance requirements as specified in FIN5.G010;
   j. Demonstrate to the satisfaction of the CM prior to the ordering of any proposed materials that the submitted proposal for the tile fixing system of wall tiling works complies with the minimum pull-off strengths by carrying out a Pull-off test in accordance with FIN5.T150 on a test mock-up sample on site;
   k. Allow for the sequence and timing for Approvals and carrying out the works without affecting the overall progress;
   l. Have no additional time or cost adjustment implications to the Contract.

2. Submit the tile fixing system for CM's Approval except when the tile fixing system or method of the wall tiling works as may be shown on the Drawings and /or described in the Specification, which is provided on a without liabilities basis, are adopted.

SLIP RESISTANCE REQUIREMENTS

FIN5.G050.9 SLIP RESISTANCE OF FLOOR SURFACE MATERIALS

1. The requirements under this clause apply to all floor surface materials including floor tiles and slabs under FIN5, and floor surface materials of other Worksection as specified;
2. Slip resistance of floor surface materials shall be measured by Wet Pendulum Test conducted in accordance with AS 4586-2013 using:
   a. Slider 96 rubber for materials used in internal areas;
   b. Slider 55 rubber for materials used in external areas.
3. For internal areas, the slip resistance value (SRV) of floor surface materials measured by wet pendulum test, and if applicable, the displacement space measured by displacement volume test, both conducted in accordance with AS 4586-2013 shall be equal to or above the lower limit of the prescribed classification in the table below:

Accommodation	Location	Classification according to **AS 4586-2013**
Domestic flats	Kitchen, bathroom, toilet	P3
Domestic flats	Shower area	P4
Common areas	Lobby, corridor, arcade, circulation area, staircase	P3
Common areas (semi-enclosed)	Corridor, staircase	P4
Ramps	Not steeper than 1:14 gradient	P3
	Steeper than 1:14 up but not steeper than 1:8	P4
Schools, offices, public buildings	Dry area	P2
	Wet area and toilet facilities etc.	P3
Commercial premises (dry areas)	Shops, supermarket, fast food outlet, food court etc.	P3
Markets (wet areas)	Fresh fruit and vegetable areas etc.	P4, V4
	Fish and meat areas etc.	P5, V8
Service areas	Refuse room, loading dock etc.	P5

4. For external areas, the slip resistance value (SRV) of floor surface materials measured by wet pendulum test conducted in accordance with AS 4586-2013 shall be equal to or above the minimum SRV stated in the table below:

Locations	Gradient of paved areas	Minimum Slip Resistance Value (SRV) according to wet pendulum test under **AS 4586-2013**
External pavements and ramps : Driveway, footpath, colonnades, walkways, pedestrian crossing, balcony, courtyards and roof deck etc.	≤ 3%	45
	>3% and ≤ 7%	50
	>7% and ≤ 12%	55
	> 12%	60

5. Submission requirements:

   Submit the original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (3) or sub-clause (4) as appropriate for CM's information. The date of the tests shall be generally within three years prior to the notified date for commencement of the Works. Submission of test reports required under this clause shall form part of the submission requirement for the individual floor surface materials.

6. Verification test requirement:

   Observe and comply with the requirements of verification test for slip resistance of floor surface materials under FIN5.T180.

MATERIALS

GENERAL

FIN5.M005.9 SUBMISSION AND DELIVERY VERIFICATION REQUIREMENTS

1. The requirements under this clause apply to all tile and slab materials under FIN5.
2. At sample submission and approval stage
   a. submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name / model name and job reference of the product;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer.
   b. submit confirmation of compliance with specification requirements, including the original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the quality requirements as appropriate for CM's information:
      i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;
      ii. The test reports shall either be submitted at the sample submission and approval stage or at a time not later than the delivery of the material to Site;
      iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
3. On Site delivery verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (2)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for the material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Dimension Check	By measurement	Within the specified BS tolerance
Surface Quality Check	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency
Check Identification Mark	Visual	To the CM's Approved sample

      ii. Frequency:

Verification Items	Sampling Frequency	Representative Batch
Dimension Check	one sample for all verification items comprising 3 pieces of tiles for each delivery per each type	Material delivered to Site under the same delivery note
Surface Quality Check		
Check Identification Mark		

c. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples each with 3 pieces of tiles selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

CERAMIC TILES GENERALLY

FIN5.M010.9 STANDARD

1. Where applicable, tiles and accessories must comply generally with BS EN 14411:2006;
2. Slip resistance of floor surface materials shall comply with and be measured by Wet Pendulum Test all in accordance with FIN5.G050.

FIN5.M020.9 CONSISTENT SUPPLY

Obtain all the tiles and accessories in a specified range from the same Approved manufacturer and ensure that they match in colour, texture, slip resistance and batch number.

FIN5.M030.N CERAMIC TILES COMPOSITION

1. Where antimony, cadmium or lead or any their compounds are used in glazes, their content shall not exceed the following specific limits:
   a. Antimony: 0.25% in weight of the glazes;
   b. Cadmium: 0.1% in weight of the glazes;
   c. Lead: 0.5% in weight of the glazes.

CERAMIC FLOOR TILES

FIN5.M110.9 SPECIALS AND SPECIAL FITTING TILES

Where ceramic floor tiles and floor quarries are specified as "including specials", ensure that the full range of accessories and fittings are available. All tiles and fittings shall be from the same manufacturer and shall match in colour, texture and slip resistance.

FIN5.M120.9 FLOOR TILES AND NOSING TILES

1. To BS EN 14411:2006:
   a. Extruded to Group AI_a or Group AI_b or Group AII_a; or Dry-pressed to Group BI_a or Group BI_b or Group BII_a;
   b. With water absorption not exceeding 6%;

c. Size: as shown or scheduled on Drawings;
d. Colour: as shown on Drawings or to Approval.

2. Including specials and special fitting tiles as in FIN5.M110 and where shown or scheduled on Drawings;
3. Slip resistance in compliance with FIN5.G050;
4. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M130.9 CLAY QUARRY TILES

1. To BS EN 14411:2006:
   a. Extruded to Group AII_a or Group AII_b. Either pressed or not pressed:
      i. The water absorption shall not exceed 10%;
      ii. Size: as scheduled on the Drawings;
      iii. Colour: as shown on Drawings or to Approval;
      iv. Including specials and special fitting tiles as in FIN5.M110 and where shown or scheduled on Drawings;
      v. Non-slip surface: as shown on Drawings or to Approval.
2. Slip resistance in compliance with FIN5.G050;
3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M140.9 NON-SLIP TILES

Where tiles are described on the Drawings or in this Specification as "non-slip" or "anti-slip", ensure that they are suitably embossed or treated with carborundum, or a similar grit, to provide an anti-slip surface with slip resistance in compliance with FIN5.G050.

FIN5.M150.9 CANTON TILES

1. Hard, sound, square, well burnt and free from twists, cracks or other defects throughout;
2. Size: uniformly, between 300 mm and 400 mm square and between 30 mm to 35 mm thick;
3. Slip resistance in compliance with FIN5.G050;
4. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M160.9 NON-SLIP TACTILE HOMOGENEOUS FLOOR TILES

1. Quality requirements:
   a. Tiles with raised profiles and suitably embossed to provide a distinctively textured walking surface easily detected by foot and cane for guidance of the visually impaired;
   b. To Group BI_a or Group BI_b of BS EN 14411: 2006, matt finish with anti-stain coating;
   c. Types: three types of tactile tiles to be used at location as shown on the Drawings:
      i. Hazard warning tiles with raised dots arranged in square grid for indication of hazard;
      ii. Directional tiles with raised strips for indication of direction; and
      iii. Positional tiles with raised dots arranged in staggered position for indication of change of direction;
   d. Nominal size: as shown on the Drawings;

e. Colour: Contrasting colour against floor background as shown on the Drawings or to Approval;

f. Slip resistance in compliance with FIN5.G050.

2. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M170.9 NON-SLIP HOMOGENEOUS FLOOR TILES

1. In addition to the submission requirements in FIN5.M005 (2), submit:

a. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

i. Original or certified true copies of certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

ii. Original or a certified true copy of the product conformity certificate to the "Product Conformity Certification Scheme For Ceramic Tiles" published by the Hong Kong Concrete Institute. The product conformity certificate shall be issued by a certification body accredited by Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM.

b. A summary of the test results under the audit testing of the "Product Conformity Certification Scheme For Ceramic Tiles". The summary shall be prepared by the accredited laboratory carried out the testing or the certified manufacturer. If so directed by the CM, submit a full set of the audit test reports to the CM for record;

c. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clauses (2)(a)(i)&(ii) for CM's information unless the test requirements are covered by the scope of the "Product Conformity Certification Scheme For Ceramic Tiles".

2. Quality Requirements:

a. To Group BI_a or Group BI_b of BS EN 14411: 2006:

i. With dimensions and surface quality, physical and chemical properties complying with the acceptance standards stated in BS EN 14411: 2006 in particular Table G.1 for Group BI_a or Table H.1 for Group BI_b for non-slip homogeneous floor tiles;

ii. With a water absorption property not exceeding 3%;

iii. Nominal size: as scheduled on the Drawings;

iv. With logo-key integrated at back of tiles.

b. Slip resistance in compliance with FIN5.G050;

c. Colour: as shown on the Drawings or to Approval.

3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

CERAMIC WALL TILES

FIN5.M210.9 GLAZED CERAMIC WALL TILES

1. In addition to the submission requirements in FIN5.M005 (2), submit:

a. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

i. Original or certified true copies of certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

ii. Original or a certified true copy of the product conformity certificate to the "Product Conformity Certification Scheme for Ceramic Tiles" published by the Hong Kong Concrete Institute. The product conformity certificate shall be issued by a certification body accredited by Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM.

b. A summary of the test results under the audit testing of the "Product Conformity Certification Scheme for Ceramic Tiles". The summary shall be prepared by the accredited laboratory carried out the testing or the certified manufacturer. If so directed by the CM, submit a full set of the audit test reports to the CM for record;

c. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(a)(i)&(ii) for the CM's information unless the test requirements are covered by the scope of the "Product Conformity Certification Scheme For Ceramic Tiles";

d. Glazed ceramic wall tiles used as lining materials for water tanks in direct contact with potable water shall comply with the relevant submission requirement as per PLU1.M1110.

2. Quality Requirements:

a. Extruded to Group AIII or dry-pressed to Group BIII of BS EN 14411:2006:

i. With dimensions, surface quality, physical and chemical properties complying with the acceptance standards stated in BS EN 14411:2006 in particular Table F.1 for Group AIII tiles or Table L.1 for Group BIII tiles;

ii. With a water absorption property exceeding 10% but not exceeding 18%;

iii. Nominal size: as shown on the Drawings;

iv. With cushion edges and round edges as shown on Drawings;

v. With logo-key integrated at back of tiles.

b. Colour: as shown on the Drawings or to Approval;

c. Glazed ceramic wall tiles used as lining materials for water tanks in direct contact with potable water shall comply with the relevant quality requirement as per PLU1.M1110.

3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M220.9 HOMOGENEOUS WALL TILES

1. In addition to the submission requirements in FIN5.M005 (2), submit:

a. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

i. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a copy of the ISO certificate is submitted, it shall be certified true by the certification body or by the QCM.

b. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(a)(i)&(ii) for CM's information.

2. Quality Requirements:

a. To Group BI_a or Group BI_b of BS EN 14411: 2006:

i. With dimensions, surface quality, physical and chemical properties complying with the acceptance standards stated in BS EN 14411:2006 in particular Table G.1 for Group BI_a or Table H.1 for Group BI_b for the homogeneous wall tiles;

ii. With a water absorption property not exceeding 3%;

iii. Nominal size: as scheduled on the Drawings;

iv. With square edges;

v. With logo-key integrated at back of tiles.

b. Colour: as shown on the Drawings or to Approval.

3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M230.9 EXTERNAL FACING TILES

1. In addition to the submission requirements in FIN5.M005 (2), submit:

a. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

i. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a copy of the ISO certificate is submitted, it shall be certified true by the certification body or by the QCM.

b. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(a)(i)&(ii) for CM's information;

c. Submit confirmation that the proposed colour ranges are in accordance with sub-clause (2)(b) below.

2. Quality Requirements:

a. To Group BI_a or Group BI_b of BS EN 14411: 2006:

i. With dimensions, surface quality, physical and chemical properties complying with the acceptance standards stated in BS EN 14411: 2006 in particular Table G.1 for Group BI_a or Table H.1 for Group BI_b for external facing tiles;

ii. With water absorption property not exceeding 3%;

iii. Type: with cushion edges as shown on Drawings;

iv. Nominal size: as shown on the Drawings;

v. With logo-key integrated at the back of tiles.

b. Colour: as shown on Drawings or to Approval.

3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M240.9 HOMOGENEOUS COVED SKIRTING TILES

1. In addition to the submission requirements in FIN5.M005 (2), submit:

a. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

i. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a copy of the ISO certificate is submitted, it shall be certified true by the certification body or by the QCM.

b. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(a)(i)&(ii) for CM's information.

2. Quality Requirements:

a. Group BI_a or Group BI_b of BS EN 14411: 2006:

i. With dimensions, surface quality, physical and chemical properties complying with the acceptance standards stated in BS EN 14411:2006 in particular Table G.1 for Group BI_a or Table H.1 for Group BI_b for the homogeneous coved skirting tiles;

ii. With water absorption property not exceeding 3%;

iii. Nominal size: as scheduled on the Drawings;

iv. With logo-key integrated at back of tiles.

b. Colour: to match floor tile or as shown on the Drawings or to Approval.

3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

CERAMIC AND VITREOUS MOSAIC TILES

FIN5.M310.9 GLAZED CERAMIC MOSAIC TILES

1. In addition to the submission requirements in FIN5.M005 (2), submit confirmation that the proposed colour ranges are in accordance with sub-clause (2)(a)(iii) below;
2. Quality Requirements:
   a. To Group BII_b of BS EN 14411: 2006:
      i. With water absorption exceeding 6% but not exceeding 10%;
      ii. Size: as scheduled on the Drawings;
      iii. Colour: as shown on Drawings or to Approval;
      iv. With square edges.
3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M320.9 UNGLAZED VITREOUS MOSAIC WALL TILES

1. In addition to the submission requirements in FIN5.M005 (2), submit:
   a. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
      i. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a copy of the ISO certificate is submitted, it shall be certified true by the certification body or by the QCM.
   b. Confirmation that the colour ranges of the proposed brand are in accordance with sub-clause (2)(b) below.
2. Quality Requirements:
   a. To Group BI_a or Group BI_b of BS EN 14411: 2006:
      i. With dimensions, surface quality, physical and chemical properties complying with the acceptance standards stated in BS EN 14411:2006 in particular Table G.1 for Group BI_a or Table H.1 for Group BI_b for unglazed vitreous mosaic wall tiles;
      ii. With water absorption property not exceeding 3%;
      iii. Nominal sizes: as shown on Drawings.
   b. Colour: generally in the ranges of light, medium and dark, and as shown on Drawings or to Approval.
3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

GLASS MOSAIC TILES

FIN5.M330.9 GLASS MOSAIC TILES

1. In addition to the submission requirements in FIN5.M005 (2), submit:
   a. When the material is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

i. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a copy of the ISO certificate is submitted, it shall be certified true by the certification body or by the QCM.

b. Confirmation that the colour ranges of the proposed brand are in accordance with sub-clause (2)(b) below.

2. Quality Requirements:

a. Fully vitrified glass mosaic tiles, regular in shape, free from cracks and sharp edges and:

i. Dimensions and surface quality:

Test Items		Test Method BS EN ISO 10545	Acceptance Standards
Nominal Size (mm)			Within the specified tolerance
- Length &Width	Deviation from Work Size (%)	Part 2 : 1997	± 1.2
- Thickness (%)			± 10
- Thickness (mm)			4
- Surface flatness	Centre curvature (%)		± 1.0
	Edge curvature (%)		± 1.0
- Surface quality (%)			> = 95

ii. Physical properties:

Test Items		Test Method BS EN ISO 10545	Acceptance Standards
Nominal Size (mm)			Within the specified tolerance
- Water absorption (%)	Average	Part 3 : 1997	< = 3
- Modules of rupture (N/mm^2)	Average	Part 4 : 1997	> = 30
E		Part 8 : 1996	< = 9.0

iii. Chemical properties:

Test Items		Test Method BS EN ISO 10545	Acceptance Standards
Nominal Size (mm)			Within the specified tolerance
- Resistance	Hydrochloric acid		Required

to acids	Lactic acid		Required
and alkali	Potassium hydroxide	Part 13:1997	Required
- Resistance to	Ammonium chloride		Required
household chemicals			
- Resistance to	Sodium hypochlorite		Required
swimming pool salts			

iv. Of uniform size as shown on Drawings.

b. Colour: generally in the ranges of light and medium as shown on Drawings or to Approval.

3. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

TERRAZZO

FIN5.M510.9 TERRAZZO FLOOR TILES

To BS 4131:1973 and:

1. Size: as shown on Drawings;
2. Colour: as shown on Drawings;
3. Surface finish: as shown on Drawings;
4. Slip resistance in compliance with FIN5.G050;
5. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

NATURAL AND RECONSTITUTED STONE

FIN5.M610.9 MARBLE SLABS

Of the quality and colours selected by the CM and:

1. Free from flaws and defects throughout;
2. Size on face as shown on the Drawings;
3. Thickness: 20 mm or as otherwise shown on the Drawings;
4. Surface finish as follows or as shown or scheduled on drawings:
   a. Highly polished;
   b. Matt finish.
5. Slip resistance in compliance with FIN5.G050 for slabs installed as floor surface material;
6. Subject to the Approval of a sample submitted before any order being placed;
7. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M620.9 GRANITE SLABS

Of the quality and colours selected by the CM and:

1. Free from flaws and defects throughout;
2. Size on face as shown on the Drawings;
3. Thickness: 20 mm or as otherwise shown on the Drawings;

4. Surface finish as follows or as shown or scheduled on drawings:
   a. Highly polished;
   b. Matt finish;
   c. Flamed finish.
5. Slip resistance in compliance with FIN5.G050 for slabs installed as floor surface material;
6. Subject to the Approval of a sample submitted before any order being placed;
7. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

FIN5.M625.9 MARBLE AND GRANITE WALL TILES

1. Maximum thickness of 7 mm;
2. Other requirements except the dimension of thickness:
   a. As FIN5.M610 for marble;
   b. As FIN5.M620 for granite.

FIN5.M630.9 NON-SLIP ARTIFICIAL GRANITE AND AGGLOMERATED MARBLE TILES

1. Size: as shown or scheduled on the Drawings;
2. Colour: all colour range;
3. With skirting tiles, tactile tiles and corner nosing tiles for steps;
4. Slip resistance in compliance with FIN5.G050;
5. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

CONCRETE TILES

FIN5.M710.9 CONCRETE FLOOR TILES

Plain concrete or granolithic to BS 1197:Part 2:1973, and

1. Size: As shown or scheduled on drawings;
2. Colour: to Approval;
3. Surface finish: to Approval;
4. Slip resistance in compliance with FIN5.G050;
5. Observe and comply with the submission and on-site delivery verification requirements as per FIN5.M005.

BEDDING AND JOINTING MATERIALS

FIN5.M810.9 CEMENT

As FIN1.M010.

FIN5.M820.9 WATER

In accordance with PRE.B10.1210 to PRE.B10.1260.

FIN5.M830.9 SAND GENERALLY

As FIN1.M402, FIN1.M405 and FIN1.M410.

FIN5.M840.9 GRADING OF SAND

As FIN1.M420.

FIN5.M860.9 CEMENT SLURRY

1. Plain or coloured cement and water mixed to a creamy consistency;
2. Do not use white cement except otherwise stated.

FIN5.M865.9 SEMI-DRY MIX

To BS 5385:Part 5:1994 with particular attention to the following:

1. Cement and sand, 1 : 3 to 4 mix;
2. Water cement ratio ranging from 0.55 to 0.6.

FIN5.M870.9 MORTAR FOR CEMENT SAND MORTAR BEDDING FIXING

Cement and sand, 1 : 3 mix.

FIN5.M880.9 BEDDING FOR MARBLE AND GRANITE FLOOR SLABS

Cement and sand, 1 : 3 mix.

FIN5.M890.9 PLASTERS FOR MARBLE AND GRANITE WALL TILES

To BS 5492:1990 Table 1 and 2.

FIN5.M900.9 FIXINGS FOR MARBLE AND GRANITE WALL SLAB

1. Dowel, adjustable plates, angle brackets, connecting bolts, washers, shins, anchor bolts shall be of stainless steel grade 304 for internal use or grade 316 for external use as in MET1.M060;
2. Stainless steel dowels shall be:
   a. No less than 3 mm diameter for wall slabs with nominal thickness of 30 mm or less;
   b. No less than 4.7 mm diameter for wall slabs with nominal thickness of 40 mm.
3. Fixing methods in accordance with the Drawings or Approved shop drawings and relevant statutory requirements.
4. At delivery stage, carry out and submit report of Chemical Drop Test according to MET1.M060 for grade 316 stainless steel fixing parts.

FIN5.M920.9 POINTING FOR MARBLE AND GRANITE FLOOR SLABS

1. Coloured cement and sand, 1 : 3 mix for 3 mm and above tile joint;
2. Neat coloured cement grout for narrow joints;
3. Colour: as shown on Drawings or to Approval.

FIN5.M930.9 POINTING FOR MARBLE AND GRANITE WALL TILES

1. Cementitious pointing:
   a. 4 : 1 cement sand mortar for narrow joints with width at 1 mm to 2 mm;
   b. 1 : 3 cement sand mortar for joints with width at 3 mm or more.
2. Sealant pointing:
   a. To BS 8298:1989 Table 8 and WAT5, 1 part polyurethane sealant or 1 part polysulphide;
   b. Other types of sealant may be submitted subject to the CM's approval;
   c. Obtain information from the sealant manufacturer that the sealant will not stain the stone;
   d. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.
3. Colour of the mortar and sealant: as shown on Drawings or to Approval.

FIN5.M940.9 GROUT FOR FLOOR TILING

Cement and sand, 1 : 1 mix, mixed to a paste with a minimum of water.

FIN5.M950.9 GROUT FOR MOSAIC TILING

White or ordinary cement mixed to a paste with a minimum of water, for tile joint not greater than 3 mm wide or cement and sand, 1 : 3 mix, for joint greater than 3 mm wide.

FIN5.M960.9 GROUT FOR GLAZED WALL TILING

White cement mixed to a paste with a minimum of water, for tile joint not greater than 3 mm wide or cement and sand 1 : 3 mix for joint greater than 3 mm wide.

FIN5.M970.9 GROUT FOR EXTERNAL FACING TILES

Cement mixed to a paste with a minimum of water, for tile joint not greater than 3 mm wide or cement and sand 1 : 3 mix for joint greater than 3 mm wide.

FIN5.M980.9 PROPRIETARY GROUT

1. Approved proprietary manufacturer and product;
2. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

FIN5.M990.9 BONDING AGENT

As FIN1.M920.

FIN5.M995.9 MOVEMENT JOINTS FOR MARBLE AND GRANITE WALL TILES AND FLOOR SLABS

Unless otherwise indicated on the Drawings or instructed by the CM:

1. Sealant: 1 part polyurethane to WAT5.M150 and in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation;
2. Back-up material to WAT5 with particular attention to the following:
   a. Compatible with the Approved sealant;
   b. Circular section strip of cellular rubber or cellular polyethylene.

TILE ADHESIVES AND GROUTING

FIN5.M1010.A TILE ADHESIVES AND TILE GROUT

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed tile adhesives and tile grout for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name / model name and job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
      v. Detailed Method Statement for the installation of the tiling systems, showing all work procedures from the preparation of background through to the cleaning of the completed assembly;

vi. Proposed arrangement for the quarantine material verification test specified in sub-clause (5), including delivery programme, quantity of each batch of delivery and storage location of tile adhesive delivered to Site and to manufacturer's factory of precast concrete components;

vii. When the tile adhesives and grout are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- Submit one sample board similar to the one maintained by the Housing Department showing the quality, detailed method statement and work procedures of the adhesives and grout. When the proposed brand of tile adhesive or grout has not been approved by HA for use in a construction project in the past five years prior to the notified date of commencement of the Works, submit an extra set of identical sample for retention by the Housing Department upon approval of sample;
- Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

- Original or a certified true copy of the product conformity certificate to the "Product Conformity Certification Scheme for Tile Adhesives" published by the Hong Kong Concrete Institute. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM.

viii. When the tile adhesive is used for fixing external wall tiles, confirmation from the tile adhesive manufacturer that the tile adhesive is suitable for external applications;

ix. VOC data submission of tile adhesive in compliance with TIM1.M090.

b. A summary of the test results under the audit testing of the "Product Conformity Certification Scheme for Tile Adhesives". The summary shall be prepared by the accredited laboratory carried out the testing or the certified manufacturer. If so directed by the CM, submit a full set of the audit test reports to the CM for record;

c. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b), (2)(c), (2)(d) & (2)(i) for the CM's information unless the test requirements are covered by the scope of the "Product Conformity Certification Scheme for Tile Adhesives":

i. The date of the test shall be generally within two years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to the CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

d. Tile grout used as lining materials for water tanks in direct contact with potable water shall comply with the relevant submission requirement as per PLU1.M1110.

2. Quality Requirements:

a. Cement based compatible with the substrate and tiles to be installed;

b. For glass mosaic tiles and other tile types (except homogeneous tiles) of size below 300x300 mm, use tile adhesive to BS EN 12004:2007 normal setting cementitious type class C1 with minimum tensile adhesive strength as follow:

Characteristic	Requirement	Test Method
Initial tensile adhesion strength	≥ 0.5 N/mm²	8.2 of BS EN 1348: 2007
Tensile adhesion strength after water immersion	≥ 0.5 N/mm²	8.3 of BS EN 1348: 2007
Tensile adhesion strength after heat ageing	≥ 0.5 N/mm²	8.4 of BS EN 1348: 2007
Tensile adhesion strength after freeze-thaw cycles	≥ 0.5 N/mm²	8.5 of BS EN 1348: 2007
Open time: tensile adhesion strength	≥ 0.5 N/mm² after not less than 20 min	BS EN 1346:2007

c. For homogeneous tiles and other tile types of size 300x300 mm or above, use tile adhesive to BS EN 12004:2007 improved cementitious type class C2E with additional characteristics and minimum tensile adhesive strength as follow:

Characteristic	Requirement	Test Method
High initial tensile adhesion strength	≥ 1 N/mm²	8.2 of BS EN 1348: 2007
High tensile adhesion strength after water immersion	≥ 1 N/mm²	8.3 of BS EN 1348: 2007
High tensile adhesion strength after heat ageing	≥ 1 N/mm²	8.4 of BS EN 1348: 2007
High tensile adhesion strength after freeze-thaw cycles	≥ 1 N/mm²	8.5 of BS EN 1348: 2007
Extended open time: tensile adhesion strength	≥ 0.5 N/mm² after not less than 30 min	BS EN 1346:2007

d. Tile grout to :

i. ANSI A118.6:1992 as follows:

Items	Test Method	Acceptance Standards	Remarks
Linear Shrinkage	ANSI A118.6:1 992 Clause H4.3	1 day shrinkage < 0.1% 7 days shrinkage < 0.2%	Cast and store grout specimens at 21° - 25°C, 45 - 55% R.H.
Water Absorption	ANSI A118.6:1 992 Clause H3.4	From 50% R.H. to immersion < 5% From immersion to dry < 7%	Determine water absorption from 50% R.H. to immersion and from immersion to dry.
Compatibility with Tile Adhesive (Tensile Adhesion)	BS 5980:1980 Appendix D with modification. A layer of tile grout is applied on tile adhesive for tensile adhesion test	Requirements of BS 5980:1980 are taken > = 950 N for 14 days in laboratory condition > = 560 N for 7 days curing in laboratory condition followed by 7 days immersion in water Laboratory Condition: 20° ± 2°C 45 to 75% R.H.	A layer of tile grout (1.5 mm thick) is applied over tile adhesive 1.5 mm thick (brand to be the one selected by the CM) which shall have been embedded in standard test piece tiles to harden for 24 hours. Ten such assemblies are prepared and cured for 14 days at laboratory condition and then subject to tensile force. Further ten assemblies are required for similar tensile tests under 7 days curing at laboratory condition followed by 7 days immersion in water.
Resistance to Mould Growth	BS 5980:1980 Appendix B	No sign or evidence of mould growth on tile grout.	3 mm thick tile grout is applied over biscuit side of test piece tile and the assembly be placed in Petri dishes for incubation at 29° ± 1°C for 24 hours after addition of potato dextrose agar. Aspergillus niger is inoculated into the grout. The whole assemble is incubated for 14 days at 29° ± 1°C.

or

ii. CGI of BS EN 13888:2009 for internal tiling and CG2WA of BS EN 13888:2009 for external tiling as follows:

Items	Test Method	Acceptance Standards	Remarks
Shrinkage	BS EN 12808-4:2009	≤ 3 mm/m	-
Water Absorption after 30 min.	BS EN 12808-5:2008	≤ 2 g	-
Water Absorption after 240 min.	BS EN 12808-5:2008	≤ 5 g	-
Compatibility with Tile Adhesive	BS EN 12004-2:2017 with modification.	- Initial tensile adhesion strength > = 950 N - Tensile adhesion strength after water immersion > = 560 N	A layer of tile grout (1.5 mm thick) is applied over tile adhesive 1.5 mm thick (brand to be the one selected by the CM) which shall

(Tensile Adhesion)	A layer of tile grout is applied on tile adhesive for tensile adhesion test		have been embedded in standard test piece tiles to harden for 24 hours. Ten such assemblies are prepared and cured for 14 days at laboratory condition and then subject to tensile force. Further ten assemblies are required for similar tensile tests under 7 days curing at laboratory condition followed by 7 days immersion in water.
Resistance to Mould Growth	BS 5980:1980 Appendix B	No sign or evidence of mould growth on tile grout.	3 mm thick tile grout is applied over biscuit side of test piece tile and the assembly be placed in Petri dishes for incubation at 29° ± 1°C for 24 hours after addition of potato dextrose agar. Aspergillus niger is inoculated into the grout. The whole assemble is incubated for 14 days at 29° ± 1°C.

e. Colour: white or grey for tile adhesive and to Approval for tile grout;

f. Packed in three ply together with preparation procedures and application methods. Minimum one set of the preparation procedures and application methods shall be printed in Chinese and diagrammatic forms for each lot that is delivered to site;

g. Brand name, batch number, type and class, manufacturing date, shelf life, pot life and open time to be clearly printed on outside of package;

h. No prior soaking of tiles is required;

i. Tile adhesive compatibility with panel wall to be demonstrated via the following test method:

   i. Test against the panel wall partition selected for the Contract complete with moisture sealer. Acceptance standard to be minimum 0.3 N/mm²;

   ii. Select four specimens of 200x200 mm ceramic glazed wall tile and fix the four tiles vertically without additional support according to the manufacturer's specification;

   iii. The interval between applying tile adhesive and placing tiles is not more than 5 minutes. Record the extent to which slip occurs per the first minute after placing tile specimen. The tile specimens are fixed by adhesive tape to prevent further slip;

   iv. The sample shall be subjected to tests of Tensile Adhesion Strength with an adhesive not exceeding 3 mm in final bed thickness;

   v. Pull off tiles on a minimum of 28 days after fixing;

   vi. Attach an aluminium / steel dolly onto the surface of the specimen by a suitable adhesive resin;

   vii. Use strong adhesive tape to fix the position of dolly until strength of the resin is developed as advised by the resin manufacturer;

viii. Connect the dolly to the Pull-off Test device. The pull-off equipment shall be capable of increasing the load steadily without jerking at a rate of (250 + 50) N/s, and must be provided with a measurement device which shall retain the maximum force exerted, the so called failure load to the nearest 0.01 KN. ;

ix. Apply a tensile force gradually by the device;

x. Record the failure force, location of failure and any other observations or abnormalities;

xi. Record the force from the readout unit;

xii. Repeat steps as described in sub-clauses (vi) to (xi) until Pull-off Tests to all four tiles are completed;

xiii. Take photographs.

j. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation;

k. Tile grout used as lining materials for water tanks in direct contact with potable water shall comply with the relevant quality requirement as per PLU1.M1110.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin, batch number and manufacturing date for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for tile adhesive and grout upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	To Approved Sample
Lot Number / Batch Number	Document Check	Same as delivery note
Expiry Date	Check information printed on the packing	Minimum 6 months from the date of delivery

ii. Frequency:

Carry out verification on one sample per every delivery of tile adhesive or grout made to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM; one sample being one packaged bag / container of tile adhesive or grout. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

4. Delivery Verification at Manufacturer's Factory of Precast Concrete Components:

a. At delivery stage, submit the following documents to the CM or his representatives resident at manufacturer's factory:
   i. Written confirmation that the material delivered to the manufacturer's factory conforms with the Approved sample submitted under sub-clause (1)(a);
   ii. Original or certified true copy of the Certificate of Origin, batch number and manufacturing date for every batch of delivery. One batch being the material quantity covered under each delivery note;
   iii. Delivery notes for all material delivered to the manufacturer's factory.

b. Carry out the following verifications for tile adhesive and grout upon delivery to the manufacturer's factory and in the presence of the CM or his representatives resident at manufacturer's factory:
   i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	To Approved Sample
Lot Number / Batch Number	Document Check	Same as delivery note
Expiry Date	Check information printed on the packing	Minimum 6 months from the date of delivery
Shelf life	Check information printed on the packing	Not expired

   ii. Frequency:

   Carry out verification for one packaged bag / container per every delivery of tile adhesive or grout made to the manufacturer's factory under each delivery note submitted in sub-clause (4)(a).

c. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off the manufacturer's factory; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM; one sample being one packaged bag / container of tile adhesive or grout. In case of failure of any verification to any one sample, remove the representative batch off the manufacturer's factory, bear all associated costs, and no extension of time will be allowed.

5. Quarantine for Material Verification Test

a. Save as stated in sub-clause (5)(e), each batch of tile adhesive delivered to Site and to manufacturer's factory of precast concrete components shall be subject to material verification test specified in the respective specification in FIN5.T105 and FIN5.T108. No tile adhesive shall be used in permanent works or precast concrete components during the material verification test unless approved by the CM under sub-clause (5)(d);

b. In the event that the tile adhesive delivered to Site is stored on Site during the material verification test to be conducted as specified in FIN5.T105, comply with the following requirements for storing the delivered materials:
   i. Store the tile adhesive in a cool, well-ventilated and covered storage accommodation on Site and in accordance with manufacturer's recommended ambient storage conditions;
   ii. Provide a record of the batch number, manufacturing date, quantity and storage location of each batch for CM's record.

c. In the event that the tile adhesive delivered to the manufacturer's factory is stored in the manufacturer's factory during the material verification test to be conducted as specified in FIN5.T108, comply with the following requirements for storing the delivered materials:

i. Store the tile adhesive in a cool, well-ventilated and covered storage accommodation in the manufacturer's factory and in accordance with manufacturer's recommended ambient storage conditions;

ii. Provide a record of the batch number, manufacturing date, quantity and storage location of each batch to the CM or his representatives resident at manufacturer's factory for record.

d. In the event of circumstances where the contractor considers necessary to use the tile adhesive in permanent works or precast concrete components during the material verification test as stipulated in sub-clause (5)(a), seek Approval in advance of the material delivery with full substantiation and proposed measures to safeguard against the risk of material non-compliance;

e. Unless otherwise instructed by the CM, sub-clauses (5)(a), (5)(b), (5)(c) and (5)(d) are not applicable to tile adhesive solely used for nosing tile or non-slip tactile homogeneous floor tile on precast staircase.

FIN5.M1020.9 EPOXY BASED TILE ADHESIVE

1. An Approved single component epoxy tile adhesive installed to manufacturer's instructions;
2. Quality performance to comply with BSEN 12004:2007 Reaction Resin Adhesive requirements, or equivalent, as follows:

Characteristic	Requirement	Test Method
Initial shear adhesion strength	≥ 2 N/mm²	7.3 of BSEN 12003: 2008
Shear adhesion strength after water immersion	≥ 2 N/mm²	7.4 of BSEN 12003: 2008
Open time: tensile adhesion strength	≥ 0.5 N/mm² after not less than 30 min	BSEN 1346:2007 (1)

(1) Back buttering shall be applied on tiles in the test of open time.

3. Brand name, batch number, type and class, manufacturing date, shelf life or expiry date, pot life and open time to be clearly printed on outside of the package. Carry out verifications at delivery stage and inform the CM who may present to witness the verifications;
4. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

CEMENT SAND MORTAR WITH LATEX

FIN5.M1050.9 CEMENT SAND MORTAR WITH LATEX FOR DIRECT APPLICATION OF TILING ON CONCRETE SURFACES

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed latex for use with cement sand mortar for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

vi. Detailed Method Statement for the installation of the tiling systems, showing all work procedures from the preparation of background, measuring and mixing of constituents, fixing of tiles through to the cleaning of the completed assembly;

v. Proposed arrangement for the quarantine material verification test specified in sub-clause (5), including delivery programme, quantity of each batch of delivery and storage location of latex delivered to Site and to manufacturer's factory of precast concrete components;

vi. Original or a certified true copy of the certification to ISO 9001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition arrangement with HKAS.

b. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be entitled.

2. Quality Requirements:

a. Approved latex, cement and sand of mix proportion recommended by the latex manufacturer and compatible with the substrate and tiles to be installed;

b. The quality and performance requirements are as follows:

Characteristic	Requirement	Test Method
Initial tensile adhesion strength	≥ 1 N/mm²	8.2 of BSEN 1348: 2007 (1)
Tensile adhesion strength after water immersion	≥ 1 N/mm²	8.3 of BSEN 1348: 2007 (1)
Tensile adhesion strength after heat ageing	≥ 1 N/mm²	8.4 of BSEN 1348: 2007 (1)
Tensile adhesion strength after freeze-thaw cycles	≥ 1 N/mm²	8.5 of BSEN 1348: 2007 (1)
Open time: tensile adhesion strength	≥ 0.5 N/mm² after not less than 30 min	BSEN 1346:2007 (1)(2)

(1) Fine-graded sand of 600 μ m grain size shall be used.

(2) Back buttering shall be applied on tiles in the test of open time.

c. Brand name, batch number, type and class, manufacturing date, shelf life or expiry date, pot life and open time to be clearly printed on outside of the latex package;

d. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin, batch number and manufacturing date for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for the latex upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Lot Number / Batch Number	Document Check	Same as delivery note
Expiry Date	Check information printed on the packing	Minimum 6 months from the date of delivery
Shelf life	Check information printed on the packing	Not expired

      ii. Frequency:

      One set of verification should be carried out for every delivery of latex made to Site under each delivery note submitted in sub-clause (3)(a).
   c. Where any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be entitled.
4. Delivery Verification at Manufacturer's Factory of Precast Concrete Components:
   a. At delivery stage, submit the following documents to the CM or his representatives resident at manufacturer's factory:
      i. Written confirmation that the material delivered to the manufacturer's factory conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin, batch number and manufacturing date for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all materials delivered to the manufacturer's factory.
   b. Carry out the following verifications for latex upon delivery to the manufacturer's factory and in the presence of the CM or his representatives resident at manufacturer's factory:
      i. Method:

Verification Items	Method	Acceptance Standards

Material and Packaging	Visual	Same as the CM's Approved Sample
Lot Number / Batch Number	Document Check	As provided
Expiry Date	Check information printed on the packing	Minimum 6 months from the date of delivery
Shelf life	Check information printed on the packing	Not expired

ii. Frequency:

One set of verification should be carried out for every delivery of latex made to the manufacturer's factory under each delivery note submitted in sub-clause (4)(a).

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off the manufacturer's factory; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off the manufacturer's factory, bear all associated costs, and no extension of time will be entitled.

5. Quarantine for Material Verification Test

a. Each batch of latex delivered to Site and to manufacturer's factory of precast concrete components shall be subject to material verification test specified in the respective specification in FIN5.T106 and FIN5.T109. No latex shall be used in permanent works or precast concrete components during the material verification test unless approved by the CM under sub-clause (5)(d);

b. In the event that the latex delivered to Site is stored on Site during the material verification test to be conducted as specified in FIN5.T106, comply with the following requirements for storing the delivered materials:

i. Store the latex in a cool, well-ventilated and covered storage accommodation on Site and in accordance with manufacturer's recommended ambient storage conditions;

ii. Provide a record of the batch number, manufacturing date, quantity and storage location of each batch for CM's record.

c. In the event that the latex delivered to the manufacturer's factory is stored in the manufacturer's factory during the material verification test to be conducted as specified in FIN5.T109, comply with the following requirements for storing the delivered materials:

i. Store the latex in a cool, well-ventilated and covered storage accommodation in the manufacturer's factory and in accordance with manufacturer's recommended ambient storage conditions;

ii. Provide a record of the batch number, manufacturing date, quantity and storage location of each batch to the CM or his representatives resident at manufacturer's factory for record.

d. In the event the contractor considers necessary to use the latex in permanent works or precast concrete components during the material verification test as stipulated in sub-clause (5)(a), seek Approval in advance of the material delivery with full substantiation and proposed measures to safeguard against the risk of material non-compliance.

ANCILLARY MATERIALS

FIN5.M1110.9 NON-SLIP SURFACE

Anti-slip system for surface treatment of granite floor tiles to CM's Approval.

FIN5.M1120.9 MOVEMENT JOINTS FOR CERAMIC AND MOSAIC TILES

Sealant and back-up material to WAT5 and to BS 5385:Part 1:1995 with particular attention to paragraph 2.10.

WORKMANSHIP

GENERAL

FIN5.W010.9 STANDARD

Except where otherwise specified carry out:

1. Internal ceramic wall tiling and mosaics generally in accordance with BS 5385-1:1995;
2. External ceramic wall tiling and mosaics generally in accordance with BS 5385-2:1991;
3. Internal ceramic floor tiling and mosaics generally in accordance with BS 5385-3:1989;
4. Terrazzo tile and natural stone slab flooring generally in accordance with BS 5385-5:1994.

FIN5.W020.9 PREPARATION OF CONCRETE SURFACES FOR DIRECT APPLICATION OF TILING

Either:

1. Prepare the surface by:
   a. Thoroughly hack the concrete surface to remove any laitance and to expose the aggregates;
   b. Thoroughly clean and wet the surface shortly before applying the finish;
   c. Brush neat cement slurry into the damp surface immediately before applying the finish; or
2. Apply proprietary bonding agent in accordance with the manufacturer's recommendations.

FIN5.W025.9 CUTTING TILES

To BS 8000:Section 11.1:1989:

1. Cut tiles neatly and accurately;
2. Maintain general joint width along cut edges;
3. Cut and fit tiling neatly around pipes, electrical boxes, etc.

FIN5.W030.9 CLEANLINESS

Clean all tiling as the work progresses, removing bedding mortar, adhesive, and grout from the tile surfaces at each stage, as soon as the initial set has taken place and before the material has fully hardened. Cleaning tiles at a later stage using corrosive cleaning agent will not be permitted.

FIN5.W040.9 CUT MITRES ETC

Cut mitres and the like only when tiles are specified without special tiles and, when a full range of tile fittings is unavailable.

FIN5.W050.9 CONSTRUCTION MOCK-UP

Construct a Construction Mock-up of around 5 m² each for the wall and floor installations in accordance with PRE.B9.440 for:

1. Wall tiling at lift lobby, bathroom and kitchen:

a. Where applicable, show the workmanship of each construction works including spatterdash, rendering, substrate preparation, junctions, jointing including movement joints, sealant, moisture sealer, E&M works and accessories, waterproofing, skirting, floor drain, bond coat, bedding, tiles laying and pointing, cleanliness etc., as directed by the CM.

2. Floor tiling at lift lobby, bathroom and kitchen:
   a. Where applicable, show the workmanship of each construction layer including substrate preparation, angles fillet, layers of waterproofing, floor drains, floor screed, bond coat, bedding, jointing including movement joints, tiles laying and pointing, cleanliness and etc., as directed by the CM.
3. Fixing marble and granite wall slab:
   a. Where applicable, show the workmanship of all fixing methods, movement joints, back-filling and pointing, cleanliness and etc., as directed by the CM.

(Guidance Note: Sub-clause (4)- specify the dimensions for the Construction Mock Up)

4. When granite or marble vertical installation is used, construct a mock up …… m wide by …….. m high to demonstrate workmanship of all construction details as shown in the approved shop drawings as per FIN5.W440, including but not limited to fixing and hanging methods, joints including movement joints if provided, and sub-frame structure etc..

FIN5.W060.9 TILE JOINT TREATMENT

1. Remove any dust or debris that is collected in the tile joints prior to grouting;
2. Proprietary grouts: do not wet joint cavities prior to grouting if proprietary grout is used particularly when fixing with adhesive or according to the manufacturer's recommendation;
3. Cement grouts: wet the joint cavities prior to grouting;
4. Use plastic string or strip to form the required width of joints in lieu of cross-shaped spacers for both ceramic and homogeneous wall tiles. Do not leave behind any plastic tile spacers or string in the tiling work.

FIN5.W070.9 TILING WORKS ADJOINING FRAMES OF TIMBER DOOR AND HOSE REEL CABINETS

1. Fix tiling works around the door frames in accordance with Drawings;
2. Do not fix tiles over frames of timber doors and cabinets.

LAYING FLOOR TILES

FIN5.W120.9 CEMENT : SAND MORTAR BEDDING METHOD

To BS 5385:Part 3:1989 with particular attention to clause 24.1:

1. Soak tiles in clean water as required in accordance with the manufacturers' instruction and allow to drain;
2. Dampen the screed with clean water to reduce suction if required;
3. Lay 1 : 3 cement and sand bedding mortar over the screed, spread and trowel to the thickness as shown on Drawings;
4. Spread the back of the tiles with slurry and immediately lay and tamp them firmly into the bedding, forming straight and even joints, 3 mm wide unless shown otherwise on Drawings;
5. Allow the bedding to set and grout up joints, cleaning any surplus grout from the face of the tiles as the work proceeds.

FIN5.W130.9 CEMENT-BASED ADHESIVE BEDDING METHOD

To BS 5385-3:1989 with particular attention to clause 24.4:

1. Fix tiles with adhesive and ensure the tile adhesive is prepared and mixed in accordance with the manufacturer's recommendations;
2. Grout up joints using proprietary grout in accordance with the grout manufacturer's recommendations.

FIN5.W140.9 SEMI-DRY METHOD

Do not use.

FIN5.W150.9 LAYING TACTILE HOMOGENEOUS FLOOR TILES

1. Avoid as much as practicable the cutting of tiles;
2. Normal tile to tile joints to be the same as that for adjacent general flooring;
3. In order not to cause any disruption to the tactile guide path, keep away accessories such as metal grating and manhole covers which will cause a disruption to the floor pattern.

FIN5.W160.9 TRAFFIC ON NEWLY LAID FLOORS

Do not allow traffic on newly laid floors until 4 days have elapsed since completion of laying. Permit only light traffic for a further period of ten days.

FIXING WALL TILES

FIN5.W210.9 CEMENT : SAND MORTAR BEDDING METHOD

To BS 5385-1:1995 with particular attention to clause 4.2.3.5.

1. Bonding coat referred to in sub-clause 4.2.3.5.1 to be in accordance with FIN5.M860;
2. Soak tiles in clean water for a minimum of 30 minutes, stack to drain and fix as soon as the surface water has drained from them. Do not soak homogeneous wall tiles;
3. Tiles to be cleaned free of dust and loose powder before application;
4. Dampen the wall render with clean water, sufficiently to prevent it absorbing water from the bedding mortar;
5. Butter the back of each tile with cement and water slurry and tamp it firmly into position so that the bed is uniformly spread throughout to a minimum thickness of 3 mm and not more than 6 mm at localised areas for rectification of slight variations in the trueness of the render background;
6. Form joints 1.5 mm wide for tiles up to 150 x 150 mm and 3.0 mm wide for tiles of 200 x 200 mm and over, unless shown otherwise on Drawings. Ensure the required joint width is provided through the entire depth of the tile joint;
7. Clean tiles and joints before the bedding hardens;
8. Grout the joints at least 24 hours after fixing the tiles and clean off surplus grout as the work proceeds.

FIN5.W220.9 CEMENT-BASED ADHESIVE BEDDING METHOD

To BS 5385-1:1995:

1. Site demonstration is to be carried out by the adhesive supplier on the whole application procedures before commencing the tiling works;
2. Tiles to be cleaned free of dust and loose powder and left thoroughly dry before immediate application;

3. Do not wet tiles when fixing with tile adhesives unless stated in the manufacturer's recommendation;
4. Prepare and mix tile adhesive in strict accordance with the manufacturer's recommendation;
5. Apply the adhesive by notched trowelling and buttering method;
6. Apply and press the adhesive into the surface to give a bed thickness of about 3 mm before combing the adhesive with a notched trowel of size recommended by manufacturer. Do not apply more adhesive on the wall than can be covered with tiles within the "open time" of the adhesive;
7. Butter a thin coating of adhesive over the back of tile to fill the ribs or keys before pressing and tamping the tiles in position on the combed adhesive bed to spread the adhesive evenly over the back of tile;
8. There should be no significant increase in the final bed thickness;
9. Form joints to width specified against respective tile sizes;
10. Grout up joints using proprietary grout in accordance with the grout manufacturer's recommendations;
11. Cleaning of tiles to be in accordance with FIN5.W030.

FIN5.W230.9 FIXING TO PANEL WALL PARTITIONS

1. Fix wall tiles using a proprietary adhesive in accordance with FIN5.M1010. Apply adhesive in accordance with FIN5.W220;
2. Grout up joints using a proprietary grout in accordance with FIN5.M1010. Apply tile grout in accordance with the grout manufacturer's recommendation.

FIN5.W240.9 FIXING TO BLOCKWORK OR CONCRETE

1. Fix wall tiles using proprietary adhesive in accordance with FIN5.M1010 on single coat render in accordance with FIN1.W520 (1); or
2. Fix wall tiles using a proprietary adhesive in accordance with FIN5.M1010 on two coats render in accordance with FIN1.W520 (2); and
3. Grout up joints using proprietary grout in accordance with FIN5.M1010. Apply tile grout in accordance with the grout manufacturer's recommendation.

FIN5.W250.9 DIRECT APPLICATION OF TILING ON CONCRETE SURFACE WITH CEMENT SAND MORTAR MIXED WITH LATEX BEDDING

1. Demonstration on Site and at manufacturer's factory of precast concrete components, where applicable, shall be carried out by the latex manufacturer on the whole application procedures before commencing the tiling works;
2. Tiles shall be cleaned, free of dust and loose powder and left thoroughly dry before immediate application;
3. Do not wet tiles when fixing with cement sand mortar with latex unless otherwise stated in the manufacturer's recommendation;
4. Sand shall be stored on impervious sheet and keep under cover before use;
5. Prepare and mix latex, cement and sand in strict accordance with the manufacturer's recommendation;
6. Apply the cement sand mortar with latex by notched trowelling and buttering method to thickness 12mm and in strict accordance to the detailed method statement. Take extreme care during application and inspection of the work. Do not apply more cement sand mortar with latex on the wall than can be covered with tiles within the "open time" of the latex;
7. Form joints to width specified against respective tile sizes;
8. Grout up joints using proprietary grout in accordance with the grout manufacturer's recommendations;

9. Cleaning of tiles to be in accordance with FIN5.W030.

FIXING MOSAIC TILES

FIN5.W310.9 FIXING TO FLOOR BY CEMENT SAND MORTAR BEDDING METHOD

To BS 5385-3:1989 with particular attention to clause 33.2 and the following:

1. Dampen the floor screed with clean water sufficiently to prevent it absorbing water from the bedding mortar;
2. Lay 1 : 3 cement and sand bedding mortar over the screed, spread and wood float finish to a minimum thickness as shown on Drawings;
3. Pre-grout the bed side of the mosaic tiles using the same colour neat cement as the final grout. Where joints are wider than 2 mm, or thickness of the mosaic tiles are greater than 4 mm, use 1 : 1 cement sand grout;
4. When using taped-backed or mesh-backed mosaic, spread and trowel over the bed with 2 mm thick slurry of neat cement or 1 : 1 cement sand;
5. Place sheets of mosaic tiles in position and tamp them firmly into the bedding, and maintain straight and regular joints between sheets;
6. Remove the backing paper, complete the final straightening and rub the surface with grout, coloured as required, to fill the joints and clean any surplus from the face of the mosaic as the work proceeds.

FIN5.W315.9 FIXING TO FLOOR BY CEMENT-BASED ADHESIVE BEDDING METHOD

To BS 5385-3:1989 with particular attention to clause 33.1 and the following:

1. Fixing mosaic with adhesive in accordance with the manufacturer's recommendations;
2. Grouting the joints with a proprietary grout applied in accordance with the grout manufacturer's recommendations.

FIN5.W320.9 FIXING TO WALLS BY CEMENT SAND MORTAR BEDDING METHOD

1. To BS 5385-1:1995 with particular attention to clause 5.4.2 for internal wall;
2. To BS 5385-2:1991 with particular attention to clause 27.2 for external wall;
3. Dampen the wall render with clean water, sufficiently to prevent it absorbing water from the bedding mortar;
4. Pregrout the back of sheets of mosaic tiles with pregrout materials to FIN5.M860;
5. Place sheets of mosaic tiles in position and tamp them firmly into the bedding, maintaining straight and regular joints;
6. Remove the backing paper, complete the final straightening and rub the surface with grout, coloured as required, to fill the joints and clean any surplus from the face of the tiles as the work proceeds;

FIN5.W330.9 FIXING TO WALLS BY CEMENT-BASED ADHESIVE BEDDING METHOD

1. To BS 5385:Part 1:1995 with particular attention to 5.4.1 for internal wall;
2. To BS 5385:Part 2:1991 with particular attention to 27.1 for external wall;
3. Fixing mosaic with adhesive in accordance with FIN5.W220;
4. Grouting the joints with a proprietary grout applied in accordance with the grout manufacturer's recommendations.

FIN5.W340.9 FIXING TO WALLS BY CEMENT SLURRY BEDDING METHOD

1. Dampen the wall surface sufficiently to prevent it absorbing water from the cement slurry;

2. Coat the surface of the wall with cement slurry in accordance with FIN5.M860 of the same colour of the final grout in one operation and coat the backs of the sheets of mosaic tiles with cement slurry, immediately before fixing;
3. Place sheets of mosaic tiles in position and tamp them firmly in maintaining straight and regular joints;
4. Remove the backing paper, complete the final straightening and rub the surface with grout, coloured as required, to fill the joints and clean any surplus from the face of the tiles as the work proceeds.

FIN5.W350.9 FIXING TO PANEL WALL PARTITIONS

Fix mosaic tiles as FIN5.W330.

FIN5.W360.9 FIXING GLASS AND GLAZED MOSAIC TO PRECAST FACADE

1. Use cement-based adhesive bedding method as FIN5.W330;
2. Fix mosaic tiles before erection, or after erection with Approval.

MARBLE AND GRANITE SLAB OR TILE FINISHES

FIN5.W405.9 APPLY PLASTERS FOR MARBLE AND GRANITE WALL TILES

As Worksection FIN1.

FIN5.W410.9 LAYING MARBLE AND GRANITE FLOOR SLABS

To BS 5385:Part 5:1994 with particular attention to the following alternative methods:

1. Lay floor slabs solid on screed base as follows:
   a. Lay bedding mortar to a minimum thickness of 20 mm, maximum 30 mm and finish with a perfectly level, even surface;
   b. Butter slabs completely with neat cement slurry, use white cement for light colour granite; a water resistant bonding agent may be incorporated in the slurry;
   c. Tap each slab firmly into position using rubber mallet;
   d. Lay slabs with joints at 1 mm to 2 mm wide for smooth finish, 6 mm wide for textured and riven finishes, and 2 mm wide for other finishes in general;
   e. Point joints and clean off any surplus grout as the work proceeds.
2. Lay floor slabs solid on concrete base with semi-dry mix method as follows:
   a. Wet the base for several hours, brush clean the base before the bedding is laid;
   b. Within 30 minutes before bedding, brush a thin layer of neat cement slurry into the base concrete;
   c. Spread the semi-dry mix to the minimum thickness of 25 mm, and to the maximum of 70 mm without fall or 100 mm with fall, and compact thoroughly;
   d. Spread and trowel an even layer of 2 mm thick cement slurry over the bedding;
   e. Follow sub-clauses (1)(b) to (1)(e) above.

FIN5.W420.9 FIXING MARBLE AND GRANITE WALL SLABS

1. Unless otherwise shown on Drawings, fix to BS 8298:1989 with particular attention to the following:
   a. Fix at a distance of 25 mm or more from structural surfaces;
   b. Partially fill the holes with cement and sand (1:3 mix) packing or approved resin before the dowels are inserted and grout the gaps between the dowels and the preformed pocket with slurry or resin before the slabs are fixed in position;

c. Unless indicated otherwise on Drawings, provide 5 mm wide, open butt joints between the slabs, or 3 mm wide for those on the ground floor. Install back-up material and point with sealant to FIN5.M930;

d. At vertical movement joints, stones should be supported by separated fixings as shown on the Drawings or Approved shop drawings.

2. Comply also with the following:

a. Drill edges of slabs to receive stainless steel fixing dowels at approximately 450 mm centres;

b. Drill slabs to receive stainless steel cramps and fixing methods at approximately 350 mm centres and solidly bed cramps to the structure and hooks to the backs of the slabs.

FIN5.W430.9 FIXING MARBLE AND GRANITE WALL TILES

1. Application of plaster, prior to fixing of tiles, as FIN5.W405;
2. Unless otherwise shown on Drawings, fix tiles to BS 5385:Part1:1995 with particular attention to the following:

a. Fix marble or granite tile after plasterwork is dry throughout or at least 4 weeks after plasterwork is completed;

b. Bed tile with 3 mm tile adhesive to BS 5980:1980 or BSEN 12004:2001.

FIN5.W440.9 SHOP DRAWINGS

For wall facing slabs, submit shop drawings of anchor details, with calculations by a Registered Structural Engineer, prior to installation.

FIN5.W450.9 FINISHING

1. Cover all marble and granite flooring and wall facing slabs with a sealer;
2. For floors, use proprietary anti-slip system in accordance with the manufacturer's recommendations.

FIN5.W460.9 PROTECTION

Protect all marble and granite flooring and wall facing slabs with a suitable covering until completion.

TOLERANCES

FIN5.W610.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

TESTING

MATERIAL VERIFICATION TEST FOR TILE ADHESIVE

FIN5.T105.A MATERIAL VERIFICATION TEST FOR TILE ADHESIVE DELIVERED TO SITE

1. Test Arrangements:
   a. For each batch of tile adhesive delivered to Site under each delivery note as specified in FIN5.M1010 (3)(a), material verification test shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to material verification test:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as specified or as directed by the CM.
   c. The material verification test shall require a minimum of 7 weeks commencing from the date of delivering the test sample to the laboratories;
   d. During the material verification test, handle tile adhesive delivered to Site as follows:
      i. Store the tile adhesive on Site in accordance with FIN5.M1010 (5)(b);
      ii. If the use of tile adhesive in the tiling works during the material verification test is approved by the CM as specified in FIN5.M1010 (5)(d), submit full record of the locations where each batch of the tile adhesive has been installed.
2. Testing Samples:
   a. Provide one set of test sample for every 60,000 kg of tile adhesive or part thereof from the batch of material delivered to Site under the delivery note as specified in FIN5.M1010 (3)(a) or as instructed by the CM;
   b. One set of test sample shall consist of one bag of tile adhesive.
3. Testing methods:
   As per FIN5.M1010 (2)(b) and FIN5.M1010 (2)(c);
4. Non-compliance:
   a. In the event that the testing sample fails to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch including material already incorporated into the permanent work off Site. Reinstate that part of the work damaged, disturbed or affected by the removal of tile adhesive to the satisfaction of the CM; or

ii. Submit a written request to the CM applying for re-testing three separate sets of sample selected by the CM from the representative batch. When the CM agrees to carry out the re-test, comply with sub-clauses (1)(b) and (2)(b) and provide sufficient sets of sample pertaining to material verification test. Bear all associated costs for the re-test which shall be conducted as specified in sub-clauses (1)(a) and (3) and no extension of time will be allowed. In case of any one selected sample fails the re-test, remove the representative batch of tile adhesive including material already incorporated into the permanent work off Site and reinstate that part of the work damaged, disturbed or affected by the removal of tile adhesive to the satisfaction of the CM. No extension of time will be allowed.

5. Material Verification Test for the Replaced Tile Adhesive:
   a. When the representative batch of tile adhesive is removed off Site and replaced with another new batch, the new batch of tile adhesive shall be subject to material verification test as specified in sub-clauses (1), (2), (3) and (4);
   b. Bear all associated costs for the test and re-test and no extension of time will be allowed.

FIN5.T106.A MATERIAL VERIFICATION TEST FOR LATEX DELIVERED TO SITE

1. Test Arrangements:
   a. For each batch of latex delivered to Site under each delivery note as specified in FIN5.M1050 (3)(a), material verification test shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to material verification test:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as specified or as directed by the CM.
   c. The material verification test shall require a minimum of 7 weeks commencing from the date of delivering the test sample to the laboratories;
   d. During the material verification test, handle latex delivered to Site as follows:
      i. Store the latex on Site in accordance with FIN5.M1050 (5)(b);
      ii. If the use of latex in the tiling works during the material verification test is approved by the CM as specified in FIN5.M1050 (5)(d), submit full record of the locations where each batch of latex mixed with cement sand mortar has been installed.
2. Testing Samples:
   a. Provide one set of test sample for every 6000 litres of latex or part thereof from the batch of material delivered to Site under the delivery note as specified in FIN5.M1050 (3)(a) or as instructed by the CM;
   b. One set of test sample shall consist of one drum of latex, cement and sand sufficient for carrying out the test.
3. Testing methods:

   As per FIN5.M1050 (2)(b);
4. Non-compliance:
   a. In the event the testing sample fails to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch including material already incorporated into the permanent work off Site. Reinstate that part of the work damaged, disturbed or affected by the removal of cement sand mortar with latex to the satisfaction of the CM; or

ii. Submit a written request to the CM applying for re-testing three separate sets of sample selected by the CM from the representative batch. When the CM agrees to carry out the re-test, comply with sub-clauses (1)(b) and (2)(b) and provide sufficient sets of sample pertaining to material verification test. Bear all associated costs for the re-test which shall be conducted as specified in sub-clauses (1)(a) and (3) and no extension of time will be entitled. In case of any one selected sample fails the re-test, remove the representative batch of latex including material already incorporated into the permanent work off Site and reinstate that part of the work damaged, disturbed or affected by the removal of cement sand mortar with latex to the satisfaction of the CM. No extension of time will be entitled.

5. Material Verification Test for the Replaced Latex:
   a. When the representative batch of latex is removed off Site and replaced with another new batch, the new batch of latex shall be subject to material verification test as specified in sub-clauses (1), (2), (3) and (4);
   b. Bear all associated costs for the test and re-test and no extension of time will be entitled.

FIN5.T108.A MATERIAL VERIFICATION TEST FOR TILE ADHESIVE DELIVERED TO MANUFACTURER'S FACTORY OF PRECAST CONCRETE COMPONENTS

1. Test Arrangements:
   a. For each batch of tile adhesive delivered to the manufacturer's factory under each delivery note as specified in FIN5.M1010 (4)(a), material verification test shall be carried out by the CM or his representatives resident at manufacturer's factory or a Direct Contractor;
   b. Comply with the following pertaining to material verification test:
      i. Provide attendance at the manufacturer's factory;
      ii. Provide, deliver and collect samples etc. as specified or as directed by the CM.
   c. The material verification test shall require a minimum of 7 weeks commencing from the date of delivering the test sample to the laboratories;
   d. During the material verification test, handle tile adhesive delivered to the manufacturer's factory as follows:
      i. Store the tile adhesive at the manufacturer's factory in accordance with FIN5.M1010 (5)(c);
      ii. If the use of tile adhesive in the tiling works during the material verification test is approved by the CM as specified in FIN5.M1010 (5)(d), submit to the CM or his representatives resident at manufacturer's factory the full record of the precast concrete elements in which each batch of the tile adhesive has been installed.
2. Testing Samples:
   a. Provide one set of test sample for every 60,000 kg of tile adhesive or part thereof from the batch of material delivered to the manufacturer's factory under the delivery note as specified in FIN5.M1010 (4)(a) or as instructed by the CM;
   b. One set of test sample shall consist of one bag of tile adhesive.
3. Testing methods:

   As per FIN5.M1010 (2)(b) and FIN5.M1010 (2)(c).
4. Non-compliance:
   a. In the event that the testing sample fails to meet the testing requirements, follow either one of the following actions:

i. Remove the representative batch including material already incorporated into the precast concrete elements off the manufacturer's factory. Reinstate that part of the precast concrete elements damaged, disturbed or affected by the removal of tile adhesive to the satisfaction of the CM; or

ii. Submit a written request to the CM applying for re-testing three separate sets of sample selected by the CM from the representative batch. When the CM agrees to carry out the re-test, comply with sub-clauses (1)(b) and (2)(b) and provide sufficient sets of sample pertaining to material verification test. Bear all associated costs for the re-test which shall be conducted as specified in sub-clauses (1)(a) and (3) and no extension of time will be allowed. In case of any one selected sample fails the re-test, remove the representative batch of tile adhesive including material already incorporated into the precast concrete elements off the manufacturer's factory and reinstate that part of the precast concrete elements damaged, disturbed or affected by the removal of tile adhesive. No extension of time will be allowed.

5. Material Verification Test for the Replaced Tile Adhesive:
   a. When the representative batch of tile adhesive is removed off the manufacturer's factory and replaced with another new batch, the new batch of tile adhesive shall be subject to material verification test as specified in sub-clauses (1), (2), (3) and (4);
   b. Bear all associated costs for the test and re-test and no extension of time will be allowed.

FIN5.T109.A MATERIAL VERIFICATION TEST FOR LATEX DELIVERED TO MANUFACTURER'S FACTORY OF PRECAST CONCRETE COMPONENTS

1. Test Arrangements:
   a. For each batch of latex delivered to the manufacturer's factory under each delivery note as specified in FIN5.M1050 (4)(a), material verification test shall be carried out by the CM or his representatives resident at manufacturer's factory or a Direct Contractor;
   b. Comply with the following pertaining to material verification test:
      i. Provide attendance at the manufacturer's factory;
      ii. Provide, deliver and collect samples etc. as specified or as directed by the CM.
   c. The material verification test shall require a minimum of 7 weeks commencing from the date of delivering the test sample to the laboratories;
   d. During the material verification test, handle latex delivered to the manufacturer's factory as follows:
      i. Store the latex at the manufacturer's factory in accordance with FIN5.M1050 (5)(c); or
      ii. If the use of latex in the tiling works during the material verification test is approved by the CM as specified in FIN5.M1050 (5)(d), submit to the CM or his representatives resident at manufacturer's factory the full record of the precast concrete elements in which each batch of the latex mixed with cement sand mortar has been installed.
2. Testing Samples:
   a. Provide one set of test sample for every 6000 litres of latex or part thereof from the batch of material delivered to the manufacturer's factory under the delivery note as specified in FIN5.M1050 (4)(a) or as instructed by the CM;

b. One set of test sample shall consist of one drum of latex, cement and sand sufficient for carrying out the test.

3. Testing methods:

   As per FIN5.M1050 (2)(b);

4. Non-compliance:

   a. In the event that the testing sample fails to meet the testing requirements, follow either one of the following actions:

      i. Remove the representative batch including material already incorporated into the precast concrete elements off the manufacturer's factory. Reinstate that part of the precast concrete elements damaged, disturbed or affected by the removal of cement sand mortar with latex to the satisfaction of the CM; or

      ii. Submit a written request to the CM applying for re-testing three separate sets of sample selected by the CM from the representative batch. When the CM agrees to carry out the re-test, comply with sub-clauses (1)(b) and (2)(b) and provide sufficient sets of sample pertaining to material verification test. Bear all associated costs for the re-test which shall be conducted as specified in sub-clauses (1)(a) and (3) and no extension of time will be entitled. In case of any one selected sample fails the re-test, remove the representative batch of latex including material already incorporated into the precast concrete elements off the manufacturer's factory and reinstate that part of the precast concrete elements damaged, disturbed or affected by the removal of the cement sand mortar with latex. No extension of time will be entitled.

5. Material Verification Test for the Replaced Latex:

   a. When the representative batch of latex is removed off the manufacturer's factory and replaced with another new batch, the new batch of latex shall be subject to material verification test as specified in sub-clauses (1), (2), (3) and (4);

   b. Bear all associated costs for the test and re-test and no extension of time will be entitled.

SURVEILLANCE TESTS

FIN5.T110.A SURVEILLANCE TEST FOR TILE GROUT

1. Test Arrangements:

   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;

   b. Comply with the following pertaining to surveillance tests:

      i. Provide attendance on the Site;

      ii. Provide, deliver and collect samples etc. as specified or as directed by the CM.

2. Testing Samples:

   a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in FIN5.M1010 (3)(a) or as instructed by the CM;

   b. One set of test sample shall consist of one bag of tile grout.

3. Testing methods:

   As per FIN5.M1010 (2)(d);

4. Non-compliance:

a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
   i. Remove the representative batch off Site; or
   ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.
b. When the representative batch of tile grout is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

FIN5.T130.A SURVEILLANCE TEST FOR FLOOR SURFACE MATERIALS

1. When Instructed, surveillance tests shall be arranged by the CM for the following materials:
   a. Floor surface materials for installation in domestic flats;
   b. Tactile homogeneous floor tiles irrespective of whether the tiles are for installation in internal or external areas.
2. Test Arrangements:
   a. Surveillance tests shall be carried out by the CM or his representatives or a Direct Testing Contractor;
   b. Comply with the following pertaining to surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as specified or as directed by the CM.
3. Test Samples:
   a. Provide one set of test sample for each type of floor surface materials including tactile homogeneous floor tiles if applicable from the batch of material delivered to Site under one delivery note or as instructed by the CM;
   b. One set of test sample shall consist of five individual test specimens.
4. Test Method:
   a. Laboratory wet pendulum friction test in accordance with AS 4586-2013;
   b. Acceptance standard:

      Minimum Slip Resistance Value (SRV) as per FIN5.G050.
5. Non-compliance:
   a. In the event that the test samples fail to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch off Site; or
      ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (4) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.

b. When the representative batch of tactile homogeneous floor tile is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (4) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (5)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (5)(a) and (5)(b). No extension of time will be allowed.

ON-SITE VERIFICATION TESTS

FIN5.T150.A IN-SITU PULL-OFF TESTS ON COMPLETED TILES

1. Test Arrangements:
   a. Carry out tests by employing a laboratory that complies with the requirements stated in PRE.B9.570.
2. Testing Samples:
   a. For domestic blocks, carry out test for each zone of each block as follows:
      i. When tiles are fixed with cement-based adhesive bedding on panel wall, on rendering over concrete substrate or direct on concrete substrate, or fixed with cement slurry on rendering over concrete substrate, a zone in a domestic block means every 5 typical floors or part thereof, unless;
         - if all samples of two immediate preceding and consecutive zones passed the testing requirements in compliance with sub-clause (3), the meaning of a zone in the domestic block shall be changed to every 10 typical floors or part thereof. Provided always that if any sample(s) subsequent to the aforesaid change of zoning fails to meet the testing requirements in compliance with sub-clause (3), the aforesaid change of zoning shall cease to apply once and for all under the domestic block and a zone thereafter means every 5 typical floors or part thereof for the remaining floors in the domestic block.

      ii. When tiles are fixed with cement sand mortar with latex direct on concrete substrate, a zone in a domestic block means every 5 typical floors or part thereof;

      iii. Two samples of wall tile specimen for each of the following locations in every zone selected by the CM - each sample comprises one wall tile specimen selected by the CM and samples are not to be taken on tiles installed over cold liquid applied waterproofing layers as WAT6.M010:
         - Typical floor lift lobby;
         - Kitchen;
         - Bathroom.

   b. For non-domestic blocks, carry out test for each zone of each non-domestic block as follows:
      i. When tiles are fixed with cement based adhesive on panel wall, on rendering over concrete substrate, or direct on concrete substrate, or fixed with cement slurry on rendering over concrete substrate, a zone in a non-domestic block means every 500m^2 of installation or part thereof, unless:

- if all samples of two immediate preceding and consecutive zones passed the testing requirements in compliance with sub-clause (3), the meaning of a zone in the non-domestic block shall be changed to every 1,000m² of installation or part thereof. Provided always that if any sample(s) subsequent to the aforesaid change of zoning fails to meet the testing requirements in compliance with sub-clause (3), the aforesaid change of zoning shall cease to apply once and for all under the non-domestic block and a zone thereafter means every 500m² of installation or part thereof for the remaining installation in the non-domestic block.

ii. When tiles are fixed with cement sand mortar with latex direct on concrete substrate, a zone in a non-domestic block means every 500m^2 of installation or part thereof;

iii. Two samples of wall tile specimen for each zone; each sample comprises of one wall tile specimen selected by the CM. Samples are not to be taken on tiles installed over cold liquid applied waterproofing layers as WAT6.M010.

3. Testing Methods:

a. To comply with the following:

i. Carry out Pull-off tests after a minimum of 28 days after tile fixing. Except for the tiles installed at facades, the Pull-off test shall be carried out within 60 days after fixing;

ii. The pull-off equipment shall be capable of increasing the load steadily without jerking at a rate of (250 + 50) N/s, and must be provided with a measurement device which shall retain the maximum force exerted, the so called failure load to the nearest 0.01KN. The measurement inaccuracy of the equipment must be less than 2%, in accordance with accuracy Grade 2 of BS 1610:Part 1:1985;

iii. Saw cut the tested portion through to the substrate;

iv. Attach an aluminium / steel dolly onto the surface of the tile by a suitable adhesive resin;

v. Use strong adhesive tape to fix the position of dolly until strength of the resin is developed as advised by the resin manufacturer;

vi. Apply a tensile force gradually by the device;

vii. Record the failure force, location of failure and any other observations or abnormalities;

viii. Record the force from the readout unit;

ix. Repeat steps as specified in sub-clauses (3)(a)(i) to (3)(a)(viii) until Pull-off tests to all selected tiles are completed;

x. Take photographs;

xi. Make good the testing areas to satisfaction of the CM.

b. The report for Pull-off test shall contain the following data and information:

i. The calculated tensile adhesion strength of individual tile and tile adhesive to the nearest 0.001 N/mm²;

ii. The pull-off load to the nearest 0.01 kN;

iii. The type of failure;

iv. The area of test piece to the nearest 1 x 1 mm;

v. A description of the test piece tile;

vi. A description of the tested substrate;

vii. The thickness of the tile adhesive bedding or mortar bedding as appropriate;

viii. The age of the bedding at the time of testing;

ix. A description of the pulling equipment by stating the make, type, test capacity and measurement range;

x. The size, the thickness and material of the dolly;

xi. The type of epoxy resin;

xii. The date of the test;

xiii. Photographs.

c. Acceptance standard for the Pull-off test shall be:

i. Minimum 0.5 N/mm² for concrete substrate, except that for glass mosaic tiles which would be 0.3 N/mm²;

ii. Minimum 0.3 N/mm² for panel wall.

4. Non-compliance:

a. In the event that any one sample in a zone fails to meet the testing requirements as specified in sub-clause (3), take three separate samples for re-test on the same type of locations or works executed by the respective gang(s) of labourers all as selected by the CM within the same zone as specified in sub-clauses (2)(a) and (2)(b);

b. Where any of the re-tests fails to meet the testing requirements as specified in sub-clause (3), comply with the following:

i. Remove all the tiling works executed on the date(s) same as the date(s) of execution of the re-test samples and the initial test samples in the said zone or part thereof executed by the respective gang(s) of labourers irrespective of the type of locations. Should there be no daily labour record for tracking down the respective gang(s) of labourers, remove all the tiling works executed on the date(s) same as the date(s) of execution of the re-test samples and the initial test samples in the said zone or part thereof regardless of whether they are executed by the respective gang(s) of labourers;

ii. Re-install the tiling works and re-test the rectified areas in accordance with sub-clauses (2), (3) and (4) but with the application of such sub-clauses limited to the rectified areas only;

iii. Observe further re-testing requirements stipulated in sub-clause (5) below.

c. Bear all associated costs and any extra time required including further re-tests.

5. For the purpose of sub-clause (4)(b)(iii), comply with the further re-testing requirements as follows:

a. Take three additional separate samples for further re-test on the same type of locations or works executed by the respective gang(s) of labourers all as selected by the CM within the said zone as specified in sub-clauses (2)(a) and (2)(b);

b. Where any of the further re-tests fails to meet the testing requirements as specified in sub-clause (3), the Contractor may elect to comply with either (i) or (ii) of the following:

i. Remove all the tiling works executed by the respective gang(s) of labourers within the said zone or part thereof irrespective of the date(s) of execution of the further re-test samples. Re-install the tiling works. Re-test the rectified areas in accordance with sub-clauses (2), (3) and (4) but with the application of such sub-clauses limited to the rectified areas only; or

ii. Carry out the following:

- Remove all the tiling works executed on the date(s) same as the date(s) of execution of the further re-test samples in the said zone or part thereof executed by the respective gang(s) of labourers irrespective of the type of locations. Should there be no daily labour record for tracking down the respective gang(s) of labourers, remove all the tiling works executed on the date(s) same as the date(s) of execution of the further re-test samples in the said zone or part thereof regardless of whether they are executed by the respective gang(s) of labourers. Re-install the tiling works. Re-test the rectified areas in accordance with sub-clauses (2), (3) and (4) but with the application of such sub-clauses limited to the rectified areas only;
- Conduct further re-tests in accordance with sub-clause (5)(a) and repeat conducting such further re-tests when any one of the re-test samples fails until the test result(s) verify that the tiling works in the said zone or part thereof comply with the specified requirements. Remove all defective tiling works identified in such further re-tests in the manner as stipulated in sub-clause (5)(b)(ii)(a). Re-install the tiling works. Re-test the rectified areas in accordance with sub-clauses (2), (3) and (4) but with the application of such sub-clauses limited to the rectified areas only.

VERIFICATION TEST FOR FLOOR SURFACE MATERIALS

FIN5.T180.A VERIFICATION TEST FOR SLIP RESISTANCE OF FLOOR SURFACE MATERIALS

1. Test Arrangements:
   a. Verification tests shall be carried out by the CM or his representative or a Direct Testing Contractor upon delivery of material to Site under a delivery note as directed by the CM. A representative batch means the material delivered to Site under the same delivery note;
   b. Comply with the followings pertaining to verification tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Test Samples:
   a. Samples shall be selected by the CM and witnessed by representative of the Contractor;
   b. Provide one set of test sample of any sizes or types of floor surface materials from any one batch of material delivered to Site under a delivery note as selected by the CM;
   c. One set of test sample shall consist of five individual test specimens.
3. Test Method:
   a. Laboratory wet pendulum friction test in accordance with AS 4586-2013;
   b. Acceptance standard:
      Minimum Slip Resistance Value (SRV) as per FIN5.G050.
4. Non-compliance:
   a. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(b), follow either one of the following actions:

i. Remove the representative batch of material off Site; or

ii. Carry out re-test for the representative batch of material in accordance with the test methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample set fails the re-test, remove the representative batch of material off Site.

b. When the representative batch of material is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 for one set of test sample selected by the CM from the replacement batch. In case of such test fails, follow action stated in sub-clause (4)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

FIN6 FLEXIBLE SHEET AND TILE FINISHES

MATERIALS

GENERAL

FIN6.M010.A QUALITY GENERALLY

1. Obtain and fix materials of an Approved type and colour and in accordance with the remaining clauses in this Worksection;
2. Plastic flooring materials: Emission of formaldehyde from the product shall not exceed 0.13 mg/m^3 air.

FIN6.M020.9 SAMPLES

Submit samples of all tile and sheet products for Approval.

FIN6.M030.9 SLIP RESISTANCE

Slip resistance of all flexible sheet and tile materials under FIN6 shall comply with FIN5.G050.

PVC TILES AND SHEET

FIN6.M110.A SEMI-FLEXIBLE TILES

To BS EN ISO 10595:2012, minimum thickness 2.5 mm or as shown on Drawings.

FIN6.M120.A UNBACKED FLEXIBLE TILES

To BS EN ISO 10581:2020: Type II, minimum thickness 1.5 mm or as shown on Drawings.

FIN6.M130.A UNBACKED FLEXIBLE SHEET

To BS EN ISO 10581:2020: Type I, minimum thickness 1.5 mm or as shown on Drawings.

FIN6.M140.A FOAM BACKED SHEET

To BS EN 651:2011 and:

1. With a wearing sheet of PVC sheet to BS EN ISO 10581:2020: Type I;
2. Minimum thickness 3 mm (1.5 mm for wearing layer) or as shown on Drawings.

FIN6.M150.9 COVED SKIRTINGS

Obtained from the same Approved manufacturer as the adjacent PVC material and matching in colour and texture.

LINOLEUM

FIN6.M210.A SHEET AND TILES

To BS EN ISO 24011:2012, minimum thickness 2 mm or as shown on Drawings.

RUBBER

FIN6.M310.A SHEET AND TILES

Solid rubber to BS EN 1817:2020, BS EN 1816:2020, BS EN 12199:2020, minimum thickness 2 mm or as shown on Drawings.

FIN6.M320.9 NON-SLIP TACTILE SYNTHETIC RUBBER FLOOR TILES

Tiles with raised profiles to provide a distinctively textured walking surface easy detectable by foot and cane for guidance of the visually impaired.

1. Type: Two types of tactile tiles to be used as shown or scheduled on drawings:
   a. Tiles with raised dots for indication of hazard or orientation; and
   b. Tiles with raised strips for indication of direction.
2. Size, thickness, profile & location: as shown or scheduled on drawings;
3. Colour: to Approval;
4. To be slip-resistant;
5. Fire rating: BS 476:Part 7: Class 2.

ANCILLARY MATERIALS

FIN6.M410.9 ADHESIVE

1. As recommended by the manufacturer of the material being fixed;
2. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic compounds) Regulation.

FIN6.M415.9 ADHESIVE FOR FIXING TACTILE SYNTHETIC RUBBER FLOOR TILE

1. Epoxy-resin-base bonding system, which must be confirmed by the manufacturer for the rubber tactile tiles that it is compatible with the tile material;
2. To ASTM C881-2002 type 1.

FIN6.M420.9 PVC WELDING RODS

Of Approved manufacture, coloured to match the material being joined.

FIN6.M430.9 POLISH

An Approved type of non-slip emulsion polish recommended by the manufacturer of the material being finished.

WORKMANSHIP

GENERAL

FIN6.W010.A GENERAL

Lay finishes generally to BS 8203:2017.

FIN6.W020.9 DAMAGED MATERIALS

Do not use tiles or sheet which have deteriorated in stock or which have a tendency to curl at the edges or corners.

FIN6.W030.9 PREPARATION OF LAYING SURFACE

Thoroughly clean the screed or wall rendering or concrete surfaces and:

1. Ensure that it is free from all loose particles, laitance, traces of grease, oil, paint, wax, dirt or dust;
2. Fill all cracks, minor holes or crevices with a suitable filler recommended by the manufacturer of the material to be laid.

LAYING SHEET AND TILES

FIN6.W110.9 GENERAL

Lay all tiles and floor and wall sheeting strictly in accordance with the manufacturer's instructions, with any pattern in accordance with the Drawings.

FIN6.W120.9 PRE-HEATED TILES

When required by the manufacturer's instructions:

1. Pre-heat tiles to a temperature just sufficient to give the required pliability;
2. Do not pre-heat single tiles.

FIN6.W130.9 APPLYING ADHESIVE

Apply in a thin film and spread evenly with a plain or notched trowel in accordance with the manufacturer's recommendations and ensure that:

1. Where a notched trowel is used:
   a. The notches are the size recommended by the manufacturer;
   b. It is renewed periodically to ensure the correct spread of adhesive.
2. Only sufficient adhesive is applied to prevent subsequent bleeding;
3. Clean off all excess adhesive as the work proceeds.

FIN6.W140.9 JOINTING AND CUTTING

Closely butt joints and cut accurately perpendicular to the finish surface, to an agreed design or as indicated on the Drawings, using only the minimum of jointing.

FIN6.W150.9 JOINTING PVC SHEET

Weld joints to form a continuous surface, with PVC welding rods.

FIN6.W160.9 FIXING TACTILE SYNTHETIC RUBBER FLOOR TILES

Fix the rubber tiles with adhesive as specified in FIN6.M415 in accordance with the following:

1. Prepare the laying surface in accordance with FIN6.W030;

2. Mix and apply the adhesive all in accordance with manufacturer's recommendations.

FIN6.W170.9 DEFECTIVE AREAS

Relay any areas insufficiently bonded or showing an uneven surface.

FINISHING

FIN6.W210.9 CLEANING

After laying, thoroughly clean the surface with water and a detergent as recommended by the finish manufacturer.

FIN6.W220.9 POLISHING

Apply two coats of polish in accordance with the manufacturer's recommendations.

FIN6.W230.9 PROTECTION

Protect floors with a suitable covering.

TOLERANCES

FIN6.W310.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

FIN7 PAINTING

MATERIALS

GENERAL

FIN7.M010.B PAINTS AND DECORATIVE MATERIALS

All paints and decorative materials must be:

1. Of an Approved type, brand and colour;
2. Supplied in sealed containers each containing the name and information of the supplier, the manufacturer label, printed instructions, batch number, date of manufacturer, expiry date / shelf life and colour code (if applicable);
3. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation. Submit VOC data as below-
   a. Submit manufacturer's product data for architectural paint and indicate VOC limits of the product;
   b. Submit documentary proof for compliance with Schedule 1 of Air Pollution Control (Volatile Organic Compounds) Regulation to show compliance with the maximum limit of the volatile organic compound content specified in Part 2, 3 & 4 of Schedule 1 of Air Pollution Control (Volatile Organic Compounds) Regulation.
4. The paint and any thinner used shall contain no more than 0.01% by wet weight of formaldehyde.

FIN7.M015.9 WATER BASED PAINTS

All water based paints must comply with the following environmental requirements:

	Material Contents	Requirements	Testing Standards
1.	Formaldehyde	<=100 mg/kg	Guo Biao 18582 - 2008
2.	Heavy Metal		
	a. Lead	<= 90 mg/kg	Guo Biao 18582 - 2008
	b. Chromium	<= 60 mg/kg	Guo Biao 18582 - 2008
	c. Cadium	<= 75 mg/kg	Guo Biao 18582 - 2008
	d. Mercury	<= 60 mg/kg	Guo Biao 18582 - 2008

FIN7.M016.9 SOLVENT BASED PAINTS

All solvent based paints must comply with the following environmental requirements:

	Material Contents	Requirements	Testing Standards
1.	Benzene	<=0.3%	Guo Biao 18581 - 2009
2.	Toluene, Xylene & Ethylbenzene	<=30%	Guo Biao 18581 - 2009
3.	Heavy Metal		
	a. Lead	<= 90 mg/kg	Guo Biao 18581 - 2009
	b. Chromium	<= 60 mg/kg	Guo Biao 18581 - 2009

c. Cadium	<= 75 mg/kg	Guo Biao 18581 - 2009
d. Mercury	<= 60 mg/kg	Guo Biao 18581 - 2009

FIN7.M020.9 UNIFORM SUPPLY

1. Where possible, obtain all the materials in a coating system from the same manufacturer;
2. Furnish the CM with two copies of the manufacturer's data sheets for the proposed paints.

PESTICIDES AND PRESERVATIVES

FIN7.M110.9 RUST INHIBITOR

An Approved proprietary chemical agent which converts rust to iron phosphate.

FIN7.M120.9 ANTI-MOULD LIQUID

An Approved fungicidal solution.

FIN7.M130.9 PESTICIDAL COATING

Containing an Approved pesticide:

1. Registered under Pesticides Ordinance;
2. Safe to use for its purpose without causing hazards;
3. Effective in killing all stages of insect infestation and protecting timber from subsequent insect attack;
4. Colourless or coloured;
5. It shall be suitable for overpainting where treated surfaces are likely to be exposed or in contact with a painted finish.

FIN7.M140.9 WOOD PRESERVATIVE

1. An Approved proprietary brand to BS 1282:1999;
2. Safe to use for its purpose without causing hazards;
3. Coloured unless otherwise approved;
4. It shall be suitable for overpainting where treated surfaces are likely to be exposed or in contact with a painted finish.

FIN7.M150.9 WATER REPELLENT LIQUID

Silicone based or other Approved water repellent.

PRIMING PAINTS AND SEALERS

FIN7.M210.9 WOOD PRIMERS

1. Aluminium primer to BS 4756:1998: Type 1 for brush application to woodwork;
2. For timber doorsets, use primer recommended by the manufacturer of the finishing paint system.

FIN7.M220.9 METAL PRIMERS

One of the following as recommended by the manufacturer of the finishing paint system:

1. Zinc phosphate primer;
2. Metallic, zinc rich primer to BS 4652:1995.

FIN7.M230.9 PRIMERS FOR GALVANIZED SURFACES

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed water based anti-corrosion primer for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name / model name and job reference of the material;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
      v. When the primer is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
         - Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
   b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for the CM's information:
      i. The date of the test shall be within three years prior to the notified date for commencement of the Works;
      ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material to Site;
      iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
2. Quality Requirements:
   a. Water based anti-corrosion primer:
      i. Resins shall be based upon acrylic resin.
   b. The quality and performance requirements are as follows:

Items	Method	Acceptance Standards
Content of zinc phosphate	Atomic Absorption Analysis	Min. 10%
Viscosity, (Kerb Units) Procedure B	ASTM D562-81	min. 70 KU max. 85 KU
Drying time - surface drying	BS 3900-C2:1994	max. 1.5 hours
Drying time - hard drying	BS 3900:Part C3: 1990	max. 3.0 hours
Fineness of grind, (µm)	BS 3900-C6:2000	max. 45 µm

Adhesion	BS 3900-E6:1992 Class 1	The dried primer film should show no failure on a cross cut test when applied to a untreated galvanized iron panel and dried for 7 days.

FIN7.M240.9 METAL PRIMERS FOR POLYURETHANE FINISHES

Polyurethane primer, as recommended by the paint finish manufacturer.

FIN7.M250.9 SEALERS FOR PLASTER, MASONRY ETC

An Approved alkali resistant primer sealer or other sealer as recommended by an Approved finishing paint manufacturer.

FIN7.M260.9 FLOOR SEALER

An Approved resin based sealer or other sealer as recommended by an Approved finishing paint manufacturer.

PAINTS

FIN7.M340.A ANTI-MOULD INTERNAL EMULSION PAINT

1. Submission Requirements:
    a. At sample submission and approval stage, submit a sample of the proposed internal emulsion paint for CM's approval together with all the following substantiation for CM's information:
        i. Catalogue, brand name / model name and job reference of the material;
        ii. Name, address and contact person of the local supplier;
        iii. Name, address and contact person of the manufacturer;
        iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
        v. When the internal emulsion paints are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
            - A sample board showing the quality, detail technical information and application procedures for the proposed internal emulsion paint;
            - Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

vi. Written confirmation from suppliers or manufacturers that the proposed internal emulsion paint is with anti-mould properties.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Water based anti-mould acrylic / modified acrylic emulsion paint in accordance with sub-clause (2)(b) comprising:

i. One sealer coat;

ii. Minimum two finishing coats;

iii. Colour: to Approval.

b. The quality and performance requirements are as follows:

Items		Method	Acceptance Standards
Preliminary examination of paint	Surface skin	BS EN ISO 1513:2010	-No surface skin
	Consistency		-No gelling
	Colour separation into layers		-No colour separation
	Visible impurities		-No visible impurities
	Sediment		-No hard settling
Drying times	Hard drying (hour)	BS EN ISO 9117-1:2009	< = 1 hour
Fineness of grind (μm)		BS EN ISO 1524:2013	< = 50 μm

Hiding power (contrast ratio %)		BS EN ISO 2814:2006	> = 75%
Gloss value (GU)	85°	BS EN ISO 2813:2014	< 15
Viscosity (procedure B)		ASTM:D562 – 10	65 - 85 KU
Scrub resistance (cycle)		ASTM:D2486 – 17	> = 400 cycles

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for internal emulsion paint upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & Delivery Note	Document check	From an Approved origin with product information same as the sample submission approval record
Packaging: Silk screen information - Proprietary brand name - Manufacturer's name and address - Supplier's name and address Printed information - Batch no. / Lot no. - Expiry date - Capacity	Visual check	Information in accordance with the Approved sample
Labeling	Visual check	Consistency
Product	Remove container cover and check the quality of the sample	No contamination, drying out and obvious colour inconsistency shall be accepted

Product validity	Check expiry date on packaging	No product is found in store on site with invalid expiry date

ii. Frequency:

Sampling frequency of verification are as follows:

Items	Sampling Frequency	Representative Batch
Manufacturer's Certificate of origin & Delivery Note	1 sample from each batch	Individual
Packaging and labelling	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note
Product and product validity	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

FIN7.M350.9 TEXTURED EMULSION PAINT

Water based acrylic emulsion paint textured with a finely dispersed aggregate by spray method or stone texture effect by trowel.

FIN7.M370.A ANTI-MOULD EXTERNAL EMULSION PAINT

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed external emulsion paint for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. When the external emulsion paints are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- A sample board showing the quality, detail technical information and application procedures for the proposed external emulsion paint;
- Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

vi. Written confirmation from suppliers or manufacturers that the proposed external emulsion paint is with anti-mould properties.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Water based anti-mould acrylic / modified acrylic external emulsion paint in accordance with sub-clause (2)(b) comprising:

i. One sealer coat;

ii. Minimum two finishing coats;

iii. Colour: to Approval.

b. The quality and performance requirements are as follows:

Items	Method	Acceptance Standards
Viscosity, (procedure B)	ASTM D562-10 (2018)	Min. 75 KU Max. 95 KU
Hiding Power (Contrast Ratio)% i. BS 04E53 (BS 4800) ii. All other colours	BS EN ISO 2814:2006	 i. Min. 60 ii. Min. 75
Drying time - hard drying	BS EN ISO 9117-1:2009	Max. 1 hour
Fineness of Grind, (µm)	BS EN ISO 1524:2013	Max. 40 µm
Gloss value (GU) (at 85º specular reflection), units	BS EN ISO 2813:2014	Min. 15 Max. 50

Wet scrub resistance, cycles	PSB SS5 Part F5:2003	Min. 1,500 cycles A dry film of the paint shall withstand the specified cycles of scrubbing without exposing the contrasting colour of the undercoat to a total length of more than 10 mm in the direction of the stroke.
Accelerated weathering, (hour)	ASTM G154-16 ("Cycle 2" in "Table X2.1 - Common Exposure Conditions" to be adopted except that UVA-340 lamp should be used in place of UVB-313)	Min. 500 hours After the specified hours of testing there shall be no signs of checking, blistering, or cracking, and the loss of gloss shall not be more than 30% of the original gloss. In addition, there shall be little change or no change in colour, and any change in colour shall be equivalent to a degree of contrast of not less than grade four of the grey scale conforming to BS EN 20105-A02:1995
Algal resistance	Refer sub-clause (c)	No sign of algal growth on the paint film

c. Determination of algal resistance:

i. General:

- The test screens only the Trentepohlia Odorata species for algal resistance in emulsion paints for decorative purposes to be used on buildings in Hong Kong. It has been found that this species predominates on surfaces of most of the local buildings, besides being the first to colonise such surfaces;
- A suitable level of an effective non-mercurial algicide shall be used. The level used should not render the finish or its film hazardous to health. The algicide used shall be one that is resistant to solar irradiation, consistent with the climatic conditions in Hong Kong.

ii. Testing apparatus:

- Sterilized petri dish, ca. 90 mm diameter;
- Shelf with fluorescent lighting, such that the light intensity incident to the test surface is 1,000 to 1,400 lux. This can be done by installing 2 tubes of 40-watt cool fluorescent lamp, ca. 25 cm apart on horizontal level and ca. 60 cm above the test surface;
- Autoclave, 1.2 to 1.5 kgf/cm^2;

- All chemicals, water and non-disposable containers and tools used for the test must be sterilized by an autoclave under the pressure of 1.2 to 1.5 kgf/cm² for 20 minutes.

iii. Reagents:

- Sterilized Bold Basal medium;
- Algae culture, predominantly Trentepohlia Odorata, maintained in Bold Basal medium.

iv. Testing procedure:

- Preparation of paint film: two coats of paint under test are applied to the interior bottom and vertical surface of the petri dish. The first coat of paint is allowed to dry overnight before the second coat is painted;
- Pre-ageing of paint film: the paint film prepared is allowed to stand at room temperature for 3 days followed by 168 hours UV ageing in accordance with ASTM G53-96. The following operating cycles shall be used:
  - 8 hours - lights on at 55ºC;
  - 4 hours - condensation on and lights off at 45ºC;
  - Light source - UV fluorescent lamps B313.
- After the ageing, allow the dish to stand at room temperature for 24 hours;
- Inoculation with algae culture: homogenise the algae culture with a tissue grinder shortly before inoculation. Adjust the concentration of the culture to 0.3 ± 0.1 mg/L chlorophyll with Bold Basal medium;
- Add 2 ml of the algae culture into the petri dish. Spread the culture to the painted surface as evenly as possible. Add the same quantity of algae culture into a blank petri dish to serve as control for the test. The same lot of algae culture is used for inoculating both the test sample and the blank dish. Replace the dish with cover after the inoculation. Subsequent operations are done on both the sample under test and on the blank;
- Exposure under lights: the petri dish is subject to exposure under fluorescent lighting at room temperature. Lighting cycle is 12 hours on followed by 12 hours off. Keep the paint film moistened by adding drops of diluted Bold Basal medium (1 part Bold Basal medium to 3 parts distilled water by volume) periodically. Normally this will require no more than 1 ml per 2 days. The petri dish is kept covered during the exposure period;
- The exposure period is 8 weeks from the day of inoculation of algae culture;
- The test is conducted in duplicate for both the paint sample and the blank.

v. Interpretation of results:

- At the end of the test, compare the growth intensity of algae on the paint sample with that of the blank control. The paint sample is deemed to pass the test if the algae culture is killed, as evidenced by the bleaching of the green colour, against the increase in algal growth in the blank petri dish;

- If no increase in growth is observed in the blank dish, the results are invalid and the test shall be repeated.

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for external emulsion paint upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & Delivery Note	Document check	From an Approved origin with product information same as the sample submission approval record
Packaging: Silk screen information - Proprietary brand name - Manufacturer's name and address - Supplier's name and address Printed information - Batch no. / Lot no. - Expiry date - Capacity	Visual check	Information in accordance with the Approved sample
Labeling	Visual check	Consistency
Product	Remove container cover and check the quality of the sample	No contamination, drying out and obvious colour inconsistency shall be accepted
Product validity	Check expiry date on packaging	No product is found in store on site with invalid expiry date

      ii. Frequency:

      Sampling frequency of verification are as follows:

Items	Sampling Frequency	Representative Batch

Manufacturer's Certificate of origin & Delivery Note	1 sample from each batch	Individual
Packaging and labelling	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note
Product and product validity	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

FIN7.M380.9 MULTI-COLOUR PAINT

An Approved brand comprising a base coat and hardwearing top coat incorporating a pigmented spatter coat.

FIN7.M400.9 EXTERNAL TEXTURED PAINT

An Approved, heavy duty masonry paint, incorporating a fine aggregate filler.

FIN7.M410.9 FIRE RETARDANT PAINT

1. An Approved intumescent paint which, when used alone, or in conjunction with other paints and applied to combustible substrates in accordance with manufacturer's tested system, achieves a Class 1 surface spread of flame rating when tested to BS 476:Part 7:1997;
2. Comply with the latest Code of Practice for Fire Safety in Buildings and the applicable Fire Services Department Circular Letter requirements and guidelines;
3. Submit details of the paint including catalogue, brand name / model name, job reference and the manufacturer’s method statement for the application for the CM’s information.

FIN7.M420.9 COLD CURE EPOXY PAINT

An Approved two pack type non-flammable solvent free epoxy resin coating; primer if required, is to be of the same painting system.

FIN7.M430.9 POLYURETHANE PAINT

A two pack type and part of an Approved system.

FIN7.M440.9 CHLORINATED RUBBER PAINT

Part of an Approved system, comprising primers, undercoats and finishes.

FIN7.M450.9 MICACEOUS IRON OXIDE PAINT

Part of an Approved system.

FIN7.M460.9 BLACK BITUMASTIC PAINT

Tar based, complying with BS 1070:1993:Type B (quick drying).

FIN7.M470.9 BLACK BITUMEN COATING SOLUTION

To BS 3416:1991:Type 1, for general purposes.

FIN7.M480.9 FLUORESCENT PAINT

1. Water or oil base as shown on Drawings;
2. Undercoat: white synthetic paint.

FIN7.M490.9 REFLECTING PAINT

Consisting of:

1. Undercoat: white synthetic paint;
2. Finish coat: white synthetic paint with a high gloss finish and a surface coating of fine grain reflective aggregate.

FIN7.M500.9 METALLIC PAINT

Composed of acrylic resin solution base mixed with:

1. Finely divided aluminium to give a bright finish; or
2. Finely divided copper or copper alloy to give a bronze finish.

FIN7.M510.9 HEAT RESISTING PAINT

Heat resisting primer, undercoat and Approved enamel finish.

FIN7.M520.9 ACID RESISTING PAINT AND THINNER

An Approved brand resistant to attack by all commonly used commercial acids and alkalis.

FIN7.M530.9 BLACK ENAMEL

High grade, quick drying black japan capable of drying to a perfectly smooth, hard and elastic surface within 12 hours at 16ºC.

FIN7.M560.9 CHALKBOARD PAINT

An Approved, hard drying, flat black or dark green paint, containing a fine abrasive.

FIN7.M570.A SYNTHETIC PAINT

1. Submission Requirements:
    a. At sample submission and approval stage, submit a sample of the proposed synthetic paint for CM's approval together with all the following substantiation for CM's information:
        i. Catalogue, brand name / model name and job reference of the synthetic paint;
        ii. Name, address and contact person of the local supplier;
        iii. Name, address and contact person of the manufacturer;
        iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
        v. When the synthetic paints are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
            - A sample board showing the quality, detail technical information and application procedures for the proposed synthetic paint;
            - Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Solvent based or water based synthetic paint in accordance with sub-clause (2)(b) comprising:

i. Number of coats as FIN7.W2210;

ii. Undercoats, if any, shall be of properly matching type with finish coats;

iii. Colour: to Approval.

b. The quality and performance requirements are as follows:

Items		Method	Acceptance Standards
Preliminary examination of paint	Surface skin	BS EN ISO 1513:2010	-No surface skin
	Consistency		-No gelling
	Colour separation into layers		-No colour separation
	Settling		-No hard settling
	Extraneous matter		-No extraneous matter
Drying times	Surface drying (hour)	BS EN ISO 9117-3:2010	< = 4
	Hard drying (hour)	BS EN ISO 9117-1:2009	< = 18
Fineness of grind (μm)		BS EN ISO 1524:2013	< = 25

Hiding power (contrast ratio %)		BS EN ISO 2814:2006	Solvent based:>=85 Water based:>=60
Gloss value (GU)	60°	BS EN ISO 2813:2014	Solvent based: >=80 Water based: >=50
Viscosity	Solvent based: by Flow Cup No. 6 (sec)	BS EN ISO 2431:2011	45 -60
	Water based: by Viscometer (KU)	ASTM D562-10 (2018)	75-85
Bending		BS EN ISO 1519:2011	No coating crack at 3 mm mandrel
Scratch (g)		BS EN ISO 1518-1:2011	> = 600
Accelerated weathering		ASTM G154-16 ("Cycle 2" in "Table X2.1 - Common Exposure Conditions" to be adopted except that UVA-340 lamp should be used in place of UVB-313)	Min. 300 hours After the specified hours of testing there shall be no signs of checking, blistering, or cracking, and the loss of gloss shall not be more than 30% of the original gloss. In addition, there shall be little change or no change in colour, and any change in colour shall be equivalent to a degree of contrast of not less than grade four of the grey scale conforming to BS EN 20105-A02:1995

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for synthetic paint upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards

Manufacturer's Certificate of Origin & Delivery Note	Document check	From an Approved origin with product information same as the sample submission approval record
Packaging: Silk screen information - Proprietary brand name - Manufacturer's name and address - Supplier's name and address Printed information - Batch no. / Lot no. - Expiry date - Capacity	Visual check	Information in accordance with the Approved sample
Labeling	Visual check	Consistency
Product	Remove container cover and check the quality of the sample	No contamination, drying out and obvious colour inconsistency shall be accepted
Product validity	Check expiry date on packaging	No product is found in store on site with invalid expiry date

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Manufacturer's Certificate of origin & Delivery Note	1 sample from each batch	Individual
Packaging and labelling	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note
Product and product validity	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

FIN7.M580.A MULTI-LAYER ACRYLIC PAINT

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed multi-layer acrylic paint for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. Documents from the supplier or manufacturer showing the appointment of the applicators for the proposed multi-layer acrylic paint.

b. When the multi-layer acrylic paints are specified for domestic blocks, submit the following within six months from commencement of the superstructure work of domestic blocks:

i. For multi-layer acrylic paints with texture, submit a sample board similar to the ones maintained by the Housing Department with a 'Visual Sample Board' and the data of minimum coverage rate of the proposed system:

- 1.3 kg/m² to 3.8 kg/m² (Medium texture) for external walls;
- 0.9 kg/m² to 3.8 kg/m² (Fine texture) for corridor walls.

to show that the quality and appearance of the paint is not below the standard of the benchmark sample boards. Submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;

ii. Technical information details and application procedures for the proposed multi-layer acrylic paint;

iii. Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

iv. The product conformity certificate as prescribed in sub-clause (1)(c) below.

c. Product conformity certificate for multi-layer acrylic paints supplied for domestic blocks:

i. Submit within the time period specified in sub-clause (1)(b) the original or a certified true copy of the product conformity certificate pursuant to the "Product Conformity Certification Scheme for Paint Products" (PCCS-PP (Issue 2)) published by the Hong Kong Association for Testing, Inspection and Certification Limited. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM;

ii. Submit together with the product conformity certificate a summary of the test results under the audit testing of the PCCS-PP (Issue 2). The summary shall be prepared by the accredited laboratory carrying out the testing or the certified manufacturer. If so directed by the CM, submit a full set of the audit test reports to the CM for record;

iii. If the product conformity certificate cannot be attained or submitted in compliance with sub-clause (1)(c)(i) above, it shall be submitted as early as possible within 24 months from the date for commencement of the Works provided that the original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) are submitted at the sample submission and approval stage for CM's information. The date of the test shall be within three years prior to the notified date for commencement of the Works;

iv. In the event of failure to submit the product conformity certificate for CM's information in compliance with sub-clauses (1)(c)(i) to (1)(c)(iii) above, the CM may order the removal of materials or delivered products off Site. The Contractor shall be responsible for all rectification works required as a result of removal of the materials or delivered products off Site, bear all associated costs and no extension of time will be granted.

d. Submit the original or a certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information, unless the product conformity certificate as prescribed in sub-clause (1)(c) has been submitted and all the requirements are covered by the scope of the PCCS-PP (Issue 2):

i. The date of the test shall be within three years prior to the notified date for commencement of the Works;

ii. The test reports shall be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a).

2. Quality Requirements:

a. Water based multi-layer acrylic paint in accordance with sub-clause (2)(b) comprising:

i. One sealer coat;

ii. One main texture coat for multi-layer acrylic paint with texture;

iii. Minimum two finishing coats;

iv. Colour: to Approval.

b. The quality and performance requirements are as follows:

Items	Method	Acceptance Standards		Remarks
		With Texture Coat	Without Texture Coat	
Low Temperature Stability	Clause 5.5 JIS A6910-1988 or Clause 7.5 JIS A6909-2003	No lumps and free from separation and aggregation of the composing materials	No lumps and free from separation and aggregation of the composing materials	Respective coatings of primer coating, main coating and top coating are regarded as the samples.
Change in Consistency	Clause 5.6 JIS A6910-1988 or Clause 7.7 JIS A6909-2003	± 15%	Not applicable	Respective coatings of primer coating, main coating and top coating are regarded as samples.
Cracking Resistance due to Initial Stage Drying	Clause 5.7 JIS A6910-1988 or Clause 7.8 JIS A6909-2003	No cracking shall occur.	Not applicable	
Adhesion Strength	Clause 5.8 JIS A6910-1988 or Clause 7.9 JIS A6909-2003	Standard condition > = 68.6 N/cm² Immersion in water > = 49.0 N/cm²	Standard condition > = 68.6N/cm² Immersion in water > = 49.0 N/cm²	
Repeated Warming and Cooling	Clause 5.9 JIS A6910-1988 or Clause 7.10 JIS A6909-2003	No peeling, cracking and blistering and remarkable discolouration and degradation in luster on the surface.	No remarkable discolouration and degradation in luster on the surface.	
Permeability	Clause 5.10 JIS A6910-1988 or Clause 7.12 JIS A6909-2003	< = 0.5 ml	< = 0.8 ml	
Impact Resistance	Clause 5.11 JIS A6910-1988 or Clause 7.14 JIS A6909-2003	Cracking, remarkable deformation and peeling shall not occur.	Not applicable	
Weather Resistance	ASTM G-154-16	Cracking and peeling shall not occur and the discolouration shall be No.3 or over in grey scale according to JIS A6910-1988.	Cracking and peeling shall not occur and the discolouration shall be No.3 or over in grey scale according to JIS 6910-1988.	The test conditions: Fluorescent UV Lamp: UVA-340 nm Cycle: 24 hrs UV at 60°C Total exposure time: 500 hours

Determination of Resistance to humid atmospheres containing sulphur dioxide	BS EN ISO 3231:1998	No blistering, loss of adhesion, rust staining, change of colour, embrittlement and other signs of deterioration.	No rust staining and change of colour.	The amount of sulphur dioxide to be used in testing is one litre. The test cycle to be 12 cycles
Resistance to Fungal Growth	FIN7.APPENDI	Resistance Index < = 1 at Day 28 for fungal resistance	Resistance Index < = 1 at Day 28 for fungal resistance	
Resistance to Algal Growth	FIN7.APPENDI	Resistance Index = 0 at Day 28 for algal resistance	Resistance Index = 0 at Day 28 for algal resistance	

c. When the multi-layer acrylic paints are supplied for domestic blocks, standard of visual quality of painted surface shall be comparable with the benchmark samples maintained by Housing Department.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for multi-layer acrylic paint upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & Delivery Note	Document check	From an Approved origin with information of product identification numbers
Packaging: Silk screen information - Proprietary brand name - Manufacturer's name and address - Supplier's name and address Printed information - Batch no./Lot no. - Expiry date - Capacity - Product identification	Visual check	Information in accordance with the Approved sample
Labeling	Visual check	Consistency
Product	Remove container cover and check the quality of the sample	No contamination, drying out and obvious colour inconsistency shall be accepted

Product validity	Check expiry date on packaging	No product is found in store on site with invalid expiry date

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Manufacturer's Certificate of Origin & Delivery Note	1 sample from each batch	Individual
Packaging and labeling	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note
Product and product validity	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

FIN7.M584.N ACRYLIC PAINT FOR INTERNAL STAINLESS STEEL PIPE BRACKETS

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed paint coating for the CM's approval together with all the following substantiation for the CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. The manufacturer’s method statement for the application.

2. Quality Requirements:

a. Water based acrylic paint in accordance with sub-clause (2)(c) comprising:

i. One sealer or primer coat;

ii. Minimum two finishing coats;

iii. Colour: to Approval.

b. Compatible with and shall not adversely affect the physical property of the stainless steel pipe brackets;

c. Application on stainless steel pipe bracket for effective insulation to attain a measured insulation resistance of not less than 45,000 Ohm as per requirements in PLU1.M440 (1) or DRA1.M260 (1);

d. The quality and performance requirements are as follows:

Items		Method	Acceptance Standards
	Surface skin		-No surface skin
	Consistency		-Normal without gelling

Preliminary examination of paint	Colour separation into layers	BS EN ISO 1513: 2010	-No colour separation
	Visible impurities		-No visible impurities
Drying times	Surface drying (mins)	BS EN ISO 9117-3: 2010	< = 2 hours for primer < = 40 mins for finishing coat
	Hard drying (hours)	BS EN ISO 9117-1: 2009	< = 4 hours for primer < = 2 hours for finishing coat
Mandrel Bending Test		BS EN ISO 1519: 2011	No coating crack at 3mm mandrel
Adhesion test (cross hatch method)		BS EN ISO 2409: 2013	Class 1 The dried film should show no failure on a cross cut test when applied to stainless steel bracket and dried for 7 days.
Water resistance		ASTM D870-15 (2020)	>= 100 hours
Resistance to fungal and algal growth of paint		FIN7.APPEND1	Resistance Index < = 1 at Day 28 for fungal resistance Resistance Index = 0 at Day 28 for algal resistance
Accelerated weathering		ASTM G154-16 (‘Cycle 2” in Table X2.1 – Common Exposure Conditions” to be adopted except that UVA-340 lamp should be used in place of UVB-313)	>= 500 hours After specified hours of testing there shall be no signs of checking, blistering, or cracking, and the loss of gloss shall not be more than 30% of the original gloss. In addition, there shall be little change in colour, and any change in colour shall be equivalent to a degree of contrast of not less than grade four of the grey scale conforming to BS EN 20105-A02:1995.

e. VOC content in compliance with the Air Pollution Control (Volatile Organic Compounds) Regulation.

FIN7.M585.9 DOORSET PAINT

An Approved proprietary water based paint product comprising:

1. Undercoat: one coat, type as recommended by the paint manufacturer;
2. Finishing coat: minimum three coats of cellulose lacquer.

FIN7.M590.9 TEXTURED SPRAYED PAINT COATING

1. Textured spray paint coating of solvent based polyurethane of all colour range and comprising:

a. Sealer;
b. Texture base;
c. Undercoat;
d. Top coat.

2. The paint system shall comply with the following requirements:

	Item	Specified Standard	Requirements
a.	Film Thickness	BS 3900-C5: 1992	1-3 mm
b.	Mandrel Bend Test	BS 3900 : Part E1: 1995	Pass 10 mm Ø
c.	Scratch Test	JLS-K-5400: 1990 8.4	"2H" in pencil hardness or higher
d.	Impact Test	JLS-K-5400: 1990 8.3	No cracking, peeling observed under the condition : Weight : 1kg Height : 30cm
e.	Cross-Cut Test	BS 3900 : Part E6: 1992	Class 1
f.	Resistance to Humidity	BS 3900-F2: 1973	Passed if no blistering, deterioration, loss of adhesion, rust staining, discoloration and embrittlement after 1 week
g.	Resistance to Salt Spray	BS 3900-F4: 1968 (1991)	No discernible change after 500 hours
h.	Weather Resistance	JLS-K5400: 1990 9.9	No discoloration, cracking, peeling after 1,000 hours
i.	Chemical Resistance	BS 3900 : Part G8: 1993 DIN 53168: 1982	No discoloration, cracking, peeling after immersion of: 720 hours in 5% NA_2CL_3 solution. 720 hours in 100% mineral spirit. 144 in 1% HCL, H_2SO_4, HNO_3, H_3PO_4 solution.
j.	Fire Resistance		Conforms to the fire-resistance material no. 0001 authorized by The Ministry of Construction in Japan.

3. Submit the following to CM for approval:
   a. Manufacturers product data sheet or catalogue in sufficient detail to reveal the characteristics of the ingredients and their properties;
   b. Supporting laboratory test data, performance test reports; including requirements listed in sub-clause (2) above;
   c. Full specification for surface preparation and method of application;
   d. Comprehensive colour chart;
   e. Delivery schedule to job site;
   f. Colour sample board of size not smaller than 600 x 600 mm for each and every colour specified by the CM (the colour of the painted sampled panel must be identical to the ones specified for application on the job site.);
   g. Previous jobs references.

FIN7.M600.N VARNISH, STAIN AND WAX POLISH COMPOSITION

Submit manufacturer's written confirmation to declare the following for all materials in FIN7.M610 to FIN7.M680:

1. Comply with the VOC content limits on regulated architectural paints (varnishes) stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation of Hong Kong;
2. Shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride);

3. Contain no more than 0.01% by wet weight of formaldehyde;
4. Contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which must include benzene, toluene, xylenes, and ethylbenzene.

CLEAR WOOD TREATMENTS

FIN7.M610.9 LINSEED OIL

To BS 6900:1987.

FIN7.M620.9 STAINS FOR VARNISHING OR POLISHING

An Approved water or spirit based stain suitable for use under varnish or wax polish.

FIN7.M630.9 SELF FINISHED STAINS

An Approved proprietary brand.

FIN7.M640.9 COPAL VARNISH

No. 1, extra pale quality for internal use only.

FIN7.M650.9 SYNTHETIC VARNISH

Long linseed oil alkyd type for internal or external use.

FIN7.M660.9 POLYURETHANE VARNISH

For internal or external use:

1. Moisture cure oil, modified one pack type for internal use only;
2. Isocyanate cure, two pack type for internal or external use.

FIN7.M670.9 WAX POLISH

An Approved proprietary brand suitable for floors, furniture and joinery as required.

FIN7.M680.9 CELLULOSE LACQUER

An Approved proprietary brand.

ANCILLARY MATERIALS

FIN7.M710.9 KNOTTING FOR METAL

An Approved proprietary brand of knotting suitable for application to coated metal pipes.

FIN7.M720.9 KNOTTING FOR WOOD

To BS 1336:1971.

FIN7.M730.9 STOPPING FOR INTERNAL WOODWORK

Linseed oil putty to BS 544:1969, tinted to match painted surface if required.

FIN7.M740.9 STOPPING FOR EXTERNAL WOODWORK

Approved proprietary oil based lead-free product.

FIN7.M750.9 FILLER FOR PLASTER SURFACES

Either:

1. Plaster of Paris to BS 1191:Part 1:1973:grade A; or
2. An Approved proprietary brand.

FIN7.M760.9 SURFACE FILLER FOR WOOD

An Approved proprietary brand.

FIN7.M770.9 WHITE SPIRIT

To BS 245:1976.

FIN7.M780.9 STONE CLEANER AND SEALER

Appropriate chemical solutions from an Approved manufacturer.

FIN7.M790.9 SKIM COAT FOR PAINT FINISHES

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed skim coat for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name / model name and job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Written confirmation from paint suppliers and skim coat suppliers that the paint finishes and the skim coat are compatible and the paint finishes will not adversely affect the performance of the skim coat and vice versa;
      v. Method statement for the application of skim coat on various substrates and for various paint finishes;
      vi. When the skim coat is supplied for domestic blocks, except those for the ancillary facilities at lower floors, include the following in the submission:
         - Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
   b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(c) for CM's information:
      i. The date of the test shall be within three years prior to the notified date for commencement of the Works;
      ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);
      iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
2. Quality Requirements:
   a. Pre-packed skim coat mix shall be mechanically mixed with the amount of water as specified by the manufacturer;
   b. The pH value of the hardened skim coat before painting shall not be more than 10;
   c. The quality and performance requirements are as follows:

Items	Test Method	Acceptance Standards	Remarks

Initial tensile adhesion strength	BSEN 1015: Part 12: 2000	Internal skim coat >=0.5 Nmm² External skim coat >=1 N/mm²	Test specimens shall be cut through the hardened skim coat layer according to clause 7.3.3 of BSEN 1015: Part 12: 2000 Modifications to BSEN 1015: Part 12: 2000 - - the concrete panel substrate shall be cast in metal mould to achieve a smooth finish and cured under 27±2ºC at a relative humidity of 55±5% not less than 28 days. - thickness of the skim coat shall be of 3 mm thick. - curing conditions for respective tests refer to sub-clause (d)
Tensile adhesion strength after water immersion	BSEN 1015: Part 12: 2000	Internal skim coat >=0.3 Nmm² External skim coat >=0.7 N/mm²	
For external skim coat only Tensile adhesion strength after heat ageing	BSEN 1015: Part 12: 2000	External skim coat >=0.7 N/mm²	
For external skim coat only Tensile adhesion strength after freeze-thaw cycles	BSEN 1015: Part 12: 2000	External skim coat >=0.7 N/mm²	
For internal skim coat only Compressive strength - 28 days	BSEN 1015: Part 11: 1999	5 - 12 N/mm²	
Water retentivity	BS 4551: 2005	>= 99%	
Applicable to non-cementitous skim coat only - Resistance to mould growth	BS 5980: 1980 Appendix B	No sign or evidence of mould growth.	

d. Curing conditions:

i. Initial tensile adhesion strength:

- Condition the test specimens under a temperature of 27±2ºC at a relative humidity of 55±5% for 27 days;
- Bond the pull-head plates to the test specimens;
- After a further 24 hours storage under a temperature of 27±2ºC at a relative humidity of 55 ± 5%, determine tensile adhesion strength according to BS EN 1015:Part 12:2000.

ii. Tensile adhesion strength after water immersion:

- Condition the test specimens under a temperature of 27±2ºC at a relative humidity of 55±5% for 7 days;
- Immerse in water at temperature of 27±2ºC for 20 days;
- Remove the test specimens from the water, wipe with a cloth and bond the pull-head plates to the test specimens;
- After a further 7 hour immerse the test specimens in water at temperature of a 27±2ºC;
- Remove the test specimens from water the following day and immediately determine tensile adhesion strength according to BS EN 1015:Part 12:2000.

iii. Tensile adhesion strength after heat ageing:

- Condition test specimens under a temperature of 27±2ºC at a relative humidity of 55±5% for 14 days;
- Place the test specimens in an air-circulating oven at 70±2ºC for a further 14 days;
- Remove the test specimens from the oven and bond the pull-head plates to the test specimens;
- Condition the test specimens for a further 24 hours at temperature of 27±2ºC at a relative humidity of 55±5%;
- Determine tensile adhesion strength according to BS EN 1015:Part 12:2000.

iv. Tensile adhesion strength after freeze-thaw cycles:

- Condition test specimens under a temperature of 27±2ºC at a relative humidity of 55±5% for 7 days;
- Immerse the test specimens in water for 21 days;
- Carry out 25 freeze-thaw cycles with each freeze-thaw cycle as follows:
  - Remove the test specimens from the water and lower the temperature to -15±3ºC within 2 hr ± 20 min.;
  - Maintain the test specimens at -15±3ºC for 2 hr ± 20 min.;
  - Immerse in water at 20±3ºC and raise the temperature to 15±3ºC and maintain this temperature for 2 hr ± 20 min..
- Allow the test specimens to reach standard conditions in air after the last cycle and determine the tensile adhesion strength according to BS EN 1015:Part 12:2000.

e. Packed in three ply paper and 1 ply ethylene together with preparation procedures and application methods. Minimum one set of the preparation procedures and application methods shall be printed in Chinese and diagrammatic forms for each lot that is delivered to site;

f. Brand name, batch number, shelf life, pot life and open time to be clearly printed on outside of package.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for skim coat upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	To Approved Sample
Lot No. / Batch No.	Document Check	As Approved

Expiry Date	Check information printed on the packing	Not expired

ii. Frequency:

One set of verification should be carried out for every delivery of skim coat made to Site under each Delivery Note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

WORKMANSHIP

GENERAL

FIN7.W010.9 STANDARD

Carry out painting generally in accordance with BS 6150:1991 and this Specification.

FIN7.W020.9 HEALTH AND SAFETY

Do not use materials or working practices which would result in any hazard or injury to operatives or to others in the vicinity of the Site.

FIN7.W030.9 HANDLING AND STORAGE

1. Store the materials on the Site or in the Contractor's workshops etc in cool, well ventilated, covered storage accommodation;
2. Fit the entrance door to the store with a "NO SMOKING" sign and provide a suitable fire extinguisher, immediately outside the entrance door for use in the event of a fire in the store.

FIN7.W040.9 PROTECTION OF EXISTING SURFACES

Protect surfaces, fittings, furniture and the like by suitable and Approved means.

FIN7.W050.9 CLEANLINESS

Remove and clean off all splashes whilst work is in progress and:

1. Make good any damage;
2. Leave the work and all areas in which the work was executed clean and perfect on completion.

FIN7.W060.9 COLOURS

Carry out decoration in colours Natural Colour System or to BS 4800: 1989 or to master colour chart by paint manufacturer as selected by the CM.

FIN7.W070.9 SAMPLE OF FINISHED WORK FOR CONSTRUCTION MOCK-UP

Provide the following and obtain Approval before commencing the work:

1. Paint sample of finished works;
2. A Construction Mock-up:

   Construct a Construction Mock-up of around 5 m² as PRE.B9.440 for painted surfaces showing the workmanship of each construction layer including preparation, applying primers, undercoats, and finishing coats etc. as applicable and as directed by CM.

FIN7.W080.9 DISPOSAL OF TINS

All paint tins shall be disposed as recycle materials after use of the contents.

PREPARATION - DEFINITION OF TERMS

FIN7.W110.9 PAINTING

Unless specifically stated to the contrary, the term "Painting work" includes also all preparatory and paint application works as defined in the remaining clauses of this sub-section necessary to:

1. Produce a first class finish, free of all blemishes, blisters and weeps;

2. Avoid brush marks.

FIN7.W120.9 WASH DOWN

Depending on the context, means:

1. The removal, with clean water, of all dirt not absorbed into the surface of a material not previously decorated; or
2. The removal, with clean water, of existing limewash, non-washable distemper or similar material not absorbed into the decorated surfaces; or
3. The removal of dirt from and the cleaning down of existing washable distempered, cement painted, synthetic painted and similarly decorated surfaces with sugar soap powder, mixed with water, followed by further applications of clean water.

FIN7.W130.9 BROOM DOWN

Means the thorough dry brushing of any surface with a stiff broom or brush so as to remove all cobwebs, dust or loose particles of previous finishes.

FIN7.W140.9 SCRAPE

Means the removal of all existing coats of paint, limewash, colourwash, distemper etc by the use of scraping tools, without the use of chemical solvents or heat and without damage to the underlying material. Make good any such damage at own expense. Wash down the surface after scraping.

FIN7.W150.9 WIRE BRUSH

Means the thorough brushing down of the surface with a wire brush.

FIN7.W160.9 STRIP

Means the complete removal, without damage to the underlying surface, of all existing coats of limewash, distemper, paints or other decorative material by means of washing and scraping, together with the application of chemical solvents or heat, if necessary. After the use of any chemical solvents, wash down the surface and neutralise in accordance with the manufacturer's recommendations.

FIN7.W170.9 STOP (PLASTER)

Means the careful trimming of the edges of all holes, cracks or crevices of any description and filling to produce an even, flat surface and touching up all patches with a coat of sealer prior to repainting.

FIN7.W180.9 STOP (WOODWORK)

Means the cleaning out and filling of all holes, cracks and crevices etc.

FIN7.W190.9 KNOT (METAL PIPES)

Means the application of one coat of patent knotting to the surface of any bitumen coated pipe.

FIN7.W200.9 KNOT (WOODWORK)

Means the application of a sufficient number of coats of knotting over all knots in the wood to prevent the bleeding of resin through the subsequent decoration.

FIN7.W210.9 RUB DOWN

Means the rubbing of newly prepared surfaces, or surfaces of existing paint remaining after preparation for redecoration, with Approved waterproof glass paper, sand paper, pumice stone or similar, to give a true and keyed surface for new paint.

FIN7.W220.9 FILL

Means the filling of the grain with surface filler.

PREPARATION - UNDECORATED SURFACES

FIN7.W310.9 GENERAL

Remove all dust, dirt, stains, efflorescence, grease, loose material and stepped joints. Provide a level surface and, unless otherwise specified, prepare new surfaces for decoration in accordance with the remaining clauses in this sub-section.

FIN7.W320.9 PLASTERED AND RENDERED SURFACES

Wash down, stop and rub down.

FIN7.W325.9 INTERNAL FAIR-FACED CONCRETE, PLASTERED SURFACES AND PANEL WALL PARTITIONS TO DOMESTIC BLOCKS

Apply cementitious skim coat of Approved type in 2 coats and sand down after the second coat.

FIN7.W330.9 CONCRETE, MASONRY AND ROOF TILES

Broom down

FIN7.W340.9 STRUCTURAL STEELWORK

As Worksection STR1.

FIN7.W350.A UNCOATED IRON AND STEEL

Chip off and remove all scale and rust, wire brush to leave a bare, clean surface and apply a rust inhibitor at least twelve hours prior to painting with the primer specified.

FIN7.W360.9 ZINC COATED IRON AND STEEL

Clean down and apply Approved primer.

FIN7.W370.9 COATED IRON AND STEEL PIPES

Clean down and knot.

FIN7.W380.9 COPPER

Where exposed copper is scheduled to be painted, wash with soap and warm water, rub down with coarse emery cloth and apply a coat of one part acetone to two parts of benzole prior to priming.

FIN7.W390.9 WOODWORK TO RECEIVE PAINT

Knot, prime, stop and rub down surfaces.

FIN7.W400.9 WOODWORK TO RECEIVE PRESERVATIVES AND PESTICIDES

Broom down surfaces.

FIN7.W410.9 WOODWORK TO RECEIVE LINSEED OIL

Rub smooth and brush clean.

FIN7.W420.9 WOODWORK TO RECEIVE CLEAR FINISHES

Rub down and fill surfaces to receive stain, varnish, wax polish or lacquer.

FIN7.W430.9 WOODWORK TO RECEIVE CHALKBOARD PAINT

Wash down surfaces.

FIN7.W440.9 ABSORBENT FIBRE BASED BOARDS

Broom down, punch down nail heads, stop all nail and screw holes, rub down and leave with a texture to match the surrounding surfaces.

FIN7.W450.9 FIBRE CEMENT

Broom down, using appropriate safety equipment to prevent the inhalation of dust and ensuring that:

1. Dust is kept down by spraying with water;
2. Operatives are provided with half mask (orinasal) respiratory protection.

FIN7.W460.9 SURFACES TO RECEIVE POLYURETHANE OR COLD-CURE EPOXY PAINTS

Fill surfaces with an Approved epoxy filler.

PREPARATION - DECORATED SURFACES

FIN7.W510.9 GENERAL

Remove all dust, dirt, stains, efflorescence, grease and loose material and, unless otherwise specified, prepare existing decorated surfaces for decoration in accordance with the remaining clauses in this sub-section.

FIN7.W520.9 SURFACES SUBJECT TO MOULD GROWTH

Wash down with one coat of anti-mould liquid before preparation of the surface for decoration and ensure that surfaces are entirely clean of old mould growth and spores.

FIN7.W530.9 LIMEWASHED OR WHITENED SURFACES

Scrape, broom down, stop, apply and bring forward bare spots with new material.

FIN7.W540.9 WASHABLE AND NON-WASHABLE DISTEMPERS

Strip off distempered washable sealer or non-washable distempered surfaces completely, wash down, stop, seal and prepare to receive new paint system as scheduled.

FIN7.W550.9 EMULSION PAINTED SURFACES

Scrape, wash down, stop, apply and bring forward bare spots with new material.

FIN7.W560.9 SYNTHETIC PAINTED SURFACES OTHER THAN METAL AND WOOD

Scrape, wash down, stop, rub down and apply primer to and bring forward bare spots with undercoat.

FIN7.W570.9 BLACK BITUMINOUS COATED SURFACES

Spot prime bare areas with black bituminous coating.

FIN7.W580.9 UNGALVANIZED IRON AND STEEL

Wash down, scrape, chip off and wire brush to remove all scale and rust, rub down, apply rust inhibitor and primer to bare areas or to such additional areas as directed and bring forward with undercoat.

FIN7.W590.9 PAINTED, ZINC COATED IRON AND STEEL

Wash down, scrape and remove all scale and rust, rub down and apply specified primer to and bring forward bare spots with undercoat.

FIN7.W600.9 SYNTHETIC PAINTED WOODWORK

Wash down, scrape, rub down, knot, prime and stop, and bring forward bare spots with undercoat.

FIN7.W610.9 POLYURETHANE OR EPOXY PAINTED WOODWORK

Wash down, scrape, rub down, stop and apply epoxy filler to, and bring forward bare spots with undercoat.

FIN7.W620.9 VARNISHED WOODWORK

Wash down, scrape, rub down and bring forward bare spots with varnish.

FIN7.W630.9 WAXED AND LACQUERED WOODWORK

Rub down, fill and again rub down to produce a smooth surface for refinishing.

FIN7.W640.9 WAXED FLOORS

Clean with wire wool or sand down as shown on Drawings.

FIN7.W650.9 STRIPPING EXISTING DECORATIONS

1. Where Instructed, strip existing decoration which is in a poor condition or which is to be replaced by a different type of finish;
2. After stripping, prepare surfaces as required for the type of finish to be applied.

APPLYING PAINTS GENERALLY

FIN7.W710.9 AMBIENT CONDITIONS

No painting works shall be carried out in adverse weather conditions such as extremely cold, raining, foggy, high humidity and where there is excessive dust in the air. Application of paints shall be in strict accordance with manufacturer's specification.

FIN7.W720.9 SURFACE CONDITION

1. Prior to application of skim coat, ensure that:
   a. Surfaces shall be level and free from stepped joints, structural cracks, broken edges, honey-combing, excessive blowholes or other irregularities;
   b. All holes, cracks and other defects in the surfaces have been made good.
2. After application of skim coat and one sealer coat of paint and before application of subsequent coat, ensure that:
   a. Blemishes shall be avoided;
   b. Surfaces shall be free from pin-holes, blowholes and blisters or other irregularities to ensure that they are smooth, clean and level to receive paint.
3. Before a subsequent coat is applied, surfaces shall be clean and dry after any previous coatings have hardened and rub down smooth with fine glass paper.

FIN7.W730.9 IRONMONGERY AND HARDWARE

1. If painting operations is obstructed, remove all articles of ironmongery, hardware etc before painting and replace, with matching screws, and plugs if required, of suitable sizes, after completion;
2. If painting operations is not obstructed, protect fittings and other surfaces with covers as appropriate;
3. Leave everything clean and completely free from all paint stains, splashes and the like.

FIN7.W740.9 MIXING AND APPLYING

Mix and apply paints in accordance with the manufacturer's recommendations.

FIN7.W750.9 THINNING

Only thin paints with Approval and in accordance with the manufacturer's recommendations.

FIN7.W760.9 BRUSH APPLICATION

Apply coatings with brushes of a suitable size, with flat wall brushes not less than 150 mm wide and:

1. Well brush each coat into the surface so that every part, including junctions and angles etc, is adequately covered;
2. Take care to avoid brush marks and an excessive or uneven thickness of paint film, particularly at edges, angles and junctions;
3. Apply the coating carefully so that the finished surface is free of unsightly marking due to excessive sanding; or inconsistent brush/roller marks;
4. Cut in neatly and cleanly without splashing or marking adjacent surfaces.

FIN7.W770.9 THICKNESSES OF COATS

Ensure the thicknesses of individual coats and the total thicknesses of paint systems fall within the standard thicknesses recommended by the manufacturers unless specified otherwise in this Worksection.

FIN7.W780.9 SUCCESSIVE COATS

Apply successive coats of paint in slightly differing tints.

FIN7.W790.9 APPLICATION BY ROLLERS, CLOTHS AND GLOVES

Do not use rollers, cloths or gloves for the application of decorative coatings unless otherwise Instructed or Approved.

FIN7.W800.9 MECHANICAL APPLICATION

Mechanical spraying machines may be used instead of brush application for emulsion paint except in proximity to pipework along corridor ceilings unless the pipework are protected with covers.

FIN7.W810.9 SURFACES LIKELY TO BECOME INACCESSIBLE

Prime and paint surfaces prior to fixing.

FIN7.W820.9 WEATHERSTRIPPING

Do not paint weatherstripping on metal windows and doors.

FIN7.W830.9 TOUCHING UP

Where Instructed, touch up coated surfaces on completion.

FIN7.W840.9 CLEANLINESS

Keep surfaces clean and free of dust during coating and drying.

FIN7.W850.9 PROTECTION OF NEWLY COATED SURFACES

1. Protect freshly applied surface coatings from damage;
2. Exhibit "WET PAINT" signs in English and Chinese and provide protective barriers where necessary.

APPLYING PRIMERS

FIN7.W910.9 GENERAL

Work primer into surface, angles, joints and end grain and:

1. Ensure that priming coats are of adequate thickness to suit the surface porosity;
2. Ensure that any primed surfaces that have deteriorated on site or in transit are touched up or re-primed;
3. Apply priming coats on new work before the articles are fixed in position.

FIN7.W920.9 METAL SURFACES

Apply primer to metal surfaces on the same day as they have been cleaned.

FIN7.W930.9 WASH AND ETCH PRIMERS

Allow wash and etch primers to harden before applying subsequent priming coats.

FIN7.W940.9 REBATES, GLAZING BEADS AND PUTTY

1. Apply a suitable primer for the glazing compounds specified in Worksection COM4 to glazing beads and rebates, before glazing;
2. Seal putty fronting with a suitable primer and paint system.

APPLYING UNDERCOATS AND FINISHING COATS

FIN7.W1010.9 UNDERCOATING

1. Apply in an even film over all surfaces, avoiding uneven thicknesses at edges and angles;
2. If the undercoating of any specified paint system is available only in white, apply an additional finishing coat in place of the second undercoat.

FIN7.W1020.9 FINISHING COATS GENERALLY

Apply in an even film over all surfaces and avoid brush marks, sags, runs and other defects.

FIN7.W1030.9 TWO FINISHING COATS

Where two hard gloss finishing coats are specified:

1. Apply the second coat when the first is dry and within 48 hours of the first or as per manufacturer's recommendations;
2. Rub down with medium/fine glass paper between coats to provide a key.

WATER REPELLENT LIQUID

FIN7.W1110.9 APPLICATION

Brush, clean down and apply one coat of water repellent liquid in accordance with the manufacturer's recommendations.

EXTERNAL TEXTURED PAINT

FIN7.W1310.9 APPLICATION

Allow a minimum drying time of 12 hours between coats unless required otherwise by the manufacturer's recommendations.

PESTICIDES AND PRESERVATIVES

FIN7.W1410.9 APPLYING PESTICIDAL COATINGS

Where specified elsewhere in this Specification, or shown on Drawings, apply over the entire surface in bands 75 mm wide in accordance with manufacturer's instructions.

FIN7.W1420.9 TIMBER PRESERVATIVE TREATMENT

Where timber is specified to be preservative treated elsewhere in this Specification or shown on Drawings:

1. Ensure that the timber has the correct moisture content before commencing the application of preservative;
2. Carry out treatment after all cutting and drilling;
3. Apply preservative to all the surfaces of the timber in accordance with the manufacturer's recommendations;
4. Stack the treated timber to dry out before priming and fixing.

BLACK BITUMEN COATING SOLUTION

FIN7.W1510.9 APPLYING COATINGS TO RECEIVE PLASTERS AND RENDERS

1. Blend the coating with clean, sharp sand while it is still tacky;
2. Ensure that the final covering is applied as soon as possible after the black bitumen coating.

BLACK ENAMEL

FIN7.W1610.9 APPLICATION

Work the paint well in with the brush and ensure that the finished surface is hard and elastic when dry.

REFLECTING PAINT

FIN7.W1710.9 APPLYING REFLECTIVE AGGREGATE

Apply reflective aggregate at the rate of 0.6 kg/m² while the finishing coat is still wet.

CLEAR WOOD TREATMENTS

FIN7.W1810.9 LINSEED OIL

Allow a minimum drying time of two hours between coats.

FIN7.W1820.9 WAX POLISH ON JOINERY

Apply with a soft cloth and:

1. Allow a minimum drying time of four hours between coats;
2. Brush the surface with a soft brush to obtain an eggshell finish.

FIN7.W1830.9 WAX POLISH FLOOR FINISHES

Apply with a weighted felt pad or an electric polisher.

FIN7.W1840.9 CELLULOSE LACQUER

Apply:

1. Undercoats and rub down with "flour grade" glass paper after each coat;
2. Final coat and polish to produce a finish free from marks and imperfections.

SIGNWRITING

FIN7.W1910.9 PAINTING LETTERS, CHARACTERS AND FIGURES

Paint to the sizes required on the Drawings in a thick coat of synthetic paint so that they stand out boldly and solidly, free from brush marks.

MULTI-LAYER ACRYLIC PAINT

FIN7.W2010.9 GENERAL

Prepare the surface and apply acrylic paint strictly in accordance with the manufacturer's recommendations for the following:

1. One sealer coat;
2. One main texture coat;
3. Minimum two finishing coats.

PAINTING TO KITCHEN, BATHROOM, FLAT ENTRANCE AND EXIT STAIRCASE DOORSETS IN DOMESTIC

FIN7.W2110.9 GENERAL

Carry out spray painting in the supplier's workshop prior to delivery to Site and in accordance with the paint manufacturer's recommendations and the requirements as specified below.

FIN7.W2120.9 SAMPLES OF FINISHED WORK

1. Prior to the order of the paints, submit a sample, for Approval, consisting of two sets of the upper half of the finished doorsets indicating materials used for the filler, undercoat and finishing coats proposed and the standard of workmanship on the paint application;
2. The Approved sample will be used as an acceptance standard for the workmanship of the spray paint finish application.

FIN7.W2130.9 COLOURS

The colour of the finishing coats of the whole doorset will be selected from the 'NCS' colour range or to master colour chart by paint manufacturer as selected by the CM.

FIN7.W2140.9 SURFACE PREPARATION

1. Fill all surface irregularities with filler or stopper as recommended by the paint manufacturer;
2. Leave to dry and sand down until smooth;
3. Ensure all surfaces to be painted are smooth, clean, dry and free from oil or grease and other contaminants.

FIN7.W2150.9 AMBIENT CONDITIONS

Do not commence painting in weather conditions with relative humidity above the limit specified by the paint manufacturer.

FIN7.W2160.9 APPLICATION OF PAINT

1. Apply one coat of undercoat by spray or by brush. Sand down and dust off;
2. Carry out thinning in accordance with the manufacturer's recommendation;
3. Allow sufficient time for the undercoat to dry before sanding and overcoating as recommended by the manufacturer;
4. Apply a minimum of three finishing coats by spray until the finished surfaces are smooth and free from wood grain. Ensure the working pressure of the pump, the nozzle size, the thinning process and the minimum recoating time satisfies the manufacturer's recommendations.

FIN7.W2170.9 DRYING AND PACKAGING

After application, leave to dry for a period of time before packing as recommended by the paint manufacturer. Wrap doorsets with uncoated white paper or equivalent material as recommended by the paint manufacturer. Do not use plastic coated materials or coloured paper for wrapping.

PAINTING TO GALVANIZED SURFACES

FIN7.W2180.9 PAINTING TO GALVANIZED SURFACES

Paint galvanized surfaces as follows:

1. Lightly sand the galvanized surfaces;
2. Remove grease, dirt, contaminants and white storage stain from the galvanized surfaces using cleanser recommended by paint suppliers for at least two times;
3. Apply water based anti-corrosion primer to the galvanized surfaces in accordance with manufacturer's recommendation;
4. Apply undercoat not less than 7 days from the date of applying the water based anti-corrosion primers or the number of days as recommended by manufacturer. Prior to applying the undercoat, remove dirt and grease from the surfaces;
5. Prior to applying the topcoat, remove dirt and grease from the surfaces.

SCHEDULES OF PAINT TYPES AND NUMBERS OF COATS

FIN7.W2210.9 GENERAL

Prepare and apply paints and coatings in the number of coats specified in the tables in the remaining clauses of this sub-section. Unless stated otherwise, treat internal and external surfaces the same.

FIN7.W2220.9 NEW PLASTER, RENDER, CONCRETE, MASONRY AND SIMILAR SURFACES

New Plaster, Render, Concrete, Masonry and Similar Surfaces					
Type of Treatment	Number of Coats				
	Sealer	Primer	Undercoat	Texture coat	Finish
Internal Emulsion Paint	1*				2 (minimum)
External Emulsion Paint	1*				2 (minimum)
Multi-layer acrylic paint with texture	1*			1	2 (minimum)
Multi-layer acrylic paint without texture	1*				2 (minimum)

Textured Emulsion Paint	1*			1 for dispersed aggregate 2 for stone texture	2 for dispersed aggregate 1 for stone texture
Multi-colour Paint		1		1	1
Synthetic Paint	1 **		1		2
External Textured Paint				1	2
Cold Cure Epoxy Paint			1		1
Pesticidal Coating					1
Marking Paint					2
Fluorescent Paint		1**	1		1
Reflecting Paint		1**	1		1

* Thinned with water in accordance with the manufacturer's recommendations.

** Alkali resistant

FIN7.W2230.9 NEW STRUCTURAL STEEL SURFACES

As STR1.W1220.

FIN7.W2250.9 NEW METAL SURFACES

New Metal Surfaces			
Type of Treatment	Number of Coats		
	Primer	Undercoat	Finish Coat
Synthetic paint	1*	1	2
Metallic paint	1*	2	1
Heat resisting paint	1*	2	1
Acid resisting paint	1*	2	1
Black enamel	1*		1
Non-toxic paint	1*		2
Polyurethane paint	1 polyurethane red lead	1	1
Cold cure epoxy paint	1 epoxy red oxide chromate	1	1
Black bitumastic			2

* Type of primer to manufacturer's recommendation

FIN7.W2270.9 NEW WOOD SURFACES

New Wood Surfaces			
Type of Treatment	Number of Coats		
	Primer	Undercoat	Finish Coat*
Synthetic paint (internally)	1*	1	1
Synthetic paint (externally)	1*	1	1
Polyurethane paint		1	1
Wood preservative			2
Linseed oil			3
Stain			2** (minimum)

Varnish			2 (minimum)
Wax polish (joinery and furniture)			3 (minimum)
Wax polish (floors)			2
Chalk-board paint			2
Cellulose lacquer			3 (minimum)

* Type of primer to manufacturer's recommendation

** Number of coats increase to achieve the correct colour.

FIN7.W2290.9 NEW BUILDING BOARDS AND ROOF COVERINGS

Building Boards and Roof Coverings		
Type of Treatment	Number of Coats	
	Primer/Sealer	Finish Coat
Emulsion paint on soft or hard fibreboard, insulating board, acoustic tiles and similar surfaces	1 thinned in accordance with the manufacturer's recommendations	2
Plastic emulsion paint on fibre cement surfaces	1 alkali resisting and 1 thinned in accordance with the manufacturer's recommendations	2
Textured emulsion paint on soft or hard fibreboard, insulating board, acoustic tiles and similar surfaces	1 thinned in accordance with the manufacturer's recommendations	2
Anti-mould acrylic emulsion paint on fibre cement surfaces	1 alkali resisting and 1 thinned in accordance with the manufacturer's recommendations	2
Synthetic paint on soft or hard fibreboard, insulating board, acoustic tiles and similar surfaces	1 (recommended sealer)	1 (undercoat) 1 (finish)
Synthetic paint on fibre cement surfaces	1 (alkali resisting primer)	1 (undercoat) 1 (finish)

PIPEWORK AND MACHINERY

FIN7.W2405.9 GENERAL

All pipeworks installations shall not be painted unless otherwise specified.

FIN7.W2410.9 INSULATED PIPES

1. Colour code all insulated pipes and trunking concealed in ducts or behind suspended ceilings and not normally accessible;
2. Plaster all insulated pipes and trunking running in accessible vertical ducts or in normally visible positions and paint in the appropriate colour code or with appropriate colour code bands.

FIN7.W2420.9 UNINSULATED PIPES

Whether concealed or visible, paint either in the appropriate colour code or as required by the CM and with the appropriate colour code bands.

FIN7.W2430.9 PAINTING MACHINERY

Unless otherwise specified, paint all machinery in green, 14 E 51, to BS 4800: 1989.

FIN7.W2460.9 CAST IRON PIPES

Paint cast iron pipes and fittings with at least 2 coats of bitumen to BS 3416: 1991 after installation.

FIN7.W2465.9 GALVANIZED PIPES

Paint galvanized pipes and fittings to this Worksection.

FIN7.W2470.9 REFRIGERANT PIPES

Bright polish and lacquer visible, uninsulated copper pipes and fittings.

FIN7.W2475.9 PAINTING UPVC PIPES

1. Paint all external uPVC water supply pipes exposed to sunlight and on roof and canopy with an Approved white acrylic paint;
2. uPVC pipes to be painted shall be cleaned, prime coated with appropriate primer and completed with two coats of white acrylic paint in accordance with the paint manufacturer's recommendation.

FIN7.W2480.9 METALWORK IN REFRIGERATOR SPACES

Finish all metalwork inside cold stores and similar refrigerator spaces in a mould resistant paint, suited to low temperature application, to the satisfaction of the CM.

FIN7.W2490.A PIPELINE IDENTIFICATION

Paint pipes and pipelines either in the colours shown in the schedule in FIN7.W2500 and FIN7.APPEND2 or as directed, and comply with the following:

1. Apply the basic identification colour banding with or without 100mm wide colour code indication at all junctions, at both sides of valves, service appliances, bulkheads, wall penetrations and at any other locations where identification is necessary or directed by the CM;
2. Paint valves with the appropriate identification colour except for those on pipelines coded for fire service supply which must be painted red;
3. Indicate the direction of flow in the pipeline by means of an arrow over the basic identification colour, painted in white or other colour as directed by the CM in order to contrast clearly with the basic identification colour;
4. Apply the direction of flow marking for drainage pipes via sump pump system. The marking is not required for drainage pipes with flow by gravity fall;
5. Add "H" labelling and indication on drainage pipes as per FIN7.APPEND3 for identification of Housing Authority (HA) pipes passing through non-HA premises.

FIN7.W2500.9 PIPELINE IDENTIFICATION SCHEDULE

Pipe Identification - Colour References to BS 4800: 1989					
Service Type	Basic Identification Colour Approx 150 mm wide	Colour Code Indication Approx 100 mm wide			Basic Identification Colour Approx 150 mm wide
Primary cooling water	Green 12 D 45	White			Green 12 D 45
Boiler feed Water	Green 12 D 45	Crimson 04 D 45	White	Crimson 04 D 45	Green 12 D 45
Condensate water	Green 12 D 45	Crimson 04 D 45	Emerald green 14 E 53	Crimson 04 D 45	Green 12 D 45
Chilled water	Green 12 D 45	White	Emerald green 14 E 53	White	Green 12 D 45

Fresh water supply	Green 12 D 45	White	Blue 18 E 53	White	Green 12 D 45
Mains hot water supply	Green 12 D 45	White	Crimson 04 D 45	White	Green 12 D 45
Central heating <100°C	Green 12 D 45	Blue 18 E 53	Crimson 04 D 45	Blue 18 E 53	Green 12 D 45
Central heating >100°C	Green 12 D 45	Crimson 04 D 45	Blue 18 E 53	Crimson 04 D 45	Green 12 D 45
Flushing water supply	Green 12 D 45				
Fire service supply	Green 12 D 45	Safety red 04 E 53			Green 12 D 45
Vacuum	Light blue 20 E 51	White			Light blue 20 E 51
Compressed Air (inc.air ducts)	Light blue 20 E 51				
Steam	Silver grey 10 A 03				
Drainage	Black 00 E 53				
Electrical ducts and conduits	Orange 06 E 51				
Manufactured and town gas	Yellow ochre 08 C 35	Emerald green 14 E 53			Yellow ochre 08 C 35
Natural gas	Yellow ochre 08 C 35	Primrose 10 E 53			Yellow ochre 08 C 35
Refrigerant gas or liquid	Yellow ochre 08 C 35	Content of the refrigerant indicated by the chemical symbol and the refrigerant number in Black			Yellow ochre 08 C 35
Diesel fuel	Brown 06 C 39	White			Brown 06 C 39
Furnace fuel	Brown 06 C 39				
Lubricating oil	Brown 06 C 39	Emerald green 14 E 53			Brown 06 C 39
Acids and alkalis	Violet 22 C 37				
Oxygen (see note)	Yellow Ochre 08 C 35	White			Yellow ochre 08 C 35
Nitrous oxide (see note)	Yellow ochre 08 C 35	French blue 20 D 45			Yellow ochre 08 C 35

Note: all pathological services are identified by an additional 06 D 45 band.

FIN7.W2510.9 UNDERGROUND SUPPLY PIPELINE IDENTIFICATION SCHEDULE

For projects with re-arrangement or tee-off connection to existing live water supply within Housing Estate, notwithstanding FIN7.W2490, paint underground pipeworks of fresh, flushing, and fire service supply mains at both sides of isolating gate valves in the colours shown in the following table, complete with the identification colour code indication:

Underground Supply Pipe Identification - Colour Reference to BS 4800: 1989		
Service Type	Colour Code Indication Approx. 50 mm each ring	No. of Colour Rings Around Pipe
Fresh Water Main	Blue 18 E 53	3
Flushing Water Main	Green 12 D 45	2
Fire Service Water Main	Safety Red 04 E 53	1

FIN7.W2520.9 PAINTING TO PIPEWORK AND EXPOSED METALWORK TO BUILDING SERVICES INSTALLATIONS

Prime and paint two undercoats and one finishing coat of gloss synthetic paint to surface mounted towngas pipework, LPG pipework, and exposed metal conduit, trunking and cable trays of the electrical installation.

TESTING

SURVEILLANCE TESTS FOR PAINTS

FIN7.T050.A SURVEILLANCE TESTS

1. Testing Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in the following for each type of paint or as instructed by the CM:
      i. FIN7.M340 (3)(a) for anti-mould internal emulsion paint;
      ii. FIN7.M370 (3)(a) for anti-mould external emulsion paint;
      iii. FIN7.M570 (3)(a) for synthetic paint;
      iv. FIN7.M580 (3)(a) for multi-layer acrylic paint with texture coat; or
      v. FIN7.M580 (3)(a) for multi-layer acrylic paint without texture coat.
   b. For emulsion and synthetic paint, one set of test sample shall consist of one container per different major colour of finishing paint or as instructed by the CM;
   c. For multi-layer acrylic paint, one set of test sample shall consist of one container each of sealer, texture coat and one container per different major colour of finishing paint or as instructed by the CM.
3. Testing methods:
   a. As per FIN7.M340 (2)(b) for anti-mould internal emulsion paint;
   b. As per FIN7.M370 (2)(b) for anti-mould external emulsion paint;
   c. As per FIN7.M570 (2)(b) for synthetic paint;
   d. As per FIN7.M580 (2)(b) for multi-layer acrylic paint with texture coat;
   e. As per FIN7.M580 (2)(b) for multi-layer acrylic paint without texture coat;
   f. As per Part 5 of Schedule 1 in Air Pollution Control (Volatile Organic Compounds) Regulations for volatile organic compound content of paints;
   g As per FIN7.M015 for water based paints;
   h. As per FIN7.M016 for solvent based paints.
4. Non-compliance:
   a. In the event that the testing samples for any type of paint fail to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch of that type of paint off Site; or

ii. Carry out re-test for the representative batch of that type of paint in accordance with the testing methods as specified in sub-clauses (3)(a), (3)(b), (3)(c), (3)(d) or (3)(e) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch for that type of paint. In case of any one sample fails the re-test, remove the representative batch of that type of paint off Site.

b. When the representative batch of that type of paint is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a), (3)(b), (3)(c), (3)(d) or (3)(e) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

INSPECTION OF EXTERNAL WALLS OF DOMESTIC BLOCKS WITH SMALL UNMANNED AIRCRAFT

FIN7.T110.N SCOPE

1. Carry out final inspection of the external walls including service pipes of domestic block(s) with Small Unmanned Aircraft (SUA) in accordance with FIN7.T130;
2. Liaise with relevant stakeholders, such as adjacent contractors, nearby structures owners, management parties, Government departments etc. for the arrangement of SUA inspection of external walls of the domestic block(s);
3. Observe the application procedure for flying SUA and other relevant regulations in Hong Kong such as Telecommunications Ordinance and Personal Data (Privacy) Ordinance etc.;
4. Comply with the Small Unmanned Aircraft Order (Cap. 448G) including but not limited to the followings:
   a. SUA operations shall be conducted by remote pilot(s) who shall hold a valid remote pilot certificate and be assigned with an Advanced rating;
   b. SUA should normally not exceed 7kg in weight and shall be registered and properly affixed with registration label in accordance with SUA Order;
   c. Comply with the operating requirements including but not limited to day-time flying, maximum flying altitude and speed, maintaining lateral separation with any uninvolved person and structure or vehicle or vessel, nothing to be dropped from SUA etc.;
   d. Permission holder of the SUA shall ensure the operation under Civil Aviation Department's permission are insured against the third-party liability arising from the operations, with a minimum coverage of HK$10 million;
5. Submit inspection report including digital files of photos and videos in the format agreed with the CM.

FIN7.T120.N SUBMISSION REQUIREMENTS

Submit to the CM not later than 6 months before completion of the Works the proposal of SUA inspection for the CM's approval. The proposal shall include the following particulars:

1. Name of the SUA inspection service provider and relevant job references;
2. Organization chart for the SUA operations;

3. Inspection plan including flight path, inspection sequence, programme, details of SUA etc.. Provide justification for those parts of the external walls that cannot be covered by the SUA inspection;
4. Methodology for detection of defects, capturing and processing of images to highlight identified defects;
5. Emergency plan in the event of breakdowns and repairs;
6. Report format including examples of the SUA photos and videos.

FIN7.T130.N SUA INSPECTION

1. SUA inspection shall include photos and videos taking by SUA to capture the surface and side-view conditions of the external walls of each floor of the domestic block(s) and to identify the defects and cracks on external walls and service pipes of the domestic block(s);
2. SUA captured image shall be in sufficient details and visibility to detect defects and cracks on the external faces of domestic block(s) with a minimum dimension as agreed with the CM. The captured image shall not be less than 20MP effective pixels with good exposure and balance colour;
3. By SUA photogrammetry and data modelling, convert captured images into 3D reality mesh building models. Process photos using Artificial Intelligence (AI) to detect, locate and highlight any defects and cracks on the external walls;
4. Provide a free and unlimited access to web-based 3D BIM+GIS+AI platform for viewing defects and cracks automatically detected by AI and 3D model until the expiry of Maintenance Period;
5. The BIM+GIS+AI system shall locate and display the SUA images with a 3D reality mesh model and show the exact location of the defects and cracks on the 3D model;
6. All communication between the web-based system to any client devices shall be encrypted with password;
7. Overlay the 3D building models created by the SUA onto the base map from Lands Department and BIM models to check the land boundary use of the domestic block(s) in a mixed reality environment.

FIN7.T140.N INSPECTION REPORT

1. Submit preliminary photos and videos within 1 week after the SUA inspection. Resubmit if necessary to ensure the quality of photos are sufficiently clear to identify the defects;
2. Submit one hard copy and one soft copy of final inspection report within 1 month after the SUA inspection. The final inspection report shall include date, time, flight path, details of SUA, photos which can be referenced to the exact location of the external faces of buildings, photos showing the locations and type of defects, etc.

APPENDIX FIN7/I

FIN7.APPEND1.9 ACCELERATED TESTS FOR RESISTANCE TO FUNGAL AND ALGAL GROWTH OF PAINT

1. Scope:

   An accelerated test method for assessing the resistance to fungal and algal growth of paint applied in the laboratory to specified fungi and algae found on the surfaces of buildings in Hong Kong.

2. Biological safety precautions:
   a. The accelerated test shall be carried out in certified or equivalent microbiology laboratory;
   b. The operator has formal microbiological training and practices with good microbiological precaution especially reference to biosafety;
   c. The treatment and handle of the biohazards shall follow the instruction and guidelines of the Department of Health, the Government of Hong Kong Special Administration Region;
   d. Containment of the micro-organisms shall be practised as far as possible;
   e. Prevention of spillage and practice of spraying using diluted bleaching solution to contaminated areas shall be practised;
   f. All the used materials shall be autoclaved before disposal.

3. Principle:
   a. Sterilized inert petri dish / multi-well plate / 6-well plate are painted. Each test fungus or alga is inoculated into individual coated petri dish / multi-well plate / 6-well plate with suitable strength nutrient broth. The inoculated petri dish / multi-well plate / 6-well plate are then incubated in an incubator under specified conditions and inspected at specified intervals for fungal and algal growth;
   b. The nutrient broth provides the start-up resources for test fungus and alga to initiate growth. As incubation period lasts, test fungus and alga if viable needs to consume the nutrient in the paint coating. Viable fungus will spread from the inocula to the nutrient broth and painted surface of petri dish / multi-well plate / 6-well plate. Viable alga will form visible green patches in the nutrient broth and painted surface;
   c. Coating resistance to microbial attack is determined by the residual viability of the artificially inoculated micro-organism. Viability refers to gain in population size, biomass and spread of micro-organism;
   d. Colony spread in terms of area coverage is an identified property for rating the filamentous growth format of a micro-organism. However, for unicellular or slow-growth micro-organisms which do not spread their colonies in fast manner, their density of the colonies might need to be assessed. Dead algae may autodegrade their organelles and biomolecules, leading to decolorization (loss of the green colour) in contrast to the live green algal patches / dots / spots. Area coverage, colony density and colour are needed for interpretation of the growth of micro-organism.

4. Testing apparatus and materials:
   a. Sterilized petri dish / multi-well plate / 6-well plate;
   b. Sterilized pipette tips (0.2, 1 and 5 mL);
   c. Sterilized potato dextrose broth (PD);
   d. Sterilized modified Allen's medium;
   e. Sterilized distilled water;

f. Sterilized Eppendorf tubes (1.8 mL);
g. Sterilized Falcon tubes (15 mL, 50 mL);
h. Sterilized plastic bags;
i. A set of Pipetteman (0.2, 1 and 5 mL);
j. Paint samples and brushes;
k. An illuminated incubator;
l. Digital camera for recording;
m. Fungal and algal cultures;
n. Biosafety cabinet class II or equivalent;
o. 70% alcohol for cleaning, diluted bleaching solution for disinfection;
p. Bunsen burner, town gas;
q. Vortex mixer for mixing;
r. Haemocytometer for determining the concentration of spore / cell in a suspension;
s. Autoclave, 1.2 to 1.5 kgf/cm²;
t. Water, non-disposable containers and tools used in the test must be sterilized by an autoclave under the pressure of 1.2 to 1.5 kgf/cm² for 20 minutes.

5. Preparation of paint samples:

Each paint sample consists of two test paints and a control.

a. Test paint:
   i. The paint shall be used before their expire dates;
   ii. Thoroughly mix and dilute the paint for coating according to the manufacturer's instruction;
   iii. Apply by brushing two coats of paint to the surface of petri dish / multi-well plate / 6-well plate. Allow the first coat of paint to dry for at least 4 hours before the second coat is applied;
   iv. Allow the coating to dry for one day before use.
b. Control:
   i. Uncoated petri dish / multi-well plate / 6-well plate contain suitable strength nutrient broth for fungus and alga to grow;
   ii. If fungus or algal growth of growth rank at or above 1 in the petri dish / multi-well plate / 6-well plate is not obtained at day 7, carry out reinoculation. This may be owing to insufficient inoculum size, poor incubation conditions in terms of environmental or nutrient conditions. Check the incubation conditions. Replenishment of the suitable strength nutrient broth may be needed;
   iii. Fungus or algal growth of growth rank above 2 at day 28 in the petri dish / multi-well plate / 6-well plate indicates viability of the fungal and algal cultures for the validity of the test results. If such result is not obtained, repeat the test with viable test micro-organisms under confirmed standardized conditions with proper nutrient composition.

6. Microbiological tests
   a. Local species of fungi and algae for test which are available in School of Life Sciences, the Chinese University of Hong Kong:
      i. Fungal species
         - *Cladosporium cladosporides* strain HK-1
         - *Trichoderma viride* strain HK-1

- *Auroebasidum pullulans* strain HK-1
- *Alternaria alternate* strain HK-1
- *Curvularia lunata* strain HK-1

ii. Algal species

- *Chlorella pyrenoidosa* strain HK-1
- *Scenedesmus sp.* strain HK-1

b. Preparation of cultures:

i. Fungal culture

Maintain a fungal culture on potato dextrose agar (PDA) of composition (g/L): potato starch, 4; dextrose, 20; agar, 15 for 7 days at 28-30°C in darkness to prepare an active growing log-phase culture.

ii. Algal culture

Maintain an algal culture in a modified Allen's broth of pH 6.3 with composition shown in table below for 14 days under illumination at 25°C:

Component	Concentration (mg/L)
$NaNO_3$	250
$CaCl_2.2H_2O$	31
$MgSO_4.7H_2O$	75
NaCl	25
KH_2PO_4	175
K_2HPO_4	75
$FeCl_3.6H_2O$	7.5
Na_2EDTA	10.3
$Na_2B_4O_7.10H_2O$	2.25
$MnCl_2.4H_2O$	0.90
$ZnCl_2.7H_2O$	0.11
$CuCl_2.2H_2O$	0.025
$Na_2MoO_4.2H_2O$	0.015
$VOSO_4.2H_2O$	0.015
$CoCl_2.6H_2O$	0.005

c. Preparation of inoculum:

i. Prepare a liquid suspension of fungal culture as follows:

- Use sterilized loop to scrape the spores / hyphal fragments from a fully grown fungal plate culture onto 1 mL nutrient broth (prepared in 1/10 strength of PD) using aseptic technique;
- To facilitate an even fungal suspension, a non-ionic surfactant, e.g. 0.05% Tween 80, may be added;
- Prepare an inoculum for a fungus at 10^8 spore / hyphal fragments per mL for test;
- Use a haemocytometer for measurement to ensure that each inoculum contains not less than 10^8 spore / hyphal fragments per mL. If this level is not present, repeat the preparation for that species using a fresh plate culture.

ii. Prepare a liquid suspension of algal culture as follows:

- Use pipetting to transfer and inoculate an algal inoculum to nutrient broth using aseptic technique;
- Prepare an inoculum for an alga at 108 cells per mL for test;
- Use haemocytometer for measurement to ensure that each inoculum contains not less than 108 cell per mL. If this level is not present, use centrifugation to concentrate the algal suspension.

d. Inoculation:

i. Thoroughly mix the inoculum using vortex mixer for 1 minute before inoculation;

ii. Using aseptic technique, 1 volume of the inoculum is inoculated into 10 volumes of the nutrient broth (1/10 strength PD for the fungus and modified Allen medium for the alga) in the coated petri dish / multi-well plate / 6-well plate as follows:

- 1 mL inoculum into 9 mL medium in a 9 cm petri dish; or
- 0.05 mL inoculum into 0.45 mL medium in a 96 multi-well plate; or
- 0.5 mL inoculum into 4.5 mL medium in a 6-well plate;
- Use sterilized 5 mL cut-off pipette tip for the transfer of the fungal inoculum which contains spores and hyphal fragments and sterilized 1 mL pipette tip for the algal inoculum which contains unicellular cells.

iii. Add the same quantity of inoculum into the same quantity of nutrient broth for the control;

iv. Take digital photo records of the paint samples and control just after inoculation;

v. Cover the inoculated petri dish / multi-well plate / 6-well plate. Seal the container with paraffin for safe transport and process.

e. Incubation:

i. The inoculated petri dish / multi-well plate / 6-well plate with cover of the plate in place are incubated in a conventional incubator with an illumination cycle. The incubation conditions are: 28 ± 2°C and 12 hour light – 12 hour dark cycle.

7. Observation and data record:

a. Observe the paint samples as follows and assess the fungal and algal growth using the growth rank in sub-clause (8)(d):

i. Observe the paint and control samples at day 7. Carry out reinoculation to paint samples and control if the growth rank is 1 or less. Replenishment of nutrient broth to prevent dry up of the test culture may be performed;

ii. Observe the paint and control samples at day 14. Replenishment of nutrient broth to prevent dry up of the test culture may be performed;

iii. Observe the paint and control samples at day 28.

b. Take digital photo records of the paint and control samples at day 7, day 14 and day 28 for comparison;

c. Use the record sheet in sub-clause (9) to record the growth rank.

8. Assessment criteria for resistance to growth:

a. The assessment is a semi-quantitative assessment with visual examination of micro-organism growth according to the principle described in sub-clause (3) above;

b. Following the assessment made in (a) above, growth of a micro-organism shall be rated by comparing its area spread, colony density and colour on the day of assessment to the situation at day 1 (to be expressed as percentage) and then ranked as follows:

i. Rank 0, No growth observed in the broth and container wall;

ii. Rank 1, trace growth ($\leqq$15%);

iii. Rank 2, light growth (> 15% but $\leqq$ 40%);

iv. Rank 3, medium / moderate growth (> 40% but $\leqq$ 70%);

v. Rank 4, heavy growth (>70%).

c. Only when the growth rank of the test micro-organism in the control is above 2 at day 28 as described in sub-clause (5)(b)(iii), the test result of the paint sample is accepted for conclusion;

d. For the two replicates of the test paint, take the average of the growth rank and round up the figure for report in the record sheet;

e. Resistance Index:

A resistance index is calculated from the growth ranks of the test micro-organisms of the same fungal or algal group in the paint sample.

i. When one of tested micro-organisms could establish on a paint coating, its colony will shield the paint biocide favouring the landing and establishment of more micro-organisms. Thus the highest growth rank among the tested micro-organisms of the same fungal or algal group is then reported as the resistance index of the paint sample as follows:

- Fungal resistance:

  the highest growth rank of the 5 tested fungal species

- Algal resistance:

  the highest growth rank of the 2 tested algal species.

9 Test report:

The test report shall include the following information:

a. The type and identification of the product tested;

b. A reference to this test method;

c. Any deviation, by agreement or otherwise, from the procedure described;

d. The assessment using the record sheet below;

e. Digital photo records of paint samples just after incubation, at day 7, day 14 and day 28;

f. The date of the assessments.

Record Sheet of Growth Rank and Resistance Index of Paint Samples

	Growth Rank[1]							Resistance Index[2]	
	Fungus					Alga			
Micro-organism	1	2	3	4	5	1	2	Fungus	Alga
	Cladosporium cladosporides	Trichoderma viride	Auroebasidum pullulans	Alternaria alternate	Curvularia lunata	Chlorella pyrenoidosa	Scenedesmus sp		
Day 7	Replenishment of nutrient broth (0.1 x strength): Yes/No Reinoculation: Yes/No								

Test Paint									
Control									
Day 14	Replenishment of nutrient broth (0.1 x strength): Yes/No								
Test Paint									
Control									
Day 28									
Test Paint									
Control									

Note 1: Growth performance

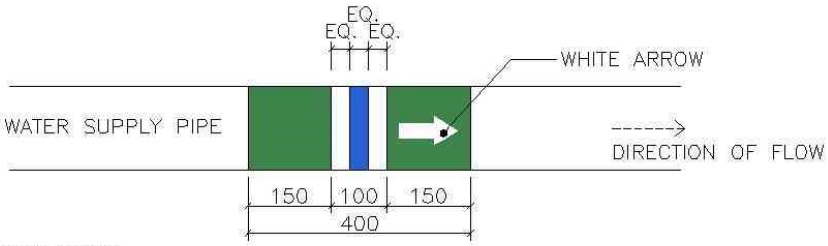
- Rank 0, No growth observed in the broth and container wall
- Rank 1, trace growth ($\leqq$15%)
- Rank 2, light growth (> 15% but $\leqq$ 40%)
- Rank 3, medium / moderate growth (> 40% but $\leqq$ 70%)
- Rank 4, heavy growth (> 70%)

Note 2: Resistance Index

- Fungal resistance: the highest growth rank of the 5 tested fungal species
- Algal resistance: the highest growth rank of the 2 tested algal species

APPENDIX FIN7/II

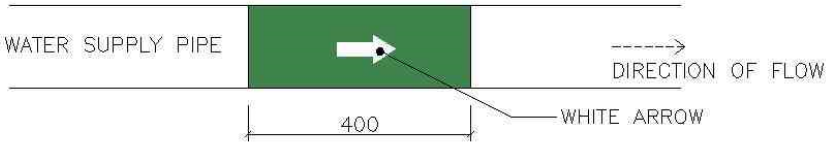
FIN7.APPEND2.9 PIPE IDENTIFICATION



AS PER FIN7.W2500–

PIPE IDENTIFICATION – COLOUR REFERENCES TO BS4800: 1989					
SERVICE TYPE	BASIC IDENTIFICATION COLOUR APPROX 150mm WIDE	COLOUR CODE INDICATION APPROX 100mm WIDE			BASIC IDENTIFICATION COLOUR APPROX 150mm WIDE
FRESH WATER SUPPLY	GREEN 12 D 45	WHITE	BLUE 18 E 53	WHITE	GREEN 12 D 45

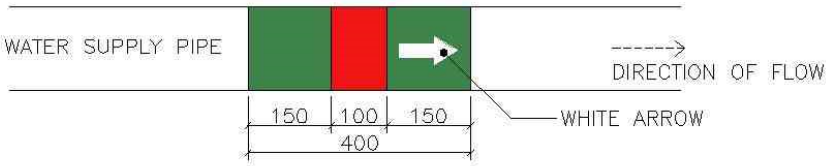
*AN ARROW OVER THE BASIC IDENTIFICATION COLOUR, PAINTED IN WHITE OR OTHER COLOUR AS DIRECTED IN ORDER TO CONTRAST CLEARLY WITH THE BASIC IDENTIFICATION COLOUR.



AS PER FIN7.W2500–

PIPE IDENTIFICATION – COLOUR REFERENCES TO BS4800: 1989			
SERVICE TYPE	BASIC IDENTIFICATION COLOUR APPROX 150mm WIDE	COLOUR CODE INDICATION APPROX 100mm WIDE	BASIC IDENTIFICATION COLOUR APPROX 150mm WIDE
FLUSHING WATER SUPPLY	GREEN 12 D 45		

*AN ARROW OVER THE BASIC IDENTIFICATION COLOUR, PAINTED IN WHITE OR OTHER COLOUR AS DIRECTED IN ORDER TO CONTRAST CLEARLY WITH THE BASIC IDENTIFICATION COLOUR.



AS PER FIN7.W2500–

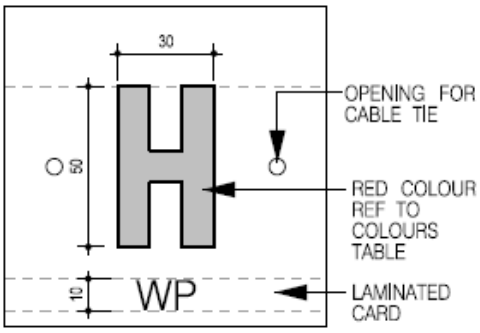
PIPE IDENTIFICATION – COLOUR REFERENCES TO BS4800: 1989			
SERVICE TYPE	BASIC IDENTIFICATION COLOUR APPROX 150mm WIDE	COLOUR CODE INDICATION APPROX 100mm WIDE	BASIC IDENTIFICATION COLOUR APPROX 150mm WIDE
FIRE SERVICE SUPPLY	GREEN 12 D 45	SAFETY RED 04 E 53	GREEN 12 D 45

*AN ARROW OVER THE BASIC IDENTIFICATION COLOUR, PAINTED IN WHITE OR OTHER COLOUR AS DIRECTED IN ORDER TO CONTRAST CLEARLY WITH THE BASIC IDENTIFICATION COLOUR.

FIN7.APPEND3.N LABELLING FOR HA PIPES PASSING THROUGH NON-HA PREMISES

NOTES :

1. ALL ENGLISH LETTERS SHOULD BE IN HELVETICA MEDIUM TYPEFACE.
2. THE TYPES OF PIPES SHOULD BE INDICATED.
3. THE MARK ONLY APPLIES TO PIPES PASS THROUGH NON-HA PREMISES.
4. THE MARK SHOULD BE INDICATED ON ALL SIZES OF PIPE.
5. ALL COLOUR CODES ARE FOR REFERENCE ONLY, ACTUAL COLOUR TO BE DETERMINED ON SITE.
6. APPLY A CARD WITH PRINTED LABEL IF THE DRAINAGE PIPE IS TOO NARROW FOR PAINT.
7. AT LEAST ONE MARK SHOULD BE APPLIED TO EACH PIPE IN EACH COMPARTMENT OR ROOM; IN A PROMINENT POSITION OF PIPE ROUTING.



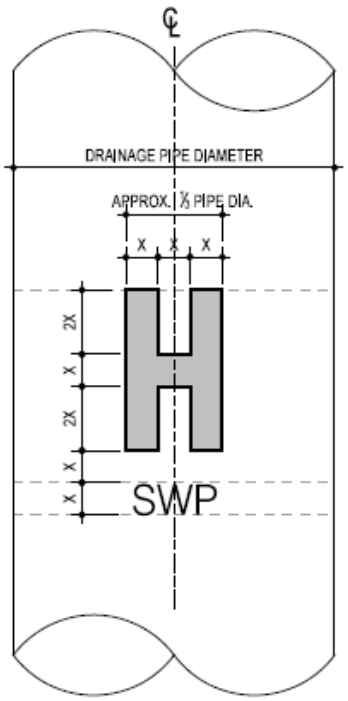
"H" LABELLING & INDICATION ON CONDENSATION DRAIN PIPE

INDICATIONS :

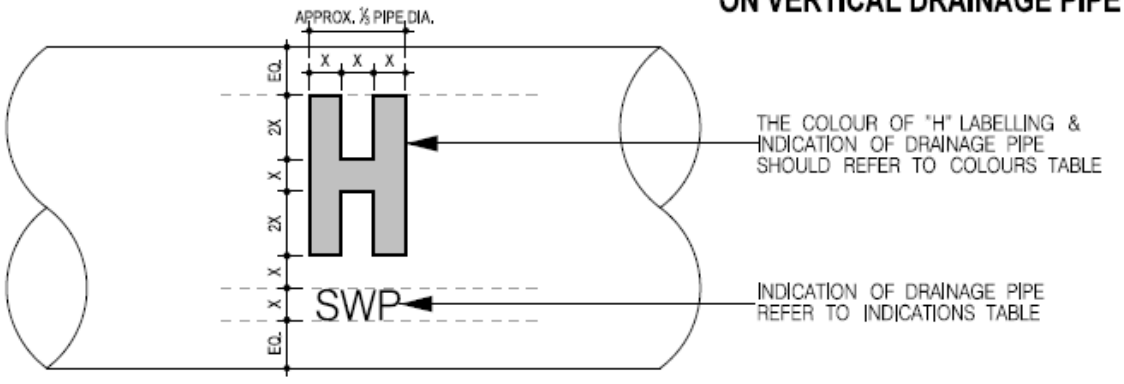
TYPE OF DRAINAGE PIPE	ABBREVIATION
SOIL AND WASTE PIPE	SWP
WASTE PIPE	WP
VENT PIPE	VP
RAIN WATER PIPE	RWP

COLOURS :

DRAINAGE PIPE MATERIALS (COLOUR OF PIPE MATERIAL)	PAINT COLOURS (CODE FOR REF.)
uPVC (WHITE)	RED (PANTONE CODE : RED 485C/U) (NCS CODE : S 1580–Y90R)
CAST IRON PIPE (BLACK)	WHITE (PANTONE CODE : WHITE C/U) (NCS CODE : S 0500–N)
EPOXY CAST IRON PIPE (RED)	WHITE (PANTONE CODE : WHITE C/U) (NCS CODE : S 0500–N)
PVC PIPE (GREY)	WHITE (PANTONE CODE : WHITE C/U) (NCS CODE : S 0500–N)
STAINLESS STEEL (SILVER)	RED (PANTONE CODE : RED 485C/U) (NCS CODE : S 1580–Y90R)



"H" LABELLING & INDICATION ON VERTICAL DRAINAGE PIPE



"H" LABELLING & INDICATION ON HORIZONTAL DRAINAGE PIPE

LABELLING FOR DRAINAGE PIPE PASS THROUGH NON-HA PREMISES

DELETED

FIN8 PROPRIETARY SUSPENDED CEILINGS

DESIGN

GENERAL

FIN8.D010.9 DRAWINGS AND SCHEDULES

Read this Specification in conjunction with layout Drawings and finishing schedules.

FIN8.D020.A STANDARD

The ceiling system must comply with BS EN 13964:2014.

FIN8.D030.9 CEILINGS SUBJECT TO EXTERNAL CONDITIONS

Design ceilings in locations subject to external conditions:

1. In accordance with the Code of Practice for Wind Effects for Hong Kong;
2. To withstand without distortion, damage, corrosion or other damage:
    a. Maximum external temperature: 36°C;
    b. Minimum external temperature: 0°C;
    c. Maximum external relative humidity: 90%.

FIN8.D040.9 ACCESS

Provide, as an integral part of the ceiling system and in the positions indicated on Drawings, suitable means of access to:

1. Permit the inspection and maintenance of any services contained within the ceiling cavity or integrated with the ceiling system;
2. Enable the ceiling components to be cleaned and maintained in accordance with the manufacturer's recommendations.

FIN8.D050.A SERVICES

Allow for the incorporation of the following services at the locations as shown on Drawings:

1. Luminaires;
2. Heating, ventilating or air conditioning registers, ducts and fittings;
3. Fire detection and extinguishing equipment;
4. Other electrical devices, wiring, conduits, etc.

FIN8.D060.9 SHOP DRAWINGS

Provide the CM in adequate time to permit Approval process and subsequent production of detail drawings sufficient to illustrate:

1. The suspension system, methods and location of attachment to the building structure;
2. The relationship of the system to the building services and the location of all access panels;
3. All cavity fire barriers and the location and methods of fire stopping around service pipes and ducts penetrating such barriers and ceilings scheduled to be fire resisting;
4. Reveals to any openings and rooflights.

FIN8.D070.9 CERTIFICATION

Obtain from the supplier and submit to the CM in adequate time before the commencement of erection of suspended ceilings on Site, certificates proving compliance with the fire performance requirements of this Specification. Such certificates must be the result of independent testing carried out by a laboratory accredited by HOKLAS or an equivalent authority.

MATERIALS

GENERAL

FIN8.M010.9 COMPONENT MATERIALS

Construct the suspended ceiling from materials which:

1. Do not contain any asbestos. Obtain from the system manufacturer, a certificate of compliance with this requirement and submit it to the CM;
2. Are non-toxic on physical contact or by inhalation of any gases produced;
3. Do not emit unpleasant odours;
4. Are resistant to infestation by vermin and the growth of moulds and mildews;
5. Can be cleaned on their exposed surfaces, using routine methods.

PANEL SYSTEM

FIN8.M110.A SUSPENDED CEILING

1. To BS EN 13964:2014;
2. Grid dimensions, suspension system and soffit panels are as shown on Drawings;
3. Fire performance:
   a. Fire resistance: tested in accordance with BS 476:Part 22:1987 to fulfil the fire resisting hours as shown on Drawings;
   b. Surface spread of flame classification: Class 1 when tested in accordance with BS 476:Part 7:1987;
   c. Index of Performance (I) not exceeding 12 and sub index (i) not exceeding 6 when tested in accordance with BS 476:Part 6:1989.

FIN8.M120.9 SAMPLES

Submit samples of the grid, the suspension system and the soffit or infill panels for Approval.

ALUMINIUM CELL SYSTEM

FIN8.M210.A SUSPENDED CEILING

To BS EN 13964:2014 and:

1. Suspension system: comprising a combination of galvanized mild steel and aluminium as follows:
   a. Suspension brackets: extruded aluminium;
   b. Accessories: galvanized steel runner splices, sliding clips etc.;
2. Grid sections: main and cross runners of 'U' profile strip:
   a. Thickness: 0.5 mm;
   b. Overall dimensions: as shown on Drawings;
   c. Including cut-outs in main runners to locate cross runners;
   d. With cross runners provided with hooked ends for connection and location in both horizontal and vertical directions.
3. Hangers: designed to facilitate the adjustment of the ceiling height and to support the weight of the ceiling with all fittings and attachments and not less than 4 mm in diameter;

4. Cells: 0.5 mm thick 'U' profile strip sections with inward returns at edges of 2.5 mm; dimensions as shown on Drawings;
5. Panels: strip cellular panels with dimension as shown on Drawings;
   a. Alloy designation: AA5050;
   b. Finish: stoved enamel.
6. Edging strip: 0.7 mm thick aluminium sheet forming the shape of the edge strip where shown on Drawings:
   a. Alloy designation: AA5050;
   b. Finish: stoved enamel.

FIN8.M220.9 SAMPLES

Submit samples of the grid, suspension system, the cells and colour samples for Approval.

FIN8.M230.X DELETED

ANCILLARY MATERIALS

FIN8.M310.9 CAVITY BARRIERS AND FIRE STOPPING

Provide, as specified in the Project Specific Specification and at the locations as shown on Drawings:

1. Cavity barriers, purpose designed to prevent the spread of fire through the ceiling void for the periods shown on Drawings;
2. Fire stopping around any service pipes penetrating such cavity barriers or ceiling soffits specified to be fire resisting.

FIN8.M320.9 INSULATION

Where shown on Drawings, provide a continuous insulation as specified in the Project Specific Specification.

FIN8.M330.9 SOFFIT FIXINGS

Either:

1. Approved sockets, anchors or other fixings cast into the slab; or
2. Approved proprietary plugs or self-drilling anchors.

WORKMANSHIP

GENERAL

FIN8.W010.9 APPROVED FIXING SUB-CONTRACTOR

Employ a specialist Sub-contractor, for the fixing of suspended ceilings, who is:

1. Licenced by the manufacturer to fix his system and whose operatives are appropriately trained in all aspects of the work;
2. Operating a Quality Assurance system certified under ISO 9001 or an Approved equivalent scheme.

INSTALLING CEILINGS

FIN8.W110.A GENERAL

Comply with:

1. All relevant provisions of BS EN 13964:2014;
2. The manufacturer's recommendations.

FIN8.W120.9 HANDLING AND STORAGE

Take delivery, handle and store suspended ceiling components:

1. Store tiles/boards on a smooth, flat base and in conditions of temperature and humidity similar to those in which they are to be fixed;
2. Protect tiles/boards and accessories from damage and distortion. Retain any protective coverings in place for as long as possible.

FIN8.W130.9 INSTALLATION CONDITIONS

Ensure that the building is fully enclosed and in proper condition with regard to cleanliness, humidity and temperature and all wet work is complete and dry at the date programmed for installation.

FIN8.W140.9 SETTING OUT

1. Ensure that all lighting, ventilation and fire protection services, having elements which are to be incorporated in the ceiling, have been installed and are accurately located relative to the ceiling grid, and that common datums have been used throughout;
2. Set out accurately, according to the Approved shop drawings, without visible undulations and with all visible lines straight and parallel with right angles accurate at 90º, or in accordance with any special setting out requirements;
3. Carry out all cutting at perimeters.

FIN8.W150.9 FIXING TRIMS

Fix all cover strips and edge trims etc in accordance with the manufacturer's recommendations.

FIN8.W160.9 CAVITY BARRIERS

Install cavity barriers at locations as shown on Drawings. Work in conjunction with ceiling fixers where necessary. Ensure barriers fully seal cavity/void, paying particular attention to seals around building services etc.

FIN8.W170.9 ELECTRICAL CONTINUITY AND EARTH BONDING

Provide electrical continuity and earth bonding to metallic parts of the system in accordance with the current edition of the IEE Regulations for electrical installations.

FIN8.W180.9 PROTECTION

Protect completed ceilings from damage and factory finished ceilings free from contamination until completion of contract. Make good any damage and remove any contamination.

ACCURACY AND TOLERANCES

FIN8.W210.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

IRO IRONMONGERY

IRO1 IRONMONGERY 4

MATERIALS 4

GENERAL 4

IRO1.M010.9 SAMPLES 4
IRO1.M020.9 MANUFACTURER'S INSTRUCTIONS 4
IRO1.M030.9 CERTIFICATION 4
IRO1.M040.9 PRODUCT RANGE 4
IRO1.M050.9 IRONMONGERY SCHEDULE 4
IRO1.M060.9 SUPPLY AND PACKAGING 5
IRO1.M070.9 KEYS 5

FINISHES TO COMPONENTS 5

IRO1.M110.9 STAINLESS STEEL 5
IRO1.M120.9 NICKEL AND CHROMIUM ELECTROPLATING 5
IRO1.M130.9 ZINC ELECTROPLATING ON IRON AND STEEL 5
IRO1.M140.9 ANODIC OXIDATION COATING ON ALUMINIUM 5
IRO1.M150.9 PHOSPHATE TREATMENT OF IRON AND STEEL 5
IRO1.M160.9 CONCEALED COMPONENTS 5

HINGES 5

IRO1.M210.9 CLASSIFICATION 5
IRO1.M220.9 THICKNESS 6
IRO1.M230.9 CLASS A1 BRASS BUTT HINGES 6
IRO1.M240.9 CLASS A1 STAINLESS STEEL HINGES 6
IRO1.M250.9 CLASS A AND CLASS B BRASS BUTT HINGES 6
IRO1.M260.9 CLASS A STAINLESS STEEL HINGES 6
IRO1.M270.9 CLASS A STEEL BUTT HINGES 6
IRO1.M280.9 CLASS B BRASS LIFT OFF OR REMOVABLE PIN HINGES 6
IRO1.M290.9 CLASS B STAINLESS STEEL HINGES 7
IRO1.M300.9 CLASS B STEEL BUTT HINGES 7
IRO1.M310.9 CLASS B SPECIAL HINGES 7
IRO1.M320.9 CLASS C BRASS BUTT HINGES 7
IRO1.M330.9 CLASS C STAINLESS STEEL HINGES 7
IRO1.M340.9 CLASS C SPECIAL HINGES 7
IRO1.M350.9 SPRING HINGES 7
IRO1.M360.9 FIXINGS FOR CLASS A1, A AND B HINGES 7
IRO1.M370.9 FIXINGS FOR CLASS C HINGES 8

FLOOR SPRINGS 8

IRO1.M400.9 FLOOR SPRINGS 8
IRO1.M410.9 CLASSIFICATION 9
IRO1.M420.9 FIRE PERFORMANCE 9
IRO1.M430.9 CONSTRUCTION 9

OVERHEAD DOOR CLOSERS 10

IRO1.M530.9 OVERHEAD DOOR CLOSERS 10

SECURITY LOCKS 15

IRO1.M610.9 CLASSIFICATION 15
IRO1.M620.9 SECURITY LOCKS 15

LOCKS AND LATCHES 16

IRO1.M710.9 CLASSIFICATION 16
IRO1.M720.9 CONSTRUCTION 16
IRO1.M730.9 CYLINDER RIM DRAWBACK LOCKS 16
IRO1.M740.9 MORTICE DEAD LOCKS 18
IRO1.M750.9 LOCKS FOR GATESETS 20

IRO1.M760.9 LEVER HANDLE FURNITURE AND LOCKS 21
IRO1.M765.9 LEVER HANDLE FURNITURE AND LOCKS WITH PLATE 25
IRO1.M770.9 KNOBSETS 26
LOCK AND LATCH FURNITURE 26
IRO1.M810.9 CLASSIFICATION 26
IRO1.M820.9 FIRE PERFORMANCE 27
IRO1.M830.9 CONSTRUCTION 27
PANIC FITTINGS 27
IRO1.M1010.9 CLASSIFICATION 27
IRO1.M1020.9 CONSTRUCTION 27
DOOR FURNITURE 28
IRO1.M1110.9 TYPE AND RANGE 28
IRO1.M1120.9 FLUSH BOLTS 28
IRO1.M1130.9 SURFACE BOLTS 28
IRO1.M1140.9 INDICATOR BOLTS 28
IRO1.M1150.9 PUSH AND KICK PLATES 28
IRO1.M1160.9 DOOR STOPS 29
IRO1.M1170.9 DOOR HOLDERS 29
IRO1.M1180.9 CABIN HOOKS 29
IRO1.M1190.9 LIMIT AND FRICTION STAYS 29
IRO1.M1200.9 DOOR SELECTORS 29
IRO1.M1210.9 DOOR CHAINS 29
IRO1.M1215.9 SECURITY DOOR GUARD (DOOR LIMITER) 29
IRO1.M1220.9 DOOR VIEWERS 29
IRO1.M1230.9 HAT AND COAT HOOKS 30
IRO1.M1240.9 ALUMINIUM INDICATOR SIGN PLATES 30
IRO1.M1250.9 EXIT SIGNS 30
IRO1.M1260.9 FIRE SAFETY SIGNS 30
IRONMONGERY FOR JOINERY FITTINGS 30
IRO1.M1310.9 TYPE AND QUALITY 30
IRO1.M1320.9 FINISH 30
IRO1.M1330.9 IRONMONGERY 30
LETTER BOX LOCKS 31
IRO1.M1610.9 LOCKS 31
IRO1.M1620.9 SCHEDULE 31
SUNDRY FITTINGS AND FIXINGS 31
IRO1.M1715.9 CURTAIN TRACKS 31
IRO1.M1720.9 SHOWER CURTAIN RAILS 31
IRO1.M1730.9 TOWEL RAILS OR GRAB BAR 33
IRO1.M1740.9 FIXING SCREWS 33
METALLIC WARNING, POSITIONAL AND DIRECTIONAL TACTILE INDICATORS . 34
IRO1.M1750.9 METALLIC WARNING, POSITIONAL AND DIRECTIONAL TACTILE GROUND SURFACE INDICATOR 34
POWERED PEDESTRIAN DOOR SYSTEM 34
IRO1.M1810.9 POWERED SLIDING DOOR SYSTEM 34
IRO1.M1820.9 SUBMISSIONS 35
IRO1.M1830.9 TESTING AND COMMISSIONING 35
IRO1.M1840.9 INSTRUCTION MANUALS 35
WORKMANSHIP 36
FIXING IRONMONGERY 36
IRO1.W010.9 MANUFACTURER'S INSTRUCTIONS 36
IRO1.W020.9 MORTICING DOORS AND FRAMES 36

IRO1.W030.9 SCREW FIXINGS 36
IRO1.W040.9 PLUGGING 36
IRO1.W045.9 FIXING DOORSET IRONMONGERY 36
IRO1.W050.9 FIXING PULL HANDLES AND PUSH PLATES 36
IRO1.W060.9 FIXING FLOOR SPRING 36
IRO1.W070.9 FIXING LETTER BOX LOCKS 36
IRO1.W080.9 FIXING CURTAIN TRACKS 37
IRO1.W090.9 FIXING SHOWER CURTAIN RAILS 37
IRO1.W100.9 FIXING TOWEL RAILS 37
IRO1.W120.9 ADJUSTMENT 37
IRO1.W130.9 PROVISION AND STORAGE OF KEYS 37

FIXING DOORSET IRONMONGERY SUPPLIED FOR DOMESTIC FLATS 37
IRO1.W210.9 IRONMONGERY POSITIONING 37
IRO1.W220.9 HINGE FIXING POSITIONS 37

INSPECTION OF FLOOR SPRING SYSTEM DURING MAINTENANCE PERIOD 37
IRO1.W310.9 INSPECTION OF FLOOR SPRING SYSTEM DURING MAINTENANCE PERIOD 37

TESTING 39

SURVEILLANCE TESTS 39
IRO1.T030.A SURVEILLANCE TESTS FOR OVERHEAD DOOR CLOSER 39
IRO1.T040.A SURVEILLANCE TESTS FOR LEVER HANDLE DOOR FURNITURE AND LOCKS 39

IRO1 IRONMONGERY

MATERIALS

GENERAL

IRO1.M010.9 SAMPLES

Obtain and submit samples of all ironmongery for Approval in accordance with PRE.B9.410.

IRO1.M020.9 MANUFACTURER'S INSTRUCTIONS

At the same time as submission of the samples, obtain for the Works one complete set of the manufacturer's ironmongery fixing and maintenance instructions.

IRO1.M030.9 CERTIFICATION

Obtain and submit to the CM full documentary evidence, including manufacturer's catalogues, test certificates etc. that indicate supplied ironmongery fully meets the requirements of this Specification.

IRO1.M040.9 PRODUCT RANGE

1. Where specified, obtain ironmongery and associated fittings from the same product range of coordinated components of matching style, finish and from a single source of manufacture unless otherwise Approved;
2. Where specified, obtain locks for gatesets of matching finish and flat entrance doors from at least 2 different sources of manufacturers in equal share distributed among the gatesets and flat entrance doors when the total number of domestic flats is more than the effective key combinations from a single source confirmed by the supplier.

IRO1.M050.9 IRONMONGERY SCHEDULE

Supply ironmongery as scheduled on drawings and in compliance with IRO1 generally.

1. After Approval of ironmongery samples, supply the CM with a consolidated ironmongery schedule, for Approval, giving the following information on a door by door format:
    a. Manufacturer and component references including products range;
    b. Fire resistance requirements including door fire rating and provision of smoke stops as applicable;
    c. Door thicknesses and handing;
    d. Suiting and master keying arrangements;
    e. Incorporating appropriate information provided on the Drawings and schedules;
    f. Any other requirements shown on the drawings.
2. The Approved schedule will form the basis for provision of ironmongery for the Contract. No alteration to the Approved schedule will be permitted without Approval.

IRO1.M060.9 SUPPLY AND PACKAGING

Ensure ironmongery and associated fixings are delivered to site suitably boxed and:

1. Marked to indicate content and site installation requirements;
2. Delivered in sets where appropriate and when so delivered each set must be bagged and labelled indicating door number to which it will be affixed.

IRO1.M070.9 KEYS

1. Material: brass or nickel plated brass;
2. Ensure each lock is supplied with a minimum of three keys supplied by the lock manufacturer. Keys forwarded to the CM shall be kept on a metal split ring with a plastic tag showing the location the lock to be installed;
3. Master keying system to the locks shall be supplied as shown in the ironmongery schedule. Forward master keys direct to the CM;
4. For security locks for installation in the high security premises such as the Cash and Shroff Offices, comply with the following:
    a. Prior to ordering, agree with the CM the method of ordering, supply, fixing and maintenance of security arrangements;
    b. Only obtain duplicate keys from original manufacturer;
    c. Master keying is not permitted.

FINISHES TO COMPONENTS

IRO1.M110.9 STAINLESS STEEL

To BS EN 10095:1999.

IRO1.M120.9 NICKEL AND CHROMIUM ELECTROPLATING

To BS 1224:1970.

IRO1.M130.9 ZINC ELECTROPLATING ON IRON AND STEEL

To BS 1706:1990.

IRO1.M140.9 ANODIC OXIDATION COATING ON ALUMINIUM

To BS 1615:1987:Grade AA10.

IRO1.M150.9 PHOSPHATE TREATMENT OF IRON AND STEEL

To BS 3189:1991.

IRO1.M160.9 CONCEALED COMPONENTS

Manufacturer's standard finishes to concealed components, including lock bodies is acceptable provided where applicable, they are in accordance with this Specification.

HINGES

IRO1.M210.9 CLASSIFICATION

1. To BS 7352:1990;

2. The following classifications for hinges are referred to in this Specification and on the Drawings:
   a. Class A1: Extra heavy duty;
   b. Class A: Heavy duty;
   c. Class B: Standard duty;
   d. Class C: Light duty.

IRO1.M220.9 THICKNESS

Hinge thickness specified to be measured adjacent the knuckle.

IRO1.M230.9 CLASS A1 BRASS BUTT HINGES

1. Material: nickel plated brass;
2. Thicknesses: 4.5 mm;
3. Construction: set screw fixed, non-removable stainless steel pin complete with four permanent attached ball bearings.

IRO1.M240.9 CLASS A1 STAINLESS STEEL HINGES

1. Material: satin finished stainless steel, grade 304 in accordance with MET1.M060;
2. Thickness: 3.3 mm;
3. Construction: non-removable stainless steel pin, with four sets of anti-friction bearings.

IRO1.M250.9 CLASS A AND CLASS B BRASS BUTT HINGES

1. Material: brass;
2. Thickness: 3.9 mm;
3. Construction: non-removable stainless steel pin with four sets of stainless steel washers;
4. Finish: as shown on Drawings.

IRO1.M260.9 CLASS A STAINLESS STEEL HINGES

1. Material: satin finished stainless steel, grade 304 in accordance with MET1.M060;
2. Thickness: 3.0 mm;
3. Construction: non-removable stainless steel pin, with at least two sets of anti-friction stainless steel bearings.

IRO1.M270.9 CLASS A STEEL BUTT HINGES

1. Material: zinc plated steel with steel washers;
2. Thickness: 2.5 mm.

IRO1.M280.9 CLASS B BRASS LIFT OFF OR REMOVABLE PIN HINGES

1. Material: brass;
2. Thickness: 3.9 mm;
3. Finish: as shown on Drawings.

IRO1.M290.9 CLASS B STAINLESS STEEL HINGES

1. Material: satin finished stainless steel, grade 304 in accordance with MET1.M060;
2. Thickness: 2 mm;
3. Construction: four nylon bushed bearings.

IRO1.M300.9 CLASS B STEEL BUTT HINGES

1. Material: zinc plated steel with nylon washers;
2. Thickness: 2 mm.

IRO1.M310.9 CLASS B SPECIAL HINGES

From the product range as IRO1.M040,

1. Type: falling or rising butts, parliament or other hinges as shown on Drawings;
2. Material: solid brass, stainless steel or anodized aluminium as shown on the Drawings, with hardened bearing surfaces;
3. Finish: as scheduled on Drawings.

IRO1.M320.9 CLASS C BRASS BUTT HINGES

To BS 7352:1990:

1. Material: brass;
2. Thickness: 2.35 mm;
3. Construction: stainless steel pin with 4 sets of stainless steel washers;
4. Finish: as shown on Drawings.

IRO1.M330.9 CLASS C STAINLESS STEEL HINGES

1. Material: satin finished stainless steel, grade 304 in accordance with MET1.M060;
2. Thickness: 1.6 mm.

IRO1.M340.9 CLASS C SPECIAL HINGES

From the product range as IRO1.M040:

1. Type: backflap, continuous or other hinges as shown on Drawings;
2. Material: solid brass or stainless steel as shown on Drawings;
3. Finish: as scheduled on Drawings.

IRO1.M350.9 SPRING HINGES

1. Type: single action;
2. Material: stainless steel;
3. Fire performance: spring hinges, fitted to appropriately rated fire door, to be tested and certified to BS 476:Part 22:1987 to confirm compliance with the fire resistance requirements shown on the Drawings.

IRO1.M360.9 FIXINGS FOR CLASS A1, A AND B HINGES

Fixing screws to match hinge material:

1. Supply hinges complete with screws and / or bolts, nuts and spring washers:

a. No. of screws per hinge: 8 nos.;

b. Gauge: 12 SG, smaller gauge permitted for 2 mm thick hinges;

c. Length:

i. 32 mm for fixing to timber;

ii. End of bolt to extend minimum 5mm from face of nut for fixing to metal door leaf and frame;

iii. Use one nut per bolt unless otherwise Approved.

2. Holes arrangement for hinges:

a. Staggered arrangement for fixing to timber;

b. Template arrangement for fixing to metal.

3. All hinges to have 8 number of counter sunk holes;

4. Depth of pre-drilled holes in door leaves prior to hinge fixing is half the length of screw.

IRO1.M370.9 FIXINGS FOR CLASS C HINGES

Fixing screws to match hinge material:

1. Supply hinges complete with screws:

a. No. of screws per hinge: 6;

b. Gauge: 6 SG;

c. Length: To suit fixing application.

2. All hinges to have 6 number of counter sunk holes in staggered or template arrangement as applicable;

3. Depth of pre-drilled holes in door leaves prior to hinge fixing is half the length of screw.

FLOOR SPRINGS

IRO1.M400.9 FLOOR SPRINGS

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed floor spring complete with all accessories for the CM's approval together with all the following substantiation for the CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent distributor in Hong Kong; or the document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of IRO1.M410 for the CM's information:

i. The date of the test shall be within five years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to the CM's consideration;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material;

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

IRO1.M410.9 CLASSIFICATION

1. To BS EN 1154:1997 or ANSI A156.4-2000;
2. Certified as tested 2,000,000 cycles to ANSI A156.4-2000 for floor spring use in building entrances.

IRO1.M420.9 FIRE PERFORMANCE

Floor springs, fitted to appropriately rated fire door, to be tested and certified to BS 476:Part 22:1987 to confirm compliance with the fire resistance requirements shown on the Drawings.

IRO1.M430.9 CONSTRUCTION

1. Action: single or double as shown on the Drawings;
2. Construction:
   a. Hydraulic check spring mechanisms sealed into an oil or hydraulic fluid filled box;
   b. Complete with a loose protective steel box for fixing into concrete floors;
   c. With detachable cover plate;
   d. With mechanical back check effective for the opening angle of the floor spring;
   e. With hold-open feature as shown on the Drawings;
   f. Floor spring shall be capable of handling the weight of door;
   g. Centre hung pivots for double acting doors and offset pivots with cover caps for single acting doors. Pivots shall be constructed of steel;

h. The non-adjustable bottom strap designed to suit type, size and weight of door, but not less than 160 mm long and holed for four screw fixings;

i. For fitting to metal doors the floor springs to be constructed as above except that a non-ferrous strap is incorporated to suit profile of the doors bottom rail and the top centre of the doors top rail.

3. Adjustment:

a. Within the box to provide full horizontal movement for door alignment, final positioning and height and adjustment;

b. After installation the position of the floor spring within the loose protection box must be adjustable;

c. The top pivot for double action floor springs must be adjustable.

4. Finish:

a. Exposed parts of floor spring to match same standard as other door ironmongery;

b. Top plate: satin finished stainless steel, grade 316 in accordance with MET1.M060.

5. Barrier free access requirements for floor springs to be used for doors/ gates at common areas:

a. Closing period:

For interior doors/gates, a period of at least 3 seconds measured from an open position of 70º to a point 75 mm from the closed position measured from the leading edge of the door.

b. Opening force:

Shall allow doors/gates to be opened with horizontal forces of not more than 30N.

OVERHEAD DOOR CLOSERS

IRO1.M530.9 OVERHEAD DOOR CLOSERS

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed overhead door closers complete with all accessories for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong; or the document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. When the overhead door closer is supplied for domestic blocks, except for the ancillary facilities at lower floors, comply with the following particular requirements:

- Submit a sample board with accessories mounted on board, similar to the one maintained by the Housing Department showing the quality, components and internal construction for the overhead door closers, for comparison of the standard of visual quality with the benchmark samples maintained by the Housing Department;
- Submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;
- Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(c) for CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Overhead door closer to BS EN 1154:1997 except clause 7.2 and to comply with the following:

i. To the product range as IRO1.M040;

ii. Horizontal pattern with regular arm unless otherwise required or scheduled;

iii. Capable of being fitted to door handing and of closing door positively;

iv. With one or more control valves to regulate closing speed;

v. Latch control to BS EN 1154:1997 sub-clause 5.2.12;

vi. Select the appropriate sizes of overhead door closers as scheduled on Drawings and to select Size 4 closers for those door closers of parallel arm installation type;

vii. Finish:

- Where closers supplied with separate covers, the covers are to be rust proof steel plated or finished to the approval of the CM.

viii. Barrier free access requirements for door closers to be used for doors to exit staircases, protected lobbies and common areas:

- Closing period: for interior doors, a period of at least 3 seconds measured from an open position of 70 degrees to a point 75 mm from the closed position measured from the leading edge of the edge of the door;
- Opening force: shall allow exterior and interior doors to be opened with forces of not more than 30 N and 22 N respectively;
- Fire rated doors installed along accessible route shall be opened with horizontal force of not more than 30N.

b. Classification according to BS EN 1154:1997:

i. Category of use: Grade 3 for closing doors from at least 105° open and Grade 4 for closing doors from 180° open;

ii. Durability: Grade 8, tested to 500,000 test cycles;

iii. Door closer power size:

- According to Table 1 of BS EN 1154:1997 as tabulated below;
- Power size of 3 for door required to have fire resistance period installed along accessible route.

Door leaf width and closing moment:

Door closer power size	Recommended door leaf width	Test door mass	Closing moment			
			Between 0° and 4°		Between 88° and 92°	Any other angle of opening
	mm max.	kg	N.m min.	N.m max.	N.m min.	N.m min.
1	<750	20	9	<13	3	2
2	850	40	13	<18	4	3
3	950	60	18	<26	6	4
4	1100	80	26	<37	9	6
5	1250	100	37	<54	12	8
6	1400	120	54	<87	18	11
7	1600	160	87	<140	29	18

Opening moment and efficiency:

Door closer power size	Opening moment between 0° and 60°	Door closer efficiency between 0° and 4°
	N.m max.	% min.
1	26	50
2	36	50

3	47	55
4	62	60
5	83	65
6	134	65
7	215	65

iv. Fire resistance: Grade 1, identified as suitable for use on fire / smoke door assemblies, or to comply BS 476:Part22:1987;

v. Safety: Grade 1, met the Essential Requirements of safety in use;

vi. Corrosion resistance: Grade 2 with moderate resistance for the closers installed at domestic flats and public areas.

c. Performance requirements as follows:

i. For the test Sample B as stated in BS EN 1154:1997, comply with the mechanical performance and durability as follows (two samples at maximum and minimum strength for adjustable strength closers):

Items (BS EN 1154 Clause 7.3)	Reference in BS EN 1154:1997	Acceptance Standards
Set test door to required mass for strength of closer on test.	7.3.1 para. 1	-
Open door to determine maximum opening angle.	7.3.1 para. 2; 5.2.7	The test door shall be opened: - Grade 3 - from at least 105° open - Grade 4 - from 180° open. The door closer shall control the door from a minimum angle of 70°, down to the closed position.
Cycle opening to 90° and allowing to close to 0°, in a time of 3 to 7 seconds, 5000 times.	7.3.2; 7.3.3.1	-
Measure torques and calculate efficiency over region 0° to 4°.	7.3.4.1; 7.3.4.2; 5.2.3 - 5.2.5	Measure the closing moments and opening moments to meet requirements in the Table of sub-clause (2)(b). Calculate the door closer efficiency and verify that the value is in accordance with the Table in sub-clause (2)(b). For door closer with a range of power sizes, the power size used for the testing shall be stated in the test report.
Measure closing time.	7.3.4.3; 5.2.6	Verify that the closing time from 90° is capable of adjustment to between 3 seconds and 20 seconds.
Closing overload test set abuse weight to value in table, set weight to be arrested at door position 15°. Set closer to close from 90° in 10 seconds. Allow weight to close door from 90° for 10 times.	7.3.4.4; 5.2.8	Able to withstand the closing overload test.
All closers cycle for a total of 500000 cycles. Measure closing time.	7.3.5.1; 7.3.6.1	The door closer shall be rejected if closing time from 90° to the fully closed position is more than 2 times, or less than 0.7 times the value after 5000 test cycles.

Calculate efficiency over region 0° to 4°.	7.3.6.2; 7.3.4.1; 7.3.4.2; 5.2.3 - 5.2.5	Measure the closing moments and opening moments to meet requirements in the Table of sub-clause (2)(b). Calculate the door closer efficiency and verify that the value is in accordance with the Table in sub-clause (2)(b). For door closer with a range of power sizes, the power size used for the testing shall be stated in the test report.
Measure closing time.	7.3.6.3	Verify that the closing time from 90° open to fully close is not less than 20 seconds.
Closing overload test set abuse weight to value in table, set weight to be arrested at door position 15°. Set closer to close from 90° in 10 seconds. Allow weight to close door from 90° for 10 times.	7.3.6.4; 7.3.4.4; 5.2.8	Able to withstand the closing overload test.
Note: There shall be no fluid leakage or damage (that would adversely affect the performance) to the door closer throughout the tests.		

ii. For the test Sample C as stated in BS EN 1154:1997, comply with the corrosion resistance as follows (one sample set to minimum strength for adjustable closers):

Items (BS EN 1154:1997 Clause 7.4)	Reference in BS EN 1154:1997	Acceptance Standards
Set test door to required mass.	7.4.1	-
Measure opening and closing torques.	7.4.2	Measure the closing moments to meet the requirements in the Table of sub-clause (2)(b).
Expose to neutral salt spray in accordance with BS EN 1670:1998 Grade 0 no exposure Grade 1 24 hours exposure Grade 2 48 hours exposure Grade 3 96 hours exposure Grade 4 240 hours exposure	7.4.3	Refer clause 5.7 of BS EN 1670:1998.
Measure closing moments	7.4.4; 7.4.2; 5.2.17	The closing moments of the door closer shall be not less than 80% of the closing moments measured prior to the test.

3. On Site Delivery Verification:

   a. At delivery stage, submit the following documents:

      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

      ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

      iii. Delivery notes for all material delivered to site.

   b. Carry out and submit report on the following verifications for overhead door closers upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

      i. Method:

Verification Items	Method	Acceptance Standards
Surface Quality	Visual	No discolouration, no damage, no staining, no blemish
Logo and label check	Visual	Same as the CM's Approval sample

ii. Frequency:

Test Items	Sampling Frequency	Representative Batch
Surface Quality	1 sample for each delivery	Same batch of material delivered to Site under one Delivery Note
Logo and label check	1 sample for each delivery	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

SECURITY LOCKS

IRO1.M610.9 CLASSIFICATION

The following classification relating to security locks are referred to in this Specification and on the Drawings:

1. Class A: security locks to BS 3621:1980;
2. Class B: locks manufactured to BS 3621:1980, with additional features, like security bolt, to comply with the performance requirements of BS 5872:1980:Category B. Locks and latches.

IRO1.M620.9 SECURITY LOCKS

1. Construction:
   a. 5 levers minimum or if pin or disc mechanism a minimum of 6 pin or disc tumblers or more than one row of pins and rollers with rows set in same plane;
   b. Forends: double thickness;
   c. Rebating sets: where applicable, capable of fitting to rebated doors with 12.5 mm or 25 mm deep rebates. Rebate depths as indicated on the Drawings;
2. Finish:
   a. Exposed parts: satin finished stainless steel, grade 316 for external and grade 304 for internal installations, both in accordance with MET1.M060;
   b. Rebating sets: matching nickel plated brass.

LOCKS AND LATCHES

IRO1.M710.9 CLASSIFICATION

The following classification relating to locks and latches are referred to in this Specification and on the Drawings:

1. Class A: to BS 5872:1980:Category B, certified as tested to 500,000 operations for locks and 1,000,000 operations when in conjunction with lever handles;
2. Class B: to BS 5872:1980:Category A, certified as tested to 300,000 operations for locks, latches, bored locks or latch sets and 150,000 operations for cylinder rim night latches. With dimensions to BS 5872:1980.

IRO1.M720.9 CONSTRUCTION

1. To BS 5872:1980:
   a. 3 Levers and 6,000 differs minimum;
   b. Cylinder locks: not less than standard 6 pin cylinders;
   c. Rebating sets: where applicable, capable of fitting to rebated doors with 12.5 mm or 25 mm deep rebates. Rebate depth as indicated on the Drawings;
   d. Where to receive lever or knob furniture: to BS 4951:1973:Category 1. Where springing system cannot meet requirements of BS 4951:1973, handles must be spring loaded. If in order to meet requirements of BS 4951:1973, handles require bolting through the lock, the lock must be drilled at 38 mm centres horizontally or vertically to accommodate bolts.
2. Master keying: as IRO1.M070;
3. Identification: stamp locks with lock number as agreed with the CM;
4. Finish:
   a. Forend and strike plate: satin finished stainless steel, grade 316 for external and grade 304 for internal installations, both in accordance with MET1.M060;
   b. Rebating sets: satin finished stainless steel or nickel plated brass;
   c. Finish and plating to match standard of other door ironmongery.
5. Suppliers' written confirmation of the number of effective differs for the lockcases and undertaking that the individual key changes will not repeat for the flat entrance door of all domestic units in the Works.

IRO1.M730.9 CYLINDER RIM DRAWBACK LOCKS

1. Submission Requirement:
   a. At sample submission and approval stage, submit a sample of the proposed material complete with all accessories for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name / model name and job reference of the material;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. When the cylinder rim drawback lock is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- One sample board similar to the one maintained by the Housing Department showing the cylinder rim drawback lock and accessories. Submit one extra sample board when the proposed lock has not been approved for use in any Housing Department's new works projects in the past three years prior to the notified date for commencement of the Works;
- Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clauses (2)(a) and (2)(b) for CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Lock to BS 3621:1980 and BS 5872:1980:

i. Cylinder rim drawback lock with pull handle;

ii. Deadbolt double thrown, locked or unlocked by key outside, thumb turn operated inside;

iii. Latch bolt withdrawn by key outside and handle inside;

iv. Backset: 60 mm minimum;

v. Minimum 6 pin or disc tumblers;

vi. Suitable for ½ hour fire resisting period door.

b. Properties: performance to BS 3621:1980;

c. Finish: chrome plated finish for exposed cylinder and pull handle.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for cylinder rim drawback locks upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Surface Quality Check	Visual	No discolouration, no damage, no staining, no blemish,
Logo and label check	Visual	Same as the CM's Approval sample

ii. Frequency:

Verification Items	Sampling Frequency	Representative Consignment
Surface Quality Check	1 sample for every 500 sets or part thereof	500 sets
Logo and label check	1 sample for every 500 sets or part thereof	500 sets

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time.

IRO1.M740.9 MORTICE DEAD LOCKS

1. Submission Requirement:

a. At sample submission and approval stage, submit a sample of the proposed material complete with all accessories for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. When the mortice dead lock is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in submission:

- One sample board similar to the one maintained by the Housing Department showing the mortice dead lock and accessories. Submit one extra sample board when the proposed lock has not been approved for use in any Housing Department’s new works projects in the past three years prior to the notified date for commencement of the Works;

- Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clauses (2)(a) and 2(b) for CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Locks to BS 5872:1980:

i. Key operated outside and no operation for door opening from inside unless specified in Drawings;

ii. Backset: Length to suit the design dimension of door and frame for ease of operation, and in no case less than 50 mm;

iii. Minimum 6 pin or disc tumblers;

iv. Master-keyed;

v. Suitable for ½ hour fire resisting period or a fire resisting period as specified in the Drawings.

b. Properties: performance to BS 3621:1980;

c. Finish: chrome plated or satin stainless steel for exposed cylinder and pull handle.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for mortice dead locks upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Surface Quality Check	Visual	No discolouration, no damage, no staining, no blemish
Logo and label check	Visual	Same as the CM's Approval sample

ii. Frequency:

Verification Items	Sampling Frequency	Representative Consignment
Surface Quality Check	1 sample for every 500 set or part thereof	500 set
Logo and label check	1 sample for every 500 set or part thereof	500 set

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

IRO1.M750.9 LOCKS FOR GATESETS

1. Submission Requirement:

a. At sample submission and approval stage, submit a sample of the proposed material complete with all accessories for the CM's approval together with all the following substantiation for the CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. When the lock is supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the followings in submission:

- One sample board similar to the one maintained by the Housing Department showing the lock and accessories. Submit one extra sample board when the proposed lock has not been approved for use in any Housing Department’s new works projects in the past three years prior to the notified date for commencement of the Works;
- Original or a certified true copy of the ISO 9001 certificate for the lock’s manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

v. Lockset details: Specification, drawings and sample of the lockset completely describes the gateset lock's construction including materials used, together with a certificate from the lockset supplier confirming compliance of the lockset with the quality requirements in sub-clause (2).

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clauses (2)(c) (i) for the CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material;

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. Upon delivery of gateset, submit an undertaking in writing together with the lockset supplier's written confirmation that the number of effective differs for the lockcases installed in the gatesets and the corresponding individual key changes will not repeat for the gateset of domestic units in the Works.

2. Quality Requirements:

a. Operation:

i. To be locked by operating the thumbturn device without key from inside and by key from outside;

ii. Openable by operating the thumbturn device from inside when locked;

iii. From outside operable by key when locked.

b. Keys: ensure each lock is supplied with a minimum of three keys provided by the manufacturer and kept on a metal split ring with a plastic tag showing the serial number of the gateset;

c. Lockcase:

i. Compliance with BS 5872:1980, item A12, 13, 14, 15, 19 & 21;

ii. Cylinder to be minimum 6 pin/discs, complete with 4 mushroom drivers / notching. Number of effective differs to be 6000 minimum;

iii. Suitable for installing into the gateset;

iv. All exposed parts to be non-rusting material.

d. Thumbturn device: Recessed type designed to prevent operation of the thumbturn device from outside by any means of tools intruding through the grille of the gateset;

e. Strike plate to be completed with strike box, all in stainless steel.

IRO1.M760.9 LEVER HANDLE FURNITURE AND LOCKS

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed lever handle furniture and locks for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong; or the document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. When the lever handle furniture and locks are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- Submit a sample board, with accessories mounted on board, similar to the one maintained by the Housing Department showing the quality, components and internal construction for the lever handle furniture and locks, for comparison of the standard of visual quality with the benchmark samples maintained by the Housing Department;
- Submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;
- Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

vi. Method statement for installation which shall cover all types of locks and cases of different door thickness.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(d) for CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. Suppliers' written confirmation of the number of effective differs for the lockcases and undertaking that the individual key changes will not repeat for the flat entrance door of all domestic units in the Works.

2. Quality Requirements:

a. Locks to BS 5872:1980:

i. To suit door thickness as shown on the Drawings. Blocking is not permitted;

ii. Lever handles on both sides with latches and locks as shown on the Drawings;

iii. Spacing between the follower-to-keyway centres shall not be less than 70 mm;

iv. Locks for flat entrance door shall comply with the following requirements:

- Backset: 64 mm minimum unless otherwise shown on the Drawings;
- Latchbolt shall be withdrawn by lever handles on both sides;
- Double throw deadbolt shall be locked or unlocked by cylinder key outside and cylinder turn inside;
- Minimum 6 pin or disc tumblers;
- Minimum 6000 key changes.

b. Finish to exposed parts:

i. As shown on the drawings; or

ii. Satin finished stainless steel grade 316 for external installations and grade 304 for internal installations in accordance with MET1.M060.

c. Locks for entrance and kitchen door to be suitable for 1 hour and ½ hour fire resisting period respectively;

d. The quality performance requirements are as follows:

Test Items	Test Method	Acceptance Standards	Remarks
i. Freedom of operation of follower and spring bolt action	BS 5872:1980 A2	Clause 8.1 After testing, the bolt shall return to its normally extended position under its own spring pressure.	Apply to all types of locks.
ii. Strength of bolt spring	BS 5872:1980 A6	Clause 8.2 When depressed to its full extent, the bolt shall just support a force within the limits given in Table 2 of the BS.	Apply to all types of locks.
iii. Strength of follower or cam, spring bolt and stopping medium	BS 5872:1980 A7	Clause 8.3 After testing, no part of the lock or latch shall be damaged or distorted.	Apply to all types of locks.

iv. Dead bolt against end pressure	BS 5872:1980 A13	Clause 8.7 When tested by the method described in A.13.1, turning the key to throw the bolt shall fully extend the bolt and lock it. A reverse turn of the key shall unlock and withdraw the bolt. After testing by the method described in A.13.2, there shall be no damage to the mechanism, and the key shall continue to operate the mechanism correctly.	Apply to Type 1 lock only.
v. Operation of security mechanism	BS 5872:1980 A14	Clause 8.8 After testing, the lock or latch shall still be operable by the key. In the case of deadbolt mechanisms, it shall not be possible to remove the key from lock before the bolt is fully thrown and properly retained. Any failure of the key on the lock or latch shall be deemed to be a failure of the test.	Apply to Type 1 lock only.
vi. Strength of keys	BS 5872:1980 A15	Clause 8.9 After testing, there shall be no permanent set to the key.	Apply to Type 1 lock only.
vii. Spring bolt through follower	BS 5872:1980 A16	Clause 8.10 After testing, the spring bolt action shall continue to function correctly.	Apply to all types of locks.
viii. Spring bolt through striking plate	BS 5872:1980 A17	Clause 8.11 After testing, the spring bolt shall continue to function correctly.	Apply to all types of locks.
ix. Strength of lock or latch case, forend and bolt	BS 5872:1980 A19	Clause 8.13 After testing, there shall be no damage or distortion to lock or latch case, forend or bolt.	Apply to all types of locks.
x. Strength of striking plate	BS 5872:1980 A21	Clause 8.15 After testing, there shall be no damage or distortion to the striking plate.	Apply to all types of locks.
xi. Strength or return mechanism of lever handle (torque test)	BS 4951:1973 B2	When tested, the angular movement of the lever from the original rest position and the return of the lever to its original position should within the specified limit as stated.	Apply to all types of locks.
xii. Strength of furniture and methods of fixing of lever handle (tensile test)	BS 4951:1973 B3	After testing the future use of the furniture shall not be affected by any one of the following as a result of the test: - A failure of any component of the furniture; - An obvious permanent distortion of any component of the furniture; - A loosening of the furniture on the test block.	Apply to all types of locks.
xiii. Durability of mechanism of lever handle (wear test)	BS 4951:1973 B4	After testing, there shall not be failure of any part or excessive wear to any component of the furniture.	Apply to all types of locks.
xiv. Repeat of Test No. (xii)	BS 4951:1973 B5	After completion of Test No. (xiii), the specimen shall be resubmitted, without adjustment, to Test No. (xii) and shall comply with the requirements of that test as a condition of acceptance of Test No. (xiii).	Apply to all types of locks.
xv. Repeat of Test No. (xi)	BS 4951:1973 B6	After completion of Test No. (xiv), the specimen shall be resubmitted to Test No. (xi).	Apply to all types of locks.

Notes:
Type 1 - Lock / Latch for Flat Entrance
Type 2 - Lock / Latch for Kitchen
Type 3 - Lock / Latch for Bathroom
Samples tested by BS 5872 can be separated from those under BS 4951

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for lever handle door furniture and locks upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Surface Quality	Visual	No discolouration, no damage, no staining, no blemish
Logo and label check	Visual	Same as the CM's Approval sample
Length of spindle	By Measurement	IRO1.M830

      ii. Frequency:

Test Items	Sampling Frequency	Representative Batch
Surface Quality	1 sample for each delivery	Same batch of material delivered to Site under one Delivery Note
Logo and label check	1 sample for each delivery	Same batch of material delivered to Site under one Delivery Note
Length of spindle	1 sample for each delivery	Same batch of material delivered to Site under one Delivery Note

   c. Where any of the verifications fail to meet the acceptance standard, either:
      i. Remove the representative batch off Site; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

IRO1.M765.9 LEVER HANDLE FURNITURE AND LOCKS WITH PLATE

1. Submission Requirements: as per IRO1.M760;
2. Quality Requirements:

a. Locks to BS 5872:1980:

i. To suit door thickness as shown on the Drawings. Blocking is not permitted;

ii. Lever handles integrated with cast stainless steel plate (overall minimum dimension 240x50x10 mm), spring loaded capable of returning the fitting to its original position after use and with latches and locks as shown on the Drawings;

iii. Spacing between the follower-to-keyway centres shall not be less than 70 mm;

iv. Locks for flat entrance door shall comply with the following requirements:

- Backset: 64 mm minimum unless otherwise shown on the Drawings;
- Latchbolt shall be withdrawn by lever handles on both sides;
- Double throw deadbolt shall be locked or unlocked by cylinder key outside and cylinder turn inside;
- Minimum 6 pin or disc tumblers;
- Minimum 6000 key changes.

b. Finish to exposed parts: as per IRO1.M760;

c. Fire resisting period of locks: as per IRO1.M760;

d. Quality performance requirements: as per IRO1.M760.

3. On Site Delivery Verification: as per IRO1.M760.

IRO1.M770.9 KNOBSETS

1. To BS 5872:1980 and from the product range as IRO1.M040:

a. To suit door thickness. Blocking is not permitted;

b. Backset: 70 mm minimum unless otherwise shown on the Drawings or scheduled is permitted to increase to 127 mm by use of adaptor;

c. Knobsets with latches: fitted with anti-thrust action (automatic dead locking) in the latch;

2. Finish: finish to exposed parts as shown on the Drawings:

a. Satin finished stainless steel, grade 316 for external and grade 304 for internal installations, both in accordance with MET1.M060;

b. Satin anodised aluminium.

LOCK AND LATCH FURNITURE

IRO1.M810.9 CLASSIFICATION

The following classifications relating to lock and latch furniture are referred to in this Specification and on the Drawings:

1. Class A: to BS 4951:1973:Category 1, suitable for heavy duty use, certified as tested to 1,000,000 operations minimum;

2. Class B: to BS 4951:1973:Category 2, suitable for general residential use, certified as tested to 300,000 operations minimum.

IRO1.M820.9 FIRE PERFORMANCE

Lock and, latch furniture and accessories as fitted to fire rated doors shall be supported by and installed in accordance with the door's fire test or assessment reports.

IRO1.M830.9 CONSTRUCTION

Knobs or lever handles with rose or back plates to BS 4951:1973 from the product range as IRO1.M040:

1. Type as shown on the Drawings;
2. Spring loaded knobs and lever handles capable of returning the fitting to its original position after use without the assistance of locker latch spring unless specifically designed for this operation;
3. Centre between keyhole and spindle: 57 mm;
4. Spindle: 7.6 mm or 8 mm square section, projecting 12 mm minimum into lever or knob fitting. In the event of fully floating spindle or spindle fixing with screws to lever or knob in both sides, the spindle shall be of such length that when the spindle is engaged to full depth of the hole of lever or knob in one side, it shall allow a minimum of 12mm engagement in the other side of lever or knob after passing through the cored hole of the door. Spindle system capable of transmitting loads defined in BS 4951:1973. Otherwise bolt fittings through door and lock at 38 mm centres.
5. Finish: knob and lever handles: finish as shown on the Drawings as:
    a. Satin finish stainless steel, grade 316 for external and grade 304 for internal installations, both in accordance with MET1.M060.
    b. Satin anodised aluminium.

PANIC FITTINGS

IRO1.M1010.9 CLASSIFICATION

The following classifications relating to panic fittings are referred to in this Specification and on the Drawings:

1. Class A: type certified for use on fire rated doors;
2. Class B: for use on other types of door.

IRO1.M1020.9 CONSTRUCTION

1. To BS 5725:Part 1:1981 and ensuit with matching product range as IRO1.M040. Type of fitting as shown on the Drawings:
    a. Operation:
        i. Horizontally activated bar across inside face of the door operated when pushed anywhere along its effective length in direction of exit and or moved in a downward arc;
        ii. Panic fittings with two point locking vertical shoots: to have automatic catches holding bolts in withdrawn position when doors opened and automatically releasing bolts on closing of the door;
        iii. Where panic fittings capable of opening from other side of door and being locked, the lock operation must not interfere with exit from the inside.

b. With anti-thrust devices to prevent operation by other means than specified above.

c. Body, push bar and covers to be of rolled steel section, zinc plated steel or pressure die cast aluminium;

d. Stainless steel bolt heads and die cast aluminium catch cover.

2. Finish: to suit other door ironmongery and:

a. Satin finished stainless steel, grade 316 for external and grade 304 for internal installations, both in accordance with MET1.M060; or

b. Satin anodised; or

c. Sprayed and stoved enamelled finish.

DOOR FURNITURE

IRO1.M1110.9 TYPE AND RANGE

From matching coordinated range as IRO1.M040. Type of furniture as shown on the Drawings.

IRO1.M1120.9 FLUSH BOLTS

Comprising:

1. Lever action bolt, 9.5 mm minimum diameter shoot;
2. Holed shoots, plate or keeper for head fixing excluding floor socket for bottom fixing;
3. Fit easy clean floor sockets in wet areas.

IRO1.M1130.9 SURFACE BOLTS

Comprising:

1. Straight barrel bolt, 9.5 mm minimum diameter shoot;
2. Holed shoot, plate or keeper for head fixing or dust excluding floor socket for bottom fixing;
3. Fit easy clean floor sockets in wet areas.

IRO1.M1140.9 INDICATOR BOLTS

Comprising:

1. Coin operated emergency bolt action;
2. Red and green indicator.

IRO1.M1150.9 PUSH AND KICK PLATES

1. Material: as applicable:

a. Satin finished stainless steel plate minimum 1.0 mm thick;

b. Satin anodised aluminium plate minimum 2.0 mm thick.

2. Features: countersunk drilled at not more than 225 mm centres to receive 8 gauge screws for kick plates and 6 gauge screws for push plates; with corners radiused and no sharp arrises;

3. Size: to provide 4 mm gap between edge of door or door frame which ever is closer.

IRO1.M1160.9 DOOR STOPS

Type as applicable:

1. Floor mounted: with more than one floor fixing point to prevent rotation or bending at fixing;
2. Wall mounted: concealed fixing with sufficient projection to prevent impact damage to door and ironmongery.

IRO1.M1170.9 DOOR HOLDERS

Floor mounted type that allows for replacement of spring mechanism and opening for cleaning.

IRO1.M1180.9 CABIN HOOKS

Appropriate type with staples securely fixed by welding or brazing to back plate.

IRO1.M1190.9 LIMIT AND FRICTION STAYS

Appropriate type capable of limiting door opening and retaining in the open position.

IRO1.M1200.9 DOOR SELECTORS

To BS EN 1158:1997.

1. Size: to suit depth of rebate and width of door leaves;
2. Type: on external doors opening outward, use screwed under frame pattern type.

IRO1.M1210.9 DOOR CHAINS

1. Short metal chain assembly complete with matching finished No. 10 x 30 mm long woodscrews, 2 No. to secure chain plate, 4 No. to secure anchor plate;
2. Chain assembly secured by bridge plate passing through end link of chain;
3. When in fixed position capable of withstanding test loading of gradually applied tensile load of 2 kN that subjects staple and chain to direct tension and the anchor plate to shear when staple and plate screwed to Grade 'A' timber in pre-bored partly drilled holes.

IRO1.M1215.9 SECURITY DOOR GUARD (DOOR LIMITER)

1. Security door guard comprised of:
    a. chrome plated zinc alloy ball catch and with the movable arms stay at the nominal positions 0°, 90° and 180°, all within the tolerance limits of ±5°;
    b. grade 304 stainless steel pivots;
    c. grade 304 stainless steel fixing screws.
2. Capable to withstand substantial impact load when engaged;
3. After installation, the movable arm staying at the normal position measured within the range of 90° to 100° to the door surface shall not touch the ball catch when the door is being closed.

IRO1.M1220.9 DOOR VIEWERS

A type with viewing angle not less than 180° supported by and installed in accordance with the door’s fire test or assessment reports.

IRO1.M1230.9 HAT AND COAT HOOKS

A type with a minimum two screw fixings.

IRO1.M1240.9 ALUMINIUM INDICATOR SIGN PLATES

1. Material: satin anodised aluminium plates not less than 1.6 mm thick;
2. Countersunk drilled at not less than 225 mm centres to receive 6 gauge screw fixings;
3. With corners radiused and no sharp arrises;
4. Size: to provide 4 mm gap between edge of door or door frame whichever is closer.

IRO1.M1250.9 EXIT SIGNS

Comply with relevant requirements at Building and Fire Services Regulations / Code of Practice.

IRO1.M1260.9 FIRE SAFETY SIGNS

To BS 5499:Part 1:1990.

IRONMONGERY FOR JOINERY FITTINGS

IRO1.M1310.9 TYPE AND QUALITY

Ironmongery to drawers, cupboards and other joinery fittings to match quality and finish of door ironmongery and from coordinated range as IRO1.M040. Type of ironmongery as shown on the Drawings.

IRO1.M1320.9 FINISH

As applicable and to match other ironmongery and door furniture:

1. Stainless steel;
2. Satin anodised aluminium;
3. Chromium plated brass.

IRO1.M1330.9 IRONMONGERY

1. Hinges: Class C;
2. Standard drawer lock comprising:
    a. Cast zinc with brass or chromium plated brass cap;
    b. Size of cap: Approximately 22 mm diameter;
    c. Four tumbler cylinder and 4 mm thick brass bolt;
3. Cash drawer locks with brass spring loaded bolt;
4. Flush or surface bolts with 6 mm minimum diameter shoot;
5. Bales catches: Comprising 9.5 mm diameter ball mounted in a face plate with matching striking plate;
6. Door catches: Magnetic type within plastic casing. Overall length 45 mm minimum;
7. Flush pulls:

a. Size: 100 mm x 500 mm x 18 mm deep;

b. Fixings: 4 No. countersunk screws;

8. Drawer pulls:

a. 7.5 mm diameter rod twice bent to form handle 100 mm x 25 mm overall. Each leg drilled and tapped 15 mm minimum to receive 3 mm threaded rod;

b. Threaded rods fitted with 2 No. flat washers and fixing nuts.

LETTER BOX LOCKS

IRO1.M1610.9 LOCKS

Camlocks:

1. Type: having 500 minimum key combinations for each lock model when used in residential blocks. If the total number of domestic flats in a block is more than the key combinations, locks supplied by different sources of manufacturers in equal share can be used;
2. Finish: chromium plated;
3. Construction:

a. 19 mm minimum diameter barrel and bright chrome finish;

b. 500 minimum key combinations;

c. Locking mechanism:

i. Require key to turn through 90° to unlock letter box;

ii. Traps key in lock in unlocked position;

iii. Frees key in locked position.

IRO1.M1620.9 SCHEDULE

Provide CM with schedule showing different numbers of all letter box locks prior to installation.

SUNDRY FITTINGS AND FIXINGS

IRO1.M1715.9 CURTAIN TRACKS

An Approved proprietary type complete with matching fitting from the same manufacturer.

IRO1.M1720.9 SHOWER CURTAIN RAILS

1. Submission Requirements:

a. At sample submission and approval stage, submit a set of sample of the proposed shower curtain rail and accessories for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong; or the document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. When the shower curtain rails are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- One sample board, with accessories mounted on board showing the quality of the components and fixings. Submit one extra sample board when the proposed rail has not been approved for use at Housing Department's new works projects in the past three years prior to the notified date for commencement of the Works;
- Original or a certified true copy of the certification to ISO 9001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification body shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

vi. Shop drawings and method statement for installation to both reinforced concrete wall and panel wall.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information:

i. The date of the test shall be within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Stainless steel hollow tube of grade 316 or glass reinforced plastic, size as shown on Drawings with matching, purpose made, end flange fixings;

b. Test Reports to demonstrate that the shower curtain rail proposed is suitably and adequately designed / fabricated to meet the functional and hygienic requirements. Testing shall cover the following aspects:

i. Single point loading;

ii. Three point loading;

iii. Uniform loading;

iv. Bending;

v. Crushing strength;

vi. Endurance;

vii. Fungal resistance;

viii. Surface hardness.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each Delivery Note;

iii. Delivery Notes for all material delivered to Site.

b. Carry out and submit report on the following verification items upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Screw fixing	Visual	Same as the CM's Approval sample
Wall thickness of rail	Measurement	Same as the CM's Approval sample

ii. Frequency:

Test Items	Sampling Frequency	Representative Batch
Screw fixing and Wall thickness of rail	1 sample for each delivery	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standard, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

IRO1.M1730.9 TOWEL RAILS OR GRAB BAR

Stainless steel heavy duty hollow tube as MET1.M050 with matching, purpose made end flange fixings.

IRO1.M1740.9 FIXING SCREWS

Stainless steel, brass or aluminium as applicable to BS 1210:1963, with countersunk heads and, unless otherwise specified, to match ironmongery being fixed.

METALLIC WARNING, POSITIONAL AND DIRECTIONAL TACTILE INDICATORS

IRO1.M1750.9 METALLIC WARNING, POSITIONAL AND DIRECTIONAL TACTILE GROUND SURFACE INDICATOR

1. Approved proprietary system complying with the following:
    a. Individually drilled-in type metallic tactile ground surface indicators of high mechanical strength, durable and suitable for both interior and exterior environments;
    b. The indicator with the anchorage stud shall be of Grade 316 stainless steel one piece forged or cast, machine finished or electropolished;
    c. Submit a laboratory test report for the CM's information at sample submission stage to show that the slip resistance results of the tactile indicator is compatible with that of the non-slip tactile homogeneous floor tiles as per FIN5.M160;
    d. Top profile of circular warning tactile indicator to be:
        i. Domical or flat, with raised or engraved groove pattern;
        ii. Centre infill, if provided, shall be heavy duty / high durability bonded aluminium oxide / carborundum grain infill in black, yellow or of a colour contrasting to the ground surface.
    e. Top profile of longitudinal directional tactile indicator to be:
        i. Flat with raised or engraved groove pattern;
        ii. Centre infill, if provided, shall be heavy duty / high durability bonded aluminium oxide / carborundum grain infill in black, yellow or of a colour contrasting to the ground surface.
    f. Overall depth of the tactile indicator to be minimum 15mm measured including the raised indicator and anchorage stud. Directional tactile indicator to have minimum 3 anchorage studs per strip. Anchorage stud shall be minimum 5mm in diameter forged or cast with the indicator;
    g. Tactile indicators for installation at floor mat or carpet shall be installed with an interconnecting base plate fit in between base substrate and carpet / underlay.
2. Installation:
    a. Submit method statement for installation onto different floors including positioning template, drilling holes, use of adhesive / sealant for fixing the indicators in place etc. with due consideration of the substrates. Cores pre-drilled into the hard surface is required when installed on hard surfaces;
    b. Install in strict accordance with the manufacturer's instructions;
    c. Layout and pattern of the tactile indicators shall be in strict compliance with the Buildings Department "Design Manual: Barrier Free Access 2008".

POWERED PEDESTRIAN DOOR SYSTEM

IRO1.M1810.9 POWERED SLIDING DOOR SYSTEM

Powered sliding door system to BS 7036:Part 1 & 2:1996 and EMSD Code of Practice for Installation of Electrically Operated Sliding Gates, Sliding Glass Doors and Rolling Shutters comprising:

1. Sliding door leaves and side screens with dimensions and details shown in the Drawings;
2. Operator which shall comply with the following requirements:
    a. Suit the door construction, configuration, location and frequency of use and operate at 230/240vAC 50Hz;
    b. Allow adjustment of opening and closing speed, hold open time, backcheck and power and allow manual override, in case of power failure;
    c. A suitable type that will not compromise the fire rating of fire rated doors and shall be linked to fire alarm systems to close automatically in case of fire.
3. Activation devices: motion or presence activators;
4. Safety devices: force limitation device for door leaves, hold-open beam at 200 mm and 1000 mm above the finished floor level and presence sensing safety devices;
5. Breakout facility: full breakout whereby sliding door leaves and side-screens can be pushed outward manually to allow emergency escape.

IRO1.M1820.9 SUBMISSIONS

Submit the following for CM's approval before the commencement of the fabrication:

1. Product data including description of materials, components, fabrication, finishes and installation;
2. Shop drawings including elevations, sections and details indicating dimensions, materials, and fabrication of door leaves, side screens, frames, operator, activation devices, safety devices, anchors, hardware, accessories, builder's works requirement etc.;
3. Operation and Maintenance Manual including spare parts list.

IRO1.M1830.9 TESTING AND COMMISSIONING

Upon completion of the installation, carry out a testing and commissioning of the powered sliding door system including verification of the detection zone.

IRO1.M1840.9 INSTRUCTION MANUALS

Provide two copies of as-built drawings and two copies of Operation and Maintenance Manual.

WORKMANSHIP

FIXING IRONMONGERY

IRO1.W010.9 MANUFACTURER'S INSTRUCTIONS

Where applicable fix ironmongery and fittings in accordance with manufacturer's instructions.

IRO1.W020.9 MORTICING DOORS AND FRAMES

1. Ensure mortices provide tight and secure fitting for ironmongery especially into fire rated doors and frames;
2. Protect items morticed into fire rated doors and frames with an Approved type of intumescent material as detailed in the Fire Test Report.

IRO1.W030.9 SCREW FIXINGS

1. Screw into drilled pilot hole using correctly sized screw driver;
2. Do not hammer screws to any depths into holes;
3. Replace all burred screw heads at own expense.

IRO1.W040.9 PLUGGING

Where appropriate, screw or bolt into appropriate plugs inserted into construction.

IRO1.W045.9 FIXING DOORSET IRONMONGERY

1. Fix ironmongery in positions shown on the Drawings;
2. Fix hinges in positions to BS 4787:Part 1:1980.

IRO1.W050.9 FIXING PULL HANDLES AND PUSH PLATES

1. Face fix with 4 No. screws minimum per handle;
2. Bolted through with 6 mm diameter minimum bolts and stabilised by a face fixing or semi-recessed washer on one side of door;
3. Fix in pairs by through bolting.

IRO1.W060.9 FIXING FLOOR SPRING

1. Coordinate with hardware manufacturers, door suppliers to establish location, reinforcement requires etc. for the fixing details;
2. Use bolts and nuts for fixings when necessary. No welding is allowed;
3. Provide access panel for the bottom strap and for the top centre of centre hung pivots to facilitate future maintenance and inspection;
4. Provide stainless steel safety chain as shown on the Drawings.

IRO1.W070.9 FIXING LETTER BOX LOCKS

Fix lock, to face of letter box doors with fixing nuts threaded into lock barrel to rear face of locks.

IRO1.W080.9 FIXING CURTAIN TRACKS

As IRO1.W010 and;

1. Fix 13 No. runners per metre of track and all other accessories including brackets, stopped ends and overlap set;
2. Where specified install cord sets and leave in correct working order.

IRO1.W090.9 FIXING SHOWER CURTAIN RAILS

1. Plug and screw end flanges to concrete, panel or masonry walls with stainless steel screws or bolts provided by the curtain rail manufacturer and install in accordance with the manufacturer's recommendations;
2. Coordinate to conceal the earthing wire if provided.

IRO1.W100.9 FIXING TOWEL RAILS

1. Plug and screw end flanges to concrete and masonry walls with stainless steel screws;
2. Coordinate to conceal the earthing wire.

IRO1.W120.9 ADJUSTMENT

On completion, oil and adjust all ironmongery as appropriate to leave in perfect working order.

IRO1.W130.9 PROVISION AND STORAGE OF KEYS

Arrange with CM safe storage and handling of keys until handing them over to CM on completion.

FIXING DOORSET IRONMONGERY SUPPLIED FOR DOMESTIC FLATS

IRO1.W210.9 IRONMONGERY POSITIONING

Fix in positions as shown on Drawings.

IRO1.W220.9 HINGE FIXING POSITIONS

To BS 4787:Part 1:1980.

INSPECTION OF FLOOR SPRING SYSTEM DURING MAINTENANCE PERIOD

IRO1.W310.9 INSPECTION OF FLOOR SPRING SYSTEM DURING MAINTENANCE PERIOD

1. Conduct half-yearly inspection of the installed floor spring system with the CM or his representatives at the 6th, the 12th, the 18th and the 24th month from the date of completion of the Works certified by the CM or where the Works are completed in Sections, from the date of completion of the respective Section;
2. The inspection shall include checking the safety and proper operation of the floor spring system including the conditions of all component parts the physical mounting and alignment;

3. Complete, sign and submit inspection form in prescribed format to the CM or his representatives for witnessing after each inspection;
4. Bear all costs of repair and replacement of any component due to defective design, materials or workmanship, which appear within the Maintenance Period.

TESTING

SURVEILLANCE TESTS

IRO1.T030.A SURVEILLANCE TESTS FOR OVERHEAD DOOR CLOSER

1. Testing Arrangements:
    a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
    b. Comply with the following pertaining to surveillance tests:
        i. Provide attendance on the Site;
        ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
    a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in IRO1.M530 (3)(a) or as instructed by the CM;
    b. One set of test samples shall consist of two overhead door closers and the associated accessories, fastenings and fixings necessary to ensure normal operation or as instructed by the CM.
3. Testing methods:

    As per IRO1.M530 (2)(c);
4. Non-compliance:
    a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
        i. Remove the representative batch off Site; or
        ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.
    b. When the representative batch of material is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one set of samples selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
    c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

IRO1.T040.A SURVEILLANCE TESTS FOR LEVER HANDLE DOOR FURNITURE AND LOCKS

1. Testing Arrangements:
    a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;

b. Comply with the following pertaining to surveillance tests:

i. Provide attendance on the Site;

ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.

2. Testing Samples:

a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in IRO1.M760 (3)(a) or as instructed by the CM;

b. One set of test sample shall consist of six lever handle furniture and lock and the associated accessories, fastenings and fixings necessary to ensure normal operation or as instructed by the CM.

3. Testing methods:

As per IRO1.M760 (2)(d);

4. Non-compliance:

a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:

i. Remove the representative batch off Site; or

ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.

b. When the representative batch of material is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

MAS MASONRY

MAS1 BRICKWORK, BLOCKWORK AND PANEL PARTITIONS 6

GENERAL 6
MAS1.M005.N PARTITION WALL BLOCK COMPOSITION 6

MATERIALS 7

BRICKS 7
MAS1.M010.9 BRICK DIMENSIONS 7
MAS1.M020.9 CLAY BRICKS GENERALLY 7
MAS1.M030.9 CONCRETE BRICKS 7
MAS1.M040.9 BRICKS FOR FAIR FACED WORK 7
MAS1.M050.9 FACING BRICKS 8
MAS1.M060.9 FIRE BRICKS 8

BLOCKS 8
MAS1.M110.A CONCRETE BLOCKS 8
MAS1.M120.9 CONCRETE BLOCKS FOR FAIR FACED WORK 8
MAS1.M130.A CONCRETE HOLLOW BLOCKS 8
MAS1.M140.9 GLASS BLOCKS 9

PANEL WALL PARTITIONS 9
MAS1.M210.A PANEL WALL PARTITIONS FOR DOMESTIC FLATS 9
MAS1.M250.9 CHARACTERISTIC STRENGTH ESTABLISHMENT FOR PANEL WALL PARTITIONS 18

ANCILLARY MATERIALS 19
MAS1.M310.9 BED-JOINT REINFORCEMENT 19
MAS1.M320.9 PLAIN EXPANDED METAL LATH 19
MAS1.M330.9 TIES BETWEEN WALL ENDS AND CONCRETE 19
MAS1.M340.9 TIES FOR WALLS BUILT AGAINST CONCRETE 19
MAS1.M350.9 MOVEMENT JOINT MATERIALS 19
MAS1.M360.9 MORTAR 19
MAS1.M370.9 JOINT SEALANT 19

SAMPLES 20
MAS1.M410.9 SAMPLES 20

PRE-INSTALLED STEEL CONDUIT SYSTEM IN PANEL WALL PARTITIONS 20
MAS1.M510.9 STANDARD 20
MAS1.M520.9 MINIMUM SIZE OF CONDUIT 20
MAS1.M530.9 CONDUIT FITTINGS 20
MAS1.M540.9 METAL BOXES FOR ACCESSORIES 20
MAS1.M550.9 CLASS OF PROTECTION AGAINST CORROSION 20
MAS1.M560.9 TYPE-TESTING FOR ELECTRICAL STEEL CONDUITS AND FITTINGS 21

PRE-INSTALLED PVC CONDUIT SYSTEM IN PANEL WALL PARTITIONS 21
MAS1.M610.9 STANDARD OF CONDUITS 21
MAS1.M620.9 MINIMUM SIZE OF CONDUIT 21
MAS1.M630.9 PVC CONDUIT FITTINGS 21
MAS1.M640.9 PVC BOXES FOR ACCESSORIES 21
MAS1.M650.9 COLOUR 21
MAS1.M660.9 MECHANICAL PROPERTIES 21
MAS1.M670.9 FLAME RESISTANCE 22
MAS1.M680.9 TEMPERATURE CLASSIFICATION 22
MAS1.M690.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUITS AND FITTINGS 22

WORKMANSHIP 23

LAYING BRICKS AND BLOCKS GENERALLY 23
MAS1.W010.9 BRITISH STANDARD 23
MAS1.W020.9 HANDLING AND STORAGE 23
MAS1.W030.9 JOINTS 23
MAS1.W040.9 LOAD-BEARING BRICK WALLS 23
MAS1.W050.9 BED-JOINT REINFORCEMENT 23
MAS1.W060.9 PROTECTIVE SKIN WALLS TO ASPHALT TANKING 24
SAMPLES OF FINISHED WORK 24
MAS1.W110.9 SAMPLES OF FINISHED WORK 24
MAS1.W120.9 CONSTRUCTION MOCK-UP 24
PRECAUTIONS AGAINST ADVERSE WEATHER 24
MAS1.W210.9 DRY WEATHER 24
MAS1.W220.9 WET WEATHER 24
DIMENSIONS AND ACCURACY 24
MAS1.W310.9 COURSING BRICKWORK 24
MAS1.W320.9 ACCURACY 24
FACEWORK 24
MAS1.W410.9 COLOUR MIXING 24
MAS1.W420.9 UNIFORMITY 25
MAS1.W430.9 PROTECTION 25
BONDING 25
MAS1.W510.9 BRICK WALLS LESS THAN ONE BRICK THICK 25
MAS1.W520.9 BRICK WALLS ONE BRICK THICK AND OVER 25
MAS1.W530.9 PERPENDS IN BRICKWORK 25
MAS1.W540.9 BLOCKWORK 25
TYING TO CONCRETE 25
MAS1.W610.9 TYING ENDS OF MASONRY WALLS TO CONCRETE 25
MAS1.W620.9 MASONRY BUILT AGAINST FACE OF CONCRETE 25
MAS1.W630.9 MOVEMENT JOINTS 25
FINISHING JOINTS 26
MAS1.W710.9 CONCEALED FACES 26
MAS1.W720.9 FAIR FACED WORK 26
MAS1.W730.9 FACEWORK 26
MAS1.W740.9 BRICKWORK FACES TO BE PLASTERED OR RENDERED 26
MAS1.W750.9 CLEANLINESS 26
OPENINGS 26
MAS1.W810.9 BUILDING TO STRUCTURAL SOFFITS 26
MAS1.W820.9 LINTELS 26
MAS1.W830.9 SOLID FRAMES 26
MAS1.W840.9 HOLES AND CHASES FOR SERVICES INSTALLATION 26
MAS1.W850.9 DISCONTINUOUS CONSTRUCTION 26
FLASHINGS AND SKIRTINGS 27
MAS1.W910.9 TURNING IN FLASHINGS AND SKIRTINGS 27
MAS1.W920.9 ASPHALT SKIRTINGS 27
MAS1.W930.9 POINTING METAL FLASHINGS 27
GLASS BLOCKS 27
MAS1.W1010.9 ERECTION GENERALLY 27
MAS1.W1020.9 PREPARATION 27
MAS1.W1030.9 LAYING BLOCKS 27
MAS1.W1040.9 MOVEMENT JOINTS 27
MAS1.W1050.9 REINFORCEMENT 27

PANEL WALL PARTITIONS 27
MAS1.W1110.9 ERECTION GENERALLY 27
MAS1.W1120.9 PANEL THICKNESS 28
MAS1.W1130.9 TREATMENT OF VOIDS, RECESSES, REBATES, GROOVES AND JOINTS 28
MAS1.W1140.9 TREATMENT AT CORNERS, INTERSECTIONS AND JUNCTIONS WITH BUILDING STRUCTURES 28
MAS1.W1150.9 JOINT REINFORCEMENT 28
MAS1.W1160.9 SURFACES TO BE PAINTED 28
MAS1.W1170.9 ARRISES 28
MAS1.W1180.9 ADJUSTMENT FOR CONCRETE TOLERANCES 28
MAS1.W1190.9 CONDUITS AND SWITCH/SOCKET BOXES 28
MAS1.W1200.9 PANELS IN BATHROOM AREAS 29
MAS1.W1210.9 PANELS IN BATHROOM AND KITCHEN AREAS 29
MAS1.W1220.9 CONTINUOUS MONITORING OF CHARACTERISTIC STRENGTH FOR PANEL WALL PARTITIONS 29

TOLERANCES 30
MAS1.W1310.9 GENERAL 30
MAS1.W1320.9 MANUFACTURING TOLERANCE 30

PRE-INSTALLED STEEL CONDUIT SYSTEM IN PANEL WALL PARTITIONS 30
MAS1.W1410.9 STEEL CONDUIT INSTALLATION 30
MAS1.W1420.9 SHOP DRAWINGS OF CONDUITS 30
MAS1.W1430.9 SUBMISSION AND APPROVAL OF CONDUITS 31
MAS1.W1435.9 WORK COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION IN PANEL WALL PARTITIONS 31
MAS1.W1440.9 CONDUIT BENDS 31
MAS1.W1450.9 BENDING, JOINTING AND TERMINATING OF CONDUITS 31
MAS1.W1460.9 SPACING BETWEEN CONDUITS 31
MAS1.W1470.9 TERMINATION OF STEEL CONDUITS AT METAL CASING 31
MAS1.W1480.9 PREVENTION OF INGRESS OF FOREIGN MATTER 31
MAS1.W1490.9 PREVENTION OF ACCUMULATION OF WATER OR MOISTURE 32
MAS1.W1500.9 SWABBING OUT OF CONDUITS 32
MAS1.W1510.9 TOOLS 32
MAS1.W1520.9 CUTTING OF HOLES 32
MAS1.W1530.9 REMOVAL OF BURRS AND SHARP EDGES 32
MAS1.W1540.9 MAKING GOOD OF DAMAGED COATING 32
MAS1.W1550.9 EARTHING FOR PRE-INSTALLED STEEL CONDUIT 32

PRE-INSTALLED PVC CONDUIT SYSTEM IN PANEL WALL PARTITIONS 32
MAS1.W1610.9 CONDUITS INSTALLATION IN PANEL WALL 32
MAS1.W1620.9 SHOP DRAWINGS OF CONDUITS 33
MAS1.W1630.9 SUBMISSION AND APPROVAL OF CONDUITS 33
MAS1.W1640.9 CONDUIT BENDS 33
MAS1.W1650.9 BENDING, JOINTING AND TERMINATING OF CONDUITS 33
MAS1.W1660.9 SPACING BETWEEN CONDUITS 33
MAS1.W1670.9 PREVENTION OF INGRESS OF FOREIGN MATTER 33
MAS1.W1680.9 PREVENTION OF ACCUMULATION OF WATER OR MOISTURE 33

TESTING 34

SURVEILLANCE TESTS FOR PANEL WALL PARTITIONS 34
MAS1.T105.A SURVEILLANCE TESTS 34

MAS2 STONEWORK 36

MATERIALS **36**
STONE **36**
MAS2.M010.9 GRANITE 36
MAS2.M020.9 CLADDING STONE 36
ANCILLARY MATERIALS **36**
MAS2.M110.9 MORTAR 36
MAS2.M120.9 DAMP PROOF COURSE 36
MAS2.M130.9 WALL TIES FOR FACING CONCRETE AND BRICKWORK 36
MAS2.M140.9 TIES FOR JUNCTIONS WITH CONCRETE OR BRICKWORK 36
MAS2.M150.9 JOINT FILLER BACK-UP MATERIAL AND BOND BREAKER 36
MAS2.M160.9 JOINT SEALANT 36
SAMPLES **36**
MAS2.M210.9 SAMPLES 36
WORKMANSHIP **37**
GENERAL **37**
MAS2.W010.9 STANDARD 37
SAMPLE PANELS **37**
MAS2.W110.9 SAMPLES OF FINISHED WORK 37
PREPARATION OF STONE **37**
MAS2.W210.9 RANDOM RUBBLE 37
MAS2.W220.9 SQUARED RUBBLE 37
MAS2.W230.9 SQUARED, COURSED RUBBLE 37
MAS2.W240.9 ASHLAR BLOCKS 37
TRANSPORTING, STORING AND HANDLING ASHLAR BLOCKS **38**
MAS2.W310.9 TRANSPORTING 38
MAS2.W320.9 STORAGE 38
MAS2.W330.9 HANDLING 38
LAYING RUBBLE WALLING **38**
MAS2.W410.9 GENERAL 38
MAS2.W420.9 RANDOM RUBBLE 38
MAS2.W430.9 SQUARED RUBBLE 38
MAS2.W440.9 SQUARED RUBBLE BROUGHT UP TO COURSES 38
MAS2.W450.9 SQUARED, COURSED RUBBLE 38
MAS2.W460.9 SQUARED RUBBLE OVER 300 MM THICK 39
MAS2.W470.9 POINTING 39
MAS2.W480.9 MOVEMENT JOINTS 39
LAYING ASHLAR **39**
MAS2.W510.9 LAYING AND JOINTING GENERALLY 39
MAS2.W520.9 BONDING 39
MAS2.W530.9 POINTING 39
BUILDING AGAINST OTHER STRUCTURAL ELEMENTS **39**
MAS2.W610.9 FACING OTHER STRUCTURAL ELEMENTS 39
MAS2.W620.9 JUNCTIONS WITH OTHER STRUCTURAL ELEMENTS 40
ACCURACY AND TOLERANCES **40**
MAS2.W710.9 GENERAL 40
NATURAL STONE CLADDING **40**
MAS2.W810.9 FIXING 40
PROTECTION AND CLEANING **40**
MAS2.W910.9 PROTECTION 40
MAS2.W920.9 CLEANING 40
MAS2.W930.9 CLEANING ASHLAR 40

APPENDIX MAS2/I 41
MAS2.APPEND1.9 TYPES OF RUBBLE WALLING 41

MAS3 MORTAR 42

MATERIALS 42
CEMENT AND LIME 42
MAS3.M010.A CEMENT 42
MAS3.M020.A HIGH ALUMINA CEMENT 42
MAS3.M030.9 LIME 42
MAS3.M040.9 LIME PUTTY 42
AGGREGATES AND WATER 42
MAS3.M110.9 SAND 42
MAS3.M120.9 SAND FOR FAIR FACED WORK 43
MAS3.M130.9 AGGREGATE FOR FIREBRICK MORTAR 43
MAS3.M140.9 WATER 43
ADDITIVES AND ADMIXTURES 43
MAS3.M210.A PLASTICIZER 43
MAS3.M220.9 WATER RESISTING ADMIXTURE 43
MAS3.M230.9 SHRINKAGE REDUCING ADMIXTURE 43
SPECIALIST MORTARS 43
MAS3.M305.9 GENERAL SUBMISSION REQUIREMENTS FOR SPECIALIST MORTARS 43
MAS3.M310.9 MORTAR FOR FIREBRICK 44
MAS3.M320.9 MORTAR FOR ASHLAR WALLING 44
MAS3.M330.9 READY-MIXED (DRY) MORTARS 44
MAS3.M340.9 NON-SHRINK CEMENT MORTAR 45
MAS3.M350.9 FIRE RATED MORTAR 45
MAS3.M360.N PROPRIETARY WATERPROOF FILLING MORTAR FOR FILLING SPACE BETWEEN PIPE AND PIPE SLEEVE AT EXTERNAL WALL 45

WORKMANSHIP 47
MIXING MORTAR 47
MAS3.W010.9 GAUGE BOXES 47
MAS3.W020.9 MIXING 47
MIX PROPORTIONS AND USES 47
MAS3.W110.9 USE OF PLASTICIZERS 47
MAS3.W120.9 LIMITS ON USE OF MIXED MORTAR 47
MAS3.W130.9 SAND 47
MAS3.W140.9 CEMENT MORTAR 47
MAS3.W150.9 CEMENT/LIME MORTAR FOR EXTERNAL WALLS 47
MAS3.W160.9 CEMENT/LIME MORTAR FOR INTERNAL WALLS 47
MAS3.W170.9 CEMENT/LIME MORTAR FOR CHINESE TILING 47
MAS3.W180.9 WATERPROOF CEMENT MORTAR 48
MAS3.W190.9 FIREBRICK MORTAR 48
MAS3.W200.9 TYPES OF MORTAR 48
MAS3.W210.N PROPRIETARY WATERPROOF FILLING MORTAR FOR FILLING SPACE BETWEEN PIPE AND PIPE SLEEVE AT EXTERNAL WALL 48
MAS3.T100.N OPEN-UP INSPECTION OF THE COMPLETED PIPE SLEEVES AT EXTERNAL WALLS OF DOMESTIC FLATS 48
MAS3.T110.N AUDIT CHECK ON COMPLETED PIPE SLEEVES AT EXTERNAL WALLS OF DOMESTIC FLATS 49

MAS1 BRICKWORK, BLOCKWORK AND PANEL PARTITIONS

GENERAL

MAS1.M005.N PARTITION WALL BLOCK COMPOSITION

1. The content of heavy metals or their compounds in the product shall not exceed below levels:
    a. Cadmium: 1 mg/L;
    b. Lead: 5 mg/L;
    c. Arsenic: 5 mg/L;
    d. Mercury: 0.2 mg/L;
    e. Hexavalent Chromium: 5 mg/L.

MATERIALS

BRICKS

MAS1.M010.9 BRICK DIMENSIONS

As shown on Drawings.

MAS1.M020.9 CLAY BRICKS GENERALLY

Approved, well burnt, hard, sound, square and clean.

MAS1.M030.9 CONCRETE BRICKS

1. Submission Requirements:
    a. At sample submission and approval stage, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:
        i. Catalogue and job reference of the product;
        ii. Name, address and contact person of the local supplier;
        iii. Name, address and contact person of the manufacturer.
    b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2) for CM's information:
        i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;
        ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (1)(c);
        iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
    c. At delivery stage, submit the following documents:
        i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
        ii. Delivery notes for all material delivered to site.
2. Quality Requirements:
    a. To BS 6073:Part 1:1981;
    b. Size: 225 x 105 x 70 mm nominal;
    c. Minimum compressive strength: 7.0 MPa.

MAS1.M040.9 BRICKS FOR FAIR FACED WORK

Selected for evenness of texture, sharpness of arris and uniformity of colour.

MAS1.M050.9 FACING BRICKS

1. Submission Requirements:
   a. As MAS1.M030 (1).
2. Quality Requirements:
   a. To BS 3921:1985;
   b. Type: as shown on Drawings;
   c. Colour/texture: as shown on Drawings.

MAS1.M060.9 FIRE BRICKS

Imported, refractory, fireclay bricks, of the best quality, light in colour, uniform in texture and:

1. Sizes: standard to BS 3056:Part 1:1985;
2. Class: to BS 3056;
3. Tested: to BS 1902.

BLOCKS

MAS1.M110.A CONCRETE BLOCKS

1. Submission Requirements:
   a. As MAS1.M030 (1).
2. Quality Requirements:
   a. To BS EN 771-3:2011+A1:2015;
   b. Average crushing strength of a randomly selected sample of 10 blocks shall be not less than 7.0 MPa and no individual test result shall be less than 2.8 MPa;
   c. Size: as shown on Drawings.

MAS1.M120.9 CONCRETE BLOCKS FOR FAIR FACED WORK

Selected for evenness of texture and sharpness of arris.

MAS1.M130.A CONCRETE HOLLOW BLOCKS

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue and job reference of the product;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer.
   b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2) for the CM's information:
      i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (1)(c);

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to site.

2. Quality Requirements:

a. To BS EN 771-3:2001+A1:2015;

b. Average crushing strength of a randomly selected sample of 10 blocks shall be not less than 5.0 MPa of the gross area unless otherwise specified and no individual test result shall be less than 2.8 MPa;

c. Size: as shown on Drawings.

MAS1.M140.9 GLASS BLOCKS

1. To BSEN 1051:Part 1:2003 or Approved equivalent;
2. For panel construction, complete with expansion strips, panel reinforcing, panel anchors, asphaltic emulsion and sealants. See Drawings for pattern and size.

PANEL WALL PARTITIONS

MAS1.M210.A PANEL WALL PARTITIONS FOR DOMESTIC FLATS

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed panel wall partitions for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Confirmation that the manufacturing plant have:

- Automatic weighing, recording and printing equipment for the preparation of the aggregates, mechanical mixing of batching;
- Curing facilities in accordance with CS1:2010, or other to be Approved;
- Weather protected production area.

v. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

vi. Original or a certified true copy of product conformity certificate for the panel walls of fire rated construction. The certification shall be to the "Product Conformity Certification Scheme For Passive Fire Protection Products" published by the Hong Kong Institute of Steel Construction. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM. The product conformity certificate shall cover:

- The tests in accordance with BS 476:Part 20:1987 and BS 476:Part 22:1987 and certified as being capable of resisting the action of fire for the specified periods by a laboratory which must be accredited for the specified test by HKAS under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS with appropriate qualifications and experience in fire resisting construction.

vii. The detail specification of the panel walls selected for the product conformity certification audit testing by the certification body, together with drawings and photographs sufficient to completely describe the panel wall partition construction and materials used;

viii. A copy of the fire test reports, assessment reports or fire test certificate which are certified true by the accredited laboratory or QCM and generally within 5 years prior to the notified date for commencement of the Works;

ix. Manuals showing:

- General product information, packaging, handling and site storage (include product labelling sample);
- General proprietary specifications (dimensional properties, density, FRR, characteristic strength, standard deviation, tolerance and shrinkage properties of panels and non-shrink mortar);
- Full dimensional drawings of all types of panels (showing profiles, reinforcement arrangements together with the corresponding manufacturing tolerance, areas of local strengthening with non-shrinkage cement sand mortar or other Approved materials filled up the core holes (if any) for inserting the anchors, typical ceiling conduits connection openings, jointing details and mechanical fixing, fixing details of panel wall to the underside of ceiling slab, fixing details of the support for overhead door panel to adjoining panel walls, etc.);
- General layout, elevations and details to panel wall partition for typical flats;

- Installation procedure and method statement including - erection of panel walls and overhead door lintel panels, treatment to joints and surface of panels. Suggestion for fixing of doors, cabinet, cooking bench and sink unit, wash hand basin and minor fixtures, repair methods to minor surface hairline cracks and extent of cracks allowed;
- All installation accessories and materials (completed with proprietary products catalogue attached and highlighted to relevant information) included - joint fibre tape, moisture sealer, joint sealant, bonding agent, non-shrink cement sand mortar / grout, crack repairing materials and fixing anchors, fixing accessories, etc..

x. Characteristic strength data as per sub-clause (2)(b);

xi. When the panel wall partitions are supplied for domestic blocks, also include the following in the submission:

- Submit a sample board similar to the ones maintained by the Housing Department with accessories mounted on boards showing the quality, detailed method statement and work procedures. Submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;
- Original or a certified true copy each of the certification to ISO 9001 and ISO 14001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(d) for CM's information:

i. The date of the test shall be generally within five years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. Before mass production, submit the following information for Approval:

i. Shop drawings of electrical conduit system complete with its accessories.

2. Quality Requirements:

a. The panel wall partitions are to be a proprietary system, homogeneous across the entire section, compatible with the building structure and building works:

i. Light-weight to be handled manually on site;

ii. Nominal width to be 600 mm, height and thickness to refer to drawings;

iii. Complete with pre-installed electrical conduits system made either of steel or PVC. If PVC conduits are used, there shall be minimum 30mm cover from the finished surface;

iv. For 25mm diameter conduit installed in 85mm thick panel wall, the conduit shall be made of steel and terminated at PVC boxes for mounting of wiring accessories;

v. All panel wall partitions delivered to Site to be individually marked with the production number and date of production, which shall be visible after erection;

vi. Each panel wall partition has to be provided with means on top of the partition for connecting to the underside of the ceiling slab by mechanical fixings;

vii. In addition to mechanical fixings to the underside of the ceiling slab, each panel wall partition installed as a lintel above doorway has to be supported by galvanised steel brackets fixed at the sides to the adjoining panels;

viii. The panel wall hollow holes next to the corners and door openings to be either solid or filled up with non-shrink cement mortar. Where wash basins, cooking bench and sink units are attached to the panel wall partitions, the hollow holes at such locations to be either solid or filled up with non-shrink cement mortar up to 1100 mm from the bottom of the partitions;

ix. All joints and pockets to be fully grouted with non-shrink grouting / mortar. All vertical and horizontal joints to be covered with a minimum 50 mm wide fibre glass reinforcement tape;

x. Tensile pull-off strength of minimum 0.3 N/mm² when tested to method specified in FIN5.M1010 sub-clauses (2)(i)(vi) to (2)(i)(xi).

b. Characteristic strength of the panel wall partitions shall be in accordance with MAS1.M250;

c. Standard of visual quality shall be comparable with the benchmark samples maintained by the Housing Department;

d. The quality and performance requirements are as follows:

Items	Method	Acceptance Standards
i. Fire Resistance	BS 476 :Part 22	One hour FRR for 85 mm panel
ii. Sound Insulation	BS EN ISO 140-3: 1995 BS EN ISO 717-1: 1997	Weight Sound Reduction Index ≥ 38 dB for 85 mm panel
iii. Thermal Insulation	BS EN ISO 8990: 1996 (Guarded hot box method)	Thermal Transmittance < 4.7 w/m²k for 85 mm panel

iv. Water Resistance	BS 4315:Part 2:1970	No penetration of water when test on tiled surface
v. Anchor Test	BS 5080:Part 1: 1993 & BS 5080: Part 2:1986	No set standard, this is a verification of design proposed by the supplier. Permissible working load corresponding to recommended anchor length for each type of anchor must be specified in the application manual.
vi. Strength and Robustness Tests	BS 5234	To satisfy the performance requirements for Heavy Duty (HD) grade unless in contrast to the following which shall take precedence.
- Stiffness	BS 5234:Part 2: 1992:Annex A (Load = 500 N)	- Maximum deflection < 15 mm; - Maximum residual deformation < 2 mm; - No damage, detachment, loosening or dislodgement of panel and its fixings.
- Small hard body impact - surface damage	BS 5234:Part 2: 1992:Annex B (Impact energy = 6 Nm)	- Depth of indentation < 1.5 mm - No visible cracking and breakage.
- Small hard body impact - perforation	BS 5234:Part 2 : 1992:Annex D (Impact energy = 15 Nm)	No perforation of facing
- Large soft body impact - damage	BS 5234:Part 2 : 1992:Annex C (Impact energy = 40 Nm)	- Maximum deformation < 2 mm; No visible cracking and breakage.
- Large soft body impact - structural damage	BS 5234:Part 2 : 1992:Annex E (Impact energy = 120 Nm)	No collapse or dangerous damage.
- Door slam	BS 5234:Part 2 : 1992:Annex F (100 Impacts)	- Maximum displacement < 1 mm; - No visible cracking and breakage of panel; - Door frame fittings and architraves shall not be detached and loosened.
- Crowd pressure	BS 5234:Part 2: 1992:Annex G (Load = 2 KN/m)	No collapse or dangerous damage.
- Lightweight anchorage - pull out	BS 5234:Part 2 : 1992:Annex H (Load = 100 N)	Shim retained and no damage to panel.
- Lightweight anchorage - pull down	BS 5234:Part 2 : 1992:Annex J (Load = 250 N)	Shim retained and 2 mm maximum displacement and no damage to panel.

- Heavyweight anchorage - wash hand basin	BS 5234:Part 2 : 1992:Annex K (Load = 1500 N). But for the test rig in Figure K.1, the overall length of the vertical legs is reduced from 185 mm to 135 mm and the vertical distance between the fixing anchors is changed from 135 mm to 85 mm.	- Shim retained; - Maximum deflection according to Fig K.3 in BS 5234:Part 2: 1992:Annex K; - 1 mm residual deformation; and - No loosening, detachment or damage to panel.
- Heavyweight anchorage - wall cupboard	BS 5234:Part 2: 1992:Annex L (Load = 4 KN)	- Shim retained and 5 mm maximum deflection and 1 mm residual deformation; - No loosening, detachment or damage to panel.
vii. Compatibility Test with Adhesive	FIN5.M1010 (2)(h)	Tensile Force ≥ 0.3 N/mm²
viii. Watertightness	As given in (d)(xi) and (d)(xii) below. Use telephone type shower head.	No seepage through the walls.
ix. Tile removal	As given in (d)(xi) and (d)(xii) below. By hydraulic tools, Annexes C & E of BS 5234. The configuration of the partition specimen to suit site conditions.	- Maximum deformation ≤ 2 mm; - No visible cracking and breakage; - No collapse or dislocation.
x. Chasing	As given in (d)(xi) and (d)(xii) below. Form 50 x 37.5 mm depth chase, Annexes C & E of BS 5234. The configuration of the partition specimen to suit site conditions.	- Maximum deformation ≤ 2 mm; - No visible cracking and breakage; - No collapse or dislocation.

xi. Set up for Watertightness, Tile Removal and Chasing tests:

- Set up Test Areas A, B, C as per testing details given below;
- Apply the recommended moisture sealer to the surface of the panel wall system facing the wet side of all 3 Test Areas;
- For Test Area A, apply to the wet side the recommended sealant and tape to all vertical joints including those between the panel wall and the concrete wall. Install 200 x 200 mm tiles from the ceiling down to 605 mm from the structural floor;
- For Test Area B, apply sealant as per Area A and form non-shrink cement / sand angle fillet and apply cold applied waterproofing material in accordance with Contract Drawings;
- For Test Area C, along the entire length of the wall, chase 50 mm high x 37.5 mm deep conduit openings at 300 mm height at both sides of the wall. Install along its length 20 mm diameter uPVC electrical conduits. Refill the openings with the recommended refilling compound;
- After the above works are adequately cured, the following tests shall be carried out with an accredited laboratory.

xii. Detail testing method for Watertightness, Tile Removal and Chasing tests:

- Tile removal demonstration (Test Area A) - 'L' shape wall in bathroom:
  - Carry out the tile removal demonstration by hydraulic tools simulating the future user's decorator's normal tile removal practice to all tiled surfaces. The tile removal to both sides of the party wall are to be carried out simultaneously;
  - Carry out the large soft body impact tests of Annexes C & E of BS 5234:Part 2 to the party wall after the tiles have been removed. The impact point shall be at the mid-point of the central panel of the party wall.
- Watertightness test (Test Area B) - 'L' shape wall in bathroom (to be different from Test Area A):
  - Carry out the watertightness test to the non-tiled L-shaped section;
  - The water shall be applied using a common domestic telephone type shower head fitted to 13 mm diameter pipe at a water pressure of 210 to 240 kPa (30 to 35 psi). The pressure gauge shall be located at a distance not exceeding 1500 mm from the shower head;
  - The shower head is moved to and fro along the tested surface, at a perpendicular distance of 300 – 600 mm from the wall or floor surface;
  - Spray water evenly to the walls up to a height of 1500 mm above finished floor level for 2 minutes duration.
- Chasing demonstration (Test Area C) - party wall between kitchens of two flat units:
  - Carry out the large soft body impact tests of Annexes C & E of BS 5234:Part 2 to the party wall after the wall has been chased. The impact point shall be at the mid-point of the central panel of the party wall.

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site;
      iv. Type Testing Certificates for electrical conduits and fittings as per MAS1.M560 and MAS1.M690;
      v. Work Completion Certificates:

- Form WR1(A) specified by Electrical and Mechanical Services Department duly signed in both Part 1 and 2 by a Registered Electrical Contractor and a Registered Electrical Worker, certifying that the pre-installed conduit system installation is in full compliance with the Specification and the Code of Practice for the Electricity (Wiring) Regulations;
- A single certificate can be issued for the production lot covered under one delivery note as per sub-clause (3)(a)(iv). Each certificate shall show the production number as per sub-clause (2)(a)(iv).

b. Carry out and submit report on the following verifications for panel wall partitions upon delivery on Site. Prior to carrying out the verifications, inform the CM including building services site staff who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin with information of product identification number
Dimension Check	By measurement	MAS1.W1310
Surface Quality	Visual	No crack, no damage, no honeycomb, same as the CM's Approved sample
Pre-installed Conduit System Installation (Note 1)	By open up the panel(s) along the pre-installed conduit system.	No damage, no blockage, correct alignment, and marking. With minimum bending radius of 2.5 times and 4 times of the outside diameter for steel conduit and PVC conduit respectively. Brand name of the concealed conduits and accessories etc. to be same as the CM's Approved sample. The setting-out of sockets / switches boxes is as Approved Drawings. Additional requirements for PVC conduit: - minimum 30mm cover from finished surface; - conduit bends with an internal radius of at least 4 times the outside diameter of the conduit; and - glue to be applied between conduit / accessories connections.
On site inspection (Note 1)	By open up the panel(s) for measurement and visual verifications	Complying with the standard at MAS1.M210 (2)(c), and the Approved submissions on wall materials, consistency, size, spacing and location of reinforcement

Note 1: The pre-installed conduit system installation and on site inspection are combined with verifications conducted on the same panel(s).

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Manufacturer's Certificate of Origin & delivery note	1 sample from each batch of bulk delivery	Individual
Dimension Check	1 sample for every 300 panels or part thereof	Same batch of material delivered to Site under one delivery note
Surface Quality	1 sample for every 300 panels or part thereof	Same batch of material delivered to Site under one delivery note
Pre-installed Conduit System Installation and On Site Inspection	1 sample for every 2000 panels or part thereof	Same batch of material delivered to Site under one delivery note

c. Where any of the verifications, except for pre-installed conduit system installation, fail to meet the acceptance standards either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

d. Where any of the verifications among the 0.05% selected panel wall samples with pre-installed conduit system installation fails to meet the acceptance standards:

i. Further inspect on 0.15%, or at least 3 nos. samples random selected from the same batch;

ii. In case of any anomalies found again, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

e. The selected panel wall partitions can be re-used again after the verification subject to approval by the CM.

MAS1.M250.9 CHARACTERISTIC STRENGTH ESTABLISHMENT FOR PANEL WALL PARTITIONS

Characteristic strength establishment is to be based on the following or similar:

1. 100 Nos. of concrete cube samples are to be made at spot in the casting yard in 3 different casting days;
2. Samples of panel wall products manufactured in one casting day using the same batch of concrete from which the cubes are taken should be selected for testing in accordance with MAS1.M210 (2)(d)(vi);
3. The cubes should be sampled and made in accordance with CS1:2010, or other methods to be Approved, and tested for compression strength at 28 days by HOKLAS accredited laboratories;
4. Establish an estimate of the characteristic strength (fcu) in accordance with Clause 6.5.2 of BS6089 and Table 7 of BS2846:Part 3:1975. fcu can be determined from the distribution of standard cube results using the expression fcu = mean concrete cube strength minus 1.93 x standard deviation;

5. When the test stipulated in sub-clause (2) is satisfactory, the characteristic strength of the panel wall resulting from the above estimation is to be the established characteristic strength and used as fcu for monitoring purpose as required in MAS1.W1220.

ANCILLARY MATERIALS

MAS1.M310.9 BED-JOINT REINFORCEMENT

1. Material: stainless steel grade 304 for external and galvanized steel for internal use;
2. Width: 40 - 50 mm less in width than wall or leaf;

MAS1.M320.9 PLAIN EXPANDED METAL LATH

To BS 1369:Part 1:1987:

1. Reference number: L3, expanded metal lath G275;
2. Size: minimum 5 mm across short way of mesh;
3. Weight: not less than 1.6 kg/m² ± 15%;
4. Coating: zinc.

MAS1.M330.9 TIES BETWEEN WALL ENDS AND CONCRETE

To be one of the following:

1. 6 mm diameter steel rods, 350 mm long, painted with 2 coats of bituminous paint; or
2. 20 x 3 mm steel flats, 350 mm long, fanged at each end; or
3. Strips of brickwork reinforcement, as MAS1.M310 (2), 350 mm long in the following widths:
   a. For 100-105 mm walls: 60 mm;
   b. For 200-225 mm walls: 110 mm.

   Strips to be fixed by shot firing may be reduced in length, subject to Approval;
4. Other methods approved by CM.

MAS1.M340.9 TIES FOR WALLS BUILT AGAINST CONCRETE

Formed from 20 x 3 mm thick steel strip, 150 mm long, fanged at both ends and galvanized after manufacture.

MAS1.M350.9 MOVEMENT JOINT MATERIALS

Comprising:

1. Joint filler: mineral wool quilt or equivalent compressible, fire resistant non-combustible material to BS 476:Part 4:1970;
2. Restraint brackets: as shown on Drawings.

MAS1.M360.9 MORTAR

As specified in Worksection MAS3.

MAS1.M370.9 JOINT SEALANT

1. Location:

a. See MAS1.W1040 for glass blocks;

b. See MAS1.W1200 for partitions in bathrooms and kitchen areas.

2. As WAT5.M310.

SAMPLES

MAS1.M410.9 SAMPLES

Submit samples of each type of brick and block for Approval in accordance with the requirements PRE.B9.410.

PRE-INSTALLED STEEL CONDUIT SYSTEM IN PANEL WALL PARTITIONS

MAS1.M510.9 STANDARD

All conduits: comply with BS 4568:Part 1:1970 (1993) or IEC 61386-21:2002 or BS EN 61386-21:2004, heavy gauge, screwed, longitudinally welded.

MAS1.M520.9 MINIMUM SIZE OF CONDUIT

1. Minimum outside diameter: 20 mm;
2. Where special situations demand, use 16 mm conduit subject to prior approval being obtained from CM.

MAS1.M530.9 CONDUIT FITTINGS

1. All conduit fittings: comply with BS EN 61386-1:2008 or IEC 61386-1:2008;
2. Bushes and plugs: brass;
3. Do not use solid or inspection tee-pieces, couplers or elbows.

MAS1.M540.9 METAL BOXES FOR ACCESSORIES

1. Metal boxes for the enclosure of electrical accessories in conduit installation: comply with IEC 60670-1:2002 with dimensions to BS 4662:2006(2009) and complete with one earthing terminal;
2. Use 35 mm and 47 mm deep boxes to house accessories such as domestic switches, socket outlets, etc.;
3. Use 16 mm and 25 mm deep boxes to house specially designed electrical accessories of shallow pattern subject to prior Approval.

MAS1.M550.9 CLASS OF PROTECTION AGAINST CORROSION

1. Steel conduits: have Class 4 protection against corrosion in accordance with BS 4568:Part 1:1970 (1993) or BS EN 61386-1:2008 or IEC 61386-1:2008 i.e. heavy protection both inside and outside (e.g. hot-dip zinc coating or sherardizing);
2. Steel conduit fittings: have Class 4 protection in accordance with BS EN 61386-1:2008 or IEC 61386-1:2008 i.e. heavy protection both inside and outside (e.g. hot-dip zinc coating or sherardizing);
3. Metal boxes for the enclosure of electrical accessories: have resistance to corrosion in accordance with IEC 60670-1:2002.

MAS1.M560.9 TYPE-TESTING FOR ELECTRICAL STEEL CONDUITS AND FITTINGS

1. The conduits and conduit fittings shall be type-tested for complete compliance with the following standards by an Independent Accredited Laboratory or an Independent Short-Circuit Testing Organisation:-

Conduits & fittings	Standards
Steel conduits	BS 4568:Part 1:1970 (1993) or IEC 61386-21:2002 or BS EN 61386-21:2004
Conduit fittings	BS EN 61386-1:2008 or IEC 61386-1:2008
Steel boxes for electrical accessories	IEC 60670-1:2002 with dimensions to BS 4662:2006(2009)

PRE-INSTALLED PVC CONDUIT SYSTEM IN PANEL WALL PARTITIONS

MAS1.M610.9 STANDARD OF CONDUITS

All PVC conduits: comply with IEC 61386-21:2002 or BS EN 61386-21:2004; heavy mechanical strength, rigid, plain and non-thread type.

MAS1.M620.9 MINIMUM SIZE OF CONDUIT

1. Nominal diameter: 20 mm to 32 mm;
2. Where special situations demands, use 16 mm conduit subject to prior approval being obtained from CM.

MAS1.M630.9 PVC CONDUIT FITTINGS

1. Jointing of conduit: use plain, moulded slip-type couplers and expansion type couplers to BS4607:Part5:1982 (1988) or IEC 61386-1:2008 or BS EN 61386-1:2008;
2. Same make as PVC conduits.

MAS1.M640.9 PVC BOXES FOR ACCESSORIES

1. PVC boxes: fitted with metal inserts for all screw holes;
2. Minimum wall thickness: 2 mm and moulded in one piece;
3. Interchangeable with steel boxes;
4. Same make as PVC conduits.

MAS1.M650.9 COLOUR

All PVC conduits, fittings and boxes: white in colour.

MAS1.M660.9 MECHANICAL PROPERTIES

1. Withstand forces encountered in conduit wiring system application;
2. Complete with provision for prevention of deformation.

MAS1.M670.9 FLAME RESISTANCE

All PVC conduits, fittings and boxes shall be non-flame-propagating and self-extinguishing.

MAS1.M680.9 TEMPERATURE CLASSIFICATION

1. For all PVC conduits, fittings and boxes, comply with the temperature classification of -5°C in accordance with IEC 61386-1:2008 or BS EN 61386-1:2008;
2. For PVC conduits, where the ambient temperature at the country of manufacture is likely to be below -5°C, the temperature classification is -25°C.

MAS1.M690.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUITS AND FITTINGS

1. Rigid plain PVC conduits and conduit fittings shall be type-tested for complete compliance with the following standards British Standards by an Independent Accredited Laboratory or an Independent Short-Circuit Testing Organisation:-

Conduits & fittings	Standards
PVC conduits	IEC 61386-21:2002 or BS EN 61386-21:2004(2010)
PVC conduit fittings	IEC 61386-1:2008 or BS EN 61386-1:2008 or BS 4607:Part 1:1984 (1993) for male bush and female adaptor or BS 4607:Part 5:1982 (1988) for plain moulded slip type coupler and expansion type coupler
PVC boxes for electrical accessories	IEC 60670-1 :2002 with dimensions to BS 4662 :2006(2009)
PVC circular conduit boxes	IEC 60670-1:2002 or BS EN 60670-1:2008 BS 4607: Part 5:1982(1988) with the following conditions: a. The marking of the PVC circular conduit boxes shall be 60/10 kg. b. The PVC circular conduit boxes shall be type-tested to 10 kg suspended load.

WORKMANSHIP

LAYING BRICKS AND BLOCKS GENERALLY

MAS1.W010.9 BRITISH STANDARD

Comply with BS 8000:Part 3:1989 in respect of:

1. Materials, handling and preparation (section 2);
2. Brick/block walling generally (subsection 3.1);
3. Jointing and pointing (subsection 3.2);
4. Fair faced masonry (subsection 3.5);
5. Constructional details (subsection 3.7).

MAS1.W020.9 HANDLING AND STORAGE

1. Unload and handle bricks and blocks without soiling, chipping or subjecting to other damage;
2. Stack bricks and blocks on level hardstandings and protect from damage and contamination.

MAS1.W030.9 JOINTS

Lay bricks or blocks on a full bed of mortar with the joints filled solid to a nominal thickness of 10 mm.

MAS1.W040.9 LOAD-BEARING BRICK WALLS

Lay single frog bricks with the frog uppermost and fill with mortar.

MAS1.W050.9 BED-JOINT REINFORCEMENT

Lay reinforcement to blockwork as follows:

1. At the vertical spacing intervals given in the following Table, unless otherwise specified:

Vertical spacing of bed-joint reinforcement	
Length to height ratio of blockwork panel (l:h)	Spacing of bed-joint reinforcement
2:1	No bed-joint reinforcement
2.5:1	Bed reinforcement every third course
3:1	Every other course
4:1	Every course

2. Flush up blockwork with mortar to provide a full even bed. Lay reinforcement in the mortar and complete joint to normal thickness;
3. Keep reinforcement 20 mm minimum back from external and 12 mm minimum back from internal building faces;
4. Lap reinforcement 225 mm at joints in length and fully at angles;

5. Openings: extended bed-joint reinforcement 600 mm minimum distance beyond either side of openings.

MAS1.W060.9 PROTECTIVE SKIN WALLS TO ASPHALT TANKING

Lay half brick thick skin, forming a 40 mm space between skin and tanking flushed up with mortar course by course as courses are laid.

SAMPLES OF FINISHED WORK

MAS1.W110.9 SAMPLES OF FINISHED WORK

1. Prepare sample panels of faced brickwork and fair faced brickwork and blockwork, including pointing, in accordance with PRE.B9.430;
2. Panel size: not less than 1 m².

MAS1.W120.9 CONSTRUCTION MOCK-UP

Construct a Construction Mock-up of about 5 m² as PRE.B9.440 for panel wall partitions. Where applicable, show the workmanship of each construction works including fixing brackets, bedding, jointing, joint reinforcement, lintel fixing, door frame fixing, installation of E&M works and accessories, grouting, sealing, waterproofing, moisture sealer and etc., all as per the installation manual and as directed by CM.

PRECAUTIONS AGAINST ADVERSE WEATHER

MAS1.W210.9 DRY WEATHER

Wet bricks and blocks, in accordance with manufacturer's recommendations, for the minimum period necessary to prevent premature drying out of the mortar.

MAS1.W220.9 WET WEATHER

Protect freshly laid brickwork and blockwork during periods of heavy rain and at the completion of each day's work.

DIMENSIONS AND ACCURACY

MAS1.W310.9 COURSING BRICKWORK

Gauge brick courses with four courses and four joints to 320 mm.

MAS1.W320.9 ACCURACY

1. Keep courses level and perpends vertically in line;
2. Plumb quoins and other angles as the work proceeds.

FACEWORK

MAS1.W410.9 COLOUR MIXING

Distribute facing bricks and selected bricks for fair faced work, of varying colour, evenly throughout the work.

MAS1.W420.9 UNIFORMITY

Carry up work without allowing any portion to rise more than 900 mm above any other at any time.

MAS1.W430.9 PROTECTION

Protect all facework until practical completion.

BONDING

MAS1.W510.9 BRICK WALLS LESS THAN ONE BRICK THICK

Lay brick walls of 70 mm and 105 mm thickness in stretcher bond.

MAS1.W520.9 BRICK WALLS ONE BRICK THICK AND OVER

Lay brick walls 225 mm thick and over in English bond unless otherwise specified.

MAS1.W530.9 PERPENDS IN BRICKWORK

Lay bricks:

1. Throughout the work with the perpends in any course not less than a quarter of a brick from those in the course below;
2. In faced brickwork and fair faced brickwork and blockwork with joints to an even and regular pattern.

MAS1.W540.9 BLOCKWORK

Lay blocks:

1. In stretcher bond;
2. In fair faced work with joints to an even and regular pattern.

TYING TO CONCRETE

MAS1.W610.9 TYING ENDS OF MASONRY WALLS TO CONCRETE

Cast in, cut and pin or shot fire ties to concrete at 320 mm centres vertically, projecting 250 mm into brick or block walls.

MAS1.W620.9 MASONRY BUILT AGAINST FACE OF CONCRETE

Cast in or cut and pin ties to concrete at 900 mm centres horizontally, 320 mm centres vertically and staggered, projecting 75 mm into brick/block walls.

MAS1.W630.9 MOVEMENT JOINTS

Construct joints as shown on Drawings and:

1. Fix brackets at the required centres;
2. Pack filler into joint ensuring no voids remain.

FINISHING JOINTS

MAS1.W710.9 CONCEALED FACES

Strike joints off flush.

MAS1.W720.9 FAIR FACED WORK

Fill joints as the work proceeds to provide a smooth surface, flush with the brick or block face.

MAS1.W730.9 FACEWORK

Finish joints either with:

1. A trowelled, weathered joint as the work proceeds; or
2. The joints raked out to a depth of 10 mm as the work proceeds. Point up with a weathered joint on completion.

MAS1.W740.9 BRICKWORK FACES TO BE PLASTERED OR RENDERED

Rake out joints to a depth of 10 mm as the work proceeds.

MAS1.W750.9 CLEANLINESS

Clean off all mortar droppings as the work proceeds.

OPENINGS

MAS1.W810.9 BUILDING TO STRUCTURAL SOFFITS

Form movement joint adjacent structural soffits using joint filler and restraint brackets as MAS1.M350 and/or as shown on Drawings.

MAS1.W820.9 LINTELS

Build in lintels with design and materials similar to that used in the adjacent walling:

1. Panel wall – lintel shall be with characteristics strength as per MAS1.M250;
2. Blockwork wall – lintel shall be of concrete grade as per CON4.M210 and reinforcement details as per CON4.W110.

MAS1.W830.9 SOLID FRAMES

Bed solid door and window frames and the like with mortar similar to that used in the adjacent walling.

MAS1.W840.9 HOLES AND CHASES FOR SERVICES INSTALLATION

Leave, form or cut chases, holes, recesses and reveals in walls to receive frames, rainwater or other pipes, conduits, electric cables and the like as required. Make good with mortar similar to that used in the adjacent walling on completion of the services installation.

MAS1.W850.9 DISCONTINUOUS CONSTRUCTION

Where brickwork or blockwork bonding is discontinued by the installation of a conduit:

1. Lay two 6 mm diameter tie rods, projecting 250 mm on both sides of the point of discontinuity at every third course;

2. Cover up conduit by packing joints solid with mortar similar to that used in the adjacent walling after conduits and junction boxes have been installed;
3. Fix a strip of steel lathing prior to the application of plaster or render.

FLASHINGS AND SKIRTINGS

MAS1.W910.9 TURNING IN FLASHINGS AND SKIRTINGS

1. Rake out joints to a depth of 25 mm;
2. Point flashings and skirtings in mortar similar to that used in adjacent walling.

MAS1.W920.9 ASPHALT SKIRTINGS

Rake out and cut bricks to form a 25 x 25 mm groove for turn in of asphalt skirtings.

MAS1.W930.9 POINTING METAL FLASHINGS

Point in mortar similar to that used in the adjacent walling.

GLASS BLOCKS

MAS1.W1010.9 ERECTION GENERALLY

Install in accordance with the manufacturer's site work instructions.

MAS1.W1020.9 PREPARATION

Paint all sides of structural opening to receive glass block panels with two coats of bituminous paint.

MAS1.W1030.9 LAYING BLOCKS

Lay blocks in cement/lime mortar and point both sides.

MAS1.W1040.9 MOVEMENT JOINTS

Allow the clearance at the head and jambs of block panels and fill gap with joint filler and sealant all in accordance with Worksection WAT5 and the glass block manufacturer's recommendations.

MAS1.W1050.9 REINFORCEMENT

Build in strips of reinforcement and carry ends of strips across the clearance gap and build into or secure to jambs of the opening in an Approved manner and in accordance with the manufacturer's recommendations.

PANEL WALL PARTITIONS

MAS1.W1110.9 ERECTION GENERALLY

Erect and install the panel wall partitions in accordance with the manufacturer's recommendations unless specified otherwise in this Worksection.

MAS1.W1120.9 PANEL THICKNESS

Construct 150 mm thick panels in one or two skins in accordance with the manufacturer's recommendations.

MAS1.W1130.9 TREATMENT OF VOIDS, RECESSES, REBATES, GROOVES AND JOINTS

Except for circumstances covered at MAS1.W1150, grout and fill up all voids, recesses and rebates in the following joints in accordance with the panel manufacturer's recommendations:

1. Joints between individual panels;
2. Joints between ceilings and top of panels;
3. Joints between floors and bottom of panels;
4. Joints between walls and end of panels;
5. Joints between windows and door frames and end of panels.

MAS1.W1140.9 TREATMENT AT CORNERS, INTERSECTIONS AND JUNCTIONS WITH BUILDING STRUCTURES

Erect, fix and finish all in accordance with the panel manufacturer's recommendations appropriate to surrounding construction.

MAS1.W1150.9 JOINT REINFORCEMENT

Apply reinforcement or joint fibre tape composed of fiberglass mesh to vertical joints and junctions to surfaces to be tiled or rendered, internally and externally, particularly in the following locations:

1. All joints between individual panels;
2. All junctions between panels and concrete, blockwork, and other partition panels;
3. All joints between skins of panels at free ends of partitions where the panel wall partitions are constructed in two skins.

MAS1.W1160.9 SURFACES TO BE PAINTED

In accordance with panel manufacturer's recommendation:

1. Flush joint all vertical joints between surfaces of individual panels;
2. Apply material as recommended by the manufacturer to smooth and to flush all voids, irregularities and uneven surfaces and across vertical joints of panel wall partitions, with 50 mm wide reinforcement tape across vertical joints.

MAS1.W1170.9 ARRISES

Ensure ends of panels at all corners and door and window jambs are square edged.

MAS1.W1180.9 ADJUSTMENT FOR CONCRETE TOLERANCES

Carry out all necessary adjustment by cutting, jointing and filling to panels to accommodate permissible tolerances on concrete.

MAS1.W1190.9 CONDUITS AND SWITCH/SOCKET BOXES

Treat in accordance with the panel manufacturer's recommendations and:

1. Cut chases, recesses, notches and the like for the installation of concealed conduits and switch/socket boxes, where required;

2. Make good all such chases, recesses, notches and the like on completion of the electrical installation.

MAS1.W1200.9 PANELS IN BATHROOM AREAS

Apply sealant, in accordance with Worksection WAT5, to fill vertical joints and intersections of the panels and also at their junctions with the concrete structure around the bath/shower area, in accordance with the panel manufacturer's recommendations, to render the joints waterproof where such gaps occur on bathroom side of the panel.

MAS1.W1210.9 PANELS IN BATHROOM AND KITCHEN AREAS

Apply moisture sealer, to the surface of the panel facing the interior of the kitchen and bathroom in accordance with the manufacturer's recommendations to render the panel waterproof after making good of all chases, recesses, notches and the like, cut or formed for conduits and switch/socket boxes.

MAS1.W1220.9 CONTINUOUS MONITORING OF CHARACTERISTIC STRENGTH FOR PANEL WALL PARTITIONS

Continuous monitoring is to be as follows or similar:

1. In accordance with CS1:2010, take one sample to make 2 test cubes (150 mm x 150 mm x 150 mm) for each casting day or every 100 m^3 of material used whichever is the greater; send the test cubes to an Approved HOKLAS accredited (or equivalent) laboratory for compression test on 28 days cube strength and submit the test result to CM for record;
2. Submit an analysis and a summary of the test result showing compliance with this clause in an agreed format to CM in monthly intervals for the production of panel wall partitions delivered to Site;
3. If the difference between the compressive strengths of 2 test cubes made from one sample of material exceeds 15% of the averaged test result;
    a. Use the higher of the compressive strengths of the 2 test cubes to assess compliance as stated in sub-clause (4)(a);
    b. Do not use the test results for that sample to assess compliance as set out in sub-clause (4)(b) nor to calculate the standard deviation.
4. The results of tests for compressive strength at 28 days of material must comply with the following acceptance criteria:
    a. No individual test result is less than the characteristic strength established in MAS1.M250 minus 2 MPa; and
    b. The average of any 4 consecutive test results must exceed the characteristic strength. Where there are less than four available test results, treat the average of the first two or first three consecutive test results in the same manner as groups of four consecutive test results.
5. Follow up action to be carried out upon failure to comply with either of the acceptance criteria in sub-clause (4) above:
    a. CM to randomly select panel walls from the batch produced in the casting day affected for a door slam test. If erection of panel wall has commenced, door slam test is to be carried out at a location directed by the CM; except for the sizes and dimensions of the panel walls and doors, other specified test requirements are not to be varied. If the sample fails to comply with the requirements of door slam test, remove all the affected batches of panel walls from the site and make necessary replacement and rectification works;

b. Submit investigation report to give explanation for the non-compliance and rectification works required.

6. When the calculated standard deviation of a set of 40 consecutive test results exceeds the standard deviation established in the 100 cubes exercise (SD100) by 30%, double the sampling frequency as mentioned in sub-clause (1). If the calculated standard deviation of a set of 40 consecutive test results exceeds the SD100 by 60%, stop the production until the problems in quality control be identified and rectified.

TOLERANCES

MAS1.W1310.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

MAS1.W1320.9 MANUFACTURING TOLERANCE

Refer to TOL.MAS1.310 in Appendix H to this Specification.

PRE-INSTALLED STEEL CONDUIT SYSTEM IN PANEL WALL PARTITIONS

MAS1.W1410.9 STEEL CONDUIT INSTALLATION

1. Pre-install galvanised steel conduit system complete with metal boxes, or with PVC boxes if otherwise specified, to IEC 60670-1:2002 with dimensions to BS 4662:2006(2009) and steel draw wires for panel wall partitions as indicated on the Drawings;
2. During manufacturing process of the panel walls, pre-installed conduits and accessories therein shall not be subjected to any attempts that cause adverse effect to their shape properties and mechanical strength;
3. All pre-installed conduits shall run vertically in panel wall partitions;
4. Provide slots at upper ends of panel walls;
5. Whenever necessary, make allowance for alignment of conduits between panel walls and ceiling slabs for subsequent interconnection of conduits by Nominated Sub-contractor for electrical installation;
6. All PVC conduits for interconnection shall have concrete, cement, plaster or similar cover to prevent penetration of cables inside conduits by nails, screws and the like; otherwise, means of mechanical protection to the PVC conduits to comply with the Code of Practice for Electricity (Wiring) Regulation shall be provided by the Main Contractor;
7. Comply with the panel wall manufacturer's recommendations to make good all such slots, recesses, notches and the like on completion of the electrical installation;
8. Provide steel draw wires for the complete conduit installation for panel wall partitions.

MAS1.W1420.9 SHOP DRAWINGS OF CONDUITS

Prepare shop drawings, coordinate and agree with the Nominated Sub-contractor for electrical installation and the supplier for panel wall partitions before submitting shop drawings for approval.

MAS1.W1430.9 SUBMISSION AND APPROVAL OF CONDUITS

Submit for approval technical details, samples and type-tested certificates for the conduit system as specified in clause MAS1.M560.

MAS1.W1435.9 WORK COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION IN PANEL WALL PARTITIONS

1. All conduits and accessories installed have to be certified by at least Grade A2 of Registered Electrical Workers (REW);
2. Provide CM and the Nominated Sub-contractor for electrical installation each a copy of the Work Completion Certificate for record.

MAS1.W1440.9 CONDUIT BENDS

Internal radius: at least 2.5 times the outside diameter of the conduit.

MAS1.W1450.9 BENDING, JOINTING AND TERMINATING OF CONDUITS

Follow conduit manufacturers' recommendation for:

1. Method of carrying out the conduit bends and conduit joints;
2. Method of fixing conduits to boxes without spouts;
3. Use of tools and materials recommended by the manufacturer of the conduits.

MAS1.W1460.9 SPACING BETWEEN CONDUITS

In general, separate adjacent or parallel conduits by a spacing of not less than 25 mm. The strength of the panel wall partitions should not be reduced if the spacing between conduits is less than 25 mm.

MAS1.W1470.9 TERMINATION OF STEEL CONDUITS AT METAL CASING

1. Where a steel conduit terminates at a metal casing, use a coupler or a brass adaptor for flexible conduit together with a brass male bush;
2. Screw the brass male bush into the coupler or adaptor from the inside of the metal casing through a clearance hole drilled in the metal casing to suit the bush;
3. Screw both the conduit and the bush tightly into the coupler or adaptor so as to grip the metal casing securely for mechanical and electrical continuity;
4. Threads on the steel conduit shall be at least half the coupler length, and no threads on the metal casing shall be allowed;
5. Fix securely the connection between the flexible conduit and the adaptor and the connection shall be effectively watertight.

MAS1.W1480.9 PREVENTION OF INGRESS OF FOREIGN MATTER

1. Plug all open ends of the conduit termination, which are liable to be filled with water, moisture or other foreign matter, with Approved conduit stopping plugs; do not use paper or rag materials for this purpose;
2. Plug conduit boxes in similar circumstances similarly to prevent concrete or plaster from entering the boxes during the building construction.

MAS1.W1490.9 PREVENTION OF ACCUMULATION OF WATER OR MOISTURE

Lay the conduits in such manners to prevent accumulation of condensed moisture in any part of the installation. Also take due care to prevent the ingress of water into the conduits from leakage in walls and ceilings of the building structure.

MAS1.W1500.9 SWABBING OUT OF CONDUITS

Where required, swab conduits out and free them from moisture before wiring work is commenced. Carry out the swabbing operation under the supervision of the authorised representative of the CM. Use only Approved draw-in tape or steel wire of appropriate size and absorbent cloth.

MAS1.W1510.9 TOOLS

1. Tighten conduit bushes, couplers and similar items with Approved tools;
2. Form conduit bends on an Approved bending machine, and do not flatten the conduits at bends.

MAS1.W1520.9 CUTTING OF HOLES

Drill holes in metal work for the termination of conduits on Site with a twist drill of the correct size or by means of an Approved hole cutting device.

MAS1.W1530.9 REMOVAL OF BURRS AND SHARP EDGES

Remove burrs and sharp edges from the ends of conduits before they are installed.

MAS1.W1540.9 MAKING GOOD OF DAMAGED COATING

Where the protective coating on a steel conduit has been damaged after installation, paint such surface with at least two coats of an Approved anti-rust paint to prevent corrosion.

MAS1.W1550.9 EARTHING FOR PRE-INSTALLED STEEL CONDUIT

The pre-installed steel conduit and metal box in the panel walls shall not form part of the earthing system of the electrical installation. Separate circuit protective conductor (CPC) in compliance with the Code of Practice for Electricity (Wiring) Regulation will be provided by Nominated Sub-contractor for electrical installation. However, the metal box shall itself be earthed to the corresponding accessories, which shall be undertaken by the same Nominated Sub-contractor with cost borne by the Main Contractor.

PRE-INSTALLED PVC CONDUIT SYSTEM IN PANEL WALL PARTITIONS

MAS1.W1610.9 CONDUITS INSTALLATION IN PANEL WALL

1. All PVC conduits pre-installed inside panel wall partitions for cable wiring shall be set at minimum 30 mm from the final finished surface of the panel wall inclusive of finishing materials as shown on the Drawings to prevent penetration of cables inside conduits by nails, screws and the like;
2. During the manufacturing process of the panel walls, the PVC conduits and accessories therein shall not be subjected to a temperature exceeding 60°C or other attempts that cause adverse effect to their shape, properties and mechanical strength;
3. All pre-installed conduits shall run vertically in panel wall partitions;
4. Provide slots at upper ends of panel walls;

5. Whenever necessary, make allowance for alignment of conduits between panel walls and ceiling slabs for subsequent interconnection of conduits by Nominated Sub-contractor for electrical installation;
6. Comply with the panel wall manufacturer's recommendations to make good all such slots, recesses, notches and the like on completion of the electrical installation;
7. Provide steel draw wires for the complete conduit installation in panel wall partitions.

MAS1.W1620.9 SHOP DRAWINGS OF CONDUITS

Prepare shop drawings, coordinate and agree with the Nominated Sub-contractor for electrical installation and the supplier for panel wall partitions before submitting shop drawings for approval.

MAS1.W1630.9 SUBMISSION AND APPROVAL OF CONDUITS

Submit for Approval technical details, samples and type-tested certificates for the conduit system as specified in clause MAS1.M690.

MAS1.W1640.9 CONDUIT BENDS

Internal radius: at least 4 times the outside diameter of the conduit.

MAS1.W1650.9 BENDING, JOINTING AND TERMINATING OF CONDUITS

Follow conduit manufacturers' recommendation for:

1. Method of carrying out the conduit bends and conduit joints;
2. Method of fixing conduits to boxes without spouts;
3. Use of tools and materials recommended by the manufacturer of the conduits.

MAS1.W1660.9 SPACING BETWEEN CONDUITS

In general, separate adjacent or parallel conduits by a spacing of not less than 25 mm, the strength of the panel wall partitions should not be reduced if the spacing between conduits is less than 25 mm.

MAS1.W1670.9 PREVENTION OF INGRESS OF FOREIGN MATTER

1. Plug all open ends of the conduit termination, which are liable to be filled with water, moisture or other foreign matter, with Approved conduit stopping plugs; do not use paper or rag materials for this purpose;
2. Plug conduit boxes in similar circumstances similarly to prevent concrete or plaster from entering the boxes during the building construction.

MAS1.W1680.9 PREVENTION OF ACCUMULATION OF WATER OR MOISTURE

Lay the conduits in such manners to prevent accumulation of condensed moisture in any part of the installation. Also take due care to prevent the ingress of water into the conduits from leakage in walls and ceilings of the building structure.

TESTING

SURVEILLANCE TESTS FOR PANEL WALL PARTITIONS

MAS1.T105.A SURVEILLANCE TESTS

1. Test Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or Direct Testing Contractor;
   b. Comply with the following pertaining to the surveillance tests:
      i. Provide attendance on the Site or on the manufacturing factory;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Test Samples:
   a. Provide one set of test samples from the batch of material delivered to Site under the delivery note as specified in MAS1.M210 (3)(a) or provide one set of test samples directly selected in the manufacturing factory (hereinafter referred to as the "representative batch") or as instructed by the CM;
   b. For Fire Resistance Test, one set of test samples shall consist of 10 pieces of panel wall partitions, including the associated fastenings and fixings necessary to ensure normal installation or as instructed by the CM;
   c. For Strength and Robustness Tests, one set of test samples shall consist of 10 pieces of panel wall partitions, including the associated fastenings and fixings necessary to ensure normal installation or as instructed by the CM;
   d. For inspection of wall materials, consistency, size, spacing and location of reinforcement, one set of test sample shall consist of 1 piece of panel wall partition.
3. Test methods:
   a. For Fire Resistance Test, as per MAS1.M210 (2)(d) test item (i);
   b. For Strength and Robustness Tests, as per MAS1.M210 (2)(d) test item (vi);
   c. For inspection of wall materials, consistency, size, spacing and location of reinforcement, open up the panel wall partition for measurement as per the approved submissions.
4. Non-compliance:
   a. In the event that any of the test samples fails to meet the test requirements, follow either one of the following actions:
      i. Remove the representative batch off Site; or
      ii. Apply to the CM for re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for one separate set of samples selected by the CM from the representative batch. The CM shall have the discretion to approve or not the commissioning of the latter laboratory for the re-test. In case any one sample for the re-test fails, remove the representative batch off Site.

b. When the representative batch of panel wall is removed off Site, replace with another new batch (hereinafter referred to as the "replacement batch"). Apply to the CM for test in accordance with the test methods as specified in sub-clause (3) by Direct Testing Contractor or by a laboratory that complies with the requirements stated in PRE.B9.570 for one set of samples selected by the CM from the replacement batch. The CM shall have the discretion to approve or not the commissioning of the latter laboratory for the test. In case any one sample fails the test, follow action stated in sub-clause (4)(a);

c. Bear the costs of any failed surveillance tests and all associated costs for the test(s) and re-test(s) required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

MAS2 STONEWORK

MATERIALS

STONE

MAS2.M010.9 GRANITE

1. Obtain locally; and
2. Free from defects which may adversely affect the strength or appearance of the stone.

MAS2.M020.9 CLADDING STONE

As shown on Drawings.

ANCILLARY MATERIALS

MAS2.M110.9 MORTAR

As specified in Worksection MAS3.

MAS2.M120.9 DAMP PROOF COURSE

To BS 6398:1983, but not hessian based types.

MAS2.M130.9 WALL TIES FOR FACING CONCRETE AND BRICKWORK

Stainless steel flat strip and:

1. Not less than 40 mm wide by 3 mm thick and 175 mm long;
2. Fanged at both ends.

MAS2.M140.9 TIES FOR JUNCTIONS WITH CONCRETE OR BRICKWORK

Stainless steel flat strip and:

1. 20 mm wide by 3 mm thick and 350 mm long;
2. Fanged at both ends.

MAS2.M150.9 JOINT FILLER BACK-UP MATERIAL AND BOND BREAKER

As Worksection WAT5.

MAS2.M160.9 JOINT SEALANT

As WAT5.M310.

SAMPLES

MAS2.M210.9 SAMPLES

Submit samples of stone for ashlar walling for Approval in accordance with PRE.B9.410 before ordering.

WORKMANSHIP

GENERAL

MAS2.W010.9 STANDARD

Comply generally with the requirements of BS 5390:1976.

SAMPLE PANELS

MAS2.W110.9 SAMPLES OF FINISHED WORK

Prepare sample panels, approximately 1 m² of stone walling, including pointing, in accordance with PRE.B9.430.

PREPARATION OF STONE

MAS2.W210.9 RANDOM RUBBLE

Prepare stones to an irregular shape and roughly cut:

1. Height: 75 - 300 mm;
2. Minimum depth: 75 mm;
3. Length on bed: 75 - 600 mm;
4. With the length or depth on bed of each stone greater than the height.

MAS2.W220.9 SQUARED RUBBLE

Prepare stones roughly square as follows:

1. Height: 75 - 300 mm, varying in 75 mm stages;
2. Depth: 100 - 150 mm;
3. Length on bed: 100 - 600 mm;
4. With the length or depth on bed of each stone greater than the height.

MAS2.W230.9 SQUARED, COURSED RUBBLE

Prepare stones roughly square as follows:

1. Height: 75 - 300 mm, to suit courses of regular height varying from 150 - 250 mm;
2. Depth: 100 - 150 mm;
3. Length on bed: 100 - 600 mm;
4. With the length or depth on bed of each stone greater than the height.

MAS2.W240.9 ASHLAR BLOCKS

Work the exposed and joint faces of each stone to a square and true, plane surface, free from hollow or rough areas and:

1. With exposed faces finely squared and dressed;
2. Stones not less than 300 mm high;

3. Each stone clearly marked to indicate its position in the finished work.

TRANSPORTING, STORING AND HANDLING ASHLAR BLOCKS

MAS2.W310.9 TRANSPORTING

Transport stone:

1. With the minimum of handling;
2. With the stones stacked carefully on the vehicle, using packing pieces to prevent damage.

MAS2.W320.9 STORAGE

Store stones in stacks, on battens and protect from the rain.

MAS2.W330.9 HANDLING

Provide adequate lifting plant to unload and handle the stones into position.

LAYING RUBBLE WALLING

MAS2.W410.9 GENERAL

Lay stones on a full and even bed of mortar in accordance with Worksection MAS3 with joints filled and between 5 and 15 mm wide.

MAS2.W420.9 RANDOM RUBBLE

Lay stones of random shapes and sizes, bonded together over each face of the wall and:

1. Select and rough dress the stones to keep joint widths to a minimum;
2. Provide at least one bonding stone per m² of 450 x 150 mm minimum dimensions carried through the full thickness of the wall as illustrated in figure a. of Appendix MAS2/I to this Worksection;
3. Do not permit any more than three stones to be adjacent to a vertical joint.

MAS2.W430.9 SQUARED RUBBLE

Lay stones of random sizes so that they are properly bonded together with continuous, straight horizontal joints as illustrated in figures b and e of Appendix MAS2/I to this Worksection, with vertical joints kept to a minimum.

MAS2.W440.9 SQUARED RUBBLE BROUGHT UP TO COURSES

Lay stones of random sizes so that they are properly bonded together and brought to level, horizontal joints at maximum centres of 750 mm, to line up with quoin and jamb stones as shown in figures c and e of Appendix MAS2/I to this Worksection.

MAS2.W450.9 SQUARED, COURSED RUBBLE

Lay stones in regular courses as shown in figures d and e of Appendix MAS2/I to this Worksection.

MAS2.W460.9 SQUARED RUBBLE OVER 300 MM THICK

Construct as shown in figure e of Appendix MAS2/I to this Worksection and:

1. Walls faced one side:
    a. Construct one face in roughly squared stones to a minimum thickness of 300 mm with a backing of random rubble;
    b. Provide at least two regularly spaced bonding stones per square metre carried through the whole thickness of the walling or 450 mm into the backing whichever is the less;
2. Walls faced both sides:
    a. Construct both faces in roughly squared stone to a minimum thickness of 150 mm with a core of random rubble;
    b. Provide bonding stones as specified in sub-clause (1)(b) above, but carried either through the whole thickness of the walling or 450 mm into the core.

MAS2.W470.9 POINTING

1. Rake out joints to a depth of 15 mm as the work proceeds;
2. Point in cement mortar with a flush, weathered or recessed joint on completion.

MAS2.W480.9 MOVEMENT JOINTS

Install movement joints, to coincide with those in the structural background in accordance with the relevant provisions of the Workmanship Section of Worksection WAT5.

LAYING ASHLAR

MAS2.W510.9 LAYING AND JOINTING GENERALLY

1. Lay stones on a full, even bed of mortar with all joints filled;
2. Joint width: 5 mm.

MAS2.W520.9 BONDING

Lay stones to bond together throughout the wall and to the backing using projecting bonding stones.

MAS2.W530.9 POINTING

1. Rake out joints to a depth of 15 mm as the work proceeds;
2. Point, using bedding mortar, with a flush joint on completion.

BUILDING AGAINST OTHER STRUCTURAL ELEMENTS

MAS2.W610.9 FACING OTHER STRUCTURAL ELEMENTS

For stone walling built as a facing to concrete or brickwork:

1. Cast in or build in for a depth of 100 mm at least 5 No wall ties per m² to project 75 mm into the stone walling;
2. Fill the joint between the stone walling and the backing with mortar.

MAS2.W620.9 JUNCTIONS WITH OTHER STRUCTURAL ELEMENTS

At junctions of stone walling with concrete or brickwork, cast or build in ties at minimum centres of 450 mm vertically, projecting 250 mm into walling.

ACCURACY AND TOLERANCES

MAS2.W710.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

NATURAL STONE CLADDING

MAS2.W810.9 FIXING

Fix stone claddings in accordance with BS 8298:1989 and as shown on Drawings.

PROTECTION AND CLEANING

MAS2.W910.9 PROTECTION

1. Protect newly erected stonework against inclement weather and firmly fix adequate protection to prevent damage to all arrises and projections;
2. Keep facework clean during construction and until completion.

MAS2.W920.9 CLEANING

Clean off and leave stonework perfect immediately before handing over.

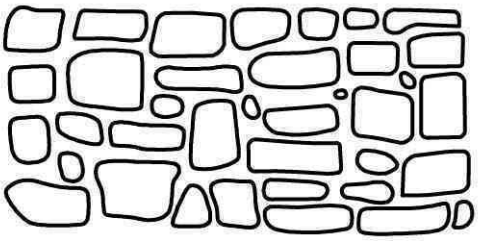
MAS2.W930.9 CLEANING ASHLAR

Clean off, rub down and leave stonework perfect immediately before handing over.

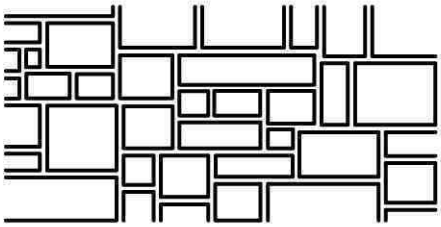
APPENDIX MAS2/I

MAS2.APPEND1.9 TYPES OF RUBBLE WALLING

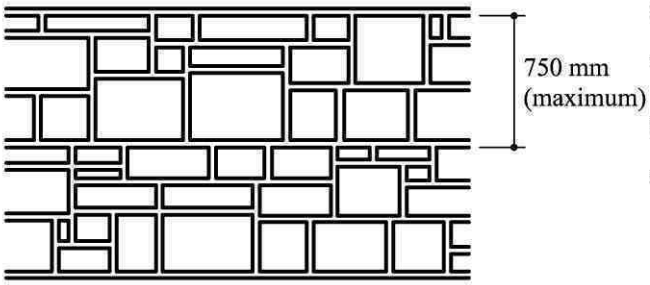
a) Radom rubble



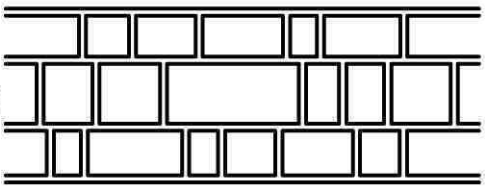
b) Squared rubble



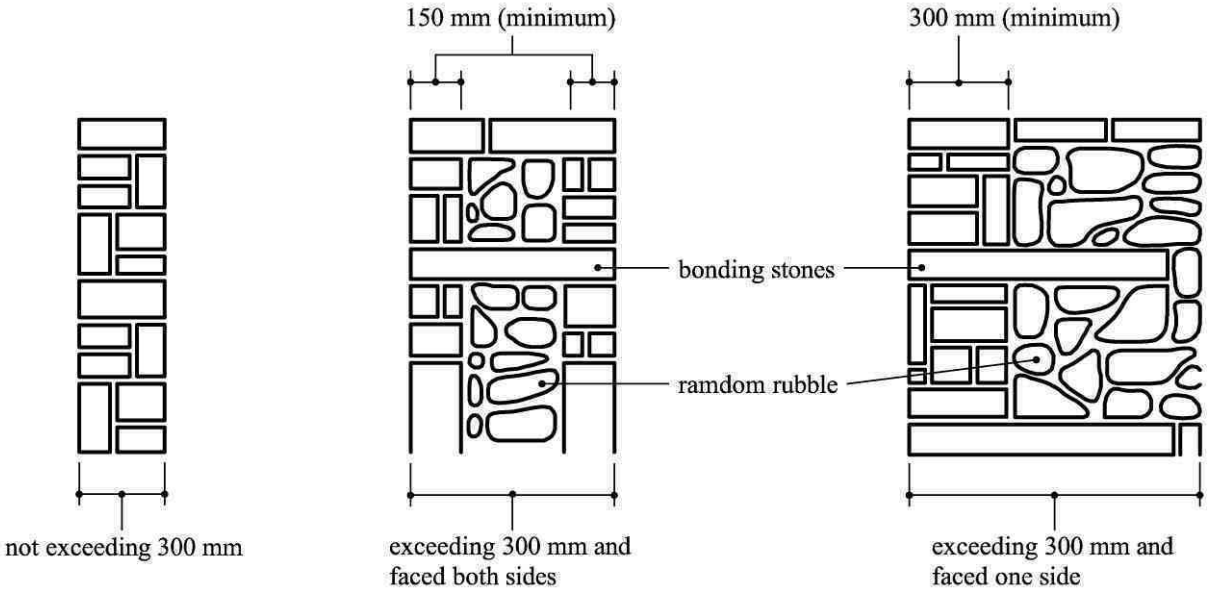
c) Squared rubble brought up to courses



d) Squared coursed rubble



e) Squared rubble walls - Sections:



MAS3 MORTAR

MATERIALS

CEMENT AND LIME

MAS3.M010.A CEMENT

1. Ordinary or rapid hardening Portland cement: as FIN 1.M010;
2. Sulphate resisting cement: to BS EN 197-1:2011;
3. Masonry cement: to BS EN 413-1:2011.

MAS3.M020.A HIGH ALUMINA CEMENT

To BS EN 14647:2005.

MAS3.M030.9 LIME

As FIN1.M020.

MAS3.M040.9 LIME PUTTY

Prepared in accordance with BS 5492:1990, clause 39.1 by adding hydrated lime to water and mixing to a thick, creamy consistency, after which the putty must be left for a minimum of 16 hours before use.

AGGREGATES AND WATER

MAS3.M110.9 SAND

1. Submission Requirements:

   As FIN1.M410 (1);

2. Quality Requirements:

   a. Clean, hard, durable crushed rock, gravel or clean sand, free from salt and its quality shall comply with the "quality of sand" as stated in BS 1199:1976 Amendment 3, and shall conform to the following grading limits:

BS Test Sieve	Percentage by weight passing BS Test Sieve
5.00 mm	100
2.36 mm	90-100
1.18 mm	70-100
600 microns	40-100
300 microns	5-70
150 microns	0-15

   b. Sand, other than the 5.00 mm size, falling outside the grading limits shown in the above table by no more than 5%, may be accepted subject to Approval;

c. The proportion of clay, fine silt or dust present, when determined according to BS 812:Section 103:1:1985, must not exceed 10% by weight.

3. On Site Delivery Verification:

a. As FIN1.M410 (3).

MAS3.M120.9 SAND FOR FAIR FACED WORK

As specified in MAS3.M110, but free from all salts likely to cause efflorescence.

MAS3.M130.9 AGGREGATE FOR FIREBRICK MORTAR

Fine, crushed firebrick.

MAS3.M140.9 WATER

As FIN1.M310.

ADDITIVES AND ADMIXTURES

MAS3.M210.A PLASTICIZER

A proprietary product to BS EN 934-1:2008 and BS EN 934-3:2009+A1:2012.

MAS3.M220.9 WATER RESISTING ADMIXTURE

As FIN1.M870.

MAS3.M230.9 SHRINKAGE REDUCING ADMIXTURE

1. An Approved proprietary product, free from chlorides, nitrates and sulphates;
2. Submit manufacturer’s written confirmation to declare that the admixture is safe for use for construction of components in contact with potable water.

SPECIALIST MORTARS

MAS3.M305.9 GENERAL SUBMISSION REQUIREMENTS FOR SPECIALIST MORTARS

1. At sample submission and approval stage, submit a sample of the specialist mortar for the CM's approval together with all the following substantiation for the CM's information:

a. Catalogue, brand name, and job reference of the material;

b. Name, address and contact person of the local supplier;

c. Name, address and contact person of the manufacturer;

d. When the material is supplied for domestic blocks, or domestic floors above non-domestic floors, also include the following in the submission:

i. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant for the CM's inspection. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

2. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the Quality Requirements for the CM's information:
    a. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;
    b. The test reports shall either be submitted at the sample submission and approval stage, or at a time not later than the delivery of the material;
    c. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

MAS3.M310.9 MORTAR FOR FIREBRICK

An Approved proprietary fire cement mortar.

MAS3.M320.9 MORTAR FOR ASHLAR WALLING

Cement and finally crushed stone, mixed 1 : 3 in proportion.

MAS3.M330.9 READY-MIXED (DRY) MORTARS

1. Submission Requirements as MAS3.M305;
2. Quality Requirements:
    a. To BS 4721:1981and ensure mix used is suited to its intended use;
    b. Comprising:
        i. Cement, lime and sand as specified in this Worksection;
        ii. Cement set retarding admixture to BS 4887:Part 2:1987.
    c. With composition and properties in accordance with BS 4721:1981 tables 3 and 4, composition and specified properties of ready-to-use mortars;
    d. The minimum mean compressive strength of cement and cement / lime mortar, when tested in accordance with clause 12 of BS 4551:Part 1:1998, is as follows:

Type of Mortar by proportions of Cement:Lime:Sand	Mean Compressive Strength at 28 Days as Determined by Site Test
1 : 0 to 0.25 : 3	11.0 MPa
1 : 1 : 5 to 6	2.5 MPa
1 : 2 : 8 to 9	1.0 MPa

3. On Site Delivery Verification:
    a. At delivery stage:
        i. Written confirmation that the materials delivered to Site is in accordance with the Approved sample submitted under sub-clause (1)(a);
        ii. Delivery notes for all material delivered to Site.
    b. Carry out and submit report on the following verifications for ready-mixed mortars upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
        i. Method:

Verification Items	Method	Acceptance Standards

Delivery note	Document Check	Material information recorded in the delivery notes to be same as the material delivered.
Material and packaging	visual	To approved sample
Expiry date	Check information printed on packaging	Minimum 6 months from the date of delivery

ii. Frequency:

Carry out verification for one packaged bag per every delivery of ready-mixed mortar to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the acceptance standards, remove the delivery off Site.

MAS3.M340.9 NON-SHRINK CEMENT MORTAR

1. Submission Requirements as MAS3.M305;
2. Non-structural use only;
3. 1: 3 cement and sand;
4. With minimum amount of water to achieve a consistency that is suitable for completely filling up voids or making up fillets;
5. The mix shall contain a shrinkage reducing admixture to MAS3.M230;
6. Not applicable to non-shrink cement mortar as used in the panel wall partitions;
7. Where it may be in contact with the Approved panel wall partition system, it shall be compatible with the panel wall partition system;

8 As an alternative and subject to the CM's approval, pre-bagged non-shrink cement mortar with its volume control mechanism in compliance with Types A, B or C under Table 1 of ASTM C1107 - 99 may be proposed to be used, with particular attention to the following:

a. Early age height change shall be within 0 % to +4%; and

b. Hardened grout or mortar height change shall be within 0% to +0.3%.

MAS3.M350.9 FIRE RATED MORTAR

1. Submission Requirements as MAS3.M305;
2. An Approved proprietary fire rated mortar;
3. To BS 476:Part20:1987 or BS EN:1366:Part3:2009 with the test carried out and report prepared by a laboratory recognised by the Hong Kong Laboratory Accreditation Scheme; or
4. Accredited by a third party product conformity scheme such as CE Marking, FM Approvals, Underwriters Laboratories (UL), BM Trada or Certifire, etc..

MAS3.M360.N PROPRIETARY WATERPROOF FILLING MORTAR FOR FILLING SPACE BETWEEN PIPE AND PIPE SLEEVE AT EXTERNAL WALL

1. Submission Requirements as MAS3.M305;
2. Proprietary waterproof filling mortar recommended by the manufacturer suitable for filling the space between pipe and pipe sleeve and approved by the CM.

DELETED

WORKMANSHIP

MIXING MORTAR

MAS3.W010.9 GAUGE BOXES

Measure constituents by volume, using clean gauge boxes of sizes to suit the volumes required.

MAS3.W020.9 MIXING

Mix:

1. By mechanical mixer or where Approved, by hand on a clean, closeboarded platform;
2. Without overmixing mortars containing plasticizers;
3. Dry constituents before mixing with lime putty or water;
4. Using the minimum amount of water to achieve the required consistency.

MIX PROPORTIONS AND USES

MAS3.W110.9 USE OF PLASTICIZERS

Use strictly in accordance with the manufacturer's recommendations and adjust the mix proportions of the mortar accordingly.

MAS3.W120.9 LIMITS ON USE OF MIXED MORTAR

Use mortar within one hour of mixing and do not:

1. Use mortar after the initial set has taken place;
2. Reconstitute mortar.

MAS3.W130.9 SAND

The proportions given in this Worksection allow for the use of dry sand and an appropriate allowance must be made for bulking.

MAS3.W140.9 CEMENT MORTAR

Cement and sand, ratio 1 : 3.

MAS3.W150.9 CEMENT/LIME MORTAR FOR EXTERNAL WALLS

Cement, lime putty and sand, ratio 1 : 1 : 6.

MAS3.W160.9 CEMENT/LIME MORTAR FOR INTERNAL WALLS

Cement, lime putty and sand, ratio 1 : 2 : 9.

MAS3.W170.9 CEMENT/LIME MORTAR FOR CHINESE TILING

Cement, lime putty and sand, ratio 1 : 1 : 6.

MAS3.W180.9 WATERPROOF CEMENT MORTAR

1. 50kg of cement to 150kg of sand to 5kg of waterproofing water resisting admixture, or in such ratio as may be recommended by the admixture manufacturer;
2. Submit manufacturer's written confirmation to declare that the waterproof cement mortar is safe for use for construction of components in contact with potable water.

MAS3.W190.9 FIREBRICK MORTAR

Either:

1. High alumina cement and aggregate mixed 1 : 2; or
2. Proprietary product used neat.

MAS3.W200.9 TYPES OF MORTAR

Use mortars as follows:

1. Cement mortar for:
   a. Work below damp proof course;
   b. Chimney stacks above roof level;
   c. Brickwork of 70 and 105 mm thickness;
   d. Concrete blockwork not exceeding 150 mm thick;
   e. Load bearing walls;
   f. Brickwork in engineering bricks;
   g. Pointing where directed by the CM and where the bedding mortar is cement mortar;
2. Firebrick mortar for firebrick work;
3. Cement/lime mortar in all other cases;
4. Ready-to-use mortar: use in situations (1) and (3) above.

MAS3.W210.N PROPRIETARY WATERPROOF FILLING MORTAR FOR FILLING SPACE BETWEEN PIPE AND PIPE SLEEVE AT EXTERNAL WALL

Mix and apply proprietary waterproof filling mortar in accordance with manufacturer's recommendation.

MAS3.T100.N OPEN-UP INSPECTION OF THE COMPLETED PIPE SLEEVES AT EXTERNAL WALLS OF DOMESTIC FLATS

1. Testing Arrangement:
   a. Carry out open-up inspection of the completed pipe sleeves at external walls of domestic flats from indoor and outdoor;
2. Testing Samples:
   a. Samples of number equal to 5% of total number of domestic flats randomly selected by the CM;
   b. One sample means minimum one number of pipe sleeve at bathroom and minimum one number of pipe sleeve at kitchen of a flat.
3. Testing Method:
   a. Remove mastic sealant from around the pipe sleeves on both sides of the pipe sleeve to expose the proprietary waterproof filling mortar or polyurethane foam;

b. Visual check the surface condition of both sides of the proprietary waterproof filling mortar or polyurethane foam that the filling material is free from any cracks, voids or other defects;

c. For proprietary waterproof filling mortar, use a hand tool to gentle tap the surface to check for soundness, cracks, voids or other defects;

d. Record the test results;

e. Make good the tested pipe sleeve and surrounding areas to the satisfaction of the CM;

f. All the open-up inspection must be witnessed by the Contractor or his representative and the CM or his representative.

4. Acceptance standard shall be:

a. Soundness and no cracks, voids or other defects observed.

5. Non-compliance:

a. In the event that any one pipe sleeve fails to meet the acceptance standard of sub-clause (4) above, take three separate pipe sleeves from bathroom and /or kitchen of the same flat for retest;

b. In case any pipe sleeve(s) fails the re-test, remove all the filling works carried out on the date same as the date of the re-test pipe sleeves;

c. Carry out remedial works subject to the approval of the CM and to the satisfaction of the CM;

d. Bear all associated costs and the extra time required including further re-tests.

MAS3.T110.N AUDIT CHECK ON COMPLETED PIPE SLEEVES AT EXTERNAL WALLS OF DOMESTIC FLATS

1. The CM may conduct audit check of the completed pipes sleeves at the external walls of domestic flats from indoor and outdoor.

2. Testing Arrangement:

a. Provide attendance on the Site and carry out the open-up inspection as per testing method in sub-clause (3) of MAS3.T100;

b. Make good the tested pipe sleeve and surrounding areas to the satisfaction of the CM;

c. All the open-up inspection must be witnessed by the Contractor or his representative and the CM or his representative.

3. Testing Samples:

a. Samples of number equal to 2% of the total number of open-up inspections in MAS3.T100 and randomly selected by the CM;

b. One sample means minimum one number of pipe sleeve at bathroom and minimum one number of pipe sleeve at kitchen of a flat.

4. Testing Method:

a. As per sub-clause (3) of MAS3.T100.

5. Acceptance standard shall be:

a. As per sub-clause (4) of MAS3.T100.

6. Non-compliance:

a. In the event that any one pipe sleeve fails to meet the acceptance standard in sub-clause (5) above:

   i. Carry out remedial works subject to the approval of the CM and to the satisfaction of the CM and submit rectified photo record to the CM;

   ii. Carry out additional open-up inspection as per sub-clause (3) of MAS3.T100 to the satisfaction of the CM;

   iii. Bear all associated costs and the extra time required including further re-test.

7. The audit check by the CM shall not relieve the Contractor from any liability or obligation under the Contract.

MET METALWORK

MET1 GENERAL METALWORK 3

DESIGN 3

FALL ARREST SYSTEM 3

MET1.D010.9 CONTRACTOR'S RESPONSIBILITY 3
MET1.D020.9 GENERAL DESCRIPTION 3
MET1.D030.9 MATERIALS AND WORKMANSHIP 4
MET1.D040.9 SUBMISSIONS 5
MET1.D050.9 INSPECTION AND COMPLETION CERTIFICATES 5
MET1.D052.9 COMMISSIONING AND REPORT 5
MET1.D060.9 MAINTENANCE MANUALS 6
MET1.D070.9 INSPECTION DURING MAINTENANCE PERIOD 6

MULTI-SENSORY MAP 6

MET1.D110.A CONTRACTOR'S RESPONSIBILITY 6
MET1.D120.A GENERAL DESCRIPTION 7
MET1.D130.A SUBMISSIONS 8

COURT ENTRANCE METAL GATE FOR SSF 9

MET1.D210.A DESIGN RESPONSIBILITY 9
MET1.D220.9 GATE OPERATION 9
MET1.D230.9 GATE COLOUR AND FINISH 9
MET1.D240.9 SHOP DRAWINGS 9

MATERIALS 10

IRON AND STEEL 10

MET1.M010.9 STRUCTURAL STEEL 10
MET1.M020.9 GREY CAST IRON 10
MET1.M030.9 GALVANIZED PLAIN STEEL SHEET AND COIL 10
MET1.M040.9 GALVANIZED STEEL TUBING 10
MET1.M050.9 STRUCTURAL STAINLESS STEEL TUBES 10
MET1.M060.9 STAINLESS STEEL PLATE, SHEET AND STRIP 10
MET1.M070.9 SLOTTED STEEL ANGLE 12
MET1.M080.9 GALVANIZED STEEL INSERT CHANNELS FOR CONCRETE 12
MET1.M090.9 STEEL WIRE MESH 12

NON-FERROUS METALS 12

MET1.M110.9 ALUMINIUM ALLOY PLATE, SHEET AND STRIP 12
MET1.M120.9 ALUMINIUM ALLOY SECTIONS 12
MET1.M130.9 STRUCTURAL ALUMINIUM SECTIONS 12
MET1.M140.9 BRASS RODS AND SECTIONS 12

FIXINGS FOR METALWORK 13

MET1.M210.9 GENERAL 13
MET1.M220.9 STUD ANCHORS AND FIXING BOLTS 13
MET1.M230.9 ADHESIVE FOR BONDING METAL TO WOOD AND METAL TO METAL COMBINATIONS 13

ARTICLES TO BE COATED 13

MET1.M310.9 METAL ARTICLES TO BE COATED 13

EQUIPOTENTIAL BONDING CONNECTION 13

MET1.M410.9 EARTHING LUG 13

MULTI-SENSORY MAP 13

MET1.M510.9 STAINLESS STEEL 13
MET1.M520.9 ALUMINIUM ALLOY 13

WORKMANSHIP 14

SAMPLES AND PROTOTYPES 14
MET1.W010.9 SAMPLES 14
MET1.W020.9 PROTOTYPE 14
FABRICATION 14
MET1.W110.9 GENERALLY 14
MET1.W120.9 SLOTTED STEEL ANGLE 14
MET1.W130.9 FIXING STEEL MESH 14
MET1.W140.9 CASTINGS 14
WELDING AND BRAZING 14
MET1.W210.9 WELDING GENERALLY 14
MET1.W220.9 ALUMINIUM WELDING 15
MET1.W230.9 STAINLESS STEEL WELDING 15
MET1.W240.9 WELDING OF GALVANIZED OR ZINC SPRAYED COATED METALWORK 15
MET1.W250.9 BRAZING 15
MET1.W260.9 JOINTING GALVANIZED STEEL TUBING 15
FINISHES TO IRON AND STEEL 15
MET1.W310.9 ELECTROPLATED ZINC COATING 15
MET1.W320.9 ZINC SPRAYED COATING 15
MET1.W330.9 HOT DIP GALVANIZING 15
MET1.W350.9 DAMAGE TO ZINC COATINGS AND GALVANIZING 16
MET1.W360.9 CHROMIUM PLATING 16
FINISHES TO ALUMINIUM 16
MET1.W410.9 NATURAL FINISH 16
MET1.W420.9 NATURAL ANODISED FINISH 16
MET1.W430.9 COLOUR ANODISED FINISH 16
MET1.W440.9 PROPRIETARY ANODISED FINISH 17
PROTECTION OF METALWORK 17
MET1.W510.9 PROTECTION OF METALWORK FINISHES 17
MET1.W520.9 AVOIDANCE OF ALUMINIUM IN CONTACT WITH OTHER MATERIALS 17
MET1.W530.9 PROTECTION OF ALUMINIUM IN CONTACT WITH OTHER MATERIALS 17
MET1.W540.9 AVOIDING BI-METALLIC CONTACT 17
MET1.W550.9 PROTECTION OF BI-METALLIC CORROSION 17
MET1.W560.9 SITE STORAGE 18
EQUIPOTENTIAL BONDING 18
MET1.W610.9 EQUIPOTENTIAL BONDING 18
MULTI-SENSORY MAP 18
MET1.W655.A TESTING AND COMMISSIONING 18
MET1.W660.A OPERATION AND MAINTENANCE MANUALS 18
COMPLETION 19
MET1.W710.9 ON COMPLETION 19

MET1 GENERAL METALWORK

DESIGN

FALL ARREST SYSTEM

MET1.D010.9 CONTRACTOR'S RESPONSIBILITY

1. Design and install the fall arrest system specified in this Worksection, employing either:
   a. The fall arrest system manufacturer; or
   b. An installation sub-contractor approved by the fall arrest system manufacturer.
2. Bear full responsibility for the design of the fall arrest system notwithstanding that the design or details of the fall arrest system are accepted by the CM.

MET1.D020.9 GENERAL DESCRIPTION

1. The fall arrest system shall be designed to safely arrest personnel who accidentally fall at their work place in accordance with the following:
   a. The system shall be suitable for 2-person (with a design load of 100 kg per person) operation;
   b. The system shall allow the users to attach or detach themselves at any point along the system. The system shall take into consideration the features, installations and changes in level in the work zone so that during system attachment, the users shall be able to walk along and reach every part of the work zone without detaching themselves from the system and the shuttle shall glide along the cable and any intermediate bracket or corner unit automatically unless protective railing or similar protective measures together with adequate warning is provided at the point of detachment;
   c. The fall arrest system shall be a proprietary system consisting of a stainless steel horizontally mounted life-line cable which serves as an attachment point for the travel restraint safety harnesses of the system and complete with all necessary components and accessories such as end clevis, tensioners, intermediate brackets, energy absorbers, corner units, end anchor, bolts and nuts;
   d. Each cable shall be mounted in accordance with the Drawings and Specification at a reachable height not lower than waist level on the external walls to cover the designated areas unless it is proven to be impractical for safety, security and / or technical reasons. The cable fixings shall be able to withstand force generated by any fall of the worker and shall ensure minimal dynamic friction to the cables. End unit tensioners shall be provided for the fall arrest system to ensure that the cables are maintained in the required positions and at working tension. A minimum of two (2) lanyard connectors with travel restraint safety harnesses shall be provided for each fall arrest system;
   e. The fall arrest system shall comply with the following standards or other EN standards whenever applicable:
      i. EN 795 Class C (system);
      ii. EN 354 (lanyard);
      iii. EN 355 (energy absorber);

iv. EN 361 (harness);

v. EN 364 (testing);

vi. BS 7883:2005 (Code of Practice for anchor device conforming to BS EN 795).

f. Each fall arrest system shall be installed so that the users are able to put on the travel restraint safety harnesses and attach to or detached from the system at the safety zone of the building or suitable protected area or the protected access / egress of the work zone. The system shall ensure that users are prevented from falling from any unprotected edges of the canopy, roof or the like by adopting suitably designed lanyard length;

g. Coordinate the fall arrest system with other building services to avoid clashes with the pipes, cables etc..

2. The design, materials, method of fabrication, assembly, erection, fastening, method of support and the like for the fall arrest system shall be in strict compliance with the manufacturer's recommendations. No additional equipment shall be used without written permission of the manufacturer;

3. Location and spacing of all anchor points shall be proposed by the system manufacturer. Fixing and supporting details shall be designed to be compatible with the waterproofing system at the location of fixing where appropriate;

4. Provide and mount an aluminium identification plate for each fall arrest system at a visible area at the access point of the fall arrest system. The identification plate shall record the following information:

a. System reference number;

b. Maximum number of person allowed;

c. Maximum weight of person allowed;

d. Maximum length of lanyard to be used;

e. Commission date;

f. Service due date.

5. Provide training courses as follows:

a. One session of training course for 25 users upon completion of the installation;

b. Another session of training course for 25 users within the Maintenance Period;

c. Additional sessions of training course as instructed by the CM.

MET1.D030.9 MATERIALS AND WORKMANSHIP

1. Comply with the relevant provisions of Worksection MET1 in respect of all materials and workmanship;

2. All main body of the system components and accessories such as end clevis, tensioners, intermediate brackets, energy absorbers and corner units, bolts & nuts, anchors, screws, and other fixing shall be manufactured from stainless steel. Rivet shall not be allowed unless otherwise approved by the CM;

3. Install in accordance with Approved shop drawings. Lifeline systems shall be installed under the supervision and direction of the manufacturer's authorized and trained competent person employed by Contractor's specialist sub-contractor;

4. Install anchorage and fasteners to obtain the allowable working loads listed on the engineering data sheet and in accordance with this Specification;

5. For anchorage drilled into concrete, comply with the following:

a. Follow instructions of the anchorage system manufacturer;

b. Do not cut or damage reinforcement;

c. Clean drill hole to remove debris and contaminants;

d. Install anchorage at indicated locations and embedment depth;

e. When clearance and spacing of anchorage is not indicated on drawings, install at locations recommended by the manufacturer so as to obtain maximum working loads in accordance with the distances provided on the engineering data sheet.

MET1.D040.9 SUBMISSIONS

1. Submit original or certified true copy of certification to ISO 9001 for the fall arrest system manufacturer to CM;
2. Submit shop drawings with schedule of works, installation method, details and specifications of the relevant components for CM's approval prior to manufacturing the component parts of the fall arrest system in factory;
3. Submit for CM's record the design calculation and the layout plan of the fall arrest system, which shall be duly endorsed by the manufacturer's authorized and trained competent person employed by the Contractor's specialist sub-contractor. Attach with the submission an output of fall-simulation analysis (from manufacturer's approved programme) of each complete fall arrest system including system span, bracket spacing, quantity of intermediate bracket and corner unit etc.. The fall-simulation analysis shall take into consideration of any obstacles beneath the work zone;
4. Submit training certificate of the manufacturer's authorized and trained competent person employed by the Contractor's specialist sub-contractor to the CM for approval prior to the installation.

MET1.D050.9 INSPECTION AND COMPLETION CERTIFICATES

1. The manufacturer's authorized and trained competent person shall inspect and make all final adjustments for proper operation when the lifeline system is installed and properly tensioned;
2. Arrange on site trial and make modification as may be necessary to demonstrate that the design and operation of the full system comply with the statutory requirements and the specification for acceptance by the CM prior to project completion;
3. Submit for CM's record the completion certificate signed by the manufacturer's authorized and trained competent person. The certificate shall record all information as shown on the identification plate of the fall arrest system.

MET1.D052.9 COMMISSIONING AND REPORT

1. Engage an independent qualified engineer (Registered Professional Engineer – RPE) to carry out load test to each individual end bracket. The RPE shall be of the relevant discipline and registered under the Engineers Registration Ordinance (Cap. 409);
2. Submit a commissioning and system checking report prepared and certified by the RPE that the installed system is safely installed and ready for operation.

MET1.D060.9 MAINTENANCE MANUALS

1. Provide CM with two hard copies and one electronic copy of the maintenance manual for the completed works. The manual shall include, but not be limited to, the following information:
    a. Name, address and telephone number of each firm and/or sub-contractor involved in the supply of materials, components, assembles and finishes;
    b. A clear and concise description of the construction method used to form the various areas of proposed design on the particular project;
    c. Copies of materials and components certification and test reports as required by this Specification;
    d. A method statement showing the means of access to all parts of the features and their safe loading;
    e. Recommendations for routine maintenance, cleaning, suitable cleaning agents and any lubrication/adjustments to the working parts;
    f. A full set of construction drawings, updated to include any changes that have been made up to the time of completion;
    g. The terms and conditions of any guarantees relating to the installed system.
2. The manuals shall be signed by the manufacturer's authorized and trained competent person employed by the Contractor's specialist sub-contractor to certify that all information contained therein is correct.

MET1.D070.9 INSPECTION DURING MAINTENANCE PERIOD

1. Provide inspection during Maintenance Period as follows:
    a. Conduct regular annual inspection of the fall arrest system and submit inspection reports to representative of Housing Authority confirming that all components of the system, lanyard and harness are in order and indicating clearly any parts or components that require repairs or replacement. The content of the report shall be approved by the CM and signed by the manufacturer's authorized and trained competent person employed by the Contractor's specialist sub-contractor;
    b. Provide safety check of the system as considered necessary by the CM and such inspection / checking shall be free of charge if the system is under normal use.
2. Bear all costs for making good the following defective design, material and workmanship which appear within the Maintenance Period for the fall arrest system including components of the personal safety kit:
    a. Any abnormal deterioration, discolouring, deformation, de-figuring, weathering of the work;
    b. Failure of operating parts to function normally;
    c. Structural failure due to pressures and forces up to specified limits;
    d. Deterioration of discolouration of stainless steel finishes;
    e. Corrosion of any component materials.

MULTI-SENSORY MAP

MET1.D110.A CONTRACTOR'S RESPONSIBILITY

1. Design and install multi-sensory map which shall fulfill the following objectives:

a. Be used as a map by the general public;

b. Be used as a Braille and tactile map by the visually impaired;

c. Be displayed in high contrasting colour for the visually impaired with low vision;

d. Be equipped with audible system for use by the visually impaired who cannot read Braille.

2. Before the commencement of the fabrication of the multi-sensory map, provide a letter from an organization of the visually impaired, the Hong Kong Society for the Blind confirming that the Braille and tactile information, text and legend shown in the shop drawings approved by the CM including script of vocal description in the sub-clause 2(e) of MET1.D120 have been proof read and the design of the multi-sensory map is suitable for use by the visually impaired;

3. Make submission in accordance with MET1.D130;

4. Upon completion of the installation of the multi-sensory map and the testing and commissioning, provide a letter from the organization of the visually impaired confirming that the multi-sensory map has been properly installed on Site, the Braille and tactile information, the vocal description of the routing and destination of the tactile guide path, text and legend in Braille shown is accurate and the completed installation is ready for operation as per MET1.W655.

MET1.D120.A GENERAL DESCRIPTION

1. Multi-sensory map shall show the following:

a. Estate: the general layout of the estate and tactile guide paths leading from the main estate entrances to the domestic blocks, major estate facilities including welfare premises, community facilities, estate management office, major transport link etc. as shown on the Drawings;

b. Commercial centre: the general layout of the commercial centre and tactile guide paths leading from the main entrances to lift zone, multi-sensory map and functional areas including information counter, public toilets at the main entrance floor etc. as shown on the Drawings.

2. Multi-sensory map shall comprise of the following:

a. Tactile map of minimum 2 mm thick stainless steel plate with aluminium top plate coated with automotive paint as tactile features and backed by a 5 mm thick stainless steel base plate. The tactile map shall be in high contrasting colour to assist persons with low vision to read the map;

b. Stainless steel / aluminium tactile symbols for staircases, ramps, lifts, escalators, main entrances, "You are here", tactile guide path etc. as shown on the Drawings;

c. Text and legend in Chinese, English and Braille. Braille shall be of stainless steel and in Cantonese and English. The font height of the map title shall be no smaller than 28 mm for Chinese and 16 mm for English. The font height for the content shall be no smaller than 8 mm for the Chinese and 6 mm for English. The Chinese, English and other markings shall be silkscreen on colour coated aluminium and electric etched on stainless steel;

d. An audible system with waterproof enclosure that comprises a sound generator with adjustable volume, a timer and loudspeakers. The audible system shall operate on 220V AC. The sound generator shall produce a musical homing signal and a pre-recorded clear vocal description of the routing and destination of the tactile guide path, using audio files in a SD card of USB drive. An adjustable timer shall control the daily operating period of the system. The loudspeakers shall be of the suitable type, wattage and arrangement that provide the optimal audio performance. A fuse shall be provided to protect the electrical circuits. The location of audible system shall avoid water ingress;

e. Vocal description of the routing and destination of the tactile guide paths in Cantonese and English activated by pressing the buttons, located at the lower left corner of the multi-sensory map with one button for Cantonese and one button for English;

f. Stainless steel sign casing of galvanized mild steel frame and stainless steel tapping rail with stainless steel stand for free standing map with footing or securely fixed on the wall for wall mounted map. The design of stainless steel sign casing shall prevent rainwater accumulated inside the casing. Sealant shall be applied around the joint of the tactile map and the casing to avoid water ingress.

3. Tactile features, tactile symbols and Braille shall be firmly fixed to the stainless steel base plate. No adhesive fixing and welding shall be allowed;

4. Sharp edges and corners shall be avoided;

5. The design of the multi-sensory map should take into account the envisaged use of persons with a disability and wheelchair users; including extra consideration in relation to access and manoeuvring space;

6. The multi-sensory map shall be inclined at 30º to 45º from the vertical and the lower edge of the multi-sensory map shall be at 900 mm to 1200 mm above the finished floor level. The uppermost legend shall not be more than 1500mm from the finished floor level;

7. The orientation of the multi-sensory map shall match with the orientation of the estate when the map is viewed;

8. The entire multi-sensory map shall be electrically earthed in accordance with the safety requirements stipulated in Electricity Ordinance and the latest edition of the Code of Practice for the Electricity (Wiring) Regulation issued by EMSD;

9. The audible system and the waterproof type electric socket outlet, if provided within the stainless steel sign casing, shall be firmly fixed within the stainless steel sign casing and at location easily and conveniently accessible from an access panel of at least 400mm x 400mm for maintenance operation and repair services.

MET1.D130.A SUBMISSIONS

1. Submit the following for the CM's approval before the commencement of the fabrication of the multi-sensory map:

   a. Shop drawings of the multi-sensory map including tactile map for the general layout shown on the Drawings in sub-clause 1 of MET1.D120, text, legend, colours of the map, audible system, stand etc.;

   b. Schematic diagrams for the audible system;

   c. Script of the audible messages in both Chinese and English;

   d. Operation manuals for audible system, etc.;

e. Installation method including fixing details for free-standing or wall-mounted multi-sensory map, and associated electricity, earthing and builder's works requirements;

f. Letter as specified in sub-clause (2) of MET1.D110.

2. When the installation is complete, submit

a. Operation and maintenance manual as specified in MET1.W660;

b. Letter as specified in sub-clause (4) of MET1.D110.

COURT ENTRANCE METAL GATE FOR SSF

MET1.D210.A DESIGN RESPONSIBILITY

Appoint a Design Certifying Consultant for the design of the court entrance metal gate. Design the court entrance metal gate in accordance with the recommendations for enhancing the safety of metal gates of PNAP APP-146, the requirements of Contract Drawings, this Worksection and the relevant clauses of MET1.

MET1.D220.9 GATE OPERATION

Ensure the operation of gate is in a smooth and quiet manner.

MET1.D230.9 GATE COLOUR AND FINISH

Submit proposed colour and finish of gate to CM for approval. Treat and finish all exposed steel and galvanized steel surfaces, including portions of the component parts forming moveable joints, pre-drilled screw holes, hinges and handles as specified in Worksection MET1.

MET1.D240.9 SHOP DRAWINGS

Submit shop drawings for CM's approval, prior to the commencement of ordering of material. Drawings must include:

1. Fixing details of entrance gate to walls/ posts and floors;
2. Positions of anchor bolts;
3. Details of hinge, roller (with brand name if applicable), completed with lubricated bearings, threaded hangers, connection bars etc. including materials specification and dimension;
4. Welding details of components and parts;
5. Details and sections to show sizes, profiles and fixings of assembling and concealed parts;
6. Fixing details of equipotential bonding connection for the gateset;
7. The Design Certifying Consultant referred to in MET.D210 shall certify and sign all shop drawings and technical substantiation including structural calculations.

MATERIALS

IRON AND STEEL

MET1.M010.9 STRUCTURAL STEEL

As specified in Worksection STR1.

MET1.M020.9 GREY CAST IRON

To BS 1452:1990, Grade 150.

MET1.M030.9 GALVANIZED PLAIN STEEL SHEET AND COIL

1. Hot dip zinc coated to BS EN 10142:2000; or
2. Hot dip coated to BS EN 10346:2009; or
3. Hot dip coated to JIS G3302-1994.

MET1.M040.9 GALVANIZED STEEL TUBING

To BS 1387:1985.

MET1.M050.9 STRUCTURAL STAINLESS STEEL TUBES

To BS 6323:Parts 1 and 8:1982, of the 18/9 chromium nickel group with surface finish as specified from the following:

1. Mill finish: No. 2B;
2. Polished finish: No. 4.

MET1.M060.9 STAINLESS STEEL PLATE, SHEET AND STRIP

1. Grade:
    a. as shown below or scheduled on Drawings;
    b. Grade 304: To BS EN 10088-1:2005 Number 1.4301 or ASTM A959-09 S30400 or JIS G4304:2005 SUS304;
    c. Grade 316: To BS EN 10088-1:2005 Number 1.4436 or ASTM A959-09 S31600 or JIS G4304:2005 SUS316.
2. Use stainless steel Grade 304 for general usage including external areas. Use stainless steel Grade 316 in public latrines, seacoast, industrial and heavily polluted areas unless stated otherwise;
3. Thickness: as shown or scheduled on drawings;
4. Finish:
    a. To BS EN 10095 or approved equivalent;
    b. As shown or scheduled on Drawings unless specified from the following:
        i. Cold rolled: No. 2B (mill finish);
        ii. Cold rolled special finishes: No. 2J (hairline / satin finish), No. 2P (mirror finish).
5. At delivery stage, submit the following documents:

a. Manufacturer's certificate:

Provide the original or a certified true copy of the manufacturer's certificate of compliance with chemical analysis for each consignment delivered to Site. The certificate shall:

i. State the standard that the material complies with;

ii. Show that the material has been tested and found to comply with the chemical composition specifically required under the standard quoted in 5(a) above.

b. Written confirmation that the materials delivered to Site conform with the requirements stated at sub-clause (1) above;

c. Delivery notes when delivered to Site.

6. On Site Delivery Verification (for grade 316 stainless steel items):

a. Verification required at delivery stage for the following items:

i. Railing at parapet;

ii. Door leave, frame and hinges at main entrances to domestic blocks, external E&M rooms;

iii. Stainless steel steps inside potable water tanks;

iv. As directed by the CM.

b. Chemical Drop Test:

Carry out and submit report on the following verifications for items stated in sub-clause 5(a) using an Approved proprietary chemical test kit to distinguish the grade of stainless steel. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
- Railing at parapet; - Door leaf, frame & hinges at main entrances to domestic blocks,external E&M Rooms; - S/S steps inside potable water tanks	Proprietary Chemical drop test (e.g. single drop of solution to distinguish between low and high molybdenum content)	Change of colour at the tested spot matching the colour indicated at the test chemical's instruction / catalogue

ii. Frequency:

Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under one Delivery Note]

- Railing at parapet; - Door leaf, frame & hinges at main entrances to domestic blocks,external E&M Rooms; - S/S steps inside potable water tanks	One test sample per item per batch	Same batch of material delivered to Site under one Delivery Note

c. When any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, carry out verification using an Approved test method for identification of the grade of stainless steel on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

MET1.M070.9 SLOTTED STEEL ANGLE

Self-finished to BS 4345:1968. Fittings to be cadmium plated.

MET1.M080.9 GALVANIZED STEEL INSERT CHANNELS FOR CONCRETE

An Approved type with expanded polystyrene temporary filler and matching sliding fixing device.

MET1.M090.9 STEEL WIRE MESH

1. Hot-dip galvanized and welded to form a square or oblong mesh to BS EN 10223-4:2012;
2. Wire mesh for rat guard to be grade 304 stainless steel.

NON-FERROUS METALS

MET1.M110.9 ALUMINIUM ALLOY PLATE, SHEET AND STRIP

Of the specified designation to BS 1470:1987.

MET1.M120.9 ALUMINIUM ALLOY SECTIONS

1. Bars, extruded tube sections and hollow sections: to BS 1474:1987, alloy designation 6063;
2. Drawn tubes: to BS 1471:1972, alloy designation 6063.

MET1.M130.9 STRUCTURAL ALUMINIUM SECTIONS

To BS 1161:1977.

MET1.M140.9 BRASS RODS AND SECTIONS

To BS 2874:1986, designation CZ106, condition M.

FIXINGS FOR METALWORK

MET1.M210.9 GENERAL

Ensure fixings are of the same material to which they are to be fixed.

MET1.M220.9 STUD ANCHORS AND FIXING BOLTS

Approved proprietary expansion bolts and used in accordance with the manufacturer's recommendations.

MET1.M230.9 ADHESIVE FOR BONDING METAL TO WOOD AND METAL TO METAL COMBINATIONS

1. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic compounds) Regulation;
2. Approved proprietary type to BS 5442:Part 3:1979.

ARTICLES TO BE COATED

MET1.M310.9 METAL ARTICLES TO BE COATED

Ensure metal articles are designed in accordance with the recommendations and relevant part of BS 4479 prior to coating.

EQUIPOTENTIAL BONDING CONNECTION

MET1.M410.9 EARTHING LUG

1. Unless otherwise specified on Drawings, provide earthing lug(s) to extraneous conducive parts including the following which are not exhaustive:
   a. Burglar bars;
   b. Grilles;
   c. Railing;
   d. Handrail;
   e. Cat ladder.
2. Earthing lug shall be of minimum 1.5 mm thick steel plates electroplated zinc galvanized to BS EN10346:2009, Coating Designation Z200 and 14 µm. The cut edges of earthing lug shall be painted with zinc-rich primer to BS 4652:1995.

MULTI-SENSORY MAP

MET1.M510.9 STAINLESS STEEL

To BS EN 10095:1999:

1. Grade 316 for in accordance with MET1.M060.

MET1.M520.9 ALUMINIUM ALLOY

Alloy designation 6061.

WORKMANSHIP

SAMPLES AND PROTOTYPES

MET1.W010.9 SAMPLES

Submit samples as Worksection PRE.B9.

MET1.W020.9 PROTOTYPE

Obtain Approval of prototype before starting fabrication of repetitive components.

FABRICATION

MET1.W110.9 GENERALLY

During fabrication:

1. Protect all surfaces that will be visible in the finished work;
2. Mitre junctions of identical sections;
3. Assemble moving parts to move freely and without binding;
4. Remove all burrs and sharp arrises which will be visible after fixing or be a hazard to the user.

MET1.W120.9 SLOTTED STEEL ANGLE

Cut square and securely bolt together using nuts, bolts and washers and angle braces as necessary.

MET1.W130.9 FIXING STEEL MESH

Fix at 75 mm centres to:

1. Steel framing by:
    a. Tack welding; or
    b. Tying with 2 mm galvanized tying wire.
2. Wood framing with 1.8 x 25 mm galvanized staples.

MET1.W140.9 CASTINGS

Sound, free from bubbles, cracks or other defects and to include the construction of patterns and moulds as required.

WELDING AND BRAZING

MET1.W210.9 WELDING GENERALLY

1. Remove grease, dirt, moisture, oxide and scale from the edges to be welded;
2. Use clamps or jigs, where practical, to ensure accuracy;
3. Fully fuse joints throughout with no holes, pores or cracks;
4. Protect self-finished surfaces from weld splutter;

5. Grind butt welds, visible in completed work, smooth and flush. Grind smooth fillet welds, if required;
6. Ensure complete removal of flux residue and slag.

MET1.W220.9 ALUMINIUM WELDING

1. Tungsten Inert Gas (TIG) welding of aluminium to BS 3019:Part 1:1984;
2. Metal Inert Gas (MIG) welding of aluminium to BS 3571:Part 1:1985.

MET1.W230.9 STAINLESS STEEL WELDING

Fusion welding to BS 3019:Part 2:1960.

MET1.W240.9 WELDING OF GALVANIZED OR ZINC SPRAYED COATED METALWORK

1. Submit proposals for Approval to carry out welding in continuous runs;
2. Allow for making good damage to zinc sprayed coating or galvanizing and for treatment of welds with two coats of zinc-rich priming paint to BS 4652:1995.

MET1.W250.9 BRAZING

To BS 1723:Part 1:1986.

MET1.W260.9 JOINTING GALVANIZED STEEL TUBING

Carefully notch, fit and weld galvanized steel tubing to produce accurate joints. Grind smooth and treat with two coats of zinc rich priming paint to BS 4652:1995, Type 2.

FINISHES TO IRON AND STEEL

MET1.W310.9 ELECTROPLATED ZINC COATING

To BS 1706:1990, Class A and 0.025 mm thick.

MET1.W320.9 ZINC SPRAYED COATING

To BS 2569:Part 1:1964, nominal thickness 0.2 mm, unless otherwise specified.

MET1.W330.9 HOT DIP GALVANIZING

1. To BS EN ISO 1461:2009;
2. The minimum coating thickness:

Article Thickness	Minimum Mean Coating Thickness
>6 mm	85 μm
>3 mm to ≤6 mm	70 μm
≥1.5 mm to ≤3 mm	55 μm
<1.5 mm	45 μm

3. Unless Approved, all components are to be galvanized after fabrication and welding;
4. The hot dip galvanizing is to be carried out by galvanizers with ISO 9001 certification. Submit the name of galvanizer for Approval;

5. Submit original invoice/delivery note and galvanizing certification for each delivery. These documents shall include the following information:
    a. Project title/number;
    b. Name of galvanizer;
    c. Types and dimensions of articles;
    d. Quantities.
6. Attach a durable identification tape or tag to each batch of galvanized articles indicating the project title, galvanizing certification number and name of galvanizer;
7. For galvanized steel items that are to be painted, no passivation shall be carried out.

MET1.W350.9 DAMAGE TO ZINC COATINGS AND GALVANIZING

Make good damage and treat cut ends of galvanized sections with two coats of zinc-rich priming paint to BS 4652:1995.

MET1.W360.9 CHROMIUM PLATING

To BS 1224:1970:

1. Service condition number: 3 (Severe);
2. Surface finish: as specified from the following:
    a. Bright finish;
    b. Dull finish;
    c. Satin finish.

FINISHES TO ALUMINIUM

MET1.W410.9 NATURAL FINISH

As specified from the following:

1. Mill finish;
2. Polished finish;
3. Polished finish and treated with a protective lacquer.

MET1.W420.9 NATURAL ANODISED FINISH

To BS EN 12373-1:2001:

1. Thickness grade: Class15 for interior work;
2. Thickness grade: Class20 for exterior work;
3. Surface texture: as specified from the following:
    a. Matt finish;
    b. Satin finish;
    c. Bright finish;
    d. Polished finish.

MET1.W430.9 COLOUR ANODISED FINISH

To BS 3987:1991,

1. Average thickness of coating not less than 25 microns;
2. Surface finish: as specified from the following:
    a. Matt finish;
    b. Satin finish;
    c. Bright finish;
    d. Polished finish.

MET1.W440.9 PROPRIETARY ANODISED FINISH

Approved proprietary anodic film finish of thickness and colour as specified.

PROTECTION OF METALWORK

MET1.W510.9 PROTECTION OF METALWORK FINISHES

1. Protect all decorative finishes to metalwork against damp, scratching and other damage;
2. Apply a strippable coating or masking tape to all stainless steel, anodised aluminium or similar surfaces and only remove as and when necessary for construction or prior to inspection for handover;
3. Remove surplus adhesive from metalwork with non-damaging solvent and wash down.

MET1.W520.9 AVOIDANCE OF ALUMINIUM IN CONTACT WITH OTHER MATERIALS

Avoid contact in the completed work between aluminium and concrete, mortar plaster or similar materials.

MET1.W530.9 PROTECTION OF ALUMINIUM IN CONTACT WITH OTHER MATERIALS

1. Ensure surfaces are clean, dry and thoroughly degreased with an Approved organic solvent, roughened if necessary by mechanical means prior to application to ensure paint adhesion;
2. Protect aluminium surfaces in contact with concrete, mortar plaster or similar materials with one coat of bituminous paint or Approved tape;
3. Do not apply bituminous paint over painted or etch primed surfaces.

MET1.W540.9 AVOIDING BI-METALLIC CONTACT

Avoid contact in the completed work between the following metals:

1. Aluminium alloys and copper alloys, nickel, lead or stainless steel;
2. Iron and steel and copper alloys;
3. Zinc (including galvanizing) and copper alloys or nickel.

MET1.W550.9 PROTECTION OF BI-METALLIC CORROSION

1. Ensure surfaces are clean, dry and thoroughly degreased with an Approved organic solvent, roughened if necessary by mechanical means prior to application to ensure paint adhesion;
2. Protect metal to metal contact as specified in MET1.W540 by coating the contact surface with bituminous paint, protective tape or other Approved means;

3. Do not apply bituminous paint over painted or etch primed surfaces.

MET1.W560.9 SITE STORAGE

Store metalwork off a levelled, well-drained and maintained hard-standing ground and in a manner which will not result in damage, deformation or contamination.

EQUIPOTENTIAL BONDING

MET1.W610.9 EQUIPOTENTIAL BONDING

1. Unless otherwise specified on Drawings, provide equipotential bonding connection for each extraneous conducive parts by:
   a. Weld one end of 1.5 mm thick galvanised mild steel earthing lug(s) to the extraneous conductive parts; and
   b. Provide a 5 mm diameter hole at the other end for connection of the bonding conductor by the Nominated Sub-contractor for Electrical Installation;
   c. Ensure that full electrical continuity is maintained between all the component elements of the metallic fixture.
2. As COM2.W465 (6).

MULTI-SENSORY MAP

MET1.W655.A TESTING AND COMMISSIONING

1. Upon completion of the installation of the multi-sensory map, carry out a testing and commissioning of the multi-sensory map in the presence of the organization of the visually impaired to ensure the multi-sensory map is properly installed and ready for operation;
2. Rectify defects identified by the organization of the visually impaired;
3. Provide a letter as specified in sub-clause (3) of MET1.D110;
4. Arrange on site demonstration for the estate management on the operation and routine maintenance of the multi-sensory map and make adjustment as necessary such as volume and timer of the audible system at the time directed by the CM.

MET1.W660.A OPERATION AND MAINTENANCE MANUALS

1. Provide two hard copies and one electronic copy of operation and maintenace manuals giving detailed operation and maintenance instructions;
2. The operation and maintenance manual shall include but not limited to the following:
   a. One copy of as-built drawings;
   b. Name, address and contact number of the suppliers of the multi-sensory map and the audible system;
   c. Script of vocal description of the routing and destination of the tactile guide paths in both Chinese and English;
   d. Audio files in both Cantonese and English of the vocal description of the routing and description of the tactile guide path;
   e. Operation and routine maintenance of the multi-sensory map including the waterproof audible system.

COMPLETION

MET1.W710.9 ON COMPLETION

Lubricate and adjust moving components and leave in perfect working order on completion.

PLU PLUMBING AND SANITARY FITTINGS

PLU1 WATER SUPPLY 7
GENERAL 7
GENERAL 7
PLU1.G010.9 SCOPE OF THE WORK 7
PLU1.G012.B APPROVED CONTRACTOR FOR FRESH AND FLUSH WATER SUPPLY INSTALLATIONS 8
PLU1.G020.9 REGULATIONS AND STANDARDS 8
PLU1.G030.9 PRECEDENCE 9
MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIMEP) 10
SCOPE OF WORK 10
PLU1.D010.N GENERAL 10
PLU1.D020.N EXTENT OF APPLICATION 10
PLU1.D030.N SITE COORDINATION 10
DESIGN OF MIMEP MODULE 11
PLU1.D040.N COMPLIANCE WITH REGULATIONS AND STANDARDS 11
PLU1.D050.N DESIGN REQUIREMENTS 11
DELIVERY AND SITE STORAGE 12
PLU1.D060.N GENERAL 12
PLU1.D070.N TRANSPORTATION 13
PLU1.D080.N PROTECTION 13
QUALITY ASSURANCE 13
PLU1.D090.N ADMINISTRATION AND RECORD 13
PLU1.D100.N QUALITY ASSURANCE MEASURES 13
PARTICULAR REQUIREMENTS OF MIMEP MODULE 14
PLU1.D110.N GENERAL 14
PLU1.D120.N WATER METER POSITION MODULE 14
PLU1.D130.N FRESH / FLUSH WATER PRESSURE REDUCING VALVE SET MODULE 14
PLU1.D140.N VERTICAL FEED PIPES MODULE 15
DOCUMENTATION 15
PLU1.D150.N INSTALLATION METHOD FOR MIMEP 15
MATERIALS 16
GENERAL 16
PLU1.M010.9 SUBMISSION OF DOCUMENTS 16
PIPES, FITTINGS AND JOINTS 16
PLU1.M110.9 GENERAL 16
PLU1.M120.A COPPER PIPES 18
PLU1.M130.A COPPER PIPE FITTINGS 20
PLU1.M140.9 PREFORMED POLYETHYLENE SHEATHS FOR CAPILLARY TYPE JOINTS AND FITTINGS OF SHEATHED COPPER PIPES 22
PLU1.M150.9 BRAZING ALLOYS FOR COPPER AND COPPER ALLOY CAPILLARY FITTINGS 22
PLU1.M160.9 SOLDERING ALLOYS FOR COPPER AND COPPER ALLOY CAPILLARY FITTINGS 22
PLU1.M170.A DUCTILE IRON PIPES, FITTINGS AND ACCESSORIES 23
PLU1.M180.9 GALVANIZED STEEL PIPES AND FITTINGS 25
PLU1.M190.9 STAINLESS STEEL PIPES 25
PLU1.M191.9 STAINLESS STEEL PIPE FITTINGS 27
PLU1.M200.9 UNPLASTICIZED PVC (UPVC) PIPES AND FITTINGS 29

PLU1.M210.9 STAINLESS STEEL TYPE EXPANSION JOINTS 29
PLU1.M220.9 STAINLESS STEEL FLEXIBLE CONNECTORS 30
PLU1.M230.9 RUBBER FLEXIBLE CONNECTORS/EXPANSION JOINTS 32
PLU1.M240.9 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES AND FITTINGS 32
PLU1.M250.9 POLYTETRAFLUOROETHYLENE (PTFE) TAPES 33

FLANGES 33
PLU1.M310.9 FLANGES 33
PLU1.M320.9 PUDDLE FLANGES 34

PIPE BRACKETS AND SLEEVES 36
PLU1.M410.A PIPE BRACKETS 36
PLU1.M420.9 PIPE BRACKET WITH VIBRATION ISOLATOR 36
PLU1.M430.A PIPE SLEEVES 37
PLU1.M440.N COATING OF PIPE BRACKETS FOR PIPEWORKS INSTALLED IN INDOOR AREAS OF DOMESTIC BLOCK 37

STRAINERS 38
PLU1.M510.9 STRAINERS 38

VALVES AND TAPS 40
PLU1.M610.9 GENERAL 40
PLU1.M620.9 VALVES FOR FRESH WATER AND FIRE SERVICES APPLICATION 42
PLU1.M630.9 VALVES FOR FLUSH WATER APPLICATIONS 43
PLU1.M640.9 NON-RETURN VALVES 44
PLU1.M650.A GATE VALVES, GLOBE VALVES AND GLOBE STOP AND CHECK VALVES 45
PLU1.M660.9 BALL VALVES 46
PLU1.M680.9 DRAW OFF TAPS 47
PLU1.M690.9 BALL FLOAT VALVES FOR FLUSHING TANKS 47
PLU1.M700.9 ANGLE VALVE FOR FLUSHING CISTERNS 48

FIXED RATIO TYPE PRESSURE REDUCING VALVE 48
PLU1.M910.9 PERFORMANCE REQUIREMENTS 48
PLU1.M920.9 FIXED RATIO TYPE PRESSURE REDUCING VALVE 48

CISTERNS AND TANKS 49
PLU1.M1110.9 GENERAL 49
PLU1.M1120.9 STAINLESS STEEL CISTERNS, FIBRE GLASS WATER TANKS, COVERS, TANKS AND CYLINDERS 50
PLU1.M1130.9 CISTERN / TANK COVERS 50

STREET FIRE HYDRANTS 50
PLU1.M1210.9 PERFORMANCE REQUIREMENTS 50
PLU1.M1220.9 HYDRANT CONSTRUCTION 51
PLU1.M1230.9 TEST CERTIFICATE 51

WORKMANSHIP 52

GENERAL 52
PLU1.W010.9 SITE STORAGE 52
PLU1.W020.9 SITE CLEANLINESS 52
PLU1.W030.9 PIPEWORK INSTALLATION 52
PLU1.W040.9 PIPEWORK ROUTING 52
PLU1.W050.9 VENTING 52
PLU1.W060.9 EASE OF DISMANTLING 53
PLU1.W070.9 BENDS AND OFFSETS OF COPPER PIPEWORK 53
PLU1.W080.9 COPPER PIPEWORK REQUIRING POLYETHYLENE SHEATH 53
PLU1.W090.9 UNDERGROUND PIPES 53
PLU1.W100.9 PIPES ON FLAT ROOFS AND CANOPIES 53

PLU1.W110.9 INSTALLATION CONTRACTOR AND ATTENDANCE FOR COMPLIANCE WITH REQUIREMENTS OF THE WATER AUTHORITY 53
PLU1.W120.9 REGISTERED FIRE SERVICES CONTRACTOR 55
FIXED RATIO TYPE PRESSURE REDUCING VALVE 55
PLU1.W130.9 MAINTENANCE REQUIREMENT DURING MAINTENANCE PERIOD 55
PIPE JOINT 56
PLU1.W210.9 GENERAL 56
PLU1.W220.9 JOINTING GALVANIZED STEEL PIPES 56
PLU1.W230.9 JOINTING DUCTILE IRON PIPES 56
PLU1.W250.9 JOINTING COPPER PIPEWORK WITH COPPER ALLOY CAPILLARY FITTINGS BY BRAZING 57
PLU1.W260.9 JOINTING COPPER PIPEWORK BY SOLDERING 57
PLU1.W270.9 CAPILLARY TYPE JOINTS AND FITTINGS OF SHEATHED COPPER PIPEWORK 57
PLU1.W290.9 JOINTING STAINLESS STEEL PIPES 57
PLU1.W291.9 JOINTING UNPLASTICIZED PVC (UPVC) PIPES 58
PLU1.W292.9 JOINTING CHLORINATED PVC (CPVC) PIPES 58
PLU1.W293.9 JOINTING CHLORINATED PVC (CPVC) PIPES TO DUCTILE IRON PIPES 58
PLU1.W294.9 JOINTING CHLORINATED PVC (CPVC) PIPES TO UNPLASTICIZED PVC (UPVC) PIPES 59
PIPEWORK SUPPORTS 59
PLU1.W310.9 GENERAL 59
PLU1.W320.9 PIPE BRACKET INTERVALS 59
PLU1.W330.9 ADDITONAL REQUIREMENTS INSIDE MASTER WATER METER ROOM AND IN OPEN TRENCH FOR WATER SUPPLY PIPES 60
PIPE SLEEVE 60
PLU1.W410.9 FIXING PIPE SLEEVES 60
PLU1.W420.A CAULKING PIPE SLEEVES AND PUDDLE SLEEVES 61
PAINTING 61
PLU1.W510.9 GENERAL 61
INSTALLATION OF VALVES 61
PLU1.W610.9 GENERAL 61
PLU1.W620.9 NON-RETURN VALVE 61
STREET FIRE HYDRANTS 61
PLU1.W720.9 FIXING 61
PLU1.W730.9 ANNUAL INSPECTION, FINAL ACCEPTANCE TEST AND CERTIFICATE OF FIRE SERVICE INSTALLATIONS AND EQUIPMENT 61
MAINTENANCE REQUIREMENT DURING MAINTENANCE PERIOD 62
PLU1.W750.9 STOP VALVES MANAGEMENT SYSTEM 62
TANKS 62
PLU1.W810.9 CONNECTION TO CONCRETE TANKS 62
COMMISSIONING REQUIREMENTS 63
PLU1.W910.9 GENERAL 63
PLU1.W912.9 PROCEDURE FOR SYSTEMATIC FLUSHING FOR FRESH WATER SYSTEM 64
PLU1.W920.9 PROCEDURE FOR CLEANSING AND DISINFECTION OF FRESH WATER INSIDE SERVICES 64

PLU1.W950.9 PROCEDURE FOR CLEANSING FLUSH WATER SYSTEM AND RAINWATER HARVESTING SYSTEM 66

WORKS DURING MAINTENANCE PERIOD 68

PLU1.W960.9 CLEANSING AND DISINFECTION DURING MAINTENANCE PERIOD 68

PROTECTION 68

PLU1.W1010.9 SEALING THE SYSTEM 68
PLU1.W1020.9 VALVES AND TAPS 68
PLU1.W1030.9 PROTECTION OF UNDERGROUND PIPES 68
PLU1.W1040.9 PIPES PASSING UNDER ROADS 69

WORKS OUTSIDE SITE BOUNDARY 69

PLU1.W1110.9 CONNECTION BY THE WATER AUTHORITY 69
PLU1.W1120.9 NOTIFY THE WATER AUTHORITY FOR INSPECTION 69

CONNECTION OF UNDERGROUND WATER SUPPLY MAINS TO EXISTING IN-SERVICE MAINS 69

PLU1.W1210.9 PROCEDURE 69
PLU1.W1220.9 INSPECTION OF CONNECTION 70

TESTING 71

GENERAL 71

PLU1.T010.9 PRE-TEST CLEANING 71
PLU1.T020.9 PERFORMANCE TESTS, ADJUSTMENTS AND COMMISSIONING 71
PLU1.T030.9 TEST INSTRUMENTS AND PERSONAL PROTECTIVE EQUIPMENT 71
PLU1.T040.9 TESTING OF CONCEALED AND UNDERGROUND PIPEWORK 71
PLU1.T050.9 WATER PRESSURE TEST 71
PLU1.T060.9 FSD INSPECTION AND WITNESS OF TESTS 72
PLU1.T070.9 WATER QUALITY TEST BEFORE WATER SUPPLY IS GIVEN FROM THE WATER AUTHORITY 72
PLU1.T091.A AUDIT CHECK ON BRAZING ALLOY FOR COPPER AND COPPER ALLOY CAPILLARY FITTINGS 73
PLU1.T092.A AUDIT CHECK ON SOLDERING ALLOY FOR COPPER AND COPPER ALLOY CAPILLARY FITTINGS 74
PLU1.T093.A AUDIT CHECK ON COPPER PIPE MATERIAL 75
PLU1.T094.C VERIFICATION TESTS FOR COPPER PIPES AND FITTINGS DELIVERED TO SITE 76
PLU1.T095.A VERIFICATION TESTS FOR SOLDER IN COPPER PIPE INTEGRAL SOLDER FITTINGS DELIVERED TO SITE 78
PLU1.T096.B VERIFICATION TESTS FOR GATE VALVES AND GLOBE VALVES WITH NOMINAL SIZES UP TO AND INCLUDING 50MM FOR FRESH WATER APPLICATION DELIVERED TO SITE 79
PLU1.T097.A VERIFICATION TESTS FOR DUCTILE IRON PIPES AND FITTINGS DELIVERED TO SITE 81

GENERAL 82

PLU1.T098.B VERIFICATION TESTS FOR GLOBE STOP AND CHECK VALVES WITH NOMINAL SIZES UP TO AND INCLUDING 40MM FOR FRESH WATER APPLICATION DELIVERED TO SITE 82

TESTING TURBIDITY FOR CONNECTION OF UNDERGROUND WATER MAINS TO EXISTING IN-SERVICE MAINS 83

PLU1.T110.9 TESTING PRIOR TO CONNECTION OF SUPPLY MAINS 83
PLU1.T120.9 PROCEDURE 83

SURVEILLANCE TESTS FOR PIPES, FITTING AND VALVES 83

PLU1.T131.A SURVEILLANCE TESTS FOR DRAW OFF TAPS 83

APPENDIX PLU1/I 85
PLU1.APPEND1.9 DECLARATION OF VALIDITY OF WSD SUBMISSION FORMS 85

APPENDIX PLU1/II 87
PLU1.APPEND2.9 DECLARATION OF THE COMPLETED PLUMBING WORKS 87

PLU2 SANITARY APPLIANCES 88

MATERIALS 88

GENERAL 88
PLU2.M010.9 SAMPLES 88
PLU2.M020.A STANDARDS 88
PLU2.M030.9 SANITARY APPLIANCES FOR STANDARD SCHOOLS 88

WCS AND CISTERNS 88
PLU2.M110.9 CLOSE-COUPLED WC SUITES 88
PLU2.M120.9 WC PAN 94
PLU2.M130.9 SQUATTING WC 94
PLU2.M140.9 CISTERNS 94

URINALS AND CISTERNS 95
PLU2.M210.A BOWL URINAL SUITE 95
PLU2.M220.9 FIRE CLAY SLAB URINALS 95
PLU2.M230.A STAINLESS STEEL SLAB URINAL 95
PLU2.M240.9 CISTERNS 95

WASH BASINS AND SINKS 95
PLU2.M310.9 WALL HUNG OR COUNTER TOP OR SEMI-RECESSED WASH BASINS 95
PLU2.M320.9 STAINLESS STEEL SINK 98

BATHS AND SHOWERS 99
PLU2.M410.9 PORCELAIN ENAMELLED CAST IRON BATHS 99
PLU2.M420.9 VITREOUS CHINA SHOWER TRAYS 101
PLU2.M430.9 ACRYLIC SHOWER CUBICLE, SHOWER TRAY AND SLIDING SHOWER DOOR 101

ANCILLARY MATERIALS 105
PLU2.M510.B MIXERS (BATH / SHOWER, BASIN AND KITCHEN SINK) AND SHOWER HANDSETS 105
PLU2.M530.9 VITREOUS CHINA SOAP HOLDERS 117
PLU2.M540.9 STAINLESS STEEL TOILET PAPER HOLDER 117
PLU2.M550.9 VITREOUS CHINA TOILET PAPER HOLDER 117

FIXING AND POINTING MATERIALS 117
PLU2.M610.9 FIXINGS 117
PLU2.M620.9 WC PAN BEDDING MATERIAL 117
PLU2.M630.9 POINTING GROUT 117
PLU2.M640.A SILICONE SEALANT 117

WORKMANSHIP 118

GENERAL 118
PLU2.W010.9 BRITISH STANDARD 118
PLU2.W020.9 HANDLING, STORAGE AND PROTECTION OF APPLIANCES 118

JOINTS 118
PLU2.W110.9 SEALANT JOINTS 118

FIXING WC SUITES 118
PLU2.W210.9 PEDESTAL WC PANS 118
PLU2.W220.9 SQUATTING WC PANS 118

PLU2.W230.9 HIGH OR LOW LEVEL FLUSHING CISTERNS 118
PLU2.W240.9 CLOSE-COUPLED FLUSHING CISTERNS 118
PLU2.W250.9 SYPHONS AND VALVES TO FLUSHING CISTERNS 119
PLU2.W260.9 FLUSH PIPES 119

FIXING URINALS 119
PLU2.W310.9 SLAB TYPE 119
PLU2.W320.9 BOWL TYPE 119
PLU2.W330.9 FLUSHING CISTERNS 119

FIXING BASINS 119
PLU2.W410.9 COUNTER TOP OR SEMI-RECESSED WASH BASINS 119
PLU2.W420.9 WALL-HUNG WASH BASINS 119

FIXING BATHS AND SHOWERS 119
PLU2.W510.9 BATHS 119
PLU2.W520.9 CLEARANCE FOR BATH TRAPS 119
PLU2.W530.9 BATH OVERFLOW 119
PLU2.W540.9 FIXING SHOWER DOORS 119
PLU2.W550.9 FIXING SHOWER CUBICLE AND SHOWER TRAY 120

TAPS AND VALVES 120
PLU2.W610.9 TAPS AND MIXERS FITTED TO SANITARY APPLIANCES 120
PLU2.W620.9 FLEXIBLE HOSE ASSEMBLY WITH STAINLESS STEEL WIRE BRAIDING 120

WASTE OUTLETS 120
PLU2.W710.9 BEDDING 120

ANCILLARY FIXINGS 120
PLU2.W810.9 SOAP HOLDERS 120
PLU2.W820.9 TOILET PAPER HOLDERS 120

EQUIPOTENTIAL BONDING 121
PLU2.W910.9 EQUIPOTENTIAL BONDING TO STAINLESS STEEL SINKS 121

TOLERANCES 121
PLU2.W1100.9 GENERAL 121

TESTING 122

SURVEILLANCE TESTS FOR WCS 122
PLU2.T110.A SURVEILLANCE TESTS FOR WC SUITES 122

SURVEILLANCE TESTS FOR MIXERS (BATH/SHOWER/BASIN/KITCHEN SINK) AND SHOWER HANDSET 122
PLU2.T310.A SURVEILLANCE TESTS 122

APPENDIX PLU2/I 124
PLU2.APPEND1.9 PRESSURE DROP TEST 124

APPENDIX PLU2/II 125
PLU2.APPEND2.9 INSTALLATION OF FLEXIBLE HOSE ASSEMBLY WITH STAINLESS STEEL WIRE BRAIDING 125

PLU1 WATER SUPPLY

GENERAL

GENERAL

PLU1.G010.9 SCOPE OF THE WORK

1. The works to be carried out under this Worksection shall include the complete plumbing installation for fresh and flush water supply, rainwater harvesting and fire services excepting the works undertaken by Nominated Sub-contractors all as shown on the Drawings and detailed in this Worksection including:
   a. Fresh and flush water supply installations commencing from the government mains at the entry of site boundary to and including individual sanitary fixtures, gas water heaters and taps. Part of the plumbing installation inside pump room, including the pumpsets, ball float valves etc., connection point inside the pump room will be carried out by the Nominated Sub-contractor for fire services and water pump installation where shown on the Drawings. The installation of gas water heater, if applicable, will be carried out by a separate gas water heater contractor. Pre-installed fresh water supply pipework, which will not be connected to the fresh water supply upon completion of work, will be installed as specified or as shown on the drawings;
   b. Rainwater harvesting pipework installation commencing from outlets of the rainwater storage tank to individual irrigation water points. Part of the rainwater harvesting installation inside pump room, including the pumpsets, ball float valves, filter, chlorination system, pipework etc., will be carried out by the Nominated Sub-contractor for fire services and water pump installation where shown on the Drawings;
   c. Fire services water pipework installation commencing from the government mains at the entry of the site boundary including the up-feed pipes to the fire services roof / transfer tank and, if applicable, down-feed pipes to the street fire hydrants. Part of the plumbing installation inside pump room, including the pumpsets, ball float valves etc., connection point inside the pump room will be carried out by the Nominated Sub-contractor for fire services and water pump installation where shown on the Drawings;
   d. Extend and connect the fresh, flush and fire services water pipes to the government mains outside the Site boundary, if applicable. Where shown in the Drawings, connection shall be made to existing in-service supply mains of adjacent Housing Authority estate instead of government mains.
2. The complete installation shall mean, not only the major items of equipment and apparatus conveyed in this Worksection, but all the incidental sundry components necessary for the complete execution of the works and for the proper operation of the installation with their labour charges, whether or not these supply components are mentioned in detail in the tender document;
3. Refer to Worksection PLU2 for the requirements on sanitary fixtures / appliances installation.

PLU1.G012.B APPROVED CONTRACTOR FOR FRESH AND FLUSH WATER SUPPLY INSTALLATIONS

1. Employ a contractor under the Development Bureau's List of Approved Suppliers of Materials and Specialist Contractors for Public Works, Plumbing Installation Category (PI List), and an associated Licensed Plumber (LP) as approved by the Water Authority, to carry out all fresh and flush water supply installations commencing from the government mains at the entry of site boundary to and including individual sanitary fixtures, gas water heaters and taps required under the Contract as described in PLU1.G010 (1)(a);
2. The plumbing installation sub-contractor employed under sub-clause (1) shall also carry out the above-ground drainage works required under the Contract;
3. Before employment of the plumbing installation sub-contractor and the associated LP in sub-clause (1), details of the plumbing installation sub-contractor and the associated LP, including the following, shall be submitted to the CM for approval:
   a. Plumbing installation sub-contractor: The certification of incorporation and its declaration of current cumulative workload in terms of number of flats under construction in hand;
   b. The LP: Name, plumber licence number, level of English proficiency (as described in PLU1.W110 (2)) and his declaration of current cumulative workload in terms of number of flats under construction in hand.
4. The plumbing installation sub-contractor and the associated LP in sub-clause (1) are allowed to undertake this Contract, provided that their respective current cumulative workload in hand plus their workload of this Contract does not exceed the following Workload Capping Limits, in terms of number of flats under construction:
   a. Plumbing installation sub-contractor: 25,000;
   b. The LP: 12,500.

Whenever a plumbing installation sub-contractor or an LP has its workload approaching the above respective Workload Capping Limit before undertaking this Contract, it will only be allowed to undertake this Contract if its workload (including the workload of this Contract) is kept within a 20% allowance in excess.

5. The workload under this Contract will be added to the current cumulative workload of the plumbing installation sub-contractor and the associated LP upon the CM's approval as per sub-clause (3) and released upon:
   a. Practical completion of this Contract; or
   b. For Contract with sectional or phased completion which involves domestic flats, the certification of completion of the respective section or phase of the Contract.

PLU1.G020.9 REGULATIONS AND STANDARDS

1. Comply with all statutory regulations together with any revisions or amendments made thereto. The following regulations and standards are particularly relevant:
   a. The Waterworks Ordinance and its Regulations;
   b. The Fire Services Ordinance and its Regulations;
   c. The Noise Control Ordinance;
   d. WSD Circular Letters issued by the Water Authority;
   e. Technical Requirements for Plumbing Works in Buildings issued by the Water Authority;
   f. Codes of Practice for Minimum Fire Services Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment and Circular Letters issued by the Fire Services Department;
   g. Factories and Industrial Undertakings (Confined Spaces) Regulation;
   h. Where applicable, relevant sections of appropriate international standards on materials and workmanship as listed in PLU1.APPEND1.

PLU1.G030.9 PRECEDENCE

In case of conflict between the requirements among the publications referred to PLU1.G020, interpretation shall be in accordance with the following order of precedence unless otherwise directed by the Contract Manager:

1. Ordinances and Regulations, Laws of Hong Kong;
2. This Specification and/or the Drawings;
3. International standards.

MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MiMEP)

SCOPE OF WORK

PLU1.D010.N GENERAL

1. The Specification in this Worksection is only applicable to off-site prefabricated modules integrating equipment, components, pipework, fittings and the associated supporting frame / hanger system;
2. The Contractor shall adopt wider use of MultiTrade Integrated Mechanical, Electrical and Plumbing (MiMEP) approach to improve site safety, more efficient and better quality control, shortened construction period, less construction waste, less demand for on-site labour, less disturbance and nuisance to the neighbourhood, etc. as far as practicable;
3. The Contractor shall liaise with Water Supplies Department (WSD) for all necessary submissions and inspections required for Modular Integrated Construction (MiC) / MiMEP installation;
4. Notwithstanding any acceptance of the design or details by the CM, and the Contractor shall assume responsibility for the design, fabrication, delivery and installation of plumbing system using the MiMEP methods.

PLU1.D020.N EXTENT OF APPLICATION

1. The plumbing installation sub-contractor shall design, assemble, install and test the off-site prefabricated MiMEP modules, including but not limited to the following items, for on-site assembly and installation:
   a. Water meter position modules for all water meter cupboard at typical domestic floor;
   b. Fresh / flush water pressure reducing valve (PRV) set modules for water meter cupboard and pipeduct at domestic floors with PRV;
   c. Vertical feed pipes modules for pipeduct at typical domestic floor.
2. The complete MiMEP module shall mean, not only the major equipment, all associated pipework and system components such as pipe fittings, valves and etc. as shown on the Drawings, but all the incidental supporting frames/hangers, lifting lugs and sundry components necessary for the complete on-site assembly and installation, whether or not these supply components are mentioned in detail in the tender documents.

PLU1.D030.N SITE COORDINATION

1. The plumbing installation sub-contractor shall coordinate with the Contractor to ensure proper site provisions, including but not limited to the following, are in place at suitable time for the smooth execution of the whole MiMEP construction process:
   a. Sufficient loading and unloading area;
   b. Hoisting / Lifting facilities;
   c. Vehicular access;
   d. Barrier-free logistic route;
   e. Temporary openings and ramps for delivery;
   f. Water meter room / cupboard space;
   g. Pipeduct space.

2. The plumbing installation sub-contractor shall be responsible for coordination with the Contractor to allow sufficient time for manufacture of MiMEP modules and subsequent delivery on Site to meet the master construction programme;
3. The construction sequences of builder's works such as erection of water tank, wall, door and curbs etc. at relevant working locations / plant rooms / cupboards shall be coordinated and adjusted as appropriate to suit the on-site assembly and installation of MiMEP modules;
4. The detailed production cycle and the on-site installation and assembly programme of MiMEP modules and its relation with the relevant builder's works schedule shall be illustrated in the master construction programme.

DESIGN OF MiMEP MODULE

PLU1.D040.N COMPLIANCE WITH REGULATIONS AND STANDARDS

1. All off-site prefabricated MiMEP modules shall comply, where applicable, with the following statutory regulations, requirements and guidelines:
   a. Statutory requirements as specified in Section ELE1.4 and FWP1.3;
   b. Guidance Note on Fixed Electrical Installations with Modular Integrated Construction Method issued by the Electrical and Mechanical Services Department;
   c. Reference Material on the Statutory Requirements for Modular Integrated Construction Projects issued by the Construction Industry Council (CIC);
   d. Road Traffic (Traffic Control) Regulations;
   e. Guidelines on Application of Construction Noise Permit for using Modular Integrated Construction (MiC) Method" by the Environmental Protection Department (EPD);
   f. Any other statutory requirements and guidelines in relating to the MiMEP construction method;
   g. FSD Circular Letter No. 3/2019 Guidance Notes on Submission, Approval and Acceptance Inspection of Fire Service Installations and Equipment in Modular Integrated Construction Building Projects issued by the Fire Services Department;
   h. Guidance Note on Household Electrical Products with Modular Integrated Construction Method issued by the Electrical and Mechanical Services Department;
   i. All relevant statutory requirements, including Buildings Ordinance, Building Regulations, Codes of Practice, Practice Notes for Authorized Persons and Registered Structural Engineers and Regulations and Standards as specified in PLU1.G020.

PLU1.D050.N DESIGN REQUIREMENTS

1. The plumbing installation sub-contractor shall address the following considerations in the design of individual off-site prefabricated MiMEP modules:
   a. Compliance with all relevant statutory requirements;
   b. Layout and configuration of water meters / water meter positions shall be well planned and coordinated to facilitate on-site assembly and installation with minimisation of pipework joints as far as practicable;
   c. Off-site prefabricated modules shall be standardised as far as practicable to maximise the benefits of MiMEP construction method;
   d. The configuration and geometry of system components shall be simplified to avoid complicated routing, excessive bends and joints;

e. Due consideration on different types of joint and flexible joints to facilitate the services connections among MiMEP modules and with associated on-site installation. Tolerance of gradient and necessary extended short length of services for alignment shall be allowed at joints;

f. The volumetric size and geometry of individual MiMEP modules shall be optimized to suit the particular site environment for proper transportation, hoisting, delivery and assembly on Site;

g. Integrity and performance of respective installation shall not be compromised due to connections and joints;

h. Adequate access to the system components for inspection, operation and maintenance shall be allowed after the assembly of MiMEP modules;

i. Temporary eyebolt with pulley / temporary and permanent supporting frame / hanger shall be designed for individual MiMEP module. The permanent steel frame / hanger shall be of robust and adjustable framing design featured with fixing and bracketry facilities for mounting of different system components in position. The flexible fixing facilities shall be able to accommodate certain degree of services fixing adjustment in order to suit the alignment of MiMEP module interfacing with on-site installation or among modules themselves;

j. Both temporary and permanent framework shall be designed and constructed without any obstruction to operation and maintenance of all components and devices inside the module;

k. Permanent metal framework and overall loading of MiMEP modules imposed on building structure shall be submitted for approval by the CM;

l. Permanent metal framework shall be fixed on reinforced concrete wall;

m. Lifting lugs, temporary supporting framework with wheels or eyebolt with pulley shall be incorporated in the design of the MiMEP modules to facilitate transportation and delivery;

n. The design of temporary steel frame / hangers and eyebolt with pulley for the sole purpose of maintaining structural integrity during transportation, delivery and erection shall be able to taken down after on-site assembly to enhance accessibility for maintenance and to be reuse as far as practicable;

o. 10% loading capacity for the integrated supporting frame / rack shall be allowed for the addition and alteration works for the system components.

2. The Contractor shall submit report to identify the extent of plumbing installation and components to adopt the MiMEP method and obtain the CM's approval at the notified date for commencement of the Works.

DELIVERY AND SITE STORAGE

PLU1.D060.N GENERAL

1. The plumbing installation sub-contractor shall be responsible for the delivery, logistic, sub-frame / support for delivery, protection and temporary storage of the MiMEP modules from the off-site workshop to the Site for assembly;
2. The plumbing installation sub-contractor shall coordinate with the Contractor to make available a proper logistic route and associated builder's works provisions to enable the seamless delivery of individual MiMEP modules of different dimensions and weight;
3. Construction sequences of builder's works such as water tank, wall, door and curbs etc. at respective working locations / plant rooms / cupboards of assembly and along the logistic route shall be adjusted as appropriate to suit the delivery programme;

4. Upon delivery of the MiMEP modules to the Site, the plumbing installation sub-contractor shall arrange inspection with various parties. Any parts or components damaged during delivery shall be recorded and replaced before on-site assembly work, unless the damaged part is fully accessible for rectification or replacement after the module is put in place on Site.

PLU1.D070.N TRANSPORTATION

1. The plumbing installation sub-contractor shall allow proper protection and make necessary provisions for road transport / shipping delivery of MiMEP modules to the Site and hoisting into place for assembly;
2. The plumbing installation sub-contractor shall coordinate with the Contractor to liaise with the Police, Transport Department and all relevant authorities ahead for permit and / or escort of laden or unladen vehicles for delivery of MiMEP modules, in case of vehicles with excessive width, weight or length;
3. The plumbing installation sub-contractor shall bear all the time and cost involved to satisfy the conditions that relevant authorities may impose including limitation on working hours for transportation of MiMEP modules.

PLU1.D080.N PROTECTION

1. MiMEP modules shall be covered with shrink wrap / protection sheet or equivalent means to the CM's satisfaction in order to protect them from exposure to weather and to prevent from damage prior to site assembly work;
2. All system components forming part of the MiMEP modules shall be protected from the ingress of water and foreign matters as detailed in PLU1.W010.

QUALITY ASSURANCE

PLU1.D090.N ADMINISTRATION AND RECORD

1. The plumbing installation sub-contractor shall keep an inspection log book, including the identification of various parties responsible for conducting the quality assurance supervision, and details of the inspection, auditing and testing of the off-site installation works, and provide the log book for ready inspection when requested;
2. The plumbing installation sub-contractor shall keep paper record and / or digital records on platform as required by the CM, including photographs and videos during inspection and testing in off-site workshop and on-site assembly process, for ready examination by the CM, his representatives or the representatives of the statutory authorities;
3. The Contractor shall propose an identification method for each MiMEP in the design, fabrication and assembly process to facilitate the traceability of the MiMEP module. Details such as room name, floor level, equipment number, etc. shall be included in the label to ensure all modules are properly positioned as designed.

PLU1.D100.N QUALITY ASSURANCE MEASURES

1. The plumbing installation sub-contractor shall allow the CM or his representatives for the regular access to the off-site workshop / off-site prefabrication yard, to carry out routine supervision and inspections;
2. The plumbing installation sub-contractor shall provide necessary transportation and temporary office accommodation in the workshop to facilitate the CM or his representatives to execute the inspection duties;
3. The plumbing installation sub-contractor shall verify on Site regarding the necessary builder's works provisions as detailed in PLU1.D030 prior to the delivery of the MiMEP modules;

4. After the MiMEP modules delivered to the Site and before the on-site assembling process, the plumbing installation sub-contractor shall arrange necessary inspection and checking with relevant parties, especially if there is concern over possible deformation damage or the like during transit and difficulty in replacing / repairing the components after assembly on Site;
5. The plumbing installation sub-contractor shall also arrange joint inspection by relevant parties to monitor the on-site assembling process.

PARTICULAR REQUIREMENTS OF MiMEP MODULE

PLU1.D110.N GENERAL

1. Each individual MiMEP module shall be designed and constructed as a self-contained packaged unit with appropriate provisions to facilitate the transportation, delivery, assembly and services connection on Site;
2. All exposed pipework and fittings shall be workshop painted according to the painting finish as detailed in PLU1.W510.

PLU1.D120.N WATER METER POSITION MODULE

1. The module shall comprise water meter positions, pipework, fittings, valves, long screw connectors, bass pipes, reducers, valves, associated accessories including identification plates, earth bonding and steel framework as required by WSD / the design and as an integrated assembly for direct mounting to the building structure;
2. All pipework, components and devices shall be assembled and properly fixed to the framework and completed with hangers, brackets, saddles, guide etc. Pipework supports shall be welded, screwed or bolted to the framework. The framework shall be designed with pre-drilled holes for on-site direct fixing to building structures;
3. Provisions shall be allowed to facilitate the transportation, delivery, assembly and services connection on Site;
4. Provide full scale mock-up of the areas using the MiMEP method at proposed locations at sample floor confirmed with the CM and obtain the CM's approval of the logistic arrangement to demonstrate the transportation and site delivery prior to proceeding with the installation works.

PLU1.D130.N FRESH / FLUSH WATER PRESSURE REDUCING VALVE SET MODULE

1. The module shall comprise pressure reducing valve, pipework, fittings, gate valves, flanges joints, pressure gauge, associated accessories including identification plates and earth bonding as required by WSD / the design and as an integrated assembly for direct mounting to the building structure;
2. All pressure reducing valves, pipework, components and devices shall be assembled in off-site workshop. The prefabricated pressure reducing valve set module shall be delivered to the water meter cupboard / pipeduct; and subsequently erected to position / level by the temporary eyebolt with pulley for final connection with downpipe and fixed to the building structure. Contractor shall check the eyebolt catalogue and demonstrate the eyebolt can take the temporary load;
3. Provisions shall be allowed to facilitate the transportation, delivery, assembly and services connection on Site;
4. Provide full scale mock-up of the areas using the MiMEP method at proposed locations at sample floor confirmed with the CM and obtain the CM's approval of the logistic arrangement to demonstrate the transportation and site delivery prior to proceeding with the installation works.

PLU1.D140.N VERTICAL FEED PIPES MODULE

1. The module shall comprise pipework, fittings, flanges joints, associated accessories including earth bonding and flexible fixing facilities / framework and as an integrated assembly for direct mounting to the building structure;
2. All pipework, components and devices shall be properly fixed to flexible fixing facilities / framework and completed with hangers, brackets, etc. in off-site workshop. The flexible fixing facilities shall be able to accommodate certain degree of services fixing adjustment in order to suit the alignment of MiMEP module interfacing with on-site installation or among modules themselves. Pipework supports shall be welded, screwed or bolted to the framework. The framework shall be designed with pre-drilled holes for on-site direct fixing to building structures;
3. Provisions shall be allowed to facilitate the transportation, delivery, assembly and services connection on Site;
4. Provide full scale mock-up of the areas using the MiMEP method at proposed locations at sample floor confirmed with the CM and obtain the CM's approval of the logistic arrangement to demonstrate the transportation and site delivery prior to proceeding with the installation works.

DOCUMENTATION

PLU1.D150.N INSTALLATION METHOD FOR MiMEP

1. The Contractor shall submit an installation method for MiMEP modules to define the detailed scope of building services components adopting MiMEP construction method for the approval by the Contract Manager before fabrication;
2. The information shall include, but not limited to, the following:
    a. The scope of the installation / system(s) to be constructed by MiMEP construction method;
    b. The detailed demarcation of the building services components of the MiMEP modules shall be provided in coloured drawing plans which portion(s) to be fabricated / assembled / installed in the off-site workshop or in-situ;
    c. Construction details of the MiMEP modules, in particular the materials, size, weight and the maximum load the modules can sustain;
    d. The use of materials, equipment, configurations, routings and positions of MiMEP modules and the associated supporting frame / hanger system;
    e. The preparation work for the fixing, jointing and assembly of the installations and associated supporting frame / hanger system on Site;
    f. The provision of site facilities including sufficient loading & unloading area, lifting, access route, module dimensions and weight, and plant room space to facilitate the adoption of MiMEP construction method;
    g. The plinth, footing and fixing details to the designated pedestals of the building structure, where applicable;
    h. Testing and commissioning procedure to be conducted at workshop;
    i. Temporary protective measures for building services installation of MiMEP modules in the course of transportation for delivery to the Site.
3. The MiMEP modules are part of the building services system components. The necessary testing and commissioning of them shall be carried out together with the complete system installed on Site.

MATERIALS

GENERAL

PLU1.M010.9 SUBMISSION OF DOCUMENTS

(Guidance Note: The revised clause shall apply for all new projects and projects under construction with Part I 1. This clause provides the general submission requirements for materials specified in PLU1 in addition to the requirements given in the individual clauses. Unless otherwise specified, comply with the submission requirements detailed in this clause in the submission of materials to the CM for approval;

2. Submit documents substantiating compliance with the requirements of the Water Authority:
   a. For plumbing materials to be reported in Form WWO 1149, submit General Acceptance Letter issued by the Water Authority;
   b. For plumbing materials not required to be reported in Form WWO 1149, submit documents as follows:
      i. Certified true copy of the test reports issued by the accredited laboratory accepted by the Water Authority showing full compliance with the requirements of the Water Authority; or
      ii Copy of Certificate issued by Water Regulations Advisory Scheme of UK (WRAS) for testing in compliance with the relevant British Standard as listed on WSD webpage.
   c. The QCM shall verify and confirm the validity and authenticity of the approval obtained from the Water Authority and / or the WRAS Certificate as appropriate.
3. For non-metallic components in contact with water intended for human consumption, submit test reports or test certificates to demonstrate compliance with the relevant requirements in BS 6920 as required by the Water Authority;
4. For materials where specified in PLU1 to be low metal leaching rate metallic plumbing products under the GA* Scheme of WSD, submit certified true copy of test reports to demonstrate compliance with AS/NZS 4020 as accepted by the Water Authority for joining the above Scheme;
5. Submission of Form WWO 1149 and the subsequent updating shall be made as soon as the proposed materials, or proposed changes of approved materials, are approved by the CM and before placement of order for such materials. All applications and forms for submission to the Water Authority shall be submitted to the CM for comment before submission and record after approval;
6. Test certificates and reports shall be issued by laboratories that comply with PRE.B9.570 and accepted by the Water Authority.

PIPES, FITTINGS AND JOINTS

PLU1.M110.9 GENERAL

1. All pipes and fittings shall:
   a. Conform to this Specification. Alternative materials may be used if approved by the CM;
   b. Be constructed of materials suitable for the required working and test pressures and temperatures of the fluid carried;

c. Be capable of withstanding system working pressure and maximum static pressure that may arise upon failure of the associated pressure reducing devices;

d. Be of standard products. Do not use on-site fabricated and locally manufactured pipes and fittings except specified elsewhere or where shown on the Drawings or approved by the CM;

e. Comply with the requirement of the Water Authority for the intended application;

f. Be taken with all necessary precautions to avoid surface damage or contamination during shipping, handling, storage and fabrication;

g. Be provided with protective wrapping, including the pipe ends;

h. Comply with BS 6920 for non-metallic components in contact with water intended for human consumption.

2. The pipes, pipe fittings and jointing materials for fresh water application including soldering and brazing alloys for fresh water application shall comply with the following requirements:

a. Submission Requirements:

At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:

i. Catalogue, brand name / model name and job reference;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Confirmation of compliance with statutory requirements in writing jointly signed by the Building Services Engineer of the Contractor and the LP;

v. Other specified submission requirements for the materials.

b. On Site Delivery Verification:

i. At delivery stage, submit the following documents for the CM's information:

- Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (2)(a) above;
- Original or certified true copy of the Certificate of Origin and batch number for every batch of delivery with one batch being the material quantity covered under each delivery note; and
- Delivery notes for material delivered to Site

ii. For those materials with BSI Kitemark or possessing two stars status under WSD's "General Acceptance Plus" (GA+) Scheme, the Certificate of Origin shall also indicate that they are manufactured from the factory under the corresponding product certification scheme;

iii. Carry out and submit report on the material verification upon delivery to Site as applicable. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications.

3. All pipes and fittings shall be acknowledged by the Water Authority with permission given for proceeding with the approved plumbing works before installation;

4. Sample board:

a. Provide a sample board to display samples of pipes, fittings and jointing materials and accessories to be used in the plumbing installation and listed in the Form WWO 1149 submitted to and approved by the Water Authority. The following items shall be included in the sample board as a minimum:

i. Pipework, fitting and their support complete with fixing accessories;

ii. Soldering and brazing alloys if used.

b. The sample board is to be kept by the CM on Site together with associated relevant certificates / test reports / catalogues / supporting documents upon submission of Form WWO 1149 to the Water Authority;

c. The sample board shall comply with the requirements of the Water Authority. Each sample, with clear numbering and labelling, shall be firmly fixed onto a rigid wooden or metal board. A list shall also be affixed on the sample board to show the item description, make and brand, country of origin and locations of installation;

d. Replace samples and relevant certificates / test reports / catalogues / supporting documents whenever amendment to Form WWO 1149 is made and approved by the Water Authority.

PLU1.M120.A COPPER PIPES

1. Be of seamless drawn copper tubes manufactured to BS EN 1057 with nominal wall thickness as below:

Nominal Outside Diameter (mm)	Nominal Wall Thickness (mm)		Hardness / Temper
	(Aboveground)	(Underground)	
15	0.7	1.0	HH
22	0.9	1.2	HH
28	0.9	1.2	HH
35	1.2	1.5	HD
42	1.2	1.5	HD
54	1.2	2.0	HD
Note: HH - Half Hard R250 HD - Hard Drawn R290			

2. Copper pipe shall be low metal leaching rate metallic plumbing products, i.e. comply with the maximum allowable concentrations of the corresponding heavy metals, under GA* scheme of WSD and possess the Kitemark Certificate or Kitemark Licence to BS EN 1057 issued by the British Standards Institution or two stars status under WSD's GA+ Scheme;
3. At sample submission and approval stage, submit a copy of the Kitemark Certificate or Kitemark Licence together with the associated test report demonstrating compliance with BS EN 1057, all issued by the British Standards Institution; or provide documentation to demonstrate the possessing for two stars status under WSD's GA+ Scheme; for the CM's information;
4. Take into account temper conditions after solder / brazed jointing or heat bending in determining their pressure withstanding capability;
5. Provide pipe markings in accordance with tube manufacturing standard BS EN 1057;
6. Copper pipes for cold water supply inside domestic flats shall be completed with factory applied plain polyethylene sheath to BS 3412. Copper pipes for cold water supply at external areas and common areas, including corridors, lobbies and plant rooms, shall be bare and without paint finishes;

7. Copper pipes for hot water supply inside and outside domestic flats shall be completed with factory applied castellated polyethylene sheath comply with BS 3412 and suitable for use up to 80°C;
8. If brazing or soldering alloy is used in the connection between water pipes:
   a. At sample submission and approval stage, submit supporting documents of brazing alloy and soldering alloy as per PLU1.M150 (1) and PLU1.M160 (1);
   b. Soldering alloys with lead and brazing alloys with cadmium are not permitted in installations for water for human consumption;
   c. Set up mock-up for internal and external brazing and soldering joint including those at external wall at the sample wing and sample flats as required under PRE.B4.080 and in fabrication workshop. Approved mock up jointing shall serve as benchmark standard of workmanship for plumbing installation;
   d. At delivery stage, implement quarantine material verification as per PRE.B6.APPEND2;
   e. Implement stringent sub-contractor supervision and on-site monitoring and testing to ensure that all workers shall use only brazing and soldering alloys approved by the Water Authority for jointing copper pipes according to the Approved Sub-contractors Management Plan for plumbing installation as per PRE.B6.APPEND2;
   f. Declare that only the Water Authority approved brazing and soldering alloys are used on completion of the plumbing works and before cleansing and disinfection of the plumbing installation.
9. On Site Delivery Verification:
   a. Further to the submission requirements at delivery stage in PLU1.M110 (2)(b), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
<For pipes, brazing alloy, soldering alloy>		
Material and Packaging	Visual	Same as the CM's Approved Sample at PLU1.M110 (4)
Logo & Label Check	Visual	Same as the CM's Approved Sample at PLU1.M110 (4)
<For pipes >		
Marking on pipe	Visual	Same as the CM's Approved Sample at PLU1.M110 (4) and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

      ii. Frequency:

      Carry out verification for one sample per every delivery of material to Site under each delivery note. A representative batch means the material delivered to Site under the same delivery note.

b. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs and any extra time required.

c. Observe and comply with the requirements of verification test for copper pipes delivered to Site under PLU1.T094.

PLU1.M130.A COPPER PIPE FITTINGS

1. Copper and copper alloy fittings such as end feed capillary, integral solder capillary and compression type bushes, reducers, bends and tees: comply with BS EN 1254 - 1, 2, 4 & 5 or equivalent standard;
2. Copper pipe integral solder fittings shall be low metal leaching rate metallic plumbing products under GA* scheme of WSD;
3. All copper and copper alloy fittings shall possess the Kitemark Certificate or Kitemark Licence to BS EN 1254 -1, 2, 4 & 5 or equivalent standard issued by the British Standards Institution or two stars status under WSD's GA+ Scheme. At sample submission and approval stage, submit a copy of the Kitemark Certificate or Kitemark Licence, together with the associated test report demonstrating compliance with BS EN 1254 -1, 2, 4 & 5 or equivalent standard, all issued by the British Standards Institution; or provide documentation to demonstrate possessing two stars status under WSD's GA+ Scheme; for the CM's information;
4. For compression type fittings used for hot water pipework, submit type test reports issued by laboratories that comply with PRE.B9.570 for proving their suitability for use at a pressure (working and / or maximum static pressure that may arise upon failure of the associated pressure reducing devices) above that allowed at 80ºC in BS EN 1254-2 or equivalent standard by the following tests:
   a. Temperature cycling test of a pipe / fitting assembly of the compression type fittings to be carried out by alternately circulating water of 80ºC and 15ºC through it and pressurizing the assembly to the working or maximum static pressure, whichever is higher, for 2 minutes after it reaches 80ºC and 15ºC respectively in each cycle. A total of 400 cycles of test shall be performed;
   b. Pressure test of the pipe / fitting assembly to be carried out after the temperature cycling test at 1.5 times the working or maximum static pressure, whichever is higher, for 24 hours with its temperature maintained at 80ºC throughout the 24-hour period;
   c. The compression type fittings are to be regarded as capable of withstanding the working and maximum static pressure that may arise upon failure of the associated pressure reducing devices at 80ºC if no sign of deformation of the fittings and water leakage from the pipe / fitting assembly are observed / detected throughout the tests as mentioned in sub-clauses (4)(a) and (4)(b) above.
5. Provide written confirmation from the manufacturer on suitability of the compression type fittings for use with hot water pipework for application at 80ºC under the working and maximum static pressure at sample submission and approval stage;
6. Subject to sub-clause (8), use compression type fittings or solder or solder / brazed capillary fittings for pipe sizes up to and including 54 mm;
7. Subject to sub-clause (8), use brazed type bolted flange joints to and comply with BS EN 1092-3 or equivalent standard;
8. Unless otherwise specified or shown on the Drawings or approved by the CM, use the following types of joints and fittings:

Application	Copper Pipe Size	Joint / Fitting
a. Up-feed to storage tank, storage tank downfeed and mains pressure direct up-feed	Up to and including 54 mm	Integral solder capillary joints. Flanged joints where future disconnection is required.
b. Meter assembly branch and pipework	Up to and including 54 mm	Integral solder capillary joints.
c. Meter outlet and consumer pipework	Up to and including 54 mm	Integral solder capillary joints. Compression or screw joint fittings for connection to valves etc. or if integral solder capillary jointing is not practical.
d. Consumer hot water pipework	Up to and including 54 mm	Integral solder capillary joints. Compression fittings for connection to valves, etc. or if integral solder capillary jointing is not practical.

9. Use dielectric fittings or epoxy coated flange with gasket for connecting copper pipe to pipes and fittings made of other metals in order to prevent direct contact with different metals;
10. On Site Delivery Verification:
    a. Further to the submission requirements at delivery stage in PLU1.M110 (2)(b), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
        i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on pipe fitting	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

        ii. Frequency:

        Carry out verification for one sample per each type per every delivery of material to Site under each delivery note. A representative batch means the material of the same type delivered to Site under the same delivery note.

    b. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs and the extra time required.

c. When integral solder capillary copper pipe fittings are used, observe and comply with the requirements of verification test for solder in the pipe fittings delivered to site under PLU1.T095.

PLU1.M140.9 PREFORMED POLYETHYLENE SHEATHS FOR CAPILLARY TYPE JOINTS AND FITTINGS OF SHEATHED COPPER PIPES

Be of "clip-on" type preformed polyethylene sheaths to BS 3412 or of equivalent quality in accordance with manufacturer's recommendation. Thickness of sheaths shall not be less than that in straight pipes and suitable for use up to 80°C.

PLU1.M150.9 BRAZING ALLOYS FOR COPPER AND COPPER ALLOY CAPILLARY FITTINGS

1. Submission Requirements:

   Further to the submission requirements in PLU1.M110 (2)(a) and as per PLU1.M120 (8)(a):

   a. Submit the supporting document of brazing material which shall be a test certificate certifying that the brazing material complies with BS EN ISO 17672. The certificate shall be issued or certified by a laboratory accepted by the Water Authority and within 5 years from the date of issue;

   b. Submit a Sub-contractors Management Plan as per PRE.B6.APPEND2 covering quarantine material verification, stringent sub-contractor supervision and on-site monitoring to ensure that all workers shall use only Approved brazing materials for jointing of copper pipes. The role of the Licensed Plumber in supervision of the plumbing installation works shall be defined under the Sub-contractors Management Plan.

2. Comply with Table 6 Section VI of BS EN 1254-1; brazing alloys with cadmium are not permitted in installations for water for human consumption;
3. Use brazing alloy comply with BS EN ISO 17672;
4. Do not use flux when brazing copper-to-copper joints;
5. For joints other than copper to copper, use only a flux that is recommended by the brazing alloy manufacturer; or use a suitable type of adaptor subject to the CM's approval;
6. Observe and comply with the requirements under PLU1.M120 (8).

PLU1.M160.9 SOLDERING ALLOYS FOR COPPER AND COPPER ALLOY CAPILLARY FITTINGS

1. Submission Requirements:

   Further to the submission requirements in PLU1.M110 (2)(a) and as per PLU1.M120 (8)(a):

   a. Submit the supporting document of soldering material which shall be a test certificate certifying that the soldering material complies with BS EN ISO 9453. The certificate shall be issued or certified by a laboratory accepted by the Water Authority and within 5 years from the date of issue;

b. Submit a Sub-contractors Management Plan as per PRE.B6.APPEND2 covering quarantine material verification, stringent sub-contractor supervision and on-site monitoring to ensure that all workers shall use only Approved soldering materials for jointing of copper pipes. The role of the Licensed Plumber in supervision of the plumbing installation works shall be defined under the Sub-contractors Management Plan.

2. Comply with BS EN 1254-1, Table 6 Sections II & III; soldering alloys with lead are not permitted in installations for water for human consumption;
3. Use soldering alloy complying with BS EN ISO 9453;
4. Use of integral solder fittings is permitted provided that the integral soldering material complies with Table 6 of BS EN 1254-1 and BS EN ISO 9453;
5. Use only a non-corrosive type of flux that is recommended by the solder alloy manufacturer;
6. Observe and comply with the requirements under PLU1.M120 (8).

PLU1.M170.A DUCTILE IRON PIPES, FITTINGS AND ACCESSORIES

1. Ductile iron pipes: comply with BS EN 545;
2. Ductile iron pipe fittings and accessories: comply with BS EN 545;
3. Ductile iron pipe shall be coated with metallic zinc and bitumen finishing externally and lined with cement mortar internally;
4. Ductile iron pipe fittings and accessories shall be coated with metallic zinc and bitumen finishing externally and lined with cement mortar or epoxy internally. Epoxy coating shall be complied with BS EN 14901-1;
5. The minimum wall thickness of pipes and fittings, which has already taken into account the negative tolerance, shall comply with the following table:

Nominal size DN	Class	Minimum wall thickness of pipes and fittings (mm)
80	100	5.62
100	100	5.80
150	100	6.35
200	64	6.90
250	64	7.45
300	64	8.00

6. Slip on flange adaptors:
   a. Be provided at check meters positions;
   b. Be designed and manufactured to suit the pipework installation. The flanges shall comply with BS EN 1092-2 PN 16 or PN 25 as appropriate;
   c. Be made of ductile iron to BS EN 545 and shall be coated with epoxy externally and internally comply with BS EN 14901;
   d. Stud bolts and nuts of the flange adaptors shall be made of stainless steel of Grade A4 to BS EN ISO 3506-1 and BS EN ISO 3506- 2 respectively;
   e. Gaskets shall be made of Ethylene Propylene Diene Monomer (EPDM) if used for potable water, it shall comply with BS 6920;

f. Be equipped with guide rod assembly to prevent damage from excessive movement. The assembly shall consist of guide rod plates, at least three guide rods each of minimum 16mm diameter and washers all made of stainless steel at least to BS EN 10088-3 Grade 1.4401 on both sides, and shall be fitted with resilient neoprene sleeves, resilient neoprene washers on at least one side of the assembly for isolating vibration transmission.

7. Ductile iron pipes and ductile iron pipe fittings shall possess the Kitemark Certificate or Kitemark Licence to BS EN 545 issued by the British Standards Institution or two stars status under WSD's GA+ Scheme;
8. At sample submission and approval stage, submit a copy of the Kitemark Certificate or Kitemark Licence, together with the associated test report demonstrating compliance with BS EN 545, all issued by the British Standards Institution, or provide documentation to demonstrate possessing two stars status under WSD's GA+ Scheme, for the CM's information;
9. On Site Delivery Verification:
   a. Further to the submission requirements at delivery stage in PLU1.M110 (2)(b), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on pipe and fitting	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

      ii. Frequency:
         - For ductile iron pipes, carry out verification for one sample per every delivery of material to Site under each delivery note. A representative batch means the material delivered to Site under the same delivery note;
         - For ductile iron pipe fittings and accessories, carry out verification for one sample per each type per every delivery of material to Site under each delivery note. A representative batch means the material of the same type delivered to Site under the same delivery note.
   b. Where any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PLU1.M180.9 GALVANIZED STEEL PIPES AND FITTINGS

1. Galvanised steel pipes: comply with BS EN 10255 with screwing to BS EN 10226-1 and of medium grade for above ground installation and of heavy grade for below ground installation unless otherwise specified or shown on the drawings;
2. Pipe fittings: galvanised malleable cast iron to BS 143 and 1256 or BS EN 10242; Or galvanised wrought steel pipe fittings (screwed BS 21 R series thread) to BS EN 10241;
3. Mechanical couplings and fitting shall be as follows:
   a. As an alternative to flanged and screwed joints, grooved end mechanical couplings may be employed subject to the approvals of the Contract Manager,
   b. Mechanical couplings shall be hot dip galvanized, self-centering, engaged and locked in place onto the grooved or shouldered pipe and pipe fitting ends. The result shall be in a positive watertight couple providing some allowance for angular pipe deflection, contraction and expansion. Coupling housing clamps shall consist of two or more malleable iron castings or rolled steel or ductile iron segment holdings with a composition water sealing gasket so designed that the internal water pressure increases in the water tightness of the seal. Sealing gasket shall be selected for the service and working temperature according to the manufacturer's recommendations. The coupling assembly shall be securely held together by two or more zinc plated track head square or oval-neck heat-treated carbon steel bolts and nuts. All pipe fittings connected to mechanical pipe couplings shall have groove and shouldered ends. Flanged or threaded end valves may be used with grooved adapters;
   c. Coupling housing material of mechanical couplings shall be as follows:
      i. Ductile iron shall be to ASTM A536 or to BS EN 545 or BS EN 1563;
      ii. Rolled steel shall be to BS EN 10162.
   d. Rubber gaskets shall be complied to the following standards:
      i. Hardness: ASTM D2240;
      ii. Tensile testing: ASTM D412;
      iii. Compression: ASTM D395;
      iv. Heat aging: ASTM D573.

PLU1.M190.9 STAINLESS STEEL PIPES

1. All stainless steel pipes and fittings shall be approved by Water Regulations Advisory Scheme (WRAS) UK and the Water Authority as suitable for use locally in conformity with the Waterworks Ordinance and Regulations for the intended application and shall be of standard products supplied by ISO 9001 accredited manufacturers;
2. All pipes, including fasteners, shall be of stainless steel to BS EN 10088-1 Grade 1.4301;
3. Stainless steel pipes with nominal outside diameter up to and including 54mm shall be suitable for use with stainless steel non-welding type fittings, pickled and supplied in solution annealed condition to BS EN 10312, Series 2;
4. Stainless steel pipes with nominal outside diameter above 54mm to BS EN 10217-7 or BS EN 10312 Series 2, suitable for use with stainless steel non-welding type fittings supplied in the solution-annealed condition or pickled. For stainless steel pipes to BS EN 10217-7, the dimensions, wall thickness, tolerances and conventional masses per unit length of pipes shall be to BS EN ISO 1127 with minimum wall thickness as below:

Nominal size (mm)	Outside diameter (mm)	Minimum wall thickness (mm)
65	76.1	2.6
80	88.9	2.6
100	114.3	2.6
150	168.3	3.0

5. Submit sample of the pipes for the CM's approval prior to placing orders. Samples submitted for approval shall be accompanied by test reports of those test methods required in the relevant standards;
6. Provide test specimens from the materials delivered to site and carry out testing on dimension and chemical composition in accordance with the relevant BS by an Approved Accredited Laboratory as required by PRE.B9.570. Rate of sampling to be one pipe per batch (regardless of size) delivered to site unless otherwise specified; one batch being the material quantity covered under each delivery note;
   a. In the event that the sample fails to meet the testing requirements, follow either one of the following actions:
      i. Remove the batch off Site; or
      ii. Carry out re-test for the batch in accordance with the testing methods as specified on three separate samples (regardless of size) selected by the CM from the batch. In case of any one sample fails the re-test, remove the batch off Site.
   b. When the batch is removed off Site, replace with another new batch and carry out test for one sample (regardless of size) selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (6)(a);
   c. Bear all associated costs for the test and re-test required.
7. On Site Delivery Verification:

   Further to the submission requirements at delivery stage in PLU1.M110 (2)(b).
   a. Submit the supplier's original delivery note / invoice and mill certificates for all pipes before installation on site and shall include the following information on the items delivered:
      i. Manufacturer's name, the date and place of manufacture;
      ii. Type, description and dimensions;
      iii. Heat number of pipes;
      iv. Quantities of items delivered;
      v. The grade and compositions of stainless steel pipes and international standard complied with;
      vi. Results of tests;
      vii. Pickling and surface treatment processed.
   b. Carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on pipe	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

ii. Frequency:

Carry out verification for one sample per every delivery of material to Site under each delivery note. A representative batch means the material delivered to Site under the same delivery note.

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PLU1.M191.9 STAINLESS STEEL PIPE FITTINGS

1. All stainless steel pipe fittings, including fasteners, shall be of stainless steel to BS EN 10088-1 Grade 1.4301;
2. Stainless steel pipe fittings shall be tested in compliance with AS 3688. Test report issued by laboratories that comply with PRE.B9.570 shall be submitted;
3. For all stainless steel non-welding type fittings, it shall be manufactured by loss wax investment casting or by stamping mould and welding, pickled and 100% inspected by hydrostatic testing. The minimum system working pressure and temperature of the fittings and pipe system shall be 20 bar and 80ºC respectively;
4. All sealing gaskets shall be silicone rubber to BS 6920 and O-rings shall be of nitrile rubber (NBR) or Ethylene Propylene Diene Monomer (EPDM);
5. All stainless steel fasteners, including bolts, screws, studs and nuts, shall be Grade 4 to BS EN ISO 3506-1 & 2 unless otherwise specified and shall be assembled to manufacturer's recommendations;
6. Use dielectric fittings or epoxy coated flange with gasket for connecting stainless steel pipe to pipes and fittings made of other metals except copper or copper alloy in order to prevent potential corrosion;
7. Submit sample of the pipe fittings for the CM's approval prior to placing orders. Samples submitted for approval shall be accompanied by test reports of those test methods required in the relevant standards;
8. Provide test specimens from the materials delivered to site and carry out testing on dimension and chemical composition in accordance with the relevant BS by an Approved Accredited Laboratory as required by PRE.B9.570. Rate of sampling to be one pipe fitting per batch (regardless of size and type) delivered to site unless otherwise specified; one batch being the material quantity covered under each delivery note;

a. In the event that the sample fails to meet the testing requirements, follow either one of the following actions:
   i. Remove the batch off Site; or
   ii. Carry out re-test for the batch in accordance with the testing methods as specified on three separate samples (regardless of size and type) selected by the CM from the batch. In case of any one sample fails the re-test, remove the batch off Site.

b. When the batch is removed off Site, replace with another new batch and carry out test for one sample (regardless of size and type) selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (9)(a);

c. Bear all associated costs for the test and re-test required.

9. On Site Delivery Verification:

Further to the submission requirements at delivery stage in PLU1.M110 (2)(b),

a. Submit the supplier's original delivery note / invoice and mill certificates for all pipes before installation on site and shall include the following information on the items delivered:
   i. Manufacturer's name, the date and place of manufacture;
   ii. Type, description and dimensions;
   iii. Heat number of pipe fittings;
   iv. Quantities of items delivered;
   v. The grade and compositions of stainless steel pipe fittings and international standard complied with;
   vi. Results of tests;
   vii. Pickling and surface treatment processed.

b. Carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
   i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on fitting	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

   ii. Frequency:

   Carry out verification for one sample per each type per every delivery of material to Site under each delivery note. A representative batch means the material of the same type delivered to Site under the same delivery note.

c. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PLU1.M200.9 UNPLASTICIZED PVC (UPVC) PIPES AND FITTINGS

1. Pipes: comply with BS 3505, Class E or BS EN ISO1452-2 series S6.3 or higher to suit system working pressure and as shown on the Drawings;
2. Fittings: comply with BS 4346-1 in conjunction with BS EN ISO 1452-3 for fittings jointed by solvent cementing, comply with BS EN ISO 1452-3 for other fittings;
3. Colour: white unless approved by the CM;
4. Jointing compound: be of a type recommended by the manufacturer of the pipes and fittings;
5. External uPVC pipes exposed to sunlight and uPVC pipes on roof and canopy shall be painted with white acrylic paint.

PLU1.M210.9 STAINLESS STEEL TYPE EXPANSION JOINTS

Use for fresh and fire services water pipeworks passing through building expansion joints or other locations as shown on the Drawings and comply with the following requirements:

1. Be of axial pattern bellows type and able to withstand designed / allowable horizontal and vertical movement;
2. Be screwed ends to BS EN 10226-1, 2, 3 or flanged ends to BS EN 1092-1 as appropriate to facilitate replacement;
3. Be manufactured from stainless steel of BS EN 10088-1 Grade 1.4301 or equivalent standard, or other Approved material appropriate to the system;
4. Be designed to withstand the test pressure of the system and maximum static pressure that may arise upon failure of the associated pressure reducing devices. Testing pressure of the expansion joints shall be not less than 1.5 times of the system working pressure involved;
5. Be equipped with guide rod assembly to prevent damage from excessive movement. The assembly shall consist of guide rod plates, guide rods and steel washers on both sides, and shall be fitted with resilient neoprene sleeves, resilient neoprene washers on at least one side of the assembly for isolating vibration transmission;
6. Be the type accepted by the Water Authority and FSD. For sprinkler system, the expansion joints shall be installed and provided to comply the design requirement of LPC Sprinkler Rules incorporating BS EN 12845;
7. Submission Requirements:

   Further to the submission requirements at delivery stage in PLU1.M110 (2)(b).

   a. Submit type hydraulic test certificates / reports issued by laboratories that comply with PRE.B9.570 and accepted by the Water Authority;
   b. Submit for Approval the installation length, material, rated movement (axial extension, axial compression, lateral deflection, angular rotation, or any combination thereof) and pressure ratings upon the CM's request;
   c. Submit details of anchors and guides installation in accordance with the recommendations of the expansion joint manufacturer for approval before manufacturing commences.
8. On Site Delivery Verification:
   a. Carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on Expansion Joint	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

ii. Frequency:

For each of the fresh water and fire services water applications, carry out verification on one sample for every 10 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material for the same application delivered to Site under the same delivery note.

b. Where any of the verifications fail to meet the acceptance standards, either:

Method:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PLU1.M220.9 STAINLESS STEEL FLEXIBLE CONNECTORS

1. Use for fresh water pipeworks at pump room and other locations for pipeline vibration elimination where shown on the Drawings:
   a. Be of omega-shape, close pitch annular corrugation, and fabricated from stainless steel plates / sheets / strips;
   b. Be able to sustain a system working pressure compatible with the pipework with which the connectors are connected. Unless otherwise specified, the system working pressure shall not be less than 16 bar, a minimum test pressure of 1.5 times of the system working pressure and a minimum burst pressure of 40 bar;
   c. Include a bellow which shall be corrosion and abrasion resistant and complete with braiding. Should the convolution of the bellow not be gradually formed by continuous rolling in shape, appropriate heat treatment shall be conducted to release the internal stress imposed on the bellow during the forming process;
   d. Be of sufficient length for absorption of offset motion and effective isolation of vibration. The total stress on bellow due to internal pressure, offset motion and vibration shall not exceed the design endurance limit. Unless otherwise specified, the minimum rated lateral movement shall be as tabulated below:

Nominal bore of braided bellow	Minimum rated lateral movement
Up to 100 mm diameter	4 mm offset motion plus ±1 mm vibration
Above 100 mm diameter	6 mm offset motion plus ±1 mm vibration

e. Be comprised of the following component materials unless otherwise specified, and inert gas arc welding shall be used for the termination of bellow and braiding at the tube ends:

i. Bellow: austenitic chromium nickel or austenitic chromium nickel molybdenum stainless steel sheet to BS EN 10029 or BS EN ISO 9445-2 or BS EN 10048 or BS EN 10051 or BS EN 10095;

ii. Braiding: stainless steel wires or plates;

iii. Flange: corrosion resistant carbon steel.

f. Have any part which is in contact with the water of the same material as the bellow;

g. Unless otherwise specified, be of flanged end connection. Flanges shall comply with BS EN 1092-1;

h. Have identification markings for the brand name, model number, bellow material, braiding material, system working pressure and bellow nominal diameter;

i. Be equipped with guide rod assembly to prevent damage from excessive movement. The assembly shall consist of guide rod plates, guide rods and steel washers, and shall be fitted with resilient neoprene sleeves and resilient neoprene washers on at least one side of the assembly for isolating vibration transmission.

2. Submission Requirements:

Further to the submission requirements in PLU1.M110 (2)(b).

a. Submit type hydraulic test certificates / reports issued by laboratories that comply with PRE.B9.570 and accepted by the Water Authority;

b. Submit for Approval the installation length, material, rated movement (axial extension, axial compression, lateral deflection, angular rotation, or any combination thereof) and pressure ratings upon the CM's request.

3. On Site Delivery Verification:

a. Carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on Connector	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

ii. Frequency:

For each of the fresh water and fire services water applications, carry out verification on one sample for every 10 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material for the same application delivered to Site under the same delivery note.

b. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PLU1.M230.9 RUBBER FLEXIBLE CONNECTORS/EXPANSION JOINTS

1. Use rubber flexible connectors for flush water and fire services water pipeworks at pump rooms and other locations for pipeline vibration elimination and use rubber expansion joints for flush water pipeworks passing through building expansion joints where shown on the Drawings and comply with the following requirements:
   a. Be of double or multiple arch/sphere type;
   b. Be able to sustain a system working pressure compatible with the pipework with which the connectors are connected. Unless otherwise specified, the system working pressure shall not be less than 16 bar, with a minimum test pressure of 1.5 times of the system working pressure and a minimum burst pressure of 55 bar;
   c. Be non-toxic, corrosion and abrasion resistant and of sufficient length for effective isolation of vibration;
   d. Be fitted with corrosion resistant steel or ductile iron floating flanges to BS EN 1092-1 or 2;
   e. Include a flexible tube made of multiple layers of high tensile fabric reinforcement with EPDM, neoprene or synthetic rubber cover and liner. Tube end shall be of locked bead construction with steel wire bead ring and raised face;
   f. Be equipped with guide rod assembly to prevent damage from excessive movement. The assembly shall consist of guide rod plates, guide rods and steel washers, and shall be fitted with resilient neoprene sleeves and resilient neoprene washers on at least one side of the assembly for isolating vibration transmission.
2. Submissions:
   a. Submit type hydraulic test certificates/reports issued by laboratories that comply with PRE.B9.570;
   b. Submit for Approval the installation length, material, rated movement (axial extension, axial compression, lateral deflection, angular rotation, or any combination thereof) and pressure ratings upon the Contract Manager's request.

PLU1.M240.9 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES AND FITTINGS

1. Pipes: comply with BS EN ISO 15877-2;
2. Fittings: comply with BS EN ISO 15877-3 for pipe fittings;
3. System: comply with BS EN ISO 15877-1 and BS 6920 for non-metallic components in contact with water intended for human consumption;
4. Colour: white unless approved by the CM;
5. Jointing compound: be of a type recommended by the manufacturer of the pipes and fittings;

6. Provide pipe markings in accordance with BS EN ISO 15877-2;
7. Outdoor CPVC pipe and fittings shall be protected from ultraviolet attack by ultraviolet resistant paint or other effective means as recommended by the manufacturer;
8. Bending to CPVC pipe of diameter exceeding 25 mm is not allowed. Where there is site restriction and subject to the CM's approval, bending to CPVC pipe of diameter equal to or less than 25mm may be carried out only in strict accordance with manufacturer's instructions;
9. Mock-up or demonstration of CPVC pipe installation shall be carried out on the Site for the CM's inspection and approval prior to the commencement of installation works.

PLU1.M250.9 POLYTETRAFLUOROETHYLENE (PTFE) TAPES

1. Use PTFE tapes complying with BS 7786 to form a leak-free seal to screw joint;
2. When used under the conditions for which they are designated, PTFE tapes in contact with, or likely to come into contact with potable water shall comply with BS 6920.

FLANGES

PLU1.M310.9 FLANGES

1. Conform to BS EN 1092-1, 2 and 3 PN16 or PN25 to suit the pressure rating of the system;
2. Gasket to BS EN 681-1 and shall be suitable for the operation condition in which they are installed;
3. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name / model name and job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Other specified submission requirements for the materials.
4. On Site Delivery Verification:
   a. At delivery stage, submit the following information for the CM’s information:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (3)(a);
      ii. Original or certified true copy of the Certificate of Origin and batch number for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for material delivered to Site.
   b. Carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on flange	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

ii. Frequency:

Carry out verification for one sample per each type of flange material per every delivery of material to Site under each delivery note. A representative batch means the material of the same type delivered to Site under the same delivery note.

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PLU1.M320.9 PUDDLE FLANGES

1. Unless otherwise specified or Approved, the following pipe connections and all accessories for setting into the tanks shall be provided:

<table>
<tr><td rowspan="3">Pipe Connection</td><td colspan="4">Connection Fittings</td></tr>
<tr><td colspan="2">Fire Services water tank, Rainwater collection tank and Rainwater mixing tank</td><td rowspan="2">Flush water tank</td><td rowspan="2">Fresh water tank</td></tr>
<tr><td>Pipe dia. less than 65 mm</td><td>Pipe dia. from 80 mm and above</td></tr>
<tr><td>a. Tank inlet</td><td rowspan="3">Puddle Flange made of Brass with flange end to BS EN 1092-3 or gunmetal with gunmetal flange end to BS EN 1092-3.</td><td rowspan="3">Puddle Flange made of Spheroidal graphite cast iron (ductile iron) to BS EN 545 with flange end connection to BS EN 1092-2 or gunmetal with gunmetal flange end to BS EN 1092-3.</td><td rowspan="3">Puddle Flange made of Spheroidal graphite cast iron (ductile iron) to BS EN 545 with flange end connection to BS EN 1092-2 or Stainless Steel to BS EN 10088-1 Grade 1.4401 with flange end connection to BS EN 1092-1 or gunmetal with gunmetal flange end to BS EN 1092-3.</td><td rowspan="3">Puddle Flange made of stainless steel to BS EN 10088-1 Grade 1.4301 with flange end connection to BS EN 1092-1 and straight pipe to BS EN 10217-7 or BS EN 10312 Series 2.</td></tr>
<tr><td>b. Tank outlet</td></tr>
<tr><td>c. Drain</td></tr>
<tr><td>d. Overflow</td><td colspan="2" rowspan="3">uPVC pipes to BS 3505 Class E or BS EN ISO 1452-2 Series 6.3</td><td rowspan="3">uPVC pipes to BS 3505 Class E or BS EN ISO 1452-2 Series 6.3</td><td rowspan="3">uPVC pipes to BS 3505 Class E or BS EN ISO 1452-2 Series 6.3</td></tr>
<tr><td>e. Sleeves for level controllers</td></tr>
<tr><td>f. Air vent</td></tr>
</table>

g. Bell mouth perforated dropper	Stainless Steel Pipes to BS EN 10088-1 Grade 1.4301		Stainless Steel Pipes to BS EN 10088-1 Grade 1.4301
h. Gasket	Gasket to BS EN 681-1 and shall be suitable for the operation condition in which they are installed.		

2. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name / model name and job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Other specified submission requirements for the materials.
3. On Site Delivery Verification:
   a. At delivery stage, submit the following information for the CM's information:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (2)(a);
      ii. Original or certified true copy of the Certificate of Origin and batch number for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for material delivered to Site.
   b. Carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on Puddle Flange	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

      ii. Frequency:

      For each of the fresh water, flush water and fire services water applications, carry out verification on one sample for every 10 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material for the same application delivered to Site under the same delivery note.
   c. Where any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PIPE BRACKETS AND SLEEVES

PLU1.M410.A PIPE BRACKETS

1. Be of sufficient strength to take the load with no noticeable deflection with clips detachable without disturbing the fixing;
2. Be of stainless steel at least to BS EN 10088-3 Grade 1.4301 unless otherwise specified;
3. Be welded to stainless steel rods / angles and lined with plastic which fitted between the pipe and the bracket;
4. Bolts, nuts and washers of the pipe brackets: stainless steel at least to BS EN 10088-3 Grade 1.4301;
5. Pattern, type and fixing ends / anchors of the pipe brackets: suitable for mounting onto the surface to which they are fixed;
6. Be with stainless steel nuts and washers to cover the drilled holes for pipe brackets as shown on the Drawings;
7. Submit sample of the pipe brackets and anchors for the CM's approval prior to installation.

PLU1.M420.9 PIPE BRACKET WITH VIBRATION ISOLATOR

1. Vibration isolator:
   a. Unless otherwise specified or approved by the Contract Manager, vibration isolator shall contain a steel spring with minimum 8mm pad of neoprene in series and enclosed in hanger box. The neoprene element shall be moulded with a rod isolation bushing that passes through the isolator hanger box. Spring diameter and isolator hanger box hole sizes shall be large enough to permit the hanger rod to swing through a 30 degrees arc before contacting the edge of the hole and short-circuiting the spring. The minimum static deflection of the spring shall be 20 mm;
   b. Select vibration isolator in accordance with manufacturer's recommendations and taking into account the weight distribution of the pipework, pipe anchor points, guide etc. so as to produce uniform deflections and to ensure that the vibration and noise generated from associated pipework would be isolated and would not be transmitted to other parts of the building, in particular, to avoid causing nuisance to the tenants of the domestic flats;
   c. Be responsible for and submit calculation to verify the correctness of selection and overall suitability of every vibration isolator as shown in the Drawings or specified in clause PLU1.W310 (3).
2. Pipe bracket:

   Details of the pipe bracket to be in accordance with PLU1.M410 wherever applicable;
3. Connection between vibration isolator and pipe bracket:

   Secure the pipe bracket firmly to the vibration isolator in accordance with manufacturer's recommendations.

PLU1.M430.A PIPE SLEEVES

1. Diameter of pipe sleeves: as shown on the Drawings, otherwise at least one size larger than the pipe that passes through with minimum 8.5mm annular space between the pipe sleeve and the pipe;
2. Except for pipes as given in sub-clause (3) below:
   a. For pipes passing through walls, slabs etc. which separate different fire compartments, use sleeves of galvanized steel to BS EN 10255 medium grade for pipe diameter below 150mm and carbon steel to BS EN 10217-1 for pipe diameter up to and above 150 mm. Pre-fabricated sleeves of hot dipped galvanized steel to BS EN 10346 can be used for pipe diameter up to and above 150mm subject to the Contract Manager's approval;
   b. For pipes passing through walls, slabs etc. within the same fire compartment, use sleeves of UPVC pipe to BS 3505 or BS EN ISO 1452-2;
   c. Where UPVC pipe passes through fire rated walls and floor slabs, provide an Approved type fire collar to BS 476-20 with equal or higher fire resistant rating than that of the walls and slabs;
   d. For pipes passing through external walls, use sleeves of UPVC pipes to BS 3505 or BS EN ISO 1452-2.
3. For pipes passing through external basement walls where there is ground water pressure, use gunmetal or stainless steel to BS EN 10088-1 Grade 1.4301 or spheroidal graphite cast iron (ductile iron) to BS EN 545 puddle sleeves cast in basement wall for pipe connection.

PLU1.M440.N COATING OF PIPE BRACKETS FOR PIPEWORKS INSTALLED IN INDOOR AREAS OF DOMESTIC BLOCK

1. All stainless steel pipe brackets for pipeworks installed in indoor areas including but not be limited to indoor communal areas where they can be accessed by the public, water meter cabinets, pipe duct rooms, etc. of domestic block, shall be applied with the Approved coating to the requirements of FIN7.M584 on the surface to maintain the measured insulation resistance between the coated pipe brackets and the main earthing terminal at not less than 45,000 Ohm even under the worst conditions of high environmental moisture such that the pipe bracket can be considered as a non-extraneous conductive part for effective insulation in accordance with the Code of Practice for The Electricity (Wiring) Regulations subject to sub-clauses (2) and (3).
2. Pipe brackets of the following shall be excluded for coating application:
   a. Fresh water pipe installed after water meters of individual flat units on domestic floors with pipe brackets installed in accordance with Master Details REF/B/WS-118;
   b. Fire services galvanized steel pipe with pipe brackets installed in accordance with Master Details REF/B/WS-102.
3. Conditions of pipe brackets required for coating application:
   a. The pipe brackets are installed within 2m from any exposed conductive parts or other extraneous conductive parts;
   b. The pipe brackets can be gripped or contacted by a major surface of human body in excess of 50mm x 50mm.
4. Coating application:
   a. Apply the Approved coating on the stainless steel pipe bracket in factory;
   b. Test each coated pipe bracket in factory by applying 500V D.C. test voltage using a suitably calibrated D.C. insulation tester to verify compliance with the minimum insulation resistance of 45,000 Ohm prior to delivery to Site.
5. Prior to mass application of coating to the pipe brackets, submit the following for approval by the CM:

a. A sample of the stainless steel pipe bracket with the Approved coating applied in accordance with the paint manufacturer's recommendations;

b. A Type Testing Report of Insulation Resistance Test for the submitted sample of pipe bracket in sub-clause (5)(a), demonstrating a measured insulation resistance of not less than 45,000 Ohm.

6. On Site Delivery Verification:

a. For each batch of coated pipe brackets required to achieve the insulation resistance performance, submit a confirmation letter to declare that the coated pipe brackets delivered complied with sub-clause (4) requirements;

b. Carry out testing with a suitably calibrated D.C. insulation tester in the presence of the CM or his representatives on random samples of one in every 100 for each batch of coated pipe brackets delivered to verify that the measured insulation resistance achieved not less than 45,000 Ohm;

c. When any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs and any extra time required.

7. Verification at Sample Floors

a. Carry out testing with a suitably calibrated D.C. insulation tester in the presence of the CM or his representatives on mock up installations for all coated pipe brackets at sample floor(s) or other locations selected by the CM or his representatives to verify that the measured insulation resistance achieved not less than 45,000 Ohm even under the worst conditions of high environmental moisture, prior to mass installation;

b. The testing method for measurement in sub-clause (7)(a) shall be proposed by the Contractor and agreed by the CM.

8. If there is any damage to the paintwork due to transportation from factory to Site, improper handling or storage on Site, subsequent touching up works with Approved paint or replacement works and re-measurement of the insulation resistance. Bear all associated costs and any extra time required.

STRAINERS

PLU1.M510.9 STRAINERS

1. Be of Y-type or U-type (Bucket / Basket type) as shown on the Drawings with minimum free flow area ratio of 2 and the maximum aperture size to be of diameter 1.5mm for strainers of nominal size 100mm or below and of diameter 3.0mm for strainers of nominal size 150mm or above, unless otherwise specified;
2. Have the same nominal sizes as the pipes in which they are connected and shall be suitable for both working and test pressures of the pipework in which they are installed;
3. Be constructed of materials suitable for the required working and test pressures and temperature of the fluid carried with the minimum standards as indicated below:

a. For nominal sizes up to and including 50mm (fresh water, fire services and flush water application):

i. Body & cover: bronze to BS EN 1982 CuSn5Zn5Pb5;

ii. Screen: stainless steel to BS EN 10088-1 Grade 1.4401.

b. For nominal sizes above 50 mm (fresh water, fire services and flush water application:

i. Body & cover: grey cast iron to BS EN 1561 EN-GJL-250, or spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15 or BS EN 1563 EN-GJS-450-15 or BS EN 1563 EN-GJS-500-15;

ii. Screen: stainless steel to BS EN 10088-1 Grade 1.4401;

iii. Drain plug: malleable iron;

iv. Stud and Nut: stainless steel to BS EN 10088-1 Grade 1.4401;

v. Grey cast iron components shall be coated with an epoxy based material as specified in PLU1.M610.

4. All bronze type strainers shall be of screwed female end connection to BS EN 10226-1, 2, 3 and all grey cast iron type strainers shall be of flanged end connection to BS EN 1092-2;
5. U-type strainer shall be equipped with quick release cover composed of clamper and hand nuts which shall be so designed that the basket can be taken out for cleaning without using tools. Appropriate safety mechanism shall be incorporated in the quick release cover;
6. Submit test certificates / reports issued by laboratories that comply with PRE.B9.570 and are acceptable by the Water Authority, confirming that the strainers have been tested in conformity with this Specification;
7. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name / model name and job reference;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. Confirmation of compliance with statutory requirements in writing jointly signed by the Building Services Engineer of the Contractor and the LP;
      v. Other specified submission requirements for the materials.
8. On Site Delivery Verification:
   a. At delivery stage, submit the following information for the CM's information:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (7)(a);
      ii. Original or certified true copy of the Certificate of Origin and batch number for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for material delivered to Site.
   b. Carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on Strainer	Visual	Same as the CM's Approved Sample

		and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

ii. Frequency:

For each of the fresh water, flush water and fire services water applications, carry out verification on one sample for every 10 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material for the same application delivered to Site under the same delivery note.

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

VALVES AND TAPS

PLU1.M610.9 GENERAL

1. Be designed and constructed of materials suitable for both the working and test pressure of the pipework in which they are installed and the temperature of the fluid carried. Be capable of withstanding system working pressure and maximum static pressure that may arise upon failure of the associated pressure reducing devices. Unless otherwise specified, all valves shall have a system working pressure of not less than 16 bar;
2. Comply with the following standards unless otherwise specified:

Size / Valve	For nominal sizes up to and including 50mm	For nominal sizes above 50mm	
		Standard of valve	Grading
Gate valves	Copper alloy to BS EN 12288	Cast iron to BS 5163-1in conjunction with BS EN 1074-1 and 2	Grey cast iron to BS EN 1561 EN-GJL-250 Spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15
Non-return valves	Copper alloy to BS 5154	Cast iron to BS EN 12334	Grey cast iron to BS EN 1561 EN-GJL-250 Spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15
Globe valves	Copper alloy to BS 5154	Cast iron to BS EN 13789	Grey cast iron to BS EN 1561 EN-GJL-250 Spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15
Globe stop and check valves	Copper alloy to BS 5154	N/A	N/A
Ball valves	uPVC to BS EN ISO 1452-4	N/A	N/A

3. Be pressure tested in accordance with the relevant British Standards / European Standards or international / national standards by the valve manufacturer before leaving the factory. Valves of the same type shall be from the same manufacturer;

4. Be of the type approved by the Water Authority. Submit type test reports / certificates issued by laboratories that comply with PRE.B9.570 and are acceptable by the Water Authority, confirming that the valves have been tested in conformity with this Specification. Provide the following type test reports / certificates wherever appropriate:
   a. Test certificates for valves in compliance with the standards quoted in sub-clause (2) above;
   b. Test certificates on composition analysis, chemical, physical and mechanical properties of the metallic materials for valves;
   c. Test certificates for resilient seating material and epoxy coating showing compliance with the physical property and thickness requirements of this Specification;
   d. In case of valves in fresh water application, test certificates issued by Water Regulations Advisory Scheme of UK or an equivalent organization for non-metallic materials of resilient seating and epoxy coating, showing compliance with the full tests of effect on water quality to BS 6920 for non-metallic components in contact with water intended for human consumption and suitable for fresh water usage.
5. Be of the same nominal size as the pipe in which they are installed except those for flow or pressure control such as modulating float valves or pressure reducing valves as shown on the Drawings;
6. Manually operated valves shall be closed by turning the handwheel in a clockwise direction when facing the handwheel. The handwheel shall be made of malleable iron or of composition having metal insert for securing positively to the stem;
7. Be located, as far as practicable, at convenient positions of operation from the floor unless otherwise specified or approved by the CM;
8. All valves shall be provided with an indicator to show the open and shut position;
9. Valves and cocks for installation in screwed joined pipework shall have taper screwed ends. Flanges of flanged valves shall be BS EN 1092-2 for PN16 rating or otherwise specified;
10. All copper alloy valves shall be of screw female end connection to BS EN 10226-1 and all grey cast iron and spheroidal graphite cast iron (ductile iron) valves shall be of the flanged end connections to BS EN 1092-2 and their bolts and nuts shall be to BS EN 1515-1;
11. Grey cast iron and spheroidal graphite cast iron (ductile iron) parts of all valves shall be coated with an epoxy based material both on internal and external surfaces. The following minimum thickness of epoxy coating shall apply:

`	Electrostatically Fusion Powder Coated (µm)	Airless Sprayed Application (µm)
i. Flat and pressurized parts	250	400
ii. Convex outer edges	150	300

12. Be robust and capable of withstanding hard water;
13. The valve and tap materials shall comply with the following requirements:
    a. Submission Requirements;

       At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:

       i. Catalogue, brand name / model name and job reference;
       ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Confirmation of compliance with statutory requirements in writing jointly signed by the Building Services Engineer of the Contractor and the Licensed Plumber;

v. Other specified submission requirements for the materials.

b. On Site Delivery Verification:

i. At delivery stage, submit the following documents for the CM's information:

- Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (13)(a);
- Original or certified true copy of the Certificate of Origin and batch number for every batch of delivery with one batch being the material quantity covered under each delivery note; and
- Delivery notes for material delivered to Site.

ii. For those materials with BSI Kitemark or two stars status under WSD's GA+ Scheme, the Certificate of Origin shall also indicate that they are manufactured from the factory under the corresponding product certification scheme;

iii. Carry out and submit report on the verification of materials as applicable for the material upon delivery to Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications.

14. Sample board:

a. Provide a sample board to display samples of valves and taps to be used in the plumbing installation and listed in the Form WWO 1149 submitted to and approved by the Water Authority;

b. The sample board is to be kept by the CM on Site together with associated relevant certificates / test reports / catalogues / supporting documents upon submission of Form WWO 1149 to the Water Authority;

c. The sample board shall comply with the requirements of the Water Authority. Each sample, with clear numbering and labelling, shall be firmly fixed onto a rigid wooden or metal board. A list shall also be affixed on the sample board to show the item description, make and brand, country of origin and locations of installation;

d. Replace samples and relevant certificates / test reports / catalogues / supporting documents whenever amendment to the Form WWO 1149 is made and approved by the Water Authority.

PLU1.M620.9 VALVES FOR FRESH WATER AND FIRE SERVICES APPLICATION

Be constructed to the following minimum standards, wherever applicable:

1. For nominal sizes up to and including 50mm:

a. Body, bonnet and disc: bronze to BS EN 1982 CuSn5Zn5Pb5;

b. Stem: brass to high tensile brass to BS EN 12163 or BS EN 12164 or BS EN 12167.

2. For nominal sizes above 50mm:

a. Body and bonnet: grey cast iron to BS EN 1561 EN-GJL-250, or spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15 or BS EN 1563-GJS-450 or BS EN 1563-GJS-500;

b. Disc:

i. Material same as body and bonnet and trimmed with bronze to BS EN 1982 CuSn5Zn5Pb5; or

ii. Material same as body and bonnet and encapsulated with resilient material BS EN 681-1, Type WA, Hardness Category "70" with nominal thickness of minimum 1.5mm on the non-seating areas and 4.0mm on the seating areas, and in case for potable water application, showing compliance with full tests of effect on water quality to BS 6920 (no body seat is required); or

iii. Solid bronze to BS EN 1982 CuSn5Zn5Pb5.

c. Body Seat:

i. Bronze to BS EN 1982 CuSn5Zn5Pb5; or

ii. Resilient material to BS EN 681-1, Type WA, Hardness Category "70" with nominal thickness of minimum 4.0mm, and in case for potable water application, showing compliance with full tests of effect on water quality to BS 6920.

d. Stem:

i. For underground application or gate valve installed in fresh water or street fire hydrant system, stainless steel to BS EN 10088-3 Grade 1.4057;

ii. For applications other than that mentioned in sub-clause (2)(c)(i) above, brass to high tensile brass to BS EN 12163 or BS EN 12164 or BS EN 12167 or stainless steel to BS EN 10088-3 Grade 1.4301, 1.4401, 1.4006, 1.4005, 1.4021 or 1.4057.

PLU1.M630.9 VALVES FOR FLUSH WATER APPLICATIONS

Be constructed to the following minimum standards, wherever applicable:

1. For nominal sizes up to and including 50 mm: use uPVC ball valves;
2. For nominal sizes above 50 mm:
   a. Body and bonnet: grey cast iron to BS EN 1561 EN-GJL-250, or spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15 or BS EN 1563-GJS-450 or BS EN 1563-GJS-500;
   b. Disc:
      i. Material same as body and bonnet and trimmed with zinc free bronze to BS EN 1982 CuSn10 or trimmed with austenitic chromium nickel stainless steel or austenitic chromium nickel molybdenum stainless steel to BS EN 10283 Grade 1.4308 or 1.4408; or
      ii. Material same as body and bonnet and encapsulated with resilient material BS EN 681-1, Type WA, Hardness Category "70" with nominal thickness of minimum 1.5mm on the non-seating areas and 4.0mm on the seating areas, (no body seat is required); or
      iii. Solid zinc free bronze to BS EN 1982 CuSn10.
   c. Body Seat:
      i. Zinc free bronze to BS EN 1982 CuSn10 or austenitic chromium nickel stainless steel or austenitic chromium nickel molybdenum stainless steel to BS EN 10283 Grade 1.4308 or 1.4408; or
      ii. Resilient material to BS EN 681-1, Type WA, Hardness Category "70" with nominal thickness of minimum 4.0mm.
   d. Stem: stainless steel to BS EN 10088-3 Grade 1.4301 or 1.4401 or 1.4057.

PLU1.M640.9 NON-RETURN VALVES

1. Be of hinged swing or recoil type suitable for horizontal installations and spring type shall be of globe or wafer type, suitable for both vertical and horizontal installations unless otherwise specified or indicated on Drawings. Hinge pins shall be of brass / bronze for nominal size of 50mm or below and stainless steel for nominal size above 50mm and springs shall be of stainless steel;
2. Be of spring type or recoil type, unless otherwise approved by the CM, if the non-return valve is installed at pump discharge or with a water head exceeding 15 m to ensure silent shut-off operation;
3. Bronze swing non-return valves shall have screwed type cap and cast iron swing non-return valves shall have the cap and body bolted together to ensure a strong, tight closure;
4. Be designed to close before reversal of flow starts;
5. Recoil or spring type non-return valves shall have a flow area not less than the cross-sectional area of the connected pipework and shall be non-slam in operations;
6. Wafer type spring non-return valves will be acceptable, provided the body ends are capable of matching connecting flanges complying with the requirements of BS EN 1092-1, -2 and -3;
7. On Site Delivery Verification:
   a. Further to the submission requirements at delivery stage in PLU1.M610 (13)(b), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on Body & Identification Plate	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

      ii. Frequency:

      For each of the fresh water, flush water and fire services water applications, carry out verification on one sample for every 10 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material for the same application delivered to Site under the same delivery note.

   b. Where any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PLU1.M650.A GATE VALVES, GLOBE VALVES AND GLOBE STOP AND CHECK VALVES

1. Types:
   a. Gate valves: full way solid or split wedge disc type with rising or non-rising stem;
   b. Globe valves: straight globe type with rising stem;
   c. Globe stop and check valves (refers to loose jumper type stopcock as per WSD's requirements): screwdown pattern type with horizontal inlet and outlet connections and incorporating a loose jumper valve permitting flow in one direction only.
2. Provided with an indicator to show the open and shut position at critical locations for cast iron valves as shown on Drawings;
3. For copper alloy type valves, the bonnet shall be of the screwed type with ample threads to ensure positive sealing to the body;
4. For grey cast iron and spheroidal graphite cast iron (ductile iron) type valve, the body and bonnet shall be bolted together and the disc shall be guided;
5. The gland shall be fitted with non-asbestos packing and shall be bolted for grey cast iron and spheroidal graphite cast iron (ductile iron) valves;
6. Gate valve with nominal sizes up to and including 50mm for fresh water application shall be low metal leaching rate metallic plumbing products under the GA* Scheme of WSD.

   Submit at sample submission and approval stage either:
   a. A copy of the Kitemark Certificate or Kitemark Licence, together with the associated test report demonstrating compliance with BS EN 12288, all issued by the British Standards Institution if available for the CM's information; or
   b. Documentation to demonstrate possessing two stars status under WSD's GA+ Scheme for the CM's information; or
   c. Test report issued or certified by the laboratory accepted by the Water Authority demonstrating full compliance with BS EN 12288 for the CM's information.
7. Globe valve with nominal sizes up to and including 50mm for fresh water application shall be low metal leaching rate metallic plumbing products under the GA* Scheme of WSD;
8. Globe stop and check valve with nominal sizes up to and including 40mm for fresh water application shall be low metal leaching rate metallic plumbing products under the GA* Scheme of WSD;
9. On Site Delivery Verification:
   a. Further to the submission requirements at delivery stage in PLU1.M610 (13)(b), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on Body, Handwheel and Identification Plate	Visual	Same as the CM's Approved Sample and Catalogue

Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

ii. Frequency:

- For copper alloy type valves, carry out verification on one sample for every 200 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material delivered to Site under the same delivery note;
- For valve materials other than copper alloy type, for each of the fresh water, flush water and fire services water applications, carry out verification on one sample for every 10 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material for the same application delivered to Site under the same delivery note.

b. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

c. When gate valves and globe valves with nominal sizes up to and including 50mm for fresh water application are used, observe and comply with the requirements of verification test for the gate valves and globe valves delivered to site under PLU1.T096;

d. For globe stop and check valves with nominal sizes up to and including 40mm for fresh water application, observe and comply with the requirements of verification test for the gate valves delivered to site under PLU1.T098.

PLU1.M660.9 BALL VALVES

Use uPVC type ball valves which comply with the following:

1. Valve components:
   a. uPVC;
   b. Ball center-pivoted, smooth and spherical with a circular orifice, and seated on resilient seating suitable for tight shut off;
   c. Stem one-piece with O-ring made of Ethylene Propylene Diene Monomer (EPDM) for positive sealing of the body.
2. Valve operation:
   a. By wrench turned in a clockwise direction to close when facing the wrench;
   b. At fully open position of valve, wrench to be mounted parallel to the flow of passage through the ball;
   c. Wrench to fully close valve at a quarter turn;
   d. Provide suitable stops for both fully open and fully closed positions of valve.
3. Valve end connections and pressure standards:
   a. Socket or union suitable for directly connecting the pipe to which it is installed;
   b. Suitable for both the working and test pressure of the pipework in which it is installed with system working pressure of at least 10 bar at 35ºC unless otherwise specified. Be capable of withstanding system working pressure and maximum static pressure that may arise upon failure of the associated pressure reducing devices;

c. Testing Method to BS EN ISO 1452-4.

4. Test certificate / report:
   a. Submit type test certificates / reports issued by laboratories that comply with PRE.B9.570 and accepted by the Water Authority confirming that the valves have been tested in conformity with sub-clause 3(c).

PLU1.M680.9 DRAW OFF TAPS

1. Comply with BS EN 200, unless otherwise specified or approved by the CM. Be of screw down type, easy-clean pattern body surface, and shall be with chromium plated unless otherwise approved by the CM. Submit sample for Approval prior to installation;
2. Decorative, electroplated materials such as nickel and / or chromium shall not be present on the internal surface of any of the components of the draw off taps that may come into contact with water;
3. On Site Delivery Verification:
   a. Further to the submission requirements at delivery stage in PLU1.M610 (13)(b), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on Body	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

      ii. Frequency:

      Carry out verification on one sample for every 200 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material delivered to Site under the same delivery note.

   b. Where any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

PLU1.M690.9 BALL FLOAT VALVES FOR FLUSHING TANKS

Be of diaphragm type, plastic body to BS 1212-3 with rubber or plastic diaphragm, unless otherwise approved by the Contract Manager and be suitable for high, medium or low pressure as required. Be suitably coated to prevent corrosion on metal parts. Submit valve sample for Approval prior to installation.

PLU1.M700.9 ANGLE VALVE FOR FLUSHING CISTERNS

1. Plastic type angle valve shall be used. It shall be type tested to comply with clause 8.1 on resistance of valve bodies to internal pressure and clause 8.4.2 on seat test of BS EN ISO 1452-4 with the approval of the Water Authority for use in flushing water plumbing system;
2. The valve shall be fully closed with the wrench or handle or knob operates at no more than a half turn;
3. The valve shall be provided with suitable stops for both fully open and fully closed positions;
4. The valve shall be suitable for both the working and testing pressure of the piping system in which it is installed with working pressure of at least 10 bar at 35ºC unless otherwise specified.

FIXED RATIO TYPE PRESSURE REDUCING VALVE

PLU1.M910.9 PERFORMANCE REQUIREMENTS

1. Comply with the following requirements:
   a. Able to maintain the outlet pressure as a fixed ratio of the inlet pressure, independent of the magnitude of the inlet pressure and the water flow across the valve;
   b. Of a size and pressure ratio as specified on the Drawings;
   c. With an operating pressure range suitable for the particular application and a rated system working pressure not less than 16 bar;
2. Submit details of the pressure reduction against flow rate and inlet pressure performance curve and submit test certificates / reports issued by laboratories that comply with PRE.B9.570 and accepted by the Water Authority confirming that the valve has been tested in accordance with the requirements of this Specification.

PLU1.M920.9 FIXED RATIO TYPE PRESSURE REDUCING VALVE

1. Quality Requirements:

   Be of gunmetal body to BS EN 1982 CuSn5Zn5Pb5 (CC491K) for fresh and flush water or stainless steel body to BS EN 10283 Grade 1.4308 for fresh water and to BS EN 10283 Grade 1.4408 for flush water:
   a. Have a piston of straight through design, constructed of stainless steel at least to BS EN 10088-3 Grade 1.4301 for fresh water a BS EN 10088-3 Grade 1.4401 for flush water unless otherwise approved by the CM;
   b. With seats and O-ring seals of high grade synthetic rubber. In case of fresh water application, the non-metallic components / parts including lubricant / grease for PRV shall show compliance with the relevant requirements in BS 6920 as required by the WSD for non-metallic components in contact with water intended for human consumption;
   c. Be provided with an arrow on the exterior to indicate the direction of flow;
   d. Be of flanged end connection to BS EN 1092-1 or BS EN 1092-3 or screwed female end connection to BS EN 10226-1, 2, 3 fitted with suitable adaptor flange to BS EN 1092-1 or BS EN 1092-3 with bolts and nuts to BS EN 1515-1.
2. Testing of valves shall comply to BS EN 1567;
3. On Site Delivery Verification:
   a. Further to the submission requirements at delivery stage in PLU1.M610 (13)(b), carry out and submit report on the following verifications as appropriate for material upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may be present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Material and Packaging	Visual	Same as the CM's Approved Sample
Logo & Label Check	Visual	Same as the CM's Approved Sample
Marking on Valve	Visual	Same as the CM's Approved Sample and Catalogue
Surface Quality	Visual	No damage
Dimension Check	By Measurement	As Specified

ii. Frequency:

For each of the fresh water and flush water applications, carry out verification on one sample for every 100 pieces or part thereof per every delivery of material to Site under each delivery note. A representative batch means the material for the same application delivered to Site under the same delivery note.

b. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be granted.

CISTERNS AND TANKS

PLU1.M1110.9 GENERAL

1. Cisterns and tanks for intended applications shall comply with the requirements of the Water Authority;
2. Lining materials in direct contact with potable water in portable water tanks shall comply with the relevant requirements of BS 6920:2014 as follows:

Type of Internal Lining Material	Testing Standards & Requirements
Tile Grout	BS 6920-1:2014 Clause 4 to 8
Ceramic Tile	BS 6920-1:2014 Clause 8
Paint/Coating	BS 6920-1:2014 Clause 4 to 8
Pre-mixed Cementitious Products	BS 6920-1:2014 Clause 4 to 8

3. Licensed Plumber shall report the details of the lining materials to be used in potable water tanks for plumbing works in Form WWO 1149 for submission to WSD together with Form WWO 46;
4. The cisterns and tanks shall be provided with safety access to the roof of the tank and railings on the roof of the tank as shown on the Drawings for maintenance and cleansing;
5. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:
   i. Catalogue, brand name / model name and job reference;
   ii. Name, address and contact person of the local supplier;
   iii. Name, address and contact person of the manufacturer;
   iv. Test reports or test certificates of lining materials in direct contact with potable water in portable water tanks to demonstrate compliance with sub-clause (2), and the corresponding General Acceptance Letter issued by the Water Authority;
   v. When fibreglass water tank is used, confirmation in writing with a declaration from the manufacturer of the fibreglass water tank that the fibreglass water tank comply with the quality requirement of PLU1.M1120 and contain no toxic material and is suitable for storage of potable water;
   vi. Other specified submission requirements for the materials.

PLU1.M1120.9 STAINLESS STEEL CISTERNS, FIBRE GLASS WATER TANKS, COVERS, TANKS AND CYLINDERS

1. Fibreglass storage cisterns for potable water shall be of an approved type or certified to contain no toxic materials and to be suitable for storage of potable water;
2. For capacity equal to 1000 litres and below, be made of stainless steel to BS EN 10088-4 Grade 1.4301 for fresh water, fire services water and rainwater harvesting systems or to BS EN 10088-4 Grade 1.4401 for flush water system or be made of fibreglass reinforced plastic with minimum 3 mm thickness for fresh water, fire services water, flush water and rainwater harvesting systems;
3. For capacity above 1000 litres, be made of fibreglass reinforced plastic, manufactured to BS EN 13923;
4. Flat bottom and a top cover with suitable reinforcing and bracing;
5. Be non-insulated with no external bracings, ribs, hoops or supporting wires required;
6. Structural calculation shall be submitted at sample submission and approval stage if the capacity of fibre glass water tank exceeds 5000 litres.

PLU1.M1130.9 CISTERN / TANK COVERS

1. For stainless steel water tanks, be fitted with stainless steel access covers and frames, the grading and thickness of stainless steel shall be the same as stainless steel water tanks.;
2. For concrete fresh water, fire services water and rainwater harvesting water tanks, be fitted with stainless steel double sealed access covers and frames, the grading of stainless steel shall be BS EN 10088-3 Grade 1.4301 and with minimum thickness of 3 mm;
3. For concrete flush water tanks, be fitted with stainless steel access covers and frames, the grading of stainless steel shall be to BS EN 10088-3 Grade 1.4401 and with minimum thickness of 3 mm;
4. For fibre glass water tanks, be fitted with fibre glass access covers, the thickness of fibre glass shall be the same as fibre glass water tanks.

STREET FIRE HYDRANTS

PLU1.M1210.9 PERFORMANCE REQUIREMENTS

1. Be of pedestal type complying with the requirements of FSD;
2. Be of an accepted standard pattern with two 65 mm outlets and one 100 mm outlet;

3. Be capable of delivering not less than 2000 litres per minute (33.3 l/s) with a minimum running pressure of 170 kPa at the outlet when tested in accordance with the provision of BS 1042 with one 65 mm outlet working;
4. The minimum output as stated in sub-clause (3) above shall be made available from two 65 mm outlets of a system delivering at same time, i.e. a total output of not less than 4000 litres per minute (66.7 l/s) at 170 kPa;
5. The maximum pressure drop through the street fire hydrant shall not be greater than 380 kPa at a flow of 66.7 l/s with two 65 mm outlets delivering at the same time;
6. Be capable of withstanding a hydraulic pressure of 25 bar;
7. Should either flow or pressure performance as specified in sub-clause (3) or (4) above is found unsatisfactory in flow test resulting from the pressure drop across the street fire hydrant, the hydrant shall be replaced at no additional cost to the Contract.

PLU1.M1220.9 HYDRANT CONSTRUCTION

Be constructed of materials with the following minimum standards:

1. Hydrant body: ferrous casting to BS EN 1561 - Grey Cast-iron Castings, Grade EN-GJL-250 (5.1301) or BS EN 1563 spheroidal graphite cast iron (ductile iron) with a density of not less than 7200 kg/m³;
2. Caps: spheroidal graphite cast iron (ductile iron) casting to BS EN 1563 of Grade EN-GJS-450-10;
3. Inlet: 150mm PN16 flange to BS EN 1092-2;
4. Outlet pieces: bronze casting to BS EN 1982 for CuSn10Pb10-C (CC480K) with zinc content not exceeding 2 %; two 65 mm and one 100 mm male thread outlets to BS 336;
5. Screw for fixing outlet pieces: M20 stainless steel countersunk square head type to BS EN 10088-3 Grade 1.4301 with the square head being cut off after the tightening of the screws;
6. Rubber gaskets to BS EN 681-1:
   a. 2 mm thick rubber insertion between the body and the outlet pieces; and
   b. 6 mm thick rubber insertion between the outlet pieces and the caps.
7. Chains: stainless steel chains attaching the caps to the hydrant body to BS EN 10088-3 Grade 1.4301;
8. Internal protection: coating to BS EN 10300 Category 1, grade c or BS 3416 type 1;
9. Painting:
   a. One coat primer of epoxy resin with aluminium mastic paint (of colour different from the undercoat);
   b. One undercoat of epoxy resin paint of grey colour with a minimum total dry film thickness of 280 µm (including the coating thickness of item (a);
   c. One finishing coat of epoxy resin paint of colour to suit FSD requirements.

PLU1.M1230.9 TEST CERTIFICATE

Submit test certificate / report for hydraulic pressure test, ferrous and non-ferrous castings, coatings and dimensions from laboratories that comply with PRE.B9.570 confirming that the street fire hydrant has been tested conforming to this Specification.

WORKMANSHIP

GENERAL

PLU1.W010.9 SITE STORAGE

1. Prior to installation, store all materials properly in accordance with the manufacturer's instructions to afford maximum protection against weather, corrosion, mechanical damage and other causes;
2. Store all pipes with closed ends;
3. Store pipes and fittings under cover and clear of a levelled, well-drained and maintained hard-standing ground;
4. Remove all damaged materials from site immediately.

PLU1.W020.9 SITE CLEANLINESS

1. Clean all pipes and fittings before erection to remove all scale, burrs, furs, sand, slag etc.;
2. Maintain cleanliness throughout erection by covering the exposed ends of the pipework.

PLU1.W030.9 PIPEWORK INSTALLATION

Unless otherwise specified, carry out pipe joint installation in accordance with BS EN 806-4.

PLU1.W040.9 PIPEWORK ROUTING

1. Coordinate the pipework installation with the work of other trades, services and structural beams and to allow for diversion of pipework to ascertain that the overall pipework is installed in a neat and tidy manner;
2. Cross-over of pipe to be kept minimum;
3. Avoid pipe runs above electrical installation as far as practicable;
4. Drawings supplied are diagrammatic and indicate only the approximate location and manner in which the pipework is to be installed.
5. Labeling system shall be provided on pipes inside pump rooms and at the lowest and highest locations of typical floors. Legibly marked with the black or white letters and arrows to indicate the type of service and direction of flow.

PLU1.W050.9 VENTING

1. Automatic air vents shall be provided as specified and at all high points of the system as shown on the Drawings;
2. Connections to the service pipes shall be made at the highest point to ensure complete venting. Automatic air vents shall be mounted so that the inlet connection is in an exact vertical plane. A lock shield valve shall be located between the service pipe and the automatic air vent;
3. Automatic air vents for water systems shall have bodies of brass, gunmetal or malleable iron, non-ferrous or stainless steel floats and guides, and noncorrodible valves and rubber seats. Connections to the pipework shall be via a screwed BSP (British Standard Parallel) or NPT (National Pipe Thread Tapered Thread) connection.

PLU1.W060.9 EASE OF DISMANTLING

Unless otherwise Approved, do not embed pipes in concrete or grout in or install in such a way as to make alterations difficult at a later date.

PLU1.W070.9 BENDS AND OFFSETS OF COPPER PIPEWORK

1. Bends and offsets of up to 90° can be formed in pipe sizes 15mm to 28mm provided they:
   a. Have a minimum centre line radius of more than or equal to 3.5 times the pipe diameter;
   b. Are only formed using tools specifically designed for that purpose, i.e. spring benders and formers;
   c. Are free of deformation that may restrict water flow.
2. Bends and offsets of up to 30° and have a minimum centre line radius of more than or equal to 3.5 times the pipe diameter can be formed in pipe sizes less than or equal to 28mm by heat bending / annealing techniques without the need for bending tools;
3. Where building design permits, offsets shall be achieved using 45° in preference to 90° bends.
4. The installations location of bends and offsets for the above mentioned shall be subjected to the Contract Manager approval.

PLU1.W080.9 COPPER PIPEWORK REQUIRING POLYETHYLENE SHEATH

1. Do not remove or damage the polyethylene sheath where bends are formed in copper pipes with factory applied polyethylene sheath;
2. Terminate factory applied polyethylene sheath at a consistent/uniform distance not more than twice the diameter of the pipe from the connecting copper fitting body.

PLU1.W090.9 UNDERGROUND PIPES

Follow procedures and requirements specified in Worksection DRA2 for excavation of underground pipes directly in trench.

PLU1.W100.9 PIPES ON FLAT ROOFS AND CANOPIES

Support pipes on flat roofs and canopies at least 150 mm above roof and canopy finish on concrete blocks with pipe clamps.

PLU1.W110.9 INSTALLATION CONTRACTOR AND ATTENDANCE FOR COMPLIANCE WITH REQUIREMENTS OF THE WATER AUTHORITY

1. Carry out all plumbing installation works mentioned in this Specification and shown on the Drawings, including, if applicable, connection work to the water town mains by contractors and associated Licensed Plumbers (LP) as approved by the Water Authority;
2. All fresh and flush water supply installations commencing from the government mains at the entry of site boundary to and including individual sanitary fixtures, gas water heaters and taps required under the Contract as described in PLU1.G010 (1)(a) shall be carried out by a plumbing installation sub-contractor and the associated LP employed under PLU1.G012 (1). The associated LP should have obtained Level 2 or above in English Language in the Hong Kong Diploma of Secondary Education Examination (HKDSEE), or Grade E or above in English Language (Syllabus B) in the Hong Kong Certificate of Education Examination (HKCEE), or equivalent. In case the LP cannot meet such requirement, the Contractor or the plumbing installation sub-contractor employed under PLU1.G012 (1) shall provide a competent personnel (e.g. registered engineer, relevant site personnel) with equivalent qualification in English to support the plumbing installation and associated works handled by the LP;

3. Submit and update all necessary applications and forms to the Water Authority and attend upon their representative for the purpose of tests and inspections for the plumbing installation. All applications and forms for submission to WSD shall be submitted to the CM for comment before submission to WSD and record after approval;
4. The LP referred to in sub-clause (1) shall:
   a. Submit material list to WSD under Form WWO 1149 and subsequent update as soon as the proposed materials, and / or proposed change of approved materials, which are approved by the CM, and before placement of order for such materials;
   b. Ensure that all pipes and fittings have been acknowledged by the Water Authority with permission given for proceeding with the approved plumbing works before installation;
   c. Carry out mandatory lead check for soldering materials in pipe-fittings with integral solder ring upon delivery to Site according to WSD's Guide to Application of Water Supply. Keep the batch delivery inventory record and the corresponding lead check test results with record photos of every batch of pipe-fittings with integral solder materials for subsequent inspections by the Water Authority when requested. Submit test records of lead checks for each batch of pipe-fittings with integral soldering materials to Water Authority together with Form WWO 46 Part IV;
   d. Supervise all plumbing installation works under his charge with attendance record submitted to the CM on monthly basis after commencement of plumbing installation works on Site;
   e. Keep photo record of all completed cleansing and disinfection of fresh water inside service and submit it to the Water Authority upon request according to WSD's requirement;
   f. Attend the Contractor's regular site meetings with Nominated Sub-contractors, Direct Contractors and utility undertaking as appropriate;
   g. Submit monthly report on quality control and progress for review at the site meetings. The report shall include progress of plumbing works, LP's site inspection and site attendance records, record of material quarantine and verification tests, updated WSD submission record etc.;
   h. Attend regular site meetings if required by the CM;
   i. Upon completion of the plumbing installation works:
      i. Submit LP's inspection report of the completed plumbing installation;
      ii. Declare that all pipes and fittings installed on Site have been approved by the Water Authority and registered with WSD under Form WWO 1149;
      iii. Declare that only cadmium-free category brazing alloy and lead-free category soldering alloy are used;
      iv. Declare that all pipes and fittings installed and any materials used for the construction and installation of the plumbing works are as prescribed by the Waterworks Regulations and approved by the Water Authority.
   j. Attend all WSD inspections.
5. The Contractor shall monitor the LP's carrying out of duties as specified in sub-clause (4) above and ensure plumbing works under the LP are in full compliance with the Specification and as prescribed by the Waterworks Regulations;

6. The Contractor shall monitor the LP's submission to WSD related to the Works. Contractor shall check the validity of the WSD Form and attachments before onward submission to the CM for comment / signing. The Contractor's checking of the WSD submission forms, with declaration that the materials used and the construction of the plumbing works described therein are as prescribed by the Waterworks Regulations, shall be recorded in a standard form in PLU1.APPEND1 which shall be jointly signed by the LP and the Contractor and submitted to the CM for record;
7. The Contractor shall verify that the LP's declaration under sub-clause (4)(h) are valid. The verification and the declaration shall be recorded in a standard form in PLU1.APPEND2 which shall be jointly signed by the LP and the Contractor and submitted to the CM for record.

PLU1.W120.9 REGISTERED FIRE SERVICES CONTRACTOR

Employ a registered Fire Services Contractor to carry out the installation work, subsequent testing and commissioning and make necessary submissions to FSD for the fire services installation carried out by Main Contractor such as street fire hydrant system and up-feed riser pipe to storage/transfer tank.

FIXED RATIO TYPE PRESSURE REDUCING VALVE

PLU1.W130.9 MAINTENANCE REQUIREMENT DURING MAINTENANCE PERIOD

The Contractor shall visit the PRV installations half-yearly to carry out the following works:

1. Inspect pipes, valves, fittings and PRV according to manufacturer recommendation to ascertain that there is no seepage at the connecting joints or the breather hole of the PRV;
2. Inspect the upstream and downstream water pressure gauges to ascertain that the PRV under water supplies is functioning in a desirable range of working pressure. Provide labels and colour indicators to clearly indicate the working pressure range;
3. If inspection result reveals that there is inadequate (i.e. less than 80% of the required pressure reduction) or no reduction in system pressure or seepage is present at the connecting joint or breather hole of the PRV, to proceed with the following:
    a. Dismantle the PRV by disconnecting screw connector / seat holder / locking bush at both ends, and take out the piston and spring (if any) from the casing body;
    b. Thoroughly cleanse all removable parts, pistons, springs and the inside of the casing body and cover to remove all mud, dirt or other foreign matters;
    c. Replacing any elastic components / parts such as rubber / EDPM etc. including O-ring / seat rings / disc gaskets that are damaged, defective or missing. Lubricate such rings with appropriate grease as recommended by the supplier. In case of fresh water application, the replacement of non-metallic components / parts including lubricant / grease for PRV for use in contact with cold water intended for human consumption shall show compliance with the full tests of effect on water quality to BS 6920;
    d. Thoroughly cleanse and removing any surface oxidation / corrosion on the external surface of the PRV;
    e. Re-assemble the PRV to ensure that the joints are properly connected, there is no leakage and the pressure readings are in order. Replace any defective flange gasket or bolts / nuts. Keep the breather hole free of obstruction.

4. If the PRV is beyond repairs, replace the defective PRV with a new one which is in compliance with the Specification. If the pressure gauge is broken, faulty or leaking, replace the defective pressure gauge with new one which is in compliance with the Specification. Replace any pipes, valves, fittings and PRV parts that are found defective and suspected of being defective;
5. Submit Maintenance Report together with records of water pressure readings to the CM within 7 days upon completion of the half-yearly maintenance or rectification work.

PIPE JOINT

PLU1.W210.9 GENERAL

1. Unless otherwise specified, store, handle and joint pipes and fittings in accordance with manufacturer's recommendations;
2. Do not make pipe joints in the thickness of any wall, floor, ceiling or beam;
3. Provide expansion joint for all pipework passing through any building expansion joint.

PLU1.W220.9 JOINTING GALVANIZED STEEL PIPES

1. Unless otherwise Approved, joint galvanized steel pipes of sizes up to and including 100mm with screwed fittings. Use screwed flanges only for connection to flanged end valves or equipment;
2. Unless otherwise Approved, joint galvanized steel pipes of size of 150mm and above with screwed fittings, screwed flanges or flanged fittings;
3. Do not joint galvanized steel pipes by welding unless approved by the CM;
4. Screwed fittings shall have pipe threads complying with BS EN 10226-1, 2, 3. Screwed joints shall have tapered threads and shall be made with Approved jointing material;
5. As an alternative to flanged and screwed joints, grooved end mechanical couplings may be employed subject to the approval of the CM:
    a. Before couplings are assembled, pipe ends and outsides of gaskets shall be lightly coated with suitable lubricant or graphite paste to facilitate installation;
    b. Pipe grooving shall be carried out by using proprietary grooving machine and in accordance with the pipe coupling manufacturer's latest specifications. The grooving shall be roll-grooved without the removal of any metal. Zinc coating damaged during the grooving operation of galvanized steel pipe shall be rectified by scrubbing clean the affected area and coated with a zinc rich galvanizing paint as recommended by the pipe manufacturer's subject to the approval by the CM;
    c. Unless otherwise specified, all mechanical couplings and fittings shall have a minimum system working pressure of not less than 1600kPa and the testing pressure shall not be less than 1.5 times the system working pressure;
    d. The electrical continuity of the mechanical couplings shall be effective and shall be verified by site measurement;
    e. The mechanical couplings and fittings shall comply with standards acceptable to Fire Services Department (FSD);
    f. The entire coupling installation shall be in accordance with the latest published selected manufacturer's recommendations.

PLU1.W230.9 JOINTING DUCTILE IRON PIPES

Unless otherwise specified, joint all ductile iron pipes as follows:

1. For above ground installation: with screwed flanges or flanged fittings;

2. For below ground installation: with flexible push-on type connection joints;
3. At master water meter and check meter positions: with slip-on flange adaptor in accordance with the requirements of Water Authority and as shown on Drawings;
4. Equip slip-on flange adaptor with guide rod assembly between flanges consisting of guide rod plates, at least three guide rods each of minimum 16mm diameter and washers all as shown on the Drawings. The guide rod assembly shall be made of stainless steel at least to BS EN 10088-3 Grade 1.4401. After installation of slip-on flange adaptor, fix and leave the guide rod assembly in position to prevent damage to the adaptor from excessive movement;
5. Provide durable marking on the pipe body to indicate the installed position of the slip-on flange adaptor for future checking of any dislocation of the adaptor;
6. After installation of all slip-on flange adaptors in a master water meter room or a check water meter cupboard/chamber, the Contract Manager shall select one installed slip-on type flange adaptor to be disconnected for checking the lap length of the adaptor on the pipe against the manufacturer's recommendation. Upon the Contract Manager's satisfaction on the lap length, connect the ductile iron pipes of the master water meter room or check water meter cupboard/chamber to the water supply.

PLU1.W250.9 JOINTING COPPER PIPEWORK WITH COPPER ALLOY CAPILLARY FITTINGS BY BRAZING

Follow the following procedures:

1. Apply flux to the tube spigot and fitting socket when brazing;
2. Remove residual flux after brazing.

PLU1.W260.9 JOINTING COPPER PIPEWORK BY SOLDERING

Follow the following procedures:

1. Remove copper oxide and dirt from pipe spigot and fitting socket prior to the application of soldering flux;
2. Apply flux sparsely and remove excess flux prior to heating;
3. Clean pipe joints with a damp cloth on completion to remove flux residues.

PLU1.W270.9 CAPILLARY TYPE JOINTS AND FITTINGS OF SHEATHED COPPER PIPEWORK

Fit "clip-on" type preformed polyethylene sheaths to cover the capillary type joints and fittings after jointing of the pipework.

PLU1.W290.9 JOINTING STAINLESS STEEL PIPES

1. Unless otherwise Approved, joint stainless steel pipes with nominal outside diameter up to and including 54mm with compatible stainless steel non-welding type fittings with stainless steel O-rings or nitrile rubber (NBR) O-rings and silicone gaskets.
2. Unless otherwise Approved, joint stainless steel pipes with nominal outside diameter above 54mm with compatible stainless steel non-welding type fittings with couplings and silicone gaskets.
3. Joint stainless steel pipes to ductile iron pipes with purpose made stainless steel flange adaptor in accordance with the manufacturer's recommendations.
4. All pipe installation to be carried out in strict accordance with the manufacturer's instructions. In addition to the requirements on Trade Tested Workers as specified in PRE.B6.065, all workers carrying out stainless steel pipes installation shall have received relevant training and be certified by recognised local institution, trade union or the pipe supplier.

5. All pipes shall be cut to square ends, free from harmful burrs and be prepared in accordance with the manufacturer's recommendations. Purpose made equipment recommended by the manufacturer shall be used for cutting the pipes and shall be submitted for the Contract Manager's approval.
6. All grooves on the pipes shall be roll-formed in accordance with the manufacturer's standards and recommendations. Purpose made equipment recommended by the manufacturer shall be used for forming the grooves and shall be submitted for the Contract Manager's approval.

PLU1.W291.9 JOINTING UNPLASTICIZED PVC (UPVC) PIPES

1. All pipes shall be cut to square ends, free from harmful burrs and be prepared in accordance with the manufacturer's recommendations. Purpose made equipment recommended by the manufacturer shall be used for cutting the pipes and shall be submitted for the CM's approval;
2. All uPVC pipes shall be jointed with sockets and fittings and as recommended by the uPVC pipes manufacturer;
3. Solvent cementing shall be used for all pipeworks. All the surfaces shall be cleaned with abrasive paper and spirit cleaner. In the application of solvent cementing, heat shall be avoided as the cement may dry before chemical bonding between the two surfaces is completed. Mating surfaces shall be turned for even spread of the solvent. Excessive cement shall be wiped off quickly;
4. Flanged joints shall be used where solvent cementing is not practicable and at locations to facilitate dismantling. Neoprene ring gaskets provided or approved by the flange manufacturer shall be used between flanges. The jointing compound for the pipe and flange must be applied in accordance with the jointing compound manufacturer's recommendation.

PLU1.W292.9 JOINTING CHLORINATED PVC (CPVC) PIPES

1. Use jointing compound as recommended by the manufacturer of the pipes and fittings. For pipe size above 50mm, primer is needed to prepare the bonding area for the additional of the cement. Refer to the manufacturer's recommendations for safety handling;
2. For solvent cementing, the solvent cement set and cure time shall be strictly conformed to the manufacturer's instructions; whereas, the required prolonged set and cure time shall be consulted and acquired from the manufacturer when the relative humidity is higher than 85% and / or the ambient temperature is below 10ºC;
3. After the pipework is installed and all solvent cement is fully cured, the system shall be pressure tested and checked for leaks using water. The method to test the water leakage of the system shall be carried out in accordance with the manufacturer's recommendations.

PLU1.W293.9 JOINTING CHLORINATED PVC (CPVC) PIPES TO DUCTILE IRON PIPES

1. Use CPVC flange joint as recommended by the manufacturer of the pipes and fittings for jointing CPVC pipes to ductile iron pipes of compatible size;
2. Flange joints shall incorporate an electrometric gasket between the mating faces to provide for seal. The gasket selected must be full-faced and have the hardness and thickness recommended by the manufacturer;
3. Flange joints shall be carefully aligned and the bolts inserted through matching holes. A flat washer shall be used beneath each nut and bolt head. The required bolt torque shall be carried out in strict accordance with the manufacturer's instructions.

PLU1.W294.9 JOINTING CHLORINATED PVC (CPVC) PIPES TO UNPLASTICIZED PVC (UPVC) PIPES

1. Use jointing compound as recommended by the manufacturer of the pipes and fittings for jointing CPVC pipes to uPVC pipes of compatible size. For pipe size above 50 mm, primer is needed to prepare the bonding area for the additional of the cement. Refer to the manufacturer's recommendations for safety handling;
2. Joint CPVC pipes to uPVC pipes of incompatible size with purpose made CPVC adaptor in accordance with the manufacturer's recommendations;
3. For solvent cement joints, the solvent cement set and cure time shall be strictly conformed to the manufacturer's instructions; whereas, the required prolonged set and cure time shall be consulted and acquired from the manufacturer when the relative humidity is higher than 85% and / or the ambient temperature is below 10ºC;
4. For threaded pipe fittings, all taper pipe threads shall be gauged in accordance with ASTM F1498;
5. After the pipework is installed and all solvent cement is fully cured, the system shall be pressure tested and checked for leaks using water. The method to test the water leakage of the system shall be carried out in accordance with the manufacturer's recommendations.

PIPEWORK SUPPORTS

PLU1.W310.9 GENERAL

1. Support pipework in such a manner as to allow adequate movement for expansion and contraction;
2. Add neoprene or rubber to BS ISO 2028 vibration isolation pad of 6 mm thick between the pipe and bracket for the section of up-feed riser pipe running through the floor from outside the pump room to where the flexible connector is installed;
3. Do not mount pipe bracket inside pump room on wall and ceiling as far as practicable. If unavoidable, add neoprene or rubber to BS ISO 2028 vibration isolation pad of 6mm thick between the pipe and bracket for brackets mounted on wall; and add vibration isolator as PLU1.M420 for brackets mounted to ceiling or steel support frames;
4. Do not fix pipe bracket to copper pipe by means of brazing or soldering;
5. Provide pipe brackets at both sides of a metal valve installed in uPVC pipes of any size and other types of pipes with nominal size of 80mm or above;
6. Provide pipe brackets at both sides of a turning point of uPVC flush water pipe riser and down pipe at communal area;
7. Provide pipe brackets at both sides of a turning point before and after the check water meter position with slip-on flange adaptors installed.
8. Provide duct foot bend fittings and support at the lowest end of water risers of 80mm diameter and above. Fittings shall be constructed of materials suitable for use in the system and shall be capable of withstanding the system working pressure. Fittings shall be connected to the riser pipes with flange joints.

PLU1.W320.9 PIPE BRACKET INTERVALS

Install pipe bracket at intervals not exceeding those shown in the following table for straight runs, and with not less than one bracket per length of pipe. Short length of pipe can be without pipe bracket if approved by the Contract Manager. Support all pipework to ensure that it is free from excessive stress due to the weight of its contents, its own dead weight, and dynamic forces due to liquid movement and take particular care to ensure that the branch is not supporting the riser.

Pipes	Nominal	Maximum Spacing (mm)	
	Size (mm)	Vertical Pipes	Horizontal Pipes
Ductile Iron	80 and 100 150	2700 3600	2700 3600
Steel	15 20 and 25 32 40 and 50 80 100 150	2400 3000 3000 3600 4500 4500 5400	1800 2400 2700 3000 3600 3900 4500
Copper	15 22 and 28 35 and 42 54 67 to 133 159	1800 2400 3000 3000 3600 4200	1200 1800 2400 2700 3000 3600
UPVC	up to 25 32 40 and 50 65 to 150	1500 1800 2000 2500	750 900 1000 1200
CPVC	With reference to manufacturer's recommendation		

PLU1.W330.9 ADDITONAL REQUIREMENTS INSIDE MASTER WATER METER ROOM AND IN OPEN TRENCH FOR WATER SUPPLY PIPES

1. Support pipes and valves at required levels by Grade 20/20D precast concrete wedges, blocks or cradles as Worksection CON1, or by other methods approved by the CM. Provide at least one support for each section of pipe and for each valve. The spacing between supports shall not exceed 3 m. Provide mounting brackets to support, and to constraint and limit movement of pipes;
2. Support bends and tees at required levels by 20/20D concrete thrust blocks as Worksection CON1; and embed bends and tees in Grade 20/20D concrete surround as Worksection CON1, for the full length of each thrust block. For vertical bends and tees where thrust blocks cannot be used, provide pipe brackets at both ends, if applicable, of each bend and tee to restrain and limit the movement of pipes;
3. All supports and brackets shall not obstruct the fixing and unfixing of bolts and nuts in the disconnection and reassembly of flange joints;
4. All concrete supports shall be anchored onto the floor by dowel bars except removable concrete supports at check meter positions as required by the Water Authority;
5. Design and submit layout and structural details of all concrete supports and sizes of mounting brackets to the CM for approval prior to any pipework installation.

PIPE SLEEVE

PLU1.W410.9 FIXING PIPE SLEEVES

1. Where pipes pass through walls, beams and floor/ceiling slabs, provide and fix sleeves with uniform annular clearance to allow for expansion and movement of pipe;
2. For pipes passing through walls and beams, fix sleeves that flush with the finished surfaces;

3. For pipe passing through floor slabs, fix sleeves in position with 100 mm projection above finished floor level and flush with the underside of the floor.

PLU1.W420.A CAULKING PIPE SLEEVES AND PUDDLE SLEEVES

1. For metal sleeves used in walls and slabs within the same fire compartment, fill the full length of annular space between the sleeve and the pipe with mineral wool or Approved equivalent materials. Caulk both ends with mastic sealant;
2. For metal sleeves used in fire-rated walls and slabs within the same fire compartment, fill the full length of annular space between the sleeve and the pipe with non-flammable mineral wool or Approved equivalent materials. Caulk both ends with fire-rated mastic sealant which is durable and effective in sound insulation to maintain the required FRP of the walls/floor slabs;
3. For metal sleeves used in walls and slabs between fire compartments, fill the full length of annular space between the sleeve and the pipe with non-flammable mineral wool or Approved equivalent materials. Caulk both ends with fire-rated mastic sealant which is durable and effective in sound insulation to maintain the required FRP of the walls/floor slabs;
4. For UPVC pipe sleeves used in external walls, fill the annular space between the pipe sleeve and the pipe with proprietary waterproof filling mortar or polyurethane foam and caulk both ends with mastic sealant;
5. For puddle sleeves passing through external basement walls, gap between the sleeve and pipework shall be filled with mastic sealant approved by the Contract Manager.

PAINTING

PLU1.W510.9 GENERAL

Paint all pipes where specified in accordance with Worksection FIN7.

INSTALLATION OF VALVES

PLU1.W610.9 GENERAL

Unless otherwise specified, install the valve in accordance with manufacturer's recommendations.

PLU1.W620.9 NON-RETURN VALVE

When valve is installed vertically, ensure water flow is in an upward direction.

STREET FIRE HYDRANTS

PLU1.W720.9 FIXING

Install the street fire hydrant and associated valves as shown on the drawings given in the Water Authority Standard Drawings [Section 1 – Mainlaying] and FSD requirements.

PLU1.W730.9 ANNUAL INSPECTION, FINAL ACCEPTANCE TEST AND CERTIFICATE OF FIRE SERVICE INSTALLATIONS AND EQUIPMENT

1. Carry out annual inspection in accordance with Fire Services Department (FSD)'s requirements;
2. Comply with the following at the end of the Maintenance Period:
   a. Maintain the street fire hydrants in good condition;
   b. Carry out the final acceptance test for the street fire hydrants;

c. Submit the Certificate of Fire Service Installations and Equipment (F.S. 251) to FSD.

3. Submit a copy of the Certificate (F.S. 251) to the Contract Manager within 14 days after the annual inspection and the final acceptance test respectively;
4. Copy, frame and display the Certificate (F.S. 251) together with a list of the fire services installation and equipment in a prominent area in accordance with the Contract Manager's instruction.

MAINTENANCE REQUIREMENT DURING MAINTENANCE PERIOD

PLU1.W750.9 STOP VALVES MANAGEMENT SYSTEM

1. Formulate a Stop Valves Management System (SVMS) as per FSD's requirements for fire hydrant / hose reel and street fire hydrant systems (FH/HR and street FH systems), except those SVMS carried out by the Fire Services and Water Pump Nominated Sub-contractor, to facilitate the future estate / property management to monitor the status of the stop valves (SV) of the FH/HR and street FH systems including but not limited to connection piping from Master Water Meter Room to Fire Service Upfeed Pump Room, upfeed piping and street fire hydrant systems, under Worksection PLU1;
2. Under the SVMS, SVs refer to all essential valves which have to be kept open for proper functioning of the systems;
3. Contractor's responsibilities under the SVMS are as follows:
   a. Keep track of the maintenance services and operation of the SVs for each of the FH/HR and street FH systems as required in a log book, which shall be submitted to the CM after completion of the Works for future maintenance and management of the systems;
   b. Provide each stop valve with a pull-up tamper-proof seal security tag using steel wire-rope with pad lock and labelling with unique tag number and a durable warning label placed inside a durable and readable plastic bag;
   c. Each stop valve shall carry an identification label with estate code, block code, floor number and valve number assigned by the Estate Management for easy identification and traceability of records. For SVMS hidden inside false ceiling or covered up area, a label shall be posted at a prominent location to show the position of the hidden SVMS;
   d. Affix a "Normally Open" weatherproof label to the valve body of each SV confirming the valve status;
   e. Maintain a proper registry of the serial numbers of the security tag. The registry shall be submitted to the CM after completion of the Works for future maintenance and management of the systems.
4. Co-ordinate with the Fire Services and Water Pump Sub-contractor to provide a dedicated cabinet for safe custody of keys of padlocks and registry information of the security tags provided by the Contractor and the Fire Services and Water pump Sub-contractor as specified;
5. Carry out regular monthly maintenance visits to ensure the SVs of the FH/HR and street FH systems are in proper operating status.

TANKS

PLU1.W810.9 CONNECTION TO CONCRETE TANKS

Unless otherwise specified or Approved, use puddle flange in accordance to PLU1.M320 for connection to tank.

COMMISSIONING REQUIREMENTS

PLU1.W910.9 GENERAL

1. Upon completion of installation of inside services, submit application to WSD for inspection and approval of the plumbing works. Comply with the WSD's latest commissioning requirements for new plumbing works, in particular the newly installed inside services for potable water purposes;
2. After satisfactory completion of WSD's final inspection, carry out systematic flushing, cleansing and disinfection of the installed fresh water mains and inside services before water supply is effected by the Water Authority as follows:
   a. Follow the WSD's latest requirements and protocol including but not limited to systematic flushing, cleansing, disinfection, testing and inspection. The fresh water mains or inside services shall be put into operation within 7 days after the successful disinfection. Result of analysis shall be submitted to the CM in parallel;
   b. Prior to commencement of the systematic flushing, cleansing and disinfection works, submit for the CM's information a detailed action plan which shall include but not be limited to the following items:
      i. Show the extent and sequence of systematic flushing, cleansing and disinfection work with vertical plumbing line diagram;
      ii. Provide programme and method statement for systematic flushing, including arrangement with WSD for provision of temporary water supply for systematic flushing if needed;
      iii. Provide programme and method statement for cleansing and disinfection of fresh water inside services and testing procedures for verifying the dosage of chlorine and residual chlorine level;
      iv. Agree with the Water Authority the locations for collecting water samples for bacteriological and chemical analysis;
      v. Liaise with the accredited laboratory for carrying out the sampling and analysis.
   c. Carry out systematic flushing of the installed fresh water inside services according to PLU1.W912;
   d. Carry out cleansing and disinfection of the installed fresh water inside services according to PLU1.W920. Cleansing and disinfection shall be in following sequence: sump tanks, up-feed pipework, roof tanks, down-feed pipework and finally plumbing fixtures and appliances;
   e. Carry out water sampling test in accordance with WSD's latest protocol and guidelines for water sampling and testing as per PLU1.T070 (1). Results of all water samples shall meet the WSD's latest testing parameters and acceptance criteria;
   f. If the result(s) of any water sampling tests failed to comply with WSD's acceptance criterion, carry out flushing, cleansing and disinfection as appropriate for the part(s) of constructed potable water inside services represented by the failed sample(s) and collect water sample(s) at the same location(s) of failed sample(s) for retesting in accordance with the latest WSD's requirements;
   g. Allow time and resources for carrying out systematic flushing, cleansing, disinfection and water sampling tests in compliance with WSD's latest commissioning requirements for the installed inside services;

h. Result of analysis of cleansing and disinfection shall be endorsed by the Licensed Plumber as true record and submitted to the CM.

3. Carry out cleansing and flushing of all the water mains and inside services of flush water system and rainwater harvesting system after completion of the systematic flushing, cleansing and disinfection of fresh water inside services as per sub-clause (2)(c) and (2)(d) and before water supply is effected by the Water Authority as follows:
   a. Cleanse all the tanks and associated pipework of the flush water system and rainwater harvesting system according to PLU1.W950;
   b. Cleansing and flushing of flush water system shall be in following sequence: sump tanks, up-feed pipework, roof tanks, down-feed pipework and finally plumbing fixtures and appliances;
   c. Cleansing and flushing of rainwater harvesting system shall be in following sequence: roof collection tanks, break tank, mixing tank, up down-feed pipework and finally water irrigation point.
4. Allow time and resources for carrying out further cleansing, disinfection and 15-minute flushing at drinking water taps of individual flats;
5. Pre-installed fresh water supply pipework, if installed, shall be cleansed and disinfected in the same manner as fresh water pipe works in accordance with sub-clause (2) above, PLU1.W912, PLU1.W920, and PLU1.W960. After cleansing and disinfection, they shall be made dry and capped off at both ends of the pipe works;
6. Witness and endorse the systematic flushing, cleansing and disinfection process by the CM's Representative and the Contractor's Representative;
7. Carry out required rectification works for any defects caused during the process of systematic flushing, cleansing and disinfection without time and cost implication.

PLU1.W912.9 PROCEDURE FOR SYSTEMATIC FLUSHING FOR FRESH WATER SYSTEM

1. Strictly follow the latest systematic flushing protocol and requirements prescribed by WSD for systematic flushing;
2. All drinking water taps of the installed inside services should be thoroughly flushed throughout the systematic flushing cycles;
3. All strainers, if installed at the drinking water taps, must be removed before carrying out systematic flushing;
4. Keep record of systematic flushing using the record form prescribed by WSD for WSD’s checking;
5. Submit record of systematic flushing certified by the licensed plumber to the CM for record.

PLU1.W920.9 PROCEDURE FOR CLEANSING AND DISINFECTION OF FRESH WATER INSIDE SERVICES

1. Strictly follow the latest guideline on cleansing and disinfection of fresh water inside services prescribed by WSD.
2. Procedures for cleansing and disinfection all the tanks of fresh water system shall be as follows:
   a. Stop the pumps;
   b. Turn off the inlet and outlet valves of the water tank;
   c. Turn on the washout valve and drain the water tank completely. The Contractor shall carefully monitor the draining process and the flow condition so that the drainage system and the buffer tank will not overflow;
   d. Thoroughly cleanse the inside walls, ceiling and the bottom of the water tank and the inlet / outlet pipes with fresh water;

e. Spray with water to ensure that all dirt and debris are removed and drained away;

f. Turn off the washout valve;

g. Fill the water tank thoroughly with a solution of chloride of lime or bleaching powder containing at least 50 ppm of chlorine solution;

h. Keep the water tanks under disinfection for a contact period of one (1) hour with an initial concentration of 50 ppm chlorine in water. If the free residual chlorine measured at the end of the contact period is less than 30 ppm, the disinfection process shall be repeated. Contractor shall indicate in the detailed action plan required under PLU1.W910 (2)(b) the contact period and the concentration of chlorine in water to be used for disinfection;

i. Rinse the water tank thoroughly with fresh water;

j. Take 2 sets of record photographs of the tank after cleansing;

k. Drain away the water through the washout pipe;

l. Fill the tank with water by turning on the inlet valve;

m. Turn on all the outlet valves;

n. Start the pump.

3. Procedures for cleansing and disinfecting the up-feed fresh water supply pipework shall be as follows:

a. Arrange the cleansing and disinfecting of up-feed fresh water supply pipework to suit the schedule for cleansing and disinfecting the sump and roof tanks;

b. Check the sump tank is cleansed and filled with a homogeneous solution of chloride of lime for disinfection. The concentration of the solution has to meet the requirement that when the up-feed water supply pipework is filled up with water, the chlorine in the water will be at least 50 ppm;

c. Turn on the inlet valves at the roof tanks and start the pump to fill up the up-feed pipework until the concentration of chlorine at least 50 ppm is confirmed via test kit approved by the CM, then stop the pump and turn off the inlet valves;

d. Keep the up-feed water pipe under disinfection for a contact period of one (1) hour with an initial concentration of 50 ppm chlorine in water. If the free residual chlorine measured at the end of the contact period is less than 30 ppm, the disinfection process shall be repeated. Contractor shall indicate in the detailed action plan required under PLU1.W910 (2)(b) the contact period and the concentration of chlorine in water to be used for disinfection;

e. Turn on the inlet valves at the roof tanks and operate the pump to thoroughly flush the up-feed water supply pipework with fresh water.

4. Procedures for cleansing and disinfecting the indirect fresh water supply pipework shall be as follows:

a. Check the roof tank (and the sump tank if the volume of the pipework to be cleansed exceeds the volume of the roof tank) is cleansed and filled with a homogeneous solution of chloride of lime for disinfection. The concentration of the solution has to meet the requirement that when the indirect fresh water supply pipework is filled up with water, the chlorine in the water will be at least 50 ppm;

b. Turn on all the main gate valves of the down-feed pipework on the roof level or on the floor below the roof, and the associated pipework of booster pump system, if any;

c. Check, if applicable, that the break tank is cleansed and filled with water;

d. Turn on the gate valves on the upstream of water meters;

e. Turn on all taps at all locations, including the fresh water pipework of water heater, until the concentration of chlorine at least 50 ppm is confirmed via test kit approved by the CM, then shut off the taps;

f. Keep the indirect fresh water supply pipework under disinfection for a contact period of one (1) hour with an initial concentration of 50 ppm chlorine in water. If the free residual chlorine measured at the end of the contact period is less than 30 ppm, the disinfection process shall be repeated. Contractor shall indicate in the detailed action plan required under PLU1.W910 (2)(b) the contact period and the concentration of chlorine in water to be used for disinfection;

g. Thoroughly flush the indirect fresh water supply pipework and turn on taps at all locations to ensure the entire pipework is thoroughly flushed with fresh water. Close all taps after flushing;

5. Procedure for cleansing and disinfection of direct fresh water supply system pipework shall be as follows:

a. Turn off all the main gate valves of supply feed pipe;

b. Turn on all the gate valves in front of water meters and taps;

c. Turn off taps at all locations;

d. Provide temporary water source, pump and any necessary equipment for filling the direct fresh water supply system pipework with homogeneous solution of chloride of lime for disinfection;

e. Check the direct fresh water supply system pipework is cleansed and filled with a homogeneous solution of chloride of lime for disinfection. The concentration of the solution has to meet the requirement that when the direct fresh water supply pipework is filled up with water, the chlorine in the water will be at least 50 ppm;

f. Turn on all taps at all locations, including the fresh water pipework of water heater, until the concentration of chlorine at least 50 ppm is confirmed via test kit approved by the CM, then shut off the taps;

g. Keep the direct fresh water supply pipework under disinfection for a contact period of one (1) hour with an initial concentration of 50 ppm chlorine in water. If the free residual chlorine measured at the end of the contact period is less than 30 ppm, the disinfection process shall be repeated. Contractor shall indicate in the detailed action plan required under PLU1.W910 (2)(b) the contact period and the concentration of chlorine in water to be used for disinfection;

h. Thoroughly flush the direct fresh water supply pipework and turn on taps at all locations to ensure the entire pipework is thoroughly flushed with fresh water. Close all taps after flushing;

PLU1.W950.9 PROCEDURE FOR CLEANSING FLUSH WATER SYSTEM AND RAINWATER HARVESTING SYSTEM

1. Procedures for cleansing all the tanks of flush water system shall be as follows:

a. Stop the pumps;

b. Turn off the inlet and outlet valves of the water tank;

c. Turn on the washout valve and drain the water tank completely. The Contractor shall carefully monitor the draining process and the flow condition so that the drainage system and the buffer tank will not overflow;

d. Thoroughly clean the inside walls, ceiling and the bottom of the water tank and the inlet / outlet pipes with fresh water;

e. Spray with water to ensure that all dirt and debris are removed and drained away;

f. Turn off the washout valve;
g. Take 2 sets of record photographs of the tank after cleansing;
h. Fill the tank with water by turning on the inlet valve;
i. Turn on all the outlet valves;
j. Start the pump.

2. Procedures for cleansing all the tanks of rainwater harvesting system shall be as follows:
   a. Stop the pumps;
   b. Turn off the inlet and outlet valves of the water tank;
   c. Shut off the vortex filter or solenoid valve to stop rainwater flowing into rainwater collection tank;
   d. Turn on the washout valve and drain the water tank completely. The Contractor shall carefully monitor the draining process and the flow condition so that the drainage system and the buffer tank will not overflow;
   e. Thoroughly clean the inside walls, ceiling and the bottom of the water tank and the inlet / outlet pipes with fresh water;
   f. Spray with water to ensure that all dirt and debris are removed and drained away;
   g. Turn off the washout valve;
   h. Take 2 sets of record photographs of the tank after cleansing;
   i. Open the vortex filter or solenoid valve;
   j. Fill the tank with water by turning on the inlet valve;
   k. Turn on all the outlet valves;
   l. Start the pump.
3. Procedures for cleansing all the flush water system pipework shall be as follows:
   a. Check that the roof tank is cleaned and filled with water;
   b. Turn on all the main gate valves of the down-feed system at the roof level and, if applicable, to the break tank;
   c. Check, if applicable, that the break tank is cleaned and filled with water;
   d. Turn on all inlet valves of flushing cistern;
   e. Start flushing water cisterns on the top most floors and then moving downwards;
   f. Flush the water cisterns at the lowest floor of the down feed system and the floor above Pressure Reducing Valve (PRV) system or transfer tank, if applicable, twice, and at the remaining floors twice;
   g. Check for satisfactory flow at the water inlet and discharge, and any leaks at cisterns;
   h. If the flow is unsatisfactory, repair the cistern. Re-test until the flow is satisfactory.
4. Procedures for cleansing all the rainwater harvesting system pipework as follows:
   a. Check that the rainwater collection tank is cleaned and filled with water;
   b. Turn on all the main gate valves of the down-feed system at the roof level and, if applicable, to the break tank;
   c. Check that the break tank is cleaned and filled with water;
   d. Turn on all the valves of the irrigation system;
   e. Turn on all watering taps. Check for satisfactory flow at water taps and submit record;
   f. If flow of taps is unsatisfactory, cleanse the filter or repair the taps. Re-test until the flow is satisfactory;

g. Resume the system into normal operating condition with all the valves adjusted to their designated operating positions.

WORKS DURING MAINTENANCE PERIOD

PLU1.W960.9 CLEANSING AND DISINFECTION DURING MAINTENANCE PERIOD

1. Pursuant to and without affecting the generality of GCC Clause 10.1
   a. Execute all Maintenance Works as are instructed by the CM during the Maintenance Period to the water supply system;
   b. Include further cleansing and disinfection of water tanks and Maintenance Works to the supply pipework, as may be necessitated by:
      i. Incomplete cleansing prior to phased completion of the Works or completion of the Works;
      ii. Works and / or materials not in conformity with the Contract.
2. In compliance with sub-clause (1)(b) above, cleanse and disinfect all the completed fresh water tanks, direct and indirect fresh water supply pipework at a date to be instructed by the CM before occupation of a new building or a part of a new building:
   a. Submit a detailed action plan which shall include but not be limited to the following items for the CM's approval prior to commencement of the cleansing and disinfection works:
      i. Show the extent and sequence of cleansing and disinfection work with vertical plumbing line diagram;
      ii. Provide programme and method statement for cleansing and disinfection of fresh water inside services;
      iii. Provide testing procedures for verifying the dosage of chlorine and residual chlorine level.
   b. Cleanse and disinfect the completed fresh water tanks, up-feed, direct and indirect fresh water supply pipework according to PLU1.W920;
   c. Cleansing and disinfection shall be in following sequence: sump tanks, up-feed pipework, roof tanks, down-feed pipework and finally plumbing fixtures and appliances.
3. When Instructed by the CM within a period of 13 months commencing from the date of occupation permit (OP), or temporary occupation permit (TOP) as the case may be, in respect of the domestic blocks during mass intake of tenants / flat owners, carry out the 15-minute flushing at sink mixer for the individual domestic flats on advance notice of CM's Representative all as specified under PRE.B6.650 (4).

PROTECTION

PLU1.W1010.9 SEALING THE SYSTEM

Seal off ends of pipes and openings during construction to prevent entry of foreign matter into the system.

PLU1.W1020.9 VALVES AND TAPS

House valves and taps installed in public areas or those not intended for public use in vandal-resistant and corrosion-resistant enclosures.

PLU1.W1030.9 PROTECTION OF UNDERGROUND PIPES

1. Protect underground pipes against corrosion and against mechanical damage;

2. Clean pipework after joining it and treat it with two coats of good quality bituminous paint to BS 3416 and wrap it with petrolatum tape for protection against corrosion due to water, salts, soil organics and rest it on concrete bed, sand or sieved soil or in concrete haunch or concrete surround before the trench is backfilled;
3. Pressure test all underground pipework before the application of bituminous paint and petrolatum tape.

PLU1.W1040.9 PIPES PASSING UNDER ROADS

Where top of the pipe is less than 900 mm from finish level, surround the pipe by concrete in accordance to the Water Authority's requirement.

WORKS OUTSIDE SITE BOUNDARY

PLU1.W1110.9 CONNECTION BY THE WATER AUTHORITY

Cap the ends of main pipes to prepare for connection to street mains by the Water Authority if the project is not under Helping Business Programme.

PLU1.W1120.9 NOTIFY THE WATER AUTHORITY FOR INSPECTION

Notify the Water Authority to inspect completed pipework and valve pit prior to back filling.

CONNECTION OF UNDERGROUND WATER SUPPLY MAINS TO EXISTING IN-SERVICE MAINS

PLU1.W1210.9 PROCEDURE

Connect to the supply mains as follows:

1. Submit proposed re-arrangement or tee-off (if any) to the Contract Manager for approval at least 24 hours prior to execution;
2. Identify existing live fresh, flush, and fire service supply mains by:
   a. Inspect as-built record drawings;
   b. Verify by valve operation. Close all the valves of the pipes and turn on valve of each pipe one by one to identify the type of each water pipes;
   c. Paint underground pipeworks of fresh, flush and fire service supply mains at both sides of isolating gate valves in colours as stated in FIN7.W2510.
3. Test turbidity to confirm salt water mains in accordance with PLU1.T110;
4. Provide temporary cover and lockable device for isolating valve pits;
5. Submit findings of the identification for inspection and confirmation by Estate Management Division;
6. Submit to Estate Management Division Form DCMP-F741 together with the Water Authority's Form 46 Part IV for making connections to existing in service supply mains within Housing Department estates;
7. Upon receipt of Part B of Form DCMP-F741, proceed with connection works;
8. Upon connection to supply mains, complete Part C of Form DCMP-F741 and submit to Estate Management Division together with a copy of Certificate Regarding Water Supply Connection issued by the Water Authority for record;
9. Remove temporary cover of the isolating valve pits after completion of the connection of supply mains.

PLU1.W1220.9 INSPECTION OF CONNECTION

Check all connected pipework to supply mains by valve operation. Close all the valves of the pipes and turn on valve of each pipe one by one to identify the type of each water pipe.

TESTING

GENERAL

PLU1.T010.9 PRE-TEST CLEANING

Before installations are subjected to inspection, testing and subsequent handover, clean thoroughly the entire installation internally and externally. Flush out all water installations with clean water. During the flushing operation, make provision to exclude filters, pumps, meters and any other item of plant which could be damaged during the cleaning operation.

PLU1.T020.9 PERFORMANCE TESTS, ADJUSTMENTS AND COMMISSIONING

1. Carry out complete performance tests for all equipment and systems installed, make all necessary adjustments including the setting of adjustable type pressure reducing valve and commission the installations in accordance with the manufacturers' instructions and to the satisfaction of the Contract Manager;
2. Prior to any tests, submit detailed procedures and a programme for testing and commissioning for the Contract Manager's approval;
3. Submit test reports to the Contract Manager for approval.

PLU1.T030.9 TEST INSTRUMENTS AND PERSONAL PROTECTIVE EQUIPMENT

1. Supply all instruments and personal protective equipment (PPE) required for inspection and testing of the installation;
2. Include, but not limited to, the following instruments required for inspection and testing purpose:
   a. Measuring tape;
   b. Hand pump;
   c. Pressure gauge;
   d. Water flow gauge;
   e. Chemical test kit which is accepted by the Water Authority and as selected by the CM for detecting the presence of lead.
3. Include, but not limited to, the following PPE required for inspection and testing purpose as recommended by the test kit supplier:
   a. Gloves for handling chemicals;
   b. Protective goggles or safety glasses with side shields;
   c. Respirator masks to avoid breathing of dust.

PLU1.T040.9 TESTING OF CONCEALED AND UNDERGROUND PIPEWORK

Before cover up of the pipework, invite the Contract Manager representative to check the pipework and witness for water pressure test in accordance with PLU1.T050. Result of water pressure test shall be satisfactory before cover up of the pipework. Submit test report for record within a week of the satisfactory test.

PLU1.T050.9 WATER PRESSURE TEST

1. Test water systems and circuits hydraulically to a minimum pressure of 1.5 times the system working pressure or a minimum of 10 bar whichever is the higher for a period of not less than one hour without leaks appearing. However, when test is carried out on copper piping with compression fittings only, the test period can be reduced to 15 minutes only;

2. Provide whatever hoses or drainage channels that are required to safely discharge the test water while carrying out these tests in order to ensure that no damage to the building and property will be caused by the test water;
3. Following the above, carry out a normal working test during which adjustments and regulation of valves shall be effected and each tap and shower shall be visually check for satisfactory rate of flow.

PLU1.T060.9 FSD INSPECTION AND WITNESS OF TESTS

1. Make necessary applications including submission of Form FSI/501a and Form FSI/314 for street fire hydrant systems (if applicable) to the CM and the Fire Services Department;
2. Attend upon representatives of the Fire Services Department for the purpose of tests and inspections for the fire service installations carried out by the Main Contractor such as street fire hydrant systems, up-feed riser pipes to storage/transfer tanks.

PLU1.T070.9 WATER QUALITY TEST BEFORE WATER SUPPLY IS GIVEN FROM THE WATER AUTHORITY

Test on the quality of fresh water for human consumption shall be carried out on each fresh water system to the satisfaction of the CM and comply with the following:

1. Arrange with the Water Authority to collect samples at representative sampling point(s) as agreed by the Water Authority for water sampling tests before a supply is given as follows:
   a. Carry out the test after completion of the systematic flushing, cleansing and disinfection of the installed fresh water mains and inside services as specified in PLU1.W910 (2) to the satisfaction of the CM of the respective fresh water supply system;
   b. Agree with the Water Authority the locations for collecting water samples for water sampling tests;
   c. Carry out water sampling test in accordance with WSD's latest requirements, protocol and guidelines for water sampling and testing. Collection, testing and analysis of the samples shall be carried out by an accredited laboratory accepted by WSD and / or Water Science Division of WSD. Results of all water samples shall meet the WSD's latest testing parameters and acceptance criteria;
   d. In the event the samples failed to comply with the water quality requirements as referred to in sub-clause (1)(c) above, carry out investigation on the cause(s) and submit investigation results and details of all necessary rectification works to the CM for approval before carrying out of the approved rectification works. After completion of the rectification works, carry out cleansing and disinfection as appropriate for the part(s) of constructed potable water inside services represented by the failed sample(s) and collect water sample(s) at the same location(s) of failed sample(s) for retesting, all according to WSD's latest requirements and guidelines. Bear all cost and expense in connection with the aforesaid investigation, rectification, cleansing and disinfection works and re-test(s) to ensure compliance of the required water quality requirements except if such investigation, rectification works and re-test(s) are the direct consequence of a conclusion from any test result(s) of the sample(s) taken at the user end of the first valve from the site boundary that water from the Water Authority failed to comply with the water quality requirements as referred to in sub-clause (1)(c);

e. Submit the detailed report on the selection of sampling points, sampling techniques, handling of water samples, water quality test results with original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements as referred to in sub-clause (1)(c) and the investigation results and approved rectification works as referred to in sub-clause (1)(d) for the CM's approval within 2 months from the date of the completion to the satisfaction of the CM of the cleansing of the plumbing installation as specified in PLU1.W910 (2) of the respective fresh water supply system.

PLU1.T091.A AUDIT CHECK ON BRAZING ALLOY FOR COPPER AND COPPER ALLOY CAPILLARY FITTINGS

1. If brazing alloy is used in the connection between fresh water pipes, the CM may conduct testing of the jointing material to ensure the use of cadmium-free category brazing alloy;
2. Test Arrangements:
   a. Test shall be carried out by the CM or his representatives or Direct Testing Contractor;
   b. Comply with the following pertaining to the surveillance test:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
   c. The test shall be witnessed by representative of the plumbing sub-contractor and / or the Licensed Plumber.
3. Test Samples:

   Samples shall be selected by the CM or his representatives. A zone in which samples are taken means every 10 typical floors or parts thereof for one domestic block, or designated area(s) of non-typical floor(s) as determined by the CM. Sampling shall cover minimum one joint from each selected pipe length within the zone.
4. Testing:
   a. Non-destructive test for the brazing material shall be conducted by appropriate means such as X-ray fluorescence (XRF) metal alloy identification as selected by the CM or his representatives;
   b. Acceptance standard:

      The result shall indicate that the brazing material complies with the specified standard of cadmium in PLU1.M150.
5. Non-compliance in initial test:
   a. In the event that any one sample fails to meet the acceptance standard as specified in sub-clause (4)(b), the CM will take three separate samples within the same zone for re-test as per sub-clauses (2), (3) and (4);
   b. Where any of the re-test samples fails to meet the acceptance standard as specified in sub-clause (4)(b), the Contractor may elect to comply with either (i) or (ii) of the following:
      i. Take sample of the brazing joint(s) in question and test the chemical composition by an independent laboratory accepted by the Water Authority at the Contractor's time and costs. If it is verified that the material satisfies the acceptance standard as specified in sub-clause (4)(b), no rectification works are required. If it is verified that the material fails to satisfy the acceptance standard, rectify the pipework as per sub-clause (5)(b)(ii); or

ii. Rectify the whole length of the selected riser pipe(s) or branch pipe(s) within the zone on which selected sample(s) are taken for testing. Re-test the rectified areas in accordance with sub-clauses (2), (3), (4) and (5). Observe further re-testing requirements under sub-clause (6) below.

c. Bear all associated costs including further re-tests and no extension of time shall be allowed.

6. In the event that any riser pipe(s) or branch pipe(s) within a zone has to be rectified in accordance with sub-clause (5)(b)(ii), the CM will take three more separate samples within the same zone for further re-testing in accordance with sub-clauses (2), (3), (4) and (5);
7. The inspection and testing under sub-clauses (1) to (6) above shall not relieve the Contractor's responsibility of material control, testing, site supervision and on-site monitoring etc. under the approved Sub-contractors Management Plan.

PLU1.T092.A AUDIT CHECK ON SOLDERING ALLOY FOR COPPER AND COPPER ALLOY CAPILLARY FITTINGS

1. If soldering alloy is used in the connection between fresh water pipes and end feed capillary or integral solder capillary fittings, the CM may conduct testing of the jointing material to ensure the use of lead-free category soldering alloy for initial pipework connection works or for water leakage repair works with additional soldering;
2. Test Arrangements:
   a. Test shall be carried out by the CM or his representatives a Direct Testing Contractor;
   b. Comply with the following pertaining to the surveillance test:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
   c. The test shall be witnessed by representative of the plumbing sub-contractor and / or the Licensed Plumber.
3. Test Samples:
   a. Samples shall be selected by the CM or his representatives;
   b. For initial pipework connection, a zone in which samples are taken means a wing or part thereof of each typical floor for one domestic block, or a lobby of each typical floor for one domestic block, or designated area(s) of non-typical floor(s) as determined by the CM. Sampling shall cover minimum one joint from the pipework in each selected flat and / or minimum two joints from the pipework in each selected common area within the zone;
   c. For water leakage repair works with additional soldering, a zone in which samples are taken means a floor of a building under construction. Sampling shall cover minimum one joint for the repair work carried out during the same day, or as directed by the CM or his representatives.
4. Testing:
   a. Non-destructive screening test for lead content in soldering material shall be conducted by using a proprietary chemical test kit which changes colour when lead is detected, or other appropriate means such as X-ray fluorescence (XRF) metal alloy identification as selected by the CM or his representatives;
   b. Acceptance standard:

      The result shall indicate that the soldering material complies with the specified standard of lead in PLU1.M160.
5. Non-compliance in initial test:

a. In the event that any one sample fails to meet the acceptance standard as specified in sub-clause (4)(b), the CM will take three separate samples within the same zone for re-test as per sub-clauses (2), (3) and (4);

b. Where any of the re-test samples fails to meet acceptance standard as specified in sub-clause (4)(b), the Contractor may elect to comply with either (i) or (ii) of the following:

i. Take sample of the soldering joint(s) in question and test the chemical composition by an independent laboratory accepted by the Water Authority at the Contractor's time and costs. If it is verified that the material satisfies the acceptance standard as specified in sub-clause (4)(b), no rectification works are required. If it is verified that the material fails to satisfy the acceptance standard, rectify the pipework as per sub-clause (5)(b)(ii); or

ii. Submit method statement for rectification works for the CM's approval. Rectify all pipework of the selected flat(s) and / or the selected common area(s) and / or the selected area used for water leakage repair works with additional soldering in which selected sample(s) are taken for testing. Re-test the rectified areas in accordance with sub-clauses (2), (3), (4) and (5). Observe further re-testing requirements under sub-clause (6) below for the initial pipework connection in the same zone.

c. Bear all associated costs including further re-tests and no extension of time shall be allowed.

6. In the event that any initial pipework connection has to be rectified in accordance with sub-clause (5)(b)(ii), the CM will take three more separate samples within the same zone for further re-testing in accordance with sub-clauses (2), (3), (4) and (5);

7. The inspection and testing under sub-clauses (1) to (6) above shall not relieve the Contractor's responsibility of material control, testing, site supervision and on-site monitoring etc. under the approved Sub-contractors Management Plan by the CM.

PLU1.T093.A AUDIT CHECK ON COPPER PIPE MATERIAL

1. If copper pipe is used for fresh water application, CM may conduct testing of the copper pipe to ensure that its chemical composition complies with the specified standard;

2. Test Arrangements:

a. Test shall be carried out by CM or his representatives or Direct Testing Contractor;

b. Comply with the following pertaining to the surveillance test:

i. Provide attendance on the Site;

ii. Provide, deliver and collect samples etc. as directed by CM or as specified.

c. The test shall be witnessed by representative of the plumbing sub-contractor and / or the Licensed Plumber.

3. Test Samples:

Samples shall be selected by CM or his representatives. A zone in which samples are taken means every 2 typical floors or parts thereof for one domestic block, or designated area(s) of non-typical floor(s) as determined by the CM. Sampling shall cover minimum one spot from each selected pipe length within the zone.

4. Testing:

a. Non-destructive X-ray fluorescence (XRF) metal alloy identification as arranged by the CM or his representatives;

b. Acceptance standard:

The result shall indicate that the chemical composition of the copper pipe complies with the specified standards in PLU1.M120.

5. Non-compliance in initial test:
   a. In the event that any one sample fails to meet the acceptance standard as specified in sub-clause (4)(b), the CM will take three separate samples within the same zone for re-test as per sub-clauses (2), (3) and (4);
   b. Where any of the re-test samples fails to meet the acceptance standard as specified in sub-clause (4)(b), the Contractor may elect to comply with either (i) or (ii) of the following:
      i. Take sample of each copper pipe in question and test the chemical composition by an independent laboratory accepted by the Water Authority at the Contractor's time and costs. If it is verified that the material satisfies the acceptance standard as specified in sub-clause (4)(b), no rectification works are required. If it is verified that the material fails to satisfy the acceptance standard, rectify the pipework as per sub-clause (5)(b)(ii); or
      ii. Remove and replace the pipework within the zone in which the selected sample(s) are taken for testing. Re-test the rectified areas in accordance with sub-clauses (2), (3), (4) and (5). Observe further re-testing requirements under sub-clause (6) below.
   c. Bear all associated costs including further re-tests and no extension of time shall be allowed.
6. In the event that any pipework within a zone has to be removed and replaced in accordance with sub-clause (5)(b)(ii), the CM will take three more separate samples within the same zone for further re-testing in accordance with sub-clauses (2), (3), (4) and (5);
7. The inspection and testing under sub-clauses (1) to (6) above shall not relieve the Contractor's responsibility of material control, testing, site supervision and on-site monitoring etc. under the approved Sub-contractors Management Plan by the CM.

PLU1.T094.C VERIFICATION TESTS FOR COPPER PIPES AND FITTINGS DELIVERED TO SITE

1. Test Arrangements:
   a. Verification tests shall be carried out by the CM or his representatives or a Direct Testing Contractor upon delivery of material to Site under a delivery note, or during the course of construction as directed by the CM. A representative batch means the material delivered to Site under the same delivery note;
   b. Comply with the followings pertaining to verification tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Samples shall be selected by the CM or his representatives and witnessed by representative of the Contractor;

      i. Provide three test samples (one for testing of chemical composition and two for testing of metal leaching rate) of any sizes of copper pipes from any one batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b) as selected by the CM;

ii. Provide four test samples (one for measuring thickness, one for testing of chemical composition and two for testing of metal leaching rate) of any sizes of copper pipe integral solder fittings from any one batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b) as selected by the CM.

b. When instructed by the CM, provide another three test samples of any size of copper pipes and another four test samples of any sizes of copper pipe integral solder fittings from any other batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b).

3. Testing Methods:

a. Laboratory testing of the following as arranged by the CM or his representatives:

i. Chemical composition of the copper pipe and copper pipe integral solder fittings;

ii. Measure the thickness of copper pipe integral solder fitting by cutting into two half sections;

iii. Metal leaching rate of the copper pipe and copper pipe integral solder fitting, which shall only be conducted when all results of the testing in sub-clause (i) complying with the acceptance standard as specified in sub-clause 3(b)(i).

b. Acceptance standard:

i. For the testing of chemical composition, the result shall indicate that the chemical composition of the copper pipe and copper pipe integral solder fitting complies with the specified standards in PLU1.M120 or the test report showing the material composition which has been accepted by Water Authority;

ii. For the thickness of copper pipe integral solder fitting, minimum wall thickness measured at any point shall in accordance with Table 5 of BS EN 1254-1;

iii. For the testing of metal leaching rate, the result shall indicate the concentration of heavy metals of the extracts from the copper pipe and copper pipe integral solder fitting complies with the provisional guideline values of maximum allowable concentrations of heavy metals as stipulated under the GA* Scheme of WSD.

4. Non-compliance:

a. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(b), follow either one of the following actions:

i. Remove the representative batch of material off Site; or

ii. Carry out re-test for the representative batch of material in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch of material off Site.

b. When the representative batch of material is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 for three samples (one for testing of chemical composition and two for testing of metal leaching rate) of copper pipes and / or four test sample (one for measuring thickness, one for testing of chemical composition and two for testing of metal leaching rate) of copper pipe integral solder fitting where applicable selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);

c. Bear all associated costs and the extra time required for the test and re-test required in sub-clauses (4)(a) and (4)(b).

PLU1.T095.A VERIFICATION TESTS FOR SOLDER IN COPPER PIPE INTEGRAL SOLDER FITTINGS DELIVERED TO SITE

1. Test Arrangements:
   a. Verification tests shall be carried out by the CM or his presentatives or a Direct Testing Contractor upon delivery of material to Site under a delivery note, or during the course of construction as directed by the CM. A representative batch means the material delivered to Site under the same delivery note;
   b. Comply with the followings pertaining to verification tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Samples shall be selected by the CM or his representatives and witnessed by representative of the Contractor;
   b. Provide one test sample of any sizes of integral solder capillary fittings from any one batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b) as selected by the CM;
   c. When instructed by the CM, provide another test sample of any sizes of integral solder capillary fittings from any other batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b).
3. Testing Methods:
   a. Laboratory testing of chemical composition of the soldering material for copper pipe fitting of integral solder capillary as arranged by the CM or his representatives;
   b. Acceptance standard:

      The result shall indicate that the soldering material for copper pipe fitting of integral solder capillary complies with the specified standard in PLU1.M160 or the test report showing the material composition which has been accepted by Water Authority.
4. Non-compliance:
   a. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(b), follow either one of the following actions:
      i. Remove the representative batch of material off Site; or

ii. Carry out re-test for the representative batch of material in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In the event that the testing sample(s) fail to meet the acceptance standard as specified in sub-clause (3)(b), remove the representative batch of material off Site.

b. When the representative batch of material is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 for one test sample of integral solder capillary fittings selected by the CM from the replacing batch. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(b), carry out re-testing as specified in sub-clause (4)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

PLU1.T096.B VERIFICATION TESTS FOR GATE VALVES AND GLOBE VALVES WITH NOMINAL SIZES UP TO AND INCLUDING 50MM FOR FRESH WATER APPLICATION DELIVERED TO SITE

1. Test Arrangements:
   a. Verification tests shall be carried out by the CM or his representatives or a Direct Testing Contractor upon delivery of material to Site under a delivery note, or during the course of construction as directed by the CM. A representative batch means the material delivered to Site under the same delivery note;
   b. Comply with the followings pertaining to verification tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Samples shall be selected by the CM or his representatives and witnessed by representative of the Contractor;
   b. For gate valve with the Kitemark Certificate or Kitemark Licence or possessing two stars status under WSD's GA+ Scheme:
      i. Provide three test samples (one for testing of chemical composition and two for testing of metal leaching rate) of any sizes of gate valves from any one batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b) as selected by the CM;
      ii. When instructed by the CM, provide another three test samples of any sizes of gate valves from any other batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b).
   c. For gate valve without the Kitemark Certificate or Kitemark Licence or not possessing two stars status under WSD's GA+ Scheme, when instructed by the CM, provide six test samples (two for testing of chemical composition and four for testing of metal leaching rate) of any sizes of gate valves from each batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b);
   d. For globe valve, when instructed by the CM, provide four test samples of any sizes of globe valves from each batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b) for testing of metal leaching rate.

3. Testing Methods:
   a. Laboratory testing of the gate valve as arranged by the CM or his representatives;
      i. Chemical composition of the body, bonnet, disc and stem of gate valve;
      ii. Metal leaching rate of the gate valve, which shall only be conducted when all results of the testing in sub-clause (i) complying with the acceptance standard as specified in sub-clause 3(c)(i).
   b. Laboratory testing of the globe valve as arranged by the CM or his representatives:
      i. Metal leaching rate of the globe valve.
   c. Acceptance standard:
      i. For the testing of chemical composition, the result shall indicate that the chemical composition of the body, bonnet, disc and stem of gate valve complies with the specified standards in PLU1.M620 or the test report showing the material composition which has been accepted by Water Authority;
      ii. For the testing of metal leaching rate, the result shall indicate the maximum allowable concentration of heavy metals of the extracts from the gate valve and globe valve complies with the provisional guideline values as stipulated under the GA* Scheme of WSD.
4. Non-compliance:
   a. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(c), follow either one of the following actions:
      i. Remove the representative batch of material off Site; or
      ii. Carry out re-test for the representative batch of material in accordance with the testing methods as specified in sub-clauses (3)(a) to (3)(c) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In the event that any of these testing samples fail to meet the acceptance standard as specified in sub-clause (3)(c), remove the representative batch of material off Site.
   b. When the representative batch of material is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a) to (3)(c) in a laboratory that complies with the requirements stated in PRE.B9.570 for:
      i. Three samples (one for testing of chemical composition and two for testing of metal leaching rate) of gate valve with the Kitemark Certificate or Kitemark Licence or possessing two stars status under WSD's GA+ Scheme; or
      ii. Six samples (two for testing of chemical composition and four for testing of metal leaching rate) of gate valve without the Kitemark Certificate or Kitemark Licence or not possessing two stars status under WSD's GA+ Scheme, all selected by the CM from the replacing batch;
      iii. Four samples of globe valve for testing of metal leaching rate, all selected by the CM from the replacing batch.

      In the event that any of these testing samples fail to meet the acceptance standard as specified in sub-clause (3)(c), carry out re-testing as specified in sub-clause (4)(a);

c. Bear all associated costs and the extra time required for the test and re-test required in sub-clauses (4)(a) and (4)(b).

PLU1.T097.A VERIFICATION TESTS FOR DUCTILE IRON PIPES AND FITTINGS DELIVERED TO SITE

1. Test Arrangements:
   a. Verification tests shall be carried out by the CM or his representatives or a Direct Testing Contractor upon delivery of material to Site under a delivery note, or during the course of construction as directed by the CM. A representative batch means the material delivered to Site under the same delivery note;
   b. Comply with the followings pertaining to verification tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Samples shall be selected by the CM or his representatives and witnessed by representative of the Contractor;
   b. Provide one test sample of any sizes of ductile iron pipes and one test sample of any sizes / types of ductile iron fittings from a batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b) as selected by the CM;
   c. When instructed by the CM, provide another test sample of any sizes of ductile iron pipes and another test sample of any sizes / types of ductile iron fittings from any other batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b).
3. Testing Methods:
   a. Laboratory testing of the external diameter, ovality, limit deviations on lengths and tensile properties of ductile iron pipes and fittings as arranged by the CM or his representatives;
   b. Acceptance standard:
      i. The result shall indicate that the external diameter, ovality, limit deviations on lengths and tensile properties of ductile iron pipes and fittings comply with the specified standards in PLU1.M170 or the test report showing the result which has been accepted by Water Authority.
4. Non-compliance:
   a. In the event that any of the testing samples fails to meet the acceptance standard as specified in sub-clause (3)(b), follow either one of the following actions:
      i. Remove the representative batch of material off Site; or
      ii. Carry out re-test for the representative batch of material in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate samples of ductile iron pipes and three separate samples of ductile iron fittings selected by the CM from the representative batch. In the event that any of the testing samples fails to meet the acceptance standard as specified in sub-clause (3)(b), remove the representative batch of material off Site.

b. When the representative batch of material is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample of ductile iron pipe and one sample of ductile iron fitting selected by the CM from the replacing batch. In the event that any of the testing samples fails to meet the acceptance standard as specified in sub-clause (3)(b), carry out re-testing as specified in sub-clause (4)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

GENERAL

PLU1.T098.B VERIFICATION TESTS FOR GLOBE STOP AND CHECK VALVES WITH NOMINAL SIZES UP TO AND INCLUDING 40MM FOR FRESH WATER APPLICATION DELIVERED TO SITE

1. Test Arrangements:
   a. Verification tests shall be carried out by the CM or his representatives or a Direct Testing Contractor upon delivery of material to Site under a delivery note, or during the course of construction as directed by the CM. A representative batch means the material delivered to Site under the same delivery note;
   b. Comply with the followings pertaining to verification tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Samples shall be selected by the CM or his representatives and witnessed by representative of the Contractor;
   b. When instructed by the CM, provide six test samples (two for testing of chemical composition and four for testing of metal leaching rate) of any sizes of globe stop and check valves from each batch of material delivered to Site under the delivery note as specified in PLU1.M110 (2)(b).
3. Testing Methods:
   a. Laboratory testing of the following as arranged by the CM or his representatives:
      i. Chemical composition of the body, bonnet, disc and stem of globe stop and check valve;
      ii. Metal leaching rate of the globe stop and check valve, which shall only be conducted when all results of the testing in sub-clause (i) complying with the acceptance standard as specified in sub-clause 3(b)(i).
   b. Acceptance standard:
      i. For the testing of chemical composition, the result shall indicate that the chemical composition of the body, bonnet, disc and stem of globe stop and check valve complies with the specified standards in PLU1.M620 or the test report showing the material composition which has been accepted by Water Authority;
      ii. For the testing of metal leaching rate, the result shall indicate the maximum allowable concentration of heavy metals of the extracts from the globe stop and check valve complies with the provisional guideline values as stipulated under the GA* Scheme of WSD.

4. Non-compliance:
   a. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(b), follow either one of the following actions:
      i. Remove the representative batch of material off Site; or
      ii. Carry out re-test for the representative batch of material in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(b), remove the representative batch of material off Site.
   b. When the representative batch of material is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that complies with the requirements stated in PRE.B9.570 for six samples (two for testing of chemical composition and four for testing of metal leaching rate) of globe stop and check valve, all selected by the CM from the replacing batch. In the event that the testing sample(s) fail to meet the acceptance standard as specified in sub-clause (3)(b), carry out re-testing as specified in sub-clause (4)(a);
   c. Bear all associated costs and the extra time required for the test and re-test required in sub-clauses (4)(a) and (4)(b).

TESTING TURBIDITY FOR CONNECTION OF UNDERGROUND WATER MAINS TO EXISTING IN-SERVICE MAINS

PLU1.T110.9 TESTING PRIOR TO CONNECTION OF SUPPLY MAINS

Test fresh, flush and fire service supply mains prior to connection works as required by PLU1.W1210.

PLU1.T120.9 PROCEDURE

Test for development of white turbidity to identify salt water mains to satisfaction of the Contract Manager, as follows:

1. Collect two 10 ml samples in clean McCartney bottles from the supply mains under investigation;
2. Add two drops of barium chloride solution to one sample;
3. Shake to mix contents and wait for approximately 3 minutes for turbidity to develop;
4. Compare with the other sample for increase in white turbidity (which would indicate the presence of salt water);
5. In doubtful cases, seek record drawings as well as laboratory services for confirmation.

SURVEILLANCE TESTS FOR PIPES, FITTING AND VALVES

PLU1.T131.A SURVEILLANCE TESTS FOR DRAW OFF TAPS

1. Testing Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or his representatives or a Direct Contractor;
   b. Comply with the following pertaining to surveillance tests:

i. Provide attendance on the Site;

ii. Provide, deliver and collect samples etc. as directed by the CM.

2. Testing Samples:

   a. When Instructed, provide one test sample from a batch of draw off tap delivered to Site under the delivery note as specified in PLU1.M610 (13)(b) selected by the CM or his representatives;

   b. Bear all cost for any replacement of samples.

3. Testing method:

   Open up inspection.

4. Acceptance standard:

   The inspection shall reveal that no decorative, electroplated materials such as nickel and / or chromium coating are present on the internal surface of any of the components of the draw off tap that may come into contact with water.

5. Non-compliance:

   a. In the event that the testing sample fails to meet the testing requirements, follow either one of the following actions:

      i. Remove the representative batch off Site; or

      ii. Carry out further inspection for the representative batch in accordance with the testing method as specified in sub-clauses (3) and (4) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case any one sample fails the inspection, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

   b. When the representative batch of draw off taps is removed off Site, replace with another new batch (hereinafter referred to as the "replacement batch"). Carry out test in accordance with the testing method as specified in sub-clauses (3) and (4) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacement batch. In case of such test fails, follow action stated in sub-clause (5);

   c. Bear all associated costs for the inspection(s) and further inspection(s) required in sub-clauses (5)(a) and (5)(b). No extension of time will be allowed.

APPENDIX PLU1/I

PLU1.APPEND1.9 DECLARATION OF VALIDITY OF WSD SUBMISSION FORMS

HOUSING DEPARTMENT

DECLARATION OF VALIDITY OF WSD SUBMISSION FORMS

Contract Title	:		Ref. No.:	
			Date:	
Contract No.	:			
File Reference	:			

To : Contract Manager's Representative (Attn : /)
*(Name of Consultant for Consultant Projects) via PCOW

From : (State Name of Contractor) _____

Pursuant to sub-clause (6) of Specification Clause No. PLU1.W110, we attach for the CM's processing / signing the following WSD Form(s) –

(please tick the box(s) whichever relevant)

(a)	☐	**WWO 542**		Application for Water Supply / Request for Work to be Carried out by the Water Authority
(b)	☐	**WWO 132**		Application for Certificate Regarding Water Supply Availability / Connection
(c)	☐	**WWO 46**	☐ **Part I** ☐ **Part II** ☐ **Part IV**	Application for Constructing / Installation, Altering or Removing an Inside Service or Fire Service
(d)	☐	**WWO 1149**		List of Pipes and Fittings to be Installed

2. We confirm that the above WSD Form(s) undercover of this declaration have been checked / verified by the Licensed Plumber, the Plumbing Sub-contractor and the Main Contractor. We hereby declare that -

(please tick the box(s) whichever relevant)

☐ The data entry in the Form is accurate.

☐ The pipes and fittings to be installed and any materials to be used for the construction, installation, alteration or removal of the Approved Plumbing Works covered by this Form, including those as listed on the attached Annex to this Form and those not listed, shall be as prescribed by the Waterworks Regulations.

☐ The pipes and fittings installed and any materials used for the construction, installation, alteration or removal of the Approved Plumbing Works covered by this Form are as prescribed by the Waterworks Regulations.

☐ The plumbing installation works for the captioned Contract have been completed in accordance with WSD Approved Drawings, WSD Circular Letters in force, the Specification and statutory requirements.

☐ The meter positions of the plumbing works of the captioned Contract are correct.

☐ Others, please state : _____

For and on behalf of the Contractor

_____ _____

(Building Service Engineer) (Licensed Plumber)

Name : _____ Name : _____

License No. : _____

APPENDIX PLU1/II

PLU1.APPEND2.9 DECLARATION OF THE COMPLETED PLUMBING WORKS

HOUSING DEPARTMENT
DECLARATION OF THE COMPLETED PLUMBING WORKS

Contract Title	:	Ref. No.	:
		Date	:
Contract No.	:		
File Reference	:		

To : Contract Manager's Representative (Attn : /)
*(Name of Consultant for Consultant Projects) via PCOW

From : (State Name of Contractor) _____

1. Pursuant to sub-clause (7) of Specification Clause No. PLU1.W110, we confirm that plumbing installation works for the captioned Contract have been completed. We hereby declare that -
   a. All pipes and fittings installed on Site have been approved by WSD and registered with WSD under Form WWO 1149;
   b. Only cadmium-free category brazing alloy and lead-free category soldering alloy are used;
   c. All pipes and fittings installed and any materials used for the constriction and installation of the plumbing works are as prescribed by the Waterworks Regulations and approved by the Water Authority.
2. The Licensed Plumber's inspection report of the completed plumbing installation is submitted herewith.

For and on behalf of the Contractor

_____ (Building Service Engineer)

Name : _____

_____ (Licensed Plumber)

Name : _____
License No. : _____

PLU2 SANITARY APPLIANCES

MATERIALS

GENERAL

PLU2.M010.9 SAMPLES

Comply with the requirements of PRE.B9.410 by submitting samples of the specified sanitary fittings for Approval.

PLU2.M020.A STANDARDS

Ensure sanitary appliances submitted for Approval comply with the following standards as applicable:

1. Vitreous china:
   a. To BS 3402:1969;
   b. Colour: white unless otherwise specified;
   c. Ensuite, complete with all necessary fittings.
2. Waste and bath overflow:
   a. To BS EN 274-1:2002;
   b. Material: chromium plated brass.
3. Taps and combination tap assemblies:
   a. To BS EN 200:2008;
   b. Material: chromium plated brass.
4. Mixers:
   a. To BS EN 1286:1999;
   b. Material: chromium plated brass.

PLU2.M030.9 SANITARY APPLIANCES FOR STANDARD SCHOOLS

As scheduled on Drawings or Approved equivalent.

WCS AND CISTERNS

PLU2.M110.9 CLOSE-COUPLED WC SUITES

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed WC suites including their component float operated valves and flushing valves as a whole assembly for the CM's approval together with all the following substantiation for the CM's information:
      i. Catalogue, brand name / model name, type of trap and job reference of the product;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;

iv. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS;

v. Copy of the close-coupled water closet's registration record under WSD's Water Efficiency Labelling Scheme (WELS) on Water Closets certified true by a certification body or by the QCM, and the associated WSD's valid General Acceptance of the flushing valves;

vi. Installation instruction of WC suites including the fixing of the flushing apparatus, the tools and method for tightening and connecting of pipes and components.

b. For close-coupled WC suites used in domestic blocks, except for the ancillary facilities at lower floors, submit original or a certified true copy of the product conformity certificate to the "Product Conformity Certification Scheme for Close-coupled Water Closet Suites with 6 Litre Flushing Capacity" (PCCS-WC) published by the Hong Kong Institution of Plumbing and Drainage Limited. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM:

i. The product conformity certificate shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a) above or at a time not later than 12 months from the date of commencement of the Works;

ii. In the event that the product conformity certificate has not been submitted for the CM's information, the CM may order the removal of materials or delivered products off Site. The Contractor shall bear all associated costs and no extension of time will be allowed.

c. Submit a summary of the test results under the audit testing of the PCCS-WC. The summary shall be prepared by the accredited laboratory carried out the testing or the certified manufacturer. If so directed by the CM, submit a full set of the audit test reports to the CM for record;

d. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for the CM's information unless the test requirements are covered by the scope of the PCCS-WC:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to the CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (4)(a);

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, the Contractor shall remove all delivered materials off Site and bear all associated costs and no extension of time will be allowed.

2. Quality and Performance Requirements:

a. Unless otherwise specified, all close-coupled WC suites used shall be to Class 2 of BS EN 997:2012+A1:2015 with dual flush combining a maximum flush of 6 litres and a reduced flush no greater than two-thirds of the maximum flush volume and suitable for salt water with quality of vitreous china to BS 3402:1969 comprising:
   i. Vitreous china washdown WC pan:
      - Horizontal outlet to BS EN 33:2011;
      - Colour: as shown on Drawings or to Approval;
      - Fixings to be in accordance with PLU2.M610 or as recommended by the manufacturer and approved by the CM;
      - Length and size to fit design layout.
   ii. Vitreous china flushing cistern:
      - Close-coupled type as part of WC suite;
      - Clearly marked internally with an indelible line to show the intended volume of flush, together with an indication of that volume;
      - All necessary fixings with stainless steel grade 304 screws / bolts.
   iii. Flushing apparatus:
      - Valve type flushing apparatus;
      - Overflow pipe and discharge to external;
      - Flushing mechanism (push button) with protective coating;
      - Flushing apparatus not fastened to the cistern cover to allow free lifting of the cover without damaging the flushing apparatus;
      - The design of the components and fixing details shall prevent bursting and flooding when the connecting component fails;
      - Properties of plastic materials shall be functional and durable in sustaining mechanical, dimensional and chemical stability, and suitable for use with salt water.
   iv. Seat and cover:
      - Plastic single ring to BS 1254:1981 (except the requirements on dimensions);
      - Colour: as shown on Drawings to match WC pan;
      - Complete with necessary fixings.

b. The quality and performance requirements are as follows:
   i. WC pan:

Items	Test Method	Acceptance Standards

Functional Dimensions	Measure the following dimensions - Connecting dimensions shown in BS EN 33: 2011 Cl.2 Table 3 & 4 - Fixing dimension for the seat shown in BS EN 33: 2011 Cl.4 Table 8 Figure 2 & 3a - Height from base to top surface measured at front of rim	- Connecting dimension: BS EN 33: 2011 Cl.2 Table 3 & 4 - Fixing dimensions for the seat: BS EN 33: 2011 Cl.4 Table 8 Figure 2 & 3a. The seat provided or recommended shall comply with the fixing dimensions. - Height from base to top surface measured at front of rim: 390 ± 15 mm. For WC pan installed at accessible toilet, height from base to top of the toilet seat shall be 380 mm to 450 mm.
Visual Examination	BS 3402:1969:Cl. 5.1 & 5.4.	BS 3402:1969:Cl. 5.1 & Table 1.
Water Absorption	BS EN 997:2012+A1:2015: Cl. 5.7.3.	BS EN 997:2012+A1:2015: Cl. 6.15.
Crazing	BS 3402:1969:Cl. 7 & App. B.	BS 3402:1969:Cl. 7.
Chemical Resistance	BS 3402:1969:Cl. 8 & App. C.	BS 3402:1969:Cl. 8.
Resistance to Staining and Burning	BS 3402:1969:Cl. 9 & App. D.	BS 3402:1969:Cl. 9.
Static Load Test	BS EN 997:2012+A1:2015: Cl. 5.7.4.	BS EN997:2012+A1:2015: Cl. 6.14.

ii. Cistern:

Items	Test Method	Acceptance Standards
Dimensional Test on:		
- Shell Thickness	BS 7357:1990:Cl. 5.1.3.	BS 7357:1990:Cl. 5.1.3.
- Spill-over Level	BS 7357:1990:Cl. 12 & Fig. 1.	BS 7357:1990:Cl. 12
- Warning Pipe and Overflow Provision	BS EN 997:2012+A1:2015: Cl. 6.17.2.	BS EN 997:2012+A1:2015: Cl. 6.4
Visual Examination	BS 3402:1969:Cl. 5.2 & 5.4.	BS 3402:1969:Cl. 5.2 & Table 2. (requirements on discolouration and polishing marks do not apply to the back of the cistern.)
Operating Mechanism Test	BS 7357:1990:Cl. 17.4 & App. H.3 for push button operating mechanism	BS 7357:1990:Cl. 17.4 for push button operating mechanism
Float Operated Valve:		
- Distortion and Deflection Tests		
i. Backnuts and Inlet Shank	BS 1212: Part 3:1990: Cl. 13.1 & App. A.	BS 1212: Part 3:1990: Cl. 13.1.
ii. Valve Assembly (for diaphragm type float operated valve only)	BS 1212: Part 3:1990: Cl. 13.2 & App. B.	BS 1212: Part 3:1990: Cl. 13.2.

iii. Float Attachment (for diaphragm type float operated valve only)	BS 1212: Part 3:1990: Cl. 13.3 & App. C.	BS 1212: Part 3:1990: Cl. 13.3.
- Hydraulic Pressure Tests : (salt water shall be used for the test)		
i. Static Pressure	BS 1212: Part 3:1990: Cl. 14.1.	BS 1212: Part 3:1990: Cl. 14.1.
ii. Shut-off Pressure	BS 1212: Part 3:1990: Cl. 14.2 & App. D. No restriction on volume of float immersed in water for compact type float operated valve.	BS 1212: Part 3: 1990: Cl. 14.2.
iii. Dynamic Pressure on Discharge Arrangement	BS 1212: Part 3:1990: Cl. 14.3 & App. E.	BS 1212: Part 3:1990: Cl. 14.3.
- Backflow Prevention	BS 1212: Part 3:1990: Cl. 15 & App. F.	BS EN 997:2012+A1:2015: Cl. 6.2.
- Endurance Test (salt water shall be used for the test and the supply pressure shall be 0.15±0.01 MPa)	BS 1212: Part 3:1990: Cl.17 & App. H. For the subsequent shut-off pressure test, no restriction on volume of float immersed in water for compact type float operated valve.	BS 1212: Part 3:1990: Cl.17
Flushing Device:		
- Physical Endurance and Leakage Test of Flushing Device (salt water shall be used for the test)	BS EN 997:2012+A1:2015: Cl. 6.17.5.	BS EN 997:2012+A1:2015: Cl. 6.7.
- Chemical Endurance of Flushing Device	BS EN 997:2012+A1:2015: Cl. 6.17.6.	BS EN 997:2012+A1:2015: Cl. 6.8.

iii. Completed assembly:

Items	Test Method	Acceptance Standards
Solid Discharge and After-flush Volume for Maximum Flush	BS EN 997:2012:A1:2015: Cl. 6.17.7.	BS EN 997:2012:A1:2015: Cl. 6.9.
Paper discharge for reduced flush volume	BS EN 997:2012+A1:2015: Cl. 6.17.8.	BS EN 997:2012+A1:2015: Cl. 6.10.
Liquid Contaminant Dye Retention	BS EN 997:2012:A1:2015: Cl. 6.17.9.	BS EN 997:2012:A1:2015: Cl. 6.11.
Wash of Bowl	BS EN 997:2012:A1:2015:Cl. 6.17.10.	BS EN 997:2012:A1:2015: Cl. 6.12.
Flush Volume		
Flush Volume - Full Flush	BS EN 997:2012:A1:2015:Cl. 6.17.3.	BS EN 997:2012:A1:2015: Cl. 6.5.1.
- Reduced Flush	BS EN 997:2012+A1:2015: Cl. 6.17.3.	BS EN 997:2012+A1:2015: Cl. 6.5.2.
Depth of Water Seal	BS EN 997:2012:A1:2015: Cl. 6.17.3.	BS EN 997:2012:A1:2015: Cl. 6.13.
Flush Rate	BS EN 997:2012:A1:2015:Cl. 6.17.4.	BS EN 997:2012:A1:2015: Cl. 6.6.

3. All close-coupled WC suites used shall be registered products under WSD's Water Efficiency Labelling Scheme (WELS) on Water Closets. The provisions of the scheme shall apply to the combination of a water closet pan and cistern i.e. the close-coupled suite, and comply with the following:
   a. Carry a water efficiency label showing the products' water consumption level and efficiency rating as follows:

Locations / applications	**Prescribed water efficiency**
Toilet(s) of domestic premises	Grade 1 or Grade 2
Toilet(s) of non-domestic premises, without automatic sensing flushing apparatus(es)	Grade 1 or Grade 2
Toilet(s) of non-domestic premises, with automatic sensing flushing apparatus(es)	Grade 1, Grade 2 or Grade 3
Disabled toilet(s) of any premises	Grade 1, Grade 2 or Grade 3

   b. Comply with the performance requirements specified in WSD's scheme document for WELS on Water Closets. These include flush volume for reduced flush (for dual flush only), solid discharge for maximum flush, paper discharge for reduced flush volume (for dual flush only), liquid contaminant dye retention and wash of bowl. The flushing valve of water closet shall be tested in accordance with the relevant requirements as specified in the Waterworks Regulations (Cap. 102A) and comply with the standards specified for the flushing valve of water closet by the Water Authority;
   c. Manufactured under a design and production system operating according to a recognized international quality system (such as ISO 9001 or equivalent);
   d. Hold a valid WELS registration record with WSD's General Acceptance of the flushing valves of the corresponding water closets.
4. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for WC suites upon delivery on Site. Prior to carrying out the verifications, inform the CM or his representatives who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Dimension check for WC pan and fixings	By measurement	Same as the CM's Approved sample and sub-clause 2(a)(i)
Shell thickness of cistern	By measurement	Same as the CM's Approved sample
Surface quality check for WC pan and cistern	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency

Surface quality check on the underside of WC pan	By measurement	• Less than or equal to 4 nos. fine, shallow, unrepaired, non-through cracks; and each crack is less than or equal to 50 mm long. • Cracks repaired other than by firing clayey material infill in furnace in the factories are not acceptable.

ii. Frequency:

Verification Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note specified in PLU2.M110 (4)(a)(iii)]
Dimension check for WC pan and fixings	1 sample from each batch	Material delivered to Site under one delivery note
Shell thickness of cistern	1 sample from each batch	Material delivered to Site under one delivery note
Surface quality check for WC pan and cistern	1 sample from each batch	Material delivered to Site under one delivery note
Surface quality check on the underside of WC pan	1 sample for every 200 nos. of WC pans or part thereof	Material delivered to Site under one delivery note

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

PLU2.M120.9 WC PAN

Comprising:

1. Vitreous china washdown pan with horizontal outlet to BS 5503:Part 3:1990;
2. Seat and cover to BS 1254:1981: plastic single ring type.

PLU2.M130.9 SQUATTING WC

Vitreous china washdown WC pan with integral treads and loose trap for fitting at floor level.

PLU2.M140.9 CISTERNS

To BS 1125:1987, comprising:

1. Flushing apparatus: valveless syphonic;
2. uPVC discharge pipe to BS 3505:1986 or BSEN 1452 Parts 1-5:2000;
3. Ball valve and overflow;

4. Type and material: low level plastic, high level plastic or low level vitreous china as shown on Drawings.

URINALS AND CISTERNS

PLU2.M210.A BOWL URINAL SUITE

Comprising:

1. Vitreous china bowl to BS 5520:1977:
   a. Inlet supply: top for surface fixed pipework or back for concealed pipeworks;
   b. Non-corroding, concealed, screw fixed brackets;
   c. Colour: as shown on Drawings or to Approval.
2. Plastics waste outlet, 40 mm nominal size with backnut and plastics or stainless steel domed outlet grating;
3. Urinal flushing valve shall be of water efficiency Grade 1 under Water Efficiency Labelling Scheme (WELS).

PLU2.M220.9 FIRE CLAY SLAB URINALS

Fire clay slab type with graded single channel, outlet and grating and fluted non-slip treads:

1. Arrangement and dimensions as shown on the Drawings;
2. Water supply, waste disposal fittings as shown on the Drawings.

PLU2.M230.A STAINLESS STEEL SLAB URINAL

To BS 4880:Part 1:1973 and:

1. Stainless steel spreaders, flush pipes and brackets;
2. Copper alloy outlet, 65 mm nominal size with backnut and hinged domed outlet grating;
3. Automatic plastics flushing cistern: to BS 1876:1990 non-corroding screw to the wall metal fixings;
4. Water supply fittings: as shown on Drawings;
5. Urinal flushing valve shall be of water efficiency Grade 1 under Water Efficiency Labelling Scheme (WELS).

PLU2.M240.9 CISTERNS

Comprising:

1. Vitreous china automatic flushing cistern to BS 1876:1990;
2. Chromium plated flush pipe and fixing clips;
3. Surface fixed or concealed chromium plated spreader;
4. Colour: as shown on Drawings and to match urinal.

WASH BASINS AND SINKS

PLU2.M310.9 WALL HUNG OR COUNTER TOP OR SEMI-RECESSED WASH BASINS

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name / model name and job reference of the product;
      ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. When the wash basins are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

c. Submit catalogue and test report (original or certified true copy issued or certified by the laboratory that complies with PRE.B9.570) showing compliance with sub-clause (2)(b)(v) for the proprietary screw anchors or threaded rods as specified in sub-clause (2)(a)(iii) for CM's agreement not later than the delivery of the material as mentioned in sub-clause (3)(a).

2. Quality Requirements:

a. Vitreous china wall hung or counter top or semi-recessed wash basin comprising:

i. Vitreous china wash basin to BS 1188:1974, with single faucet hole to CM's approval for monoblock basin mixer with aerator, pop up waste and flexible supply pipes:

- Type: wall hung or counter top or semi-recessed as shown on Drawings;
- Colour: as shown on Drawings or to Approval;
- Size to fit design layout and with sufficient space between the wall surface and the basin mixer for the operation of the pop up waste;
- Diameter of the central tap hole to BS EN 31:2011 sub-clause 3.1 and Table 1.

ii. Fixing for counter top or semi-recessed wash basins: in accordance with manufacturer's recommendations approved by the CM;

iii. Fixing for wall-hung wash basins: proprietary screw anchors or threaded rods with flexible washers, plastic plugs (other types to be Approved) and all necessary fixing accessories to suit the site conditions.

b. The quality and performance requirements are as follows:

Items	Test Method	Acceptance Standards
i. Water Absorption	BS 3402:1969 0.76% MAX.	BS 3402:1969

ii. Crazing	BS 3402:1969 No defects	BS 3402:1969
iii. Chemical Resistance		
- Acetic acid		
- Citric acid		
- Detergent	BS 3402:1969	BS 3402:1969
- HCL acid	No visual defects	
- NaOH		
- Sodium stearate		
- Sulphuric acid hole		
iv. Resistance to Staining and Burning		
- Aqueous solution of ethylene blue		
- Aqueous solution of sodium hypochloride		
- Aqueous solution of hydrogen peroxide	BS 3402:1969 No stain	BS 3402:1969
- AMYL acetate		
- Carbon tetrachloride		
- Iodine in alcohol		
- Lighted cigarette		
v. Load Resistance (for wall hung and semi-recessed wash basin only)	BS EN 14688:2006	- No cracking, breaking or permanent distortion of wash basins - No observable movement or loosening of screw anchors, threaded rods or plastic plugs

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for vitreous china wash basins upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Dimension Check and fixings	By measurement	Same as the CM's Approved sample and sub-clause 2(a)(ii)&(iii)

Surface Quality	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency
On-site Load Resistance Test	BS EN 14688:2006	Same as sub-clause (2)(b)(v)

ii. Frequency:

Verification Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note specified in PLU2.M310 (3)(a)(ii)]
Dimension Check and fixings	1 sample from each batch	Material delivered to Site under one delivery note
Surface Quality	1 sample from each batch	Material delivered to Site under one delivery note
On-site Load Resistance Test	2 samples in the sample flats for wash basins on both concrete and panel walls. Where the wash basins are only attached to one type of wall, 1 sample is taken.	Material delivered to Site for sample flat installation

c. Where any of the verifications fail to meet the acceptance standards, either:
   i. Remove the representative batch off Site; or
   ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

PLU2.M320.9 STAINLESS STEEL SINK

Stainless steel non-magnetic and corrosive resistant and to BS 1244:Part 2:1988, comprising:

1. Bowl and drainer of steel grade 304S15 to BS 1449:Part 2:1983 with mill surface finish No.2A or with AISI 304 18/8, complete with 90 mm waste fittings, insert clips; rubber underlining, 0.8 mm thickness, polished finish;
2. Type: sit-on or inset type with number of bowls and drains as shown on Drawings;
3. Chromium plated brass chain and stay with rubber plug;
4. Pierced waste outlet to accommodate waste fitting;
5. Stainless steel drain outlets consisting of stainless steel strainer and fixing screws with PVC couplings for connection to 40 mm diameter PVC bottle traps and pipes;
6. Sound deadening pads fitted underneath sink and drainer;
7. 25 mm x 1.6 mm thick stainless steel earthing lug for equipotential bonding connection, or otherwise as indicated on Drawings.

BATHS AND SHOWERS

PLU2.M410.9 PORCELAIN ENAMELLED CAST IRON BATHS

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name / model name and job reference of the product;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;
      iv. When the cast iron baths are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
         - Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
   b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information:
      i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;
      ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);
      iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
2. Quality Requirements:
   a. Porcelain enamelled cast iron bath to BS 1189:1986 comprising:
      i. Porcelain enamelled cast iron non-apron type bath with non-slip surface:
         - Colour: as shown on Drawings or to Approval.
      ii. Adjustable cast iron feet capable of raising top of bath to the height as shown on Drawings;
      iii. Chromium plated brass bath pop up drain and flexible overflow assembly;
      iv. 1.5 mm removable enamelled pressed steel apron with skirting and fixing devices:
         - Colour: as shown on Drawings to match the bath.
   b. The quality and performance requirements are as follows:
      i. Cast iron bath tub and waste bodies:

Items	Test Method	Acceptance Standards	Remark
Visual Inspection	Cl. 3.3, 3.4 and 3.5 of BS 1189:1986.	Cl. 3.3, 3.4 and 3.5 of BS 1189:1986.	• All items are applicable to the bath.
Dimensional Check			

- Overall Dimensions	Cl. 6 of BS 1189:1986.	Length = L + 5 mm, - 10 mm. Width = W ± 5 mm. where L, W are dimensions shown on Drawings.	• Visual inspection, dimensional check, functional characteristics and finish are applicable to apron • For visual inspection, adjust the cast iron feet so that the top of the bath is set at a height of 525 mm above test floor level.
- Connecting Dimensions	Cl. 4.1 of BS 1189:1986 on dimensions H, D_1, D_2, D_4 & a.	Table 1 of BS 1189:1986.	
- Dimensional Deviations	Cl. 8.1 to 8.6 and App. B5 of BS 1189:1986	Cl. 8.2 to 8.6 of BS 1189:1986.	
Functional Characteristics	Cl. 7 of BS 1189:1986.	Cl. 7 of BS 1189:1986.	
Finish	Cl. 3.2.1 to 3.2.6 of BS 1189:1986.	Cl. 3.2.1. to 3.2.6. of BS 1189:1986.	
Pop Up Waste Assembly			
- Waste Plugs	See Test Method No. 1 as given in (b)(ii) below	Minimum 95% volume of water shall be left in the bath.	
- Coating Appearance	Cl. 6.1.1 of BS 4641:1986	Cl. 6.1.1 of BS 4641:1986	
- Overflow Body - Coating Appearance	Cl. 6.1.1 of BS 4641:1986	Cl. 6.1.1 of BS 4641:1986	
Rigidity	Test 1 to 5 of Cl. B.6 of BS 1390:1990	Same as the requirements stipulated in columns 'Type 1, Grade 22' of Table 4 of BS 1390:1990.	
Impact Resistance	Cl. B.7 of BS 1390:1990. (drop height to be 1.4 m)	Cl. B.7.2. of BS 1390:1990	

ii. Test Method No. 1:

- Operate the pop up drain five times;
- Close the waste plug. Check if it is watertight fit in the waste body by filling 50 mm depth of water at 25 ± 1°C into the bath and observe for sign of water leakage 5 min. later. There shall be no sign of leakage. Drain the water and repeat the test if leakage is found. The specimen fails the test if watertightness cannot be achieved after three attempts;
- Fill the bath with known volume of water at 32 ± 1°C up to 400 mm depth, measured at mid-length of the bath. This procedure shall be completed in less than 5 minutes;
- Maintain the temperature at 32 ± 1°C during the test;
- Measure volume of the water left in the bath after 1 hour.

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for baths upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Test Method	Acceptance Standards
Dimension Check	By measurement	Same as the CM's Approved sample
Surface Quality	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency

ii. Frequency:

Verification Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note specified in PLU2.M410 (3)(a)(ii)]
Dimension Check	1 sample from each batch	Material delivered to Site under one delivery note
Surface Quality	1 sample from each batch	Material delivered to Site under one delivery note

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

PLU2.M420.9 VITREOUS CHINA SHOWER TRAYS

Vitreous china, to BS 6340:Part 8:1985:

1. Length and size to fit design layout;
2. Colour: as shown on Drawings or to Approval.

PLU2.M430.9 ACRYLIC SHOWER CUBICLE, SHOWER TRAY AND SLIDING SHOWER DOOR

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the product;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. When the shower cubicle and shower trays are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Acrylic shower cubicle, shower tray and sliding shower door to BS 3193:1989, BS 5286:1978, BS 6206:1981 and BS 6340:Part 5:1983 or equivalent:

i. Arcylic shower cubicle or shower tray:

- Length and size to fit design layout;
- Colour: as shown on Drawings or to Approval;
- Flat shower tray with adjustable feet and removable front panel. The shower trays shall be premounted and can be adjusted easily in height. The front panel shall be fixed at the frame by concealed clip system.

ii. Sliding shower door:

- Number and size of doors as shown on Drawings;
- Fully framed shower enclosure constructed of PVC coated or powder coated epoxy finished aluminium framing with 5 mm thick (minimum) clear tempered safety glass and magnetic closure device;
- Adjustability of the panel by two mounting profiles;
- Ball-bearing wheels for the panels to enable easy sliding of the doors;
- Door panels should be demountable for easy cleaning.

b. The quality and performance requirements are as follows:

i. Shower cubicle or shower tray:

Shower tray:

Test Method BS 6340:Part 5:1983, AMD 4980, AMD 5913			Acceptance Standard	Remarks
Clause 4	Dimensions	Length (mm) Width (mm) Height (mm) Radius (mm)	± 5 mm	The dimensions shall not deviate from the work size quoted by the manufacturer by more than the acceptance standards
Clause 6 and Appendix B.2	Dimensional	Squaring Straightness of the sides	± 5 mm	

	Deviations	Straightness of the rim edge				
		Flatness of the top surface of rim				
Clause 7 and Appendix B.3 & B.5	Resistance to Temperature Changes		1. To meet the requirements of Clause 5. 2. The maximum deflection at the gauge position is not greater than 4 mm 3. No evidence of distortion or other defects at the impact sites.			
Clause 8 and Appendix B.4	Resistance to Domestic Chemicals and Stains		No permanent staining or deterioration.			
Clause 9 and Appendix B.5	Resistance to Impact		No evidence of distortion or other defects.			
Clause 10 and Appendix B.6	Determination of rigidity after simulated installation of the shower tray		Test No	Maximum Permissible Deflection		
				Under load	Residual	
				mm	mm	
			1	2	0.3	
			2	3	0.3	

Shower cubicle:

Test Method			Acceptance Standards		Remarks
Dimensions	Assembly	Length (mm)	± 5 mm		The dimensions shall not deviate from the work size quoted by the manufacturer by more than the acceptance standards
		Width (mm)			
		Height (mm)			
		Radius (mm)			
	Thickness of Door (Outer Frame) (mm)		± 2 mm		
	Thickness of Enclosure Wall (Outer Frame) (mm)		± 2 mm		
	Thickness of Tempered Glass (mm)		Minimum 5 mm		
BS 6340:Part 3:1985 Appendix A	Test on Rigid Enclosure Walls		Maximum Permissible Deflection		
			Under load	Residual	
			55 mm	5 mm	
BS 6340:Part 3:1985 Appendix A	Leakage Test		Inspect at the other side of the cubicle to check no water leakage / seepage.		

Tempered glass:

Test Method		Acceptance Standard	Remarks
BS 6206:1981 & AMD 8693	Test for Toughening Quality	BS 6206:1981 Clause 5.14 Have a minimum particle count of 40 particles in any 50 x 50 mm square.	If the test result of this test does not comply to the acceptance standard, the impact test shall not be carried out. The material shall not be classified.
	Test for Behavior on Impact	BS 6340:Part 3:1985	

		The safety glass to be Class C or higher class.	
BS 3193:1989 Appendix C	Resistance to Thermal Shock	BS 3193:1989 The glass panel shall not fracture	

Sliding shower doors:

Test Method		Acceptance Standard	Remarks
Dimensions (Assembly)	Height (mm)	± 5 mm	The dimensions shall not deviate from the work size quoted by the manufacturer by more than the acceptance standards
	Width (mm)	± 5 mm	
	Thickness of Door (mm) (Outer Frame)	± 2 mm	
Dimensions (Each sliding door panel)	Height (mm)	± 5 mm	The dimensions shall not deviate from the work size quoted by the. manufacturer by more than the acceptance standards Each sliding door panel shall be tested separately.
	Width (mm)	± 5 mm	
	Thickness of Panel (mm)	± 2 mm	
	Thickness of Tempered Glass (mm)	Minimum 4 mm	
BS 5286:1978 & AMD 4641	Ease of Sliding	Force not less than 10 N and not exceeding 60 N applied at the hand-grip position to set the panel in motion.	Each sliding door panel shall be tested separately.
	Resistance to Excessive Operation Force	The force 150 N shall not cause a deflection of the stile greater than 3 mm and there shall be no permanent deflection on release of load.	
	Resistance to Accidental Loading	With the force 300 N applied, the stile shall not twist off the glazing and there shall not subsequently be any permanent deformation	
See methods given in (b)(ii) & (b)(iii) below	Test on Endurance Performance	No damage after 100,000 cycling test, back and forth movement. Force not less than 10 N and not exceeding 60 N applied at the hand-grip position to set the panel in motion after cycling test.	
BS 6340:Part 3: 1985 Appendix B	Leakage Test	Inspect at the other side of the door to check no water leakage / seepage.	The sliding door assembly shall be tested.

ii. Test on endurance performance of sliding door:
- Install the specimen unit according to the manufacturer's specification;
- Connect the test door at the hand-grip position to mechanical system (see cycling test mechanism below) capable of producing a uniform back and forth movement to the test door;
- Move the test door back and forth over a full travel distance for 100,000 cycles;
- Set the speed of operation of the test door between successive open / close cycles to a minimum of 5 seconds and a maximum of 10 seconds.

iii. Cycling test mechanism:
- The mechanism shall provide smooth opening of the test door and return of the test door to the closed position;
- The mechanism shall be capable of providing 100,000 continuous cycles of open / close;

- Means shall be provided for recording the number of operating cycles;
- Check for damage, examine and record the wear and tear conditions and carry out "Ease of Sliding Test" after 5,000, 10,000, 20,000 cycles and therefore after every 20,000 cycles.

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for shower cubicle and tray upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Dimension Check	By measurement	Same as the CM's Approved sample
Surface Quality	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency

      ii. Frequency:

Verification Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note specified in PLU2.M430 (3)(a)(ii)]
Dimension Check	1 sample from each batch	Material delivered to Site under one delivery note
Surface Quality	1 sample from each batch	Material delivered to Site under one delivery note

   c. Where any of the verifications fail to meet the acceptance standards, either:
      i. Remove the representative batch off Site; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

ANCILLARY MATERIALS

PLU2.M510.B MIXERS (BATH / SHOWER, BASIN AND KITCHEN SINK) AND SHOWER HANDSETS

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed mixers and shower handsets for the CM's approval together with all the following substantiation for the CM's information:
   i. Catalogue, brand name / model name and job reference;
   ii. Name, address and contact person of the local supplier;
   iii. Name, address and contact person of the manufacturer;
   iv. Approval by the Water Authority with a valid approval document for the mixers;
   v. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
   vi. Nominal flow rates of mixers and shower head;
   vii. Calculation in accordance to the method described in BEAM Plus New Buildings (Version 2.0) manual to demonstrate that the use of the proposed mixers and shower head in the project will lead to an annual saving of consumption of potable water of not less than 30%;
   viii. When the mixers and shower handsets are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
      - Two identical panels with accessories mounted on boards similar to the one maintained by the Housing Department showing the quality and components for the mixers and shower handsets;
      - Original or certified true copies of certification to ISO 9001 and ISO 14001 for the manufacturing plant. If the mixers and shower handsets are not manufactured in the same plant, the certification is required for all manufacturing plants. If a copy of the ISO certificate is submitted, it shall be certified true by the certification bodies or by the QCM. The certification bodies shall be as follows:

ISO	Certification Body
ISO 9001	The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
ISO 14001	The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS.

   ix. Confirmation of compliance with statutory requirements in writing jointly signed by the Building Services Engineer of the Contractor and the Licensed Plumber.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with requirements of the Water Authority and the performance requirements of sub-clauses (2)(a)(iv), (2)(b)(v), (2)(c)(vi) and (2)(d)(iv) for the CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to the CM's consideration on the track records as maintained by the Housing Department;

ii. The test reports shall either be submitted at the sample submission and approval stage as per sub-clause (1)(a), or at a time not later than the delivery of the material as per sub-clause (3)(a);

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and the extra time required.

c. Submission of material list (Form WWO 1149) to WSD and the subsequent updating shall be made as soon as the proposed materials, or proposed change of approved materials, are approved by the CM and before placement of order for such materials. All applications and forms for submission to WSD shall be submitted to the CM for comment before submission to WSD and record after approval;

d. Sample board:

i. Submit a sample board similar to the one maintained by the Housing Department showing samples of mixers and accessories to be used in the plumbing installation and listed in the Form WWO 1149 submitted to WSD as per PLU1.M010 (4). The sample board is to be kept by the CM on Site together with associated relevant certificates / test reports / catalogues / supporting documents upon submission of Form WWO 46 to the Water Authority;

ii. When the mixers and shower handsets are supplied for domestic blocks, submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;

iii. The sample boards shall comply with the requirements of the Water Authority. Each sample, with clear numbering and labelling, shall be firmly fixed onto a rigid wooden or metal board. A list shall also be affixed on the sample board to show the item description, make and brand, country of origin and locations of installation;

iv. Replace samples and relevant certificates / test reports / catalogues / supporting documents whenever amendment to Form WWO 1149 is made and approved by the Water Authority.

2. Quality Requirements:

a. Mixer (Bath / Shower):

i. Design and construction requirements:

- Bath mixer: single lever wall mounted type with double outlets and diverter for shower point connection with removable type aerator / strainer at the spout of the bath mixer;
- Shower mixer: single lever wall mounted type with single outlet for shower point connection;
- All taps identified for use on hot and cold water with either colour coding and / or character identification;
- Corrosion resisting copper alloy with chrome plated finish to body of mixer;

- Threaded end connection to mixer suitable for directly connecting the pipe to which it is installed. S-connection to be covered;
- Nominal size of the mixer as shown on the Drawings;
- Fixing to be in accordance with PLU2.M610 or as recommended by the manufacturer and approved by the CM.

ii. Chemical and hygiene requirements:

- All materials coming into contact with water intended for human consumption shall present no risk to health. They shall not cause any change of the drinking water in terms of quality, appearance, smell or taste;
- Decorative, electroplated materials such as nickel and / or chromium shall not be present on the internal surface of any of the components of the mixer that may come into contact with water.

iii. Pressure and temperature requirements:

- Suitability for both working and test pressure and temperature of the plumbing system in which it is installed and complying with BS EN 1286:1999 on pressure requirements;
- Total pressure drop across the mixer with the hot water tap fully open and cold water tap fully closed not more than 0.25 bar at 7 1/min.

iv. Performance requirements:

Items	Method	Acceptance Standards	Remark
Flow Rate	BS EN 1286:1999 Cl.10.5.1 & 10.5.2	BS EN 1286:1999 Cl. 10.5.3	For bath mixer, both nozzle and shower sides shall be tested.
Leak tightness Characteristics	BS EN 1286:1999 Cl. 9	BS EN 1286:1999 Cl. 9	
Pressure Resistance Characteristics	BS EN 1286:1999 Cl. 11	No permanent deformation in any part of the mixer or BS EN 1286:1999 Cl.11	
Mechanical Strength Characteristics	BS EN 1286:1999 Cl. 13.2	BS EN 1286:1999 Cl. 13.2.4	
Mechanical Endurance Characteristics			
- Endurance Characteristics of the Operating Mechanism	BS EN 1286:1999 Cl. 12.1	BS EN 1286:1999 Cl. 12.1	
- Endurance Test of Diverters (For bath mixer only)	BS EN 1286:1999 Cl. 12.2	BS EN 1286:1999 Cl. 12.2	
Pressure Drop Test (For bath mixer & shower mixer only)	Please refer to Method No. 1 as given in (a)(v) below.	Total pressure drop across the mixer with hot water tap fully open and cold water tap fully closed not more than 0.25 bar at 7 litre/minute.	For bath mixer, test both nozzle and shower sides.

Blend Water Extreme Temperature	BS 5779:1979:Cl. 16 & App K Temp. of supply water: cold water = 20°C ± 1°C hot water = 82°C ± 1°C	BS 5779:1979:Cl. 16	For bath mixer, test both nozzle and shower sides.
Exposed Surface Coatings			
Visual Examination	BS EN 248 : 2002 : Cl. 4.3	BS EN 248 : 2002 : Cl. 4.4	
Corrosion Resistance Test	BS EN 248 : 2002 : Cl. 5.1.2	BS EN 248 : 2002 : Cl. 5.1.3	
Internal Surface			
Visual Examination	Open up inspection	No electroplated material such as nickel and / or chromium present on the internal surface of any of the components of the mixer that may come into contact with water	

v. Method No.1:

- For Shower Mixer:

- Refer to Appendix PLU2/I for arrangement of the testing set-up;
- To test hot water side:

  Set the lever handle of the mixer valve so that hot water side is fully open and cold water side is fully close. Allow maximum flow of water at 25°C ± 1°C and 7 1/min. ±2% to pass through the sample at the hot water side. Take reading of the pressure gauges to an accuracy of 2%.

  Pressure drop should be taken as the difference in flow pressure between the inlet and outlet.

- For Bath Mixer:

- Refer to Appendix PLU2/I for arrangement of the testing set-up;
- Allow water at 25°C ± 1°C to pass through the sample at 7 1/min. ±2%;
- To test hot water side:

  The diverter shall be set so that water is discharged only through the connection to the shower hose. Set the lever handle of the mixer valve so that hot water side is fully open and cold water side is fully close. Allow maximum flow of water at 25°C ± 1°C and 7 1/min. ±2% to pass through the sample at the hot water side. Take reading of the pressure gauges to an accuracy of 2%.

  Pressure drop should be taken as the difference in flow pressure between the inlet and outlet.

b. Mixer (Basin):

i. Chromium plated brass monoblock basin mixer with non-ferrous or corrosion resisting pop-up waste and flexible hose assembly with stainless steel wire braiding;

ii. Design and construction requirements:

- Lever type fitted with removable type aerator / strainer at the spout;
- Fixing to be in accordance with PLU2.M610 or as recommended by the manufacturer and approved by the CM.

iii. Chemical and hygiene requirements:

- All materials coming into contact with water intended for human consumption shall present no risk to health. They shall not cause any change of the drinking water in terms of quality, appearance, smell or taste;
- Decorative, electroplated materials such as nickel and / or chromium shall not be present on the internal surface of any of the components of the mixer that may come into contact with water.

iv. Water efficiency requirements:

- Grade 1 under the Voluntary Water Efficiency Labelling Scheme on Water Taps by the Water Authority with nominal flow rate not greater than 5 litres/minute at 5 bar for mixing type water taps;
- The nominal flow rate shall satisfy the calculation in sub-clause (1)(a)(vii);
- Achieve at least 30% annual water use reduction compared to the baseline case in credit WU P1 in BEAM Plus New Buildings (Version 2.0) manual.

v. Performance requirements:

Items	Method	Acceptance Standards
Mixer		
Flow Rate Test	In accordance with the testing methodology of "Flow Rate Test" specified in Water Authority's "Voluntary Water Efficiency Labelling Scheme on Water Taps".	Flow rate to sub-clause 2(b)(iv). The variation of the actual flow rates under dynamic pressures 150 kPa, 250 kPa and 350 kPa shall be within ±1 litre/minute of the nominal flow rate determined from the measured flow rates in this test The maximum difference between the highest and lowest average flow rates is not to exceed 2.0 litres/minute
Leak tightness Characteristics	BS EN 1286:1999 Cl. 9	BS EN 1286:1999 Cl. 9
Pressure Resistance Characteristics	BS EN 1286:1999 Cl. 11	BS EN 1286:1999 Cl. 11
Mechanical Strength Characteristics	BS EN 1286:1999 Cl. 13.2	BS EN 1286:1999 Cl. 13.2.4
Mechanical Endurance Characteristics - Endurance Test of the Operating Mechanism	BS EN 1286:1999 Cl.12.1	BS EN 1286:1999 Cl.12.1
Blend Water Extreme Temperature	BS 5779:1979:Cl. 16 & App K Temp. of supply water: cold water = 20°C ± 1°C hot water = 82°C ± 1°C	BS 5779:1979:Cl. 16
Exposed Surface Coatings		

Visual Examination	BS EN 248 : 2002 : Cl. 4.3	BS EN 248 : 2002 : Cl. 4.4
Corrosion Resistance Test	BS EN 248 : 2002 : Cl. 5.1.2	BS EN 248 : 2002 : Cl. 5.1.3
Internal Surface		
Visual Examination	Open up inspection	No electroplated material such as nickel and / or chromium present on the internal surface of any of the components of the mixer that may come into contact with water
Flexible Hose Assembly with Stainless Steel Wire Braiding		
Leak Tightness under Internal Hydrostatic Pressure	BS EN 13618 : 2016 : Cl. 4.2.3.3 & Annex B.4	BS EN 13618 : 2016 : Cl. 4.2.3.3
Tensile Stress Resistance	BS EN 13618 : 2016 : Cl. 4.2.3.4 & Annex B.3	BS EN 13618 : 2016 : Cl. 4.2.3.4
Resistance to Corrosion	BS EN 13618 : 2016 : Cl. 4.2.3.9 & Annex B.8 BS EN ISO 1456:2009 Cl. 6.5 Duration of corrosion test : Acetic acid salt spray test for 48 hours For surveillance test in PLU2.T310, fitting or integrated flange at the ends of the flexible hose is excluded from testing if original or certified true copy of the test report is submitted to show that the fitting is made from copper or copper alloy selected from materials specified in European copper and copper alloy product standards with max. Lead content <6%.	BS EN 13618 : 2016 : Cl. 4.2.3.9
Flexibility	BS EN 13618 : 2016 : Cl. 4.2.3.11 & Annex B.9 For surveillance test in PLU2.T310, length of test specimen L = length of flexible hose sampled from the Site.	BS EN 13618 : 2016 : Cl. 4.2.3.11

c. Mixer (Kitchen Sink):

i. Chromium plated brass deck mounted kitchen sink mixer consisting of

- Spouts of nominal thickness 0.6 to 0.8mm;
- Flexible hose assembly with stainless steel wire braiding.

ii. Design and construction requirements:

- Single lever type;
- All taps identified for use on hot and cold water with either colour coding and / or character identification;
- Corrosion resisting copper alloy with chrome plated finish to body of mixer;
- Fixing to be in accordance with PLU2.M610 or as recommended by the manufacturer and approved by the CM;
- Nominal size of the mixer as shown on the Drawings.

iii. Chemical and hygiene requirements:

- All materials coming into contact with water intended for human consumption shall present no risk to health. They shall not cause any change of the drinking water in terms of quality, appearance, smell or taste;
- Decorative, electroplated materials such as nickel and / or chromium shall not be present on the internal surface of any of the components of the mixer that may come into contact with water.

iv. Pressure and temperature requirements:

- Suitability for both working and test pressure and temperature of the plumbing system in which it is installed.

v. Water efficiency requirements:

- Grade 1 under the Voluntary Water Efficiency Labelling Scheme on Water Taps by the Water Authority with nominal flow rate not greater than 5 litres/minute for the non-residential mixing type kitchen sink;
- Grade 1 or 2 under the Voluntary Water Efficiency Labelling Scheme on Water Taps by the Water Authority with nominal flow rate not greater than 7 litres/minute for the residential mixing type kitchen sink;
- The nominal flow rate shall satisfy the calculation in sub-clause (1)(a)(vii).

vi. Performance requirements:

Items	Method	Acceptance Standards
Mixer		
Flow Rate Test	In accordance with the testing methodology of "Flow Rate Test" specified in Water Authority's "Voluntary Water Efficiency Labelling Scheme on Water Taps".	Flow rate to sub-clause 2(c)(iv). The variation of the actual flow rates under dynamic pressures 150 kPa, 250 kPa and 350 kPa shall be within ±1 litre/minute of the nominal flow rate determined from the measured flow rates in this test The maximum difference between the highest and lowest average flow rates is not to exceed 2.0 litres/minute
Leak tightness Characteristics	BS EN 1286:1999 Cl. 9	BS EN 1286:1999 Cl. 9
Pressure Resistance Characteristics	BS EN 1286:1999 Cl. 11	BS EN 1286:1999 Cl. 11
Mechanical Strength Characteristics	BS EN 1286:1999 Cl. 13.2	BS EN 1286:1999 Cl. 13.2.4
Mechanical Endurance Characteristics		
- Endurance Characteristics of the Operating Mechanism	BS EN 1286:1999 Cl. 12.1	BS EN 1286:1999 Cl. 12.1
- Endurance of Swivel Nozzles	BS EN 1286:1999 Cl. 12.3	BS EN 1286:1999 Cl. 12.3

Blend Water Extreme Temperature	BS 5779:1979:Cl. 16 & App K Temperature of supply water: cold water = 20°C ± 1°C hot water = 82°C ± 1°C	BS 5779:1979:Cl. 16
Exposed Surface Coatings		
Visual Examination	BS EN 248 : 2002 : Cl. 4.3	BS EN 248 : 2002 : Cl. 4.4
Corrosion Resistance Test	BS EN 248 : 2002 : Cl. 5.1.2	BS EN 248 : 2002 : Cl. 5.1.3
Internal Surface		
Visual Examination	Open up inspection	No electroplated material such as nickel and / or chromium present on the internal surface of any of the components of the mixer that may come into contact with water
Flexible Hose Assembly with Stainless Steel Wire Braiding		
Leak Tightness under Internal Hydrostatic Pressure	BS EN 13618 : 2016 : Cl. 4.2.3.3 & Annex B.4	BS EN 13618 : 2016 : Cl. 4.2.3.3
Tensile Stress Resistance	BS EN 13618 : 2016 : Cl. 4.2.3.4 & Annex B.3	BS EN 13618 : 2016 : Cl. 4.2.3.4
Resistance to Corrosion	BS EN 13618 : 2016 : Cl. 4.2.3.9 & Annex B.8 BS EN ISO 1456:2009 Cl. 6.5 Duration of corrosion test : Acetic acid salt spray test for 48 hours For surveillance test in PLU2.T310, fitting or integrated flange at the ends of the flexible hose is excluded from testing if original or certified true copy of the test report is submitted to show that the fitting is made from copper or copper alloy selected from materials specified in European copper and copper alloy product standards with max. Lead content <6%.	BS EN 13618 : 2016 : Cl. 4.2.3.9
Flexibility	BS EN 13618 : 2016 : Cl. 4.2.3.11 & Annex B.9 For surveillance test in PLU2.T310, length of test specimen L = length of flexible hose sampled from the Site.	BS EN 13618 : 2016 : Cl. 4.2.3.11

d. Shower Handset:

i. Shower Handsets consisting:

- 1000 mm shower rail;
- 1500 mm flexible plastic shower hose;
- Shower head with adjustable spray pattern;
- Soap dish;
- Fixing to be in accordance with PLU2.M610 or as recommended by the manufacturer and approved by the CM.

ii. Shower hose:

- Design and construction requirements:

- Corrosion resistant, flexible and of durable construction with lock nut / adapter at both ends for connection to mixer and shower head;
- 1500 mm long.

- Pressure and temperature requirements:

- Suitability for both the working and test pressure and temperature of the plumbing system in which it is installed.

iii. Shower head:

- Design and construction requirements:

- Hand shower type, corrosion resistant and of durable construction with threaded ends for connecting to a shower hose.

- Pressure and temperature requirements:

- Suitability for both working and test pressure and temperature of the plumbing system in which it is installed.

- Water efficiency requirements:

- Grade 1 under the Voluntary Water Efficiency Labelling Scheme on Showers for Bathing by the Water Authority with nominal flow rate not greater than 8 litres/minute at 5 bar;
- The nominal flow rate shall satisfy the calculation in sub-clause (1)(a)(vii);
- Achieve at least 30% annual water use reduction compared to the baseline case in credit WU P1 in BEAM Plus New Buildings (Version 2.0) manual.

iv. Performance requirements:

Items	Method	Acceptance Standards
Flow Rate Test	In accordance with the testing methodology of "Flow Rate Test" specified in Water Authority's "Voluntary Water Efficiency Labelling Scheme on Showers for Bathing"	Flow rate to sub-clause 2(d)(iii) The variation of the actual flow rates under dynamic pressures 150 kPa, 250 kPa and 350 kPa shall be within ±1 litre/minute of the nominal flow rate determined from the measured flow rates in this test The difference between the highest and the lowest average flow rates measured in the nominal flow rate measurement shall not exceed 2.0 litre/minute
Mean Spray Spread Angle	In accordance with the testing methodology of "Mean Spray Spread Angle" specified in Water Authority's "Voluntary Water Efficiency Labelling Scheme on Showers for Bathing"	The mean spread angle shall be between 0°and 8°.
Temperature Drop	In accordance with the testing methodology of "Temperature Drop" specified in Water Authority's "Voluntary Water Efficiency Labelling Scheme on Showers for Bathing"	The temperature drop shall not exceed 3°C.

Hot Water Resistance Test	Please refer to Method No. 2 as given below.	The maximum temperature measured at the shower head shall not be greater than 45°C and the maximum temperature measured at the shower hose shall not be greater than 55°C. No visual defect e.g. melting of any component. The sample shall be able to pass Flow Rate Test after being cooled for 5 minutes. No leakage or defect found in hydraulic test.

v. Method No. 2:

- Allow hot water at 76°C ± 1°C to pass through the sample for five minutes at a rate of 7 1/min.;
- Four random points evenly distributed across the surface of the shower head (two points at the handle) and four points along the length of the hose, measure the temperature at these locations to the nearest 0.1°C while the hot water is still running;
- Visually examine the sample for defect;
- Stop the hot water running, let the sample be cooled down to 25°C ± 1°C for five minutes;
- Carry out Flow Rate Test to the sample again;
- The hose shall also be subject to a static hydraulic pressure test of 5 bar for one minute. Observe for any sign of leakage and defect.

e. When the mixers and shower handset are supplied for domestic blocks, standard of visual quality shall be comparable with the benchmark samples maintained by the Housing Department.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for mixers and shower handsets upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Surface Quality	Visual	No damage, no staining, no blemish, appearance same as the CM's approved sample.
Design and Fixings	Visual	Same as the CM's approved sample and sub-clause 2(a)(i), 2(b)(ii), 2(c)(ii) and 2(d)(i)

Logo and label check	Visual	Same as the CM's approved sample

ii. Frequency:

Verification Items	Sampling Frequency	Representative Batch [the batch of material delivered to Site under the delivery note specified in PLU2.M510 (3)(a)(ii)]
Surface Quality	1 sample from each batch	Same batch of material delivered to Site under one delivery note
Design and Fixings		
Logo and label check		

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

d. Observe and comply with the requirements of verification test for mixers delivered to site under sub-clause (4).

4. Open Up Inspections of mixers:

a. Testing Arrangements:

i. Open up inspection shall be carried out by the CM or a Direct Testing Contractor upon delivery of material to Site under a delivery note, or during the course of construction as directed by the CM. A representative batch means the same type of mixer in the same batch of material delivered to Site under a delivery note as specified in sub-clause (3)(a)(ii);

ii. Comply with the following pertaining to open up inspection:

- Provide attendance on the Site;
- Provide, deliver and collect samples etc. as directed by the CM.

b. Testing Samples:

i. Samples shall be selected by the CM and witnessed by representative of the Contractor;

ii. Provide one test sample of mixer of bath / shower or basin or kitchen sink from a batch of material delivered to Site under the delivery note as specified in PLU2.M510 (3)(a)(ii) as selected by the CM;

iii. When instructed by the CM, provide another test sample of mixer from any other batch of material delivered to Site under the delivery note as specified in PLU2.M510 (3)(a)(ii).

c. Acceptance standard:

The inspection shall reveal that decorative, electroplated materials such as nickel and / or chromium are not present on the internal surface of any of the components of the mixer that may come into contact with water;

d. Non-compliance:

i. In the event that the testing sample fails to meet the testing requirements, follow either one of the following actions:

- Remove the representative batch off Site; or
- Apply to the CM for further inspection for the representative batch in accordance with sub-clause (4)(c) on three separate samples selected by the CM. In case of failure of any inspection to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

ii. When the representative batch of mixers is removed off Site, replace with another new batch (hereinafter referred to as the "replacement batch"). Apply to the CM for inspection in accordance with sub-clauses (4)(a), (4)(b), and (4)(c) above for the replacement batch. In case any one sample fails the inspection, follow the action stated in sub-clause (4)(d);

iii. Bear the costs of any failed open up inspections and all associated costs for the inspection(s) and further inspection(s) required in sub-clauses (4)(d)(i) and (4)(d)(ii). No extension of time will be allowed.

PLU2.M530.9 VITREOUS CHINA SOAP HOLDERS

Vitreous china, semi-recessed type with drain spout on descending rim:

1. Length and size to fit design layout;
2. Colour: as shown on Drawings or to Approval.

PLU2.M540.9 STAINLESS STEEL TOILET PAPER HOLDER

Stainless Steel, surface mount type, polished surface with plastic roller, size as shown on Drawings.

PLU2.M550.9 VITREOUS CHINA TOILET PAPER HOLDER

Vitreous china, surface mount type, with plastic roller, size as shown on Drawings.

FIXING AND POINTING MATERIALS

PLU2.M610.9 FIXINGS

Provide the following as applicable to the sanitary appliances and mixers being fixed:

1. Fixings:
   a. Stainless steel grade 304 screws and plastic caps with plastic plugs or;
   b. Proprietary fixing screws and plastic caps with plastic plugs supplied by the same manufacturer of the sanitary appliances subject to CM's approval.
2. Fixing screws for WC pan and mixers shall be non-ferrous or corrosion resisting materials.

PLU2.M620.9 WC PAN BEDDING MATERIAL

White cement.

PLU2.M630.9 POINTING GROUT

White cement.

PLU2.M640.A SILICONE SEALANT

1. As WAT5.M170;
2. VOC data submission in accordance with WAT5.M110.

WORKMANSHIP

GENERAL

PLU2.W010.9 BRITISH STANDARD

Comply with BS 8000:Part 13:1989, unless specified otherwise in respect of the following:

1. Materials handling and preparation (section 2);
2. Installation of sanitary appliances (sub-section 3.2);
3. Protection (sub-section 3.3).

PLU2.W020.9 HANDLING, STORAGE AND PROTECTION OF APPLIANCES

1. Store components off a levelled, well-drained and maintained hard-standing ground and in a manner which will not result in damage. Protect components from the weather;
2. Prevent contact with harmful elements, such as water, mud, plaster, cement etc;
3. Retain protective coverings in position for as long as possible and in place during fixing wherever practicable;
4. Use dust sheets or polythene sheets as protection when items do not have manufacturer's own packaging;
5. Prevent pre-finished surfaces from rubbing together;
6. Replace any units which have been chipped or scratched either before or after fixing.

JOINTS

PLU2.W110.9 SEALANT JOINTS

Seal joints in accordance with Worksection WAT5 and BS 8000:Part 13:1989, paragraph 3.2.3.

FIXING WC SUITES

PLU2.W210.9 PEDESTAL WC PANS

1. Set pan correctly in relation to finished floor level by using bedding materials;
2. Fix pan securely to floor using fixings in PLU2.M610;
3. The fixing screws shall not damage the waterproofing in the floor slab.

PLU2.W220.9 SQUATTING WC PANS

Bed on concrete floor in cement and sand bedding mortar and joint to soil pipe in similar mortar.

PLU2.W230.9 HIGH OR LOW LEVEL FLUSHING CISTERNS

Fix at heights as recommended by the pan manufacturer on brackets screwed to the wall or with stainless steel screws and plastics plugs. Fix supplementary support brackets where supplied by the manufacturer.

PLU2.W240.9 CLOSE-COUPLED FLUSHING CISTERNS

Fix to WC pan with bracket and bolts supplied by the manufacturer and to wall with stainless steel screws and plastic plugs.

PLU2.W250.9 SYPHONS AND VALVES TO FLUSHING CISTERNS

Assemble and adjust syphon and operating mechanism; fit float operated valve for fixing to water supply and union for connection to overflow.

PLU2.W260.9 FLUSH PIPES

Assemble and adjust so that they empty completely after each flush.

FIXING URINALS

PLU2.W310.9 SLAB TYPE

1. Bed channel outlet to waste connector in proprietary jointing compound;
2. Bed treads in cement sand mortar (1 : 3) with fall towards channel;
3. Fill space behind slabs with cement sand mortar (1 : 5);
4. Rake out joints to a depth of 5 mm and point flush using a proprietary, white grout. Joint width to be 3 mm maximum.

PLU2.W320.9 BOWL TYPE

Fix bowl and division to wall at centres shown on Drawings using brackets, concealed hangers or screws supplied by manufacture.

PLU2.W330.9 FLUSHING CISTERNS

Fix at heights as shown on Drawings on brackets securely fixed to the wall or with stainless steel and plastics plugs. Fix supplementary support brackets where supplied by the manufacturer.

FIXING BASINS

PLU2.W410.9 COUNTER TOP OR SEMI-RECESSED WASH BASINS

1. Seat and fix according to the manufacturer's recommendations approved by CM;
2. Height of rim above finished floor level as shown on Drawings.

PLU2.W420.9 WALL-HUNG WASH BASINS

1. Fix wash basins directly to walls by installing proprietary screw anchors or threaded rods with flexible washers, plastic plugs (other types to be Approved) to pre-formed fixing holes at the back of the basins;
2. Height of rim above finished floor level as shown on Drawings.

FIXING BATHS AND SHOWERS

PLU2.W510.9 BATHS

Fix in accordance with the manufacturer's instructions.

PLU2.W520.9 CLEARANCE FOR BATH TRAPS

Pack where necessary to set the bath at a height to suit the depth of trap.

PLU2.W530.9 BATH OVERFLOW

Connect bath overflow to waste trap with proprietary trap connector or union.

PLU2.W540.9 FIXING SHOWER DOORS

Fix in accordance with manufacturer's instructions and with neoprene gasket seal between components and floor/wall.

PLU2.W550.9 FIXING SHOWER CUBICLE AND SHOWER TRAY

1. For vitreous china shower tray, fix in accordance with arrangement drawings. In-situ joints are to be watertight.
2. For acrylic shower tray, fix in accordance with manufacturer's instructions.

TAPS AND VALVES

PLU2.W610.9 TAPS AND MIXERS FITTED TO SANITARY APPLIANCES

Fix in position shown on Drawings or as Instructed using fixings in PLU2.M610. Fix hot taps on the left unless otherwise Instructed. Loosen and re-tighten the joint between body and head prior to fixing.

PLU2.W620.9 FLEXIBLE HOSE ASSEMBLY WITH STAINLESS STEEL WIRE BRAIDING

1. Follow the installation method of the flexible hose recommended by the flexible hose supplier;
2. Comply with the following for the installation of the flexible hose:
   a. Avoid twisting of the flexible hose during the installation;
   b. Use suitable length of flexible hose which is not too long to cause unnecessary bending or too short to cause tension. Allow a slight slack on the straight length of the flexible hose as illustrated at Appendix PLU/II to this Worksection;
   c. Observe minimum bending radius recommended by the flexible hose supplier if bending of the flexible hose is inevitable;
   d. Avoid acute bending of the flexible hose. Bending shall be formed by a specially made 90 degree bend component supplied by the flexible hose supplier;
   e. Use two wrenches in tightening the hose to the connection points of water supply pipes. Hold the flexible hose steady with one wrench while tighten the hose nut to the connection point with the other wrench as illustrated at Appendix PLU/II to this Worksection.
3. Replace any damaged, kinked, severely twisted or deformed flexible hose.

WASTE OUTLETS

PLU2.W710.9 BEDDING

Bed waste outlets to wash basins, sinks and baths in proprietary jointing compound.

ANCILLARY FIXINGS

PLU2.W810.9 SOAP HOLDERS

Fix with cement sand mortar to location as specified on Drawings.

PLU2.W820.9 TOILET PAPER HOLDERS

1. Fix vitreous china toilet paper holders with cement sand mortar to location as specified on Drawings;
2. Fix stainless steel toilet paper holders with stainless steel and plastic plugs to location as specified on Drawings.

EQUIPOTENTIAL BONDING

PLU2.W910.9 EQUIPOTENTIAL BONDING TO STAINLESS STEEL SINKS

1. Provide equipotential bonding connection for stainless steel sinks by:
   a. Weld one end of the earthing lug to sink; and
   b. Form a 5 mm diameter hole at the other end of the earthing lug for connection of bonding conductor by the Nominated Sub-contractor for Electrical Installation.
2. As COM2.W465 (6).

TOLERANCES

PLU2.W1100.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

TESTING

SURVEILLANCE TESTS FOR WCS

PLU2.T110.A SURVEILLANCE TESTS FOR WC SUITES

1. Test Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to surveillance tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in PLU2.M110 (4)(a) for WC suites or as instructed by the CM;
   b. One set of test sample shall consist of three specimens of WC pan, two specimens of cisterns, float-operated valves and flushing devices, or as instructed by the CM.
3. Testing methods:
   a. As per PLU2.M110 (2)(b).
4. Non-compliance:
   a. In the event that the testing sample fails to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch off Site; or
      ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.
   b. When the representative batch is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3)(a) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
   c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

SURVEILLANCE TESTS FOR MIXERS (BATH/SHOWER/BASIN/KITCHEN SINK) AND SHOWER HANDSET

PLU2.T310.A SURVEILLANCE TESTS

1. Test Arrangements:
   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
   b. Comply with the following pertaining to surveillance tests:

i. Provide attendance on the Site;

ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.

2. Testing Samples:
   a. Provide test sample(s) as per sub-clause (2)(b) from the batch of material delivered to Site under the delivery note as specified in PLU2.M510 (3)(a) or as instructed by the CM;
   b. Test sample shall consist of:
      i. Four specimens for testing of bath / shower mixer;
      ii. Four specimens for testing of basin mixer;
      iii. Four specimens for testing of kitchen sink mixer;
      iv. Twelve specimens for testing of flexible hose assembly with stainless steel wire braiding;
      v. Two specimens for testing of shower handset;

      or as instructed by the CM.
3. Testing methods:
   a. As per PLU2.M510 (2)(a)(iv) for bath / shower mixer;
   b. As per PLU2.M510 (2)(b)(v) for basin mixer and flexible hose assembly with stainless steel wire braiding;
   c. As per PLU2.M510 (2)(c)(vi) for kitchen sink mixer and flexible hose assembly with stainless steel wire braiding;
   d. As per PLU2.M510 (2)(d)(iv) for shower handset.
4. Non-compliance:
   a. In the event that the testing samples for any type of mixer or shower handset fails to meet the testing requirements, follow either one of the following actions:
      i. Remove the representative batch of that type of mixer or shower handset off Site; or
      ii. Carry out re-test for the representative batch of that type of mixer or shower handset in accordance with the testing methods as specified in sub-clauses (3)(a), (3)(b), (3)(c) or (3)(d) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch of that type of mixer or shower handset off Site.
   b. When the representative batch of mixer or shower handset is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a), (3)(b), (3)(c) or (3)(d) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
   c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

APPENDIX PLU2/I

PLU2.APPEND1.9 PRESSURE DROP TEST

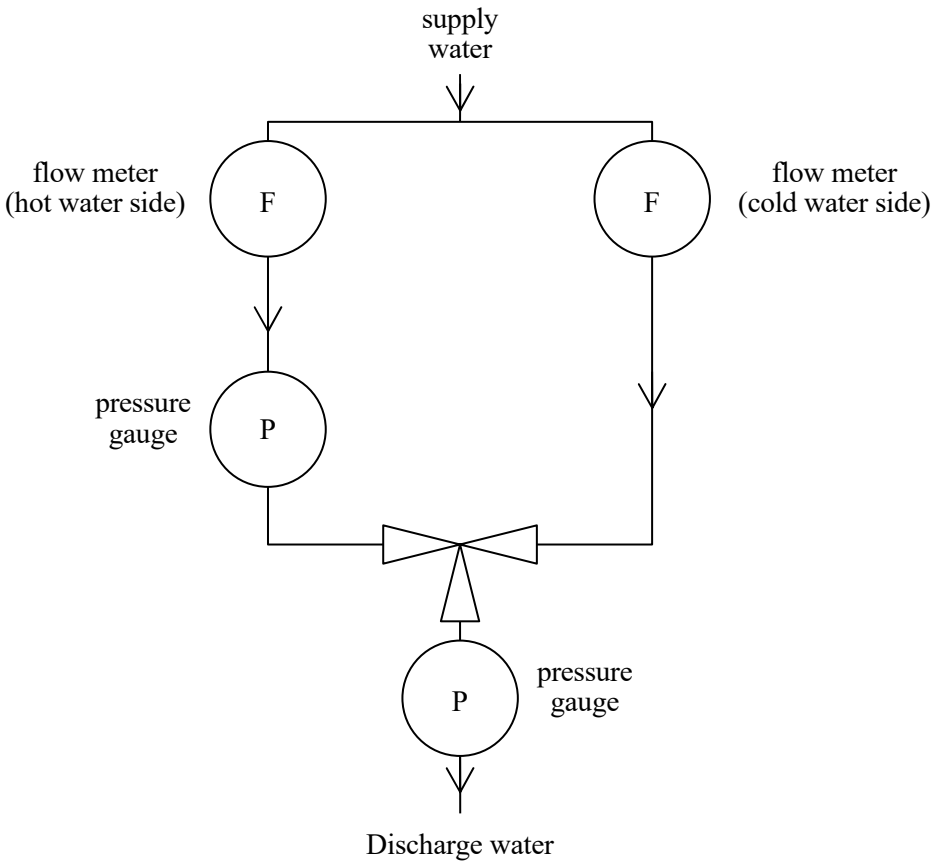
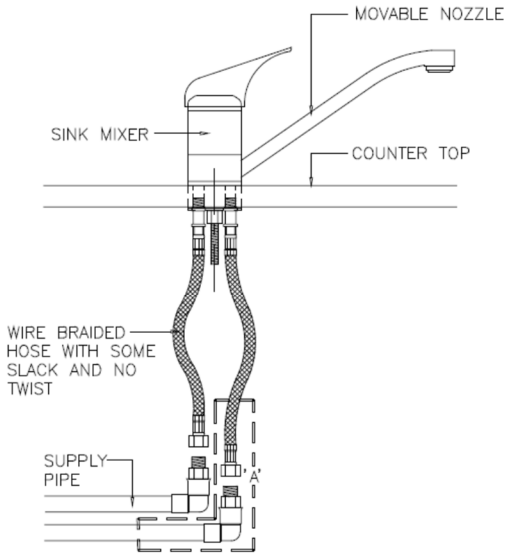


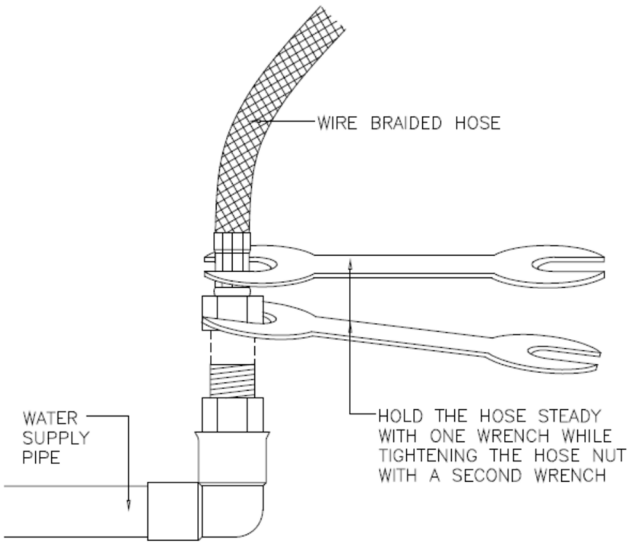
Figure a

APPENDIX PLU2/II

PLU2.APPEND2.9 INSTALLATION OF FLEXIBLE HOSE ASSEMBLY WITH STAINLESS STEEL WIRE BRAIDING



Typical Connection of Flexible Hose



Method of Connection Flexible Hose to Water Supply Pipe

TIM TIMBER WORKS

TIM1 CARPENTRY AND JOINERY 3

MATERIALS 3

GENERAL 3

TIM1.M010.A TIMBER QUALITY GENERALLY 3
TIM1.M020.9 STORAGE 4
TIM1.M030.9 AVERAGE PERMISSIBLE MOISTURE CONTENT 4
TIM1.M040.9 EXPOSED GRAIN FINISH 4
TIM1.M050.9 SOFTWOOD FOR CARPENTRY 4
TIM1.M060.9 HARDWOOD FOR CARPENTRY AND JOINERY 4
TIM1.M070.9 TEAK 4
TIM1.M080.9 FIRE RATED DOOR 4
TIM1.M090.N SUBMISSION OF VOC DATA AND OTHER SUBSTANCES FOR ADHESIVES 5

TIMBER FLOORING 5

TIM1.M110.9 TIMBER STRIP FLOORING 5
TIM1.M120.9 WOOD BLOCK FLOORING 5

TIMBER BOARDING AND ISOLATED TRIMS 5

TIM1.M210.9 WOOD TRIMS 5
TIM1.M220.9 SKIRTINGS 6

WOOD-BASED PANEL PRODUCTS 6

TIM1.M310.A PLYWOOD 6
TIM1.M320.A MARINE PLYWOOD 6
TIM1.M330.A BLOCKBOARD 6
TIM1.M340.A HARDBOARD 6
TIM1.M350.A INSULATING BOARD (SOFTBOARD) 6
TIM1.M360.A MEDIUM DENSITY FIBREBOARD (MDF) 6
TIM1.M370.9 WOOD CHIPBOARD 6

NON-TIMBER QUILT, SHEET AND BOARD PRODUCTS 7

TIM1.M410.9 GLASS FIBRE INSULATION QUILT 7
TIM1.M420.9 GLASS FIBRE INSULATION BOARD 7
TIM1.M430.9 POLYSTYRENE BOARD 7
TIM1.M440.9 EXTRUDED POLYSTYRENE INSULATION BOARD 7
TIM1.M450.9 PVC AND ACRYLIC SHEET 7
TIM1.M460.9 CEMENT BOARD 7
TIM1.M470.A LAMINATED PLASTIC SHEET 7
TIM1.M480.9 ACOUSTIC TILES 8

FIXINGS AND FASTENINGS 8

TIM1.M610.9 NAILS GENERALLY 8
TIM1.M620.A STEEL NAILS 8
TIM1.M630.9 WOOD SCREWS GENERALLY 8
TIM1.M640.A WOOD SCREWS 8
TIM1.M650.9 SCREW CUPS 9
TIM1.M660.9 MASONRY NAILS AND DRIVE PINS 9
TIM1.M670.9 EXPLOSIVE CARTRIDGE FIXINGS 9
TIM1.M680.9 PLUGS FOR FIXINGS 9
TIM1.M690.9 CRAMPS FOR FIXING DOOR AND WINDOW FRAMES TO MASONRY 9
TIM1.M700.9 EXPANDING ANCHOR FOR FIXING DOOR AND WINDOW FRAMES TO CONCRETE 9
TIM1.M701.9 EXPANDING ANCHOR FOR FIXING DOOR TO PANEL WALL 9
TIM1.M710.A ADHESIVES FOR WOOD 9

SUNDRY ITEMS **10**
TIM1.M810.9 WOOD PRESERVATIVE AND PESTICIDAL COATING 10
TIM1.M820.9 MOSQUITO GAUZE 10

WORKMANSHIP **11**
GENERAL **11**
TIM1.W010.9 GENERALLY 11
TIM1.W020.9 TIMBER GENERALLY 11
TIM1.W030.9 TIMBER DIMENSIONS 11
TIM1.W040.9 FINISH TO JOINERY 11
TIM1.W050.9 FRAMED JOINERY GENERALLY 11
TIM1.W060.9 RUNNING BONDED JOINTS 11
TIM1.W070.9 PROTECTION OF FINISHED JOINERY 11
TIM1.W080.9 PROTOTYPES 11
TIM1.W090.9 APPLICATION OF WOOD PRESERVATIVE AND PESTICIDAL COATING 11
SECURING TIMBER SECTIONS **12**
TIM1.W110.9 GENERAL 12
TIM1.W120.9 NAILING GENERALLY 12
TIM1.W130.9 NAILING TIMBER WEATHER BOARDING 12
TIM1.W140.9 EXPLOSIVE CARTRIDGE FIXINGS 12
TIM1.W150.9 SCREWING 12
TIM1.W160.9 FIXING PLASTIC SHEETS 12
TIM1.W170.9 ACOUSTIC TILES 12
LAYING FLOORING **13**
TIM1.W210.9 LAYING BOARDED OR STRIP FLOORING ON CONCRETE SUB-BASE 13
TIM1.W220.9 LAYING WOOD BLOCK FLOORING 13
TIM1.W230.9 LAYING MOSAIC PARQUET FLOORING 13
TIMBER DOOR AND CUPBOARD CONSTRUCTION **14**
TIM1.W310.9 LEDGED DOORS 14
TIM1.W320.9 LEDGED AND BRACED DOORS 14
TIM1.W330.9 FRAMED, LEDGED AND BRACED DOORS 14
TIM1.W340.9 PANELLED DOORS 14
TIM1.W350.9 TIMBER FLUSH DOORS 15
TIM1.W360.9 CUPBOARD DOORS 15
TIM1.W370.9 CUPBOARD DRAWERS 15
TIM1.W380.9 OPENING IN FLUSH DOORS 15
TIM1.W390.9 GLAZING BEADS 16
FIXING DOOR AND WINDOW FRAMES **16**
TIM1.W410.9 FIXING DOOR AND WINDOW FRAMES TO MASONRY 16
TIM1.W420.9 FIXING DOOR AND WINDOW FRAMES TO CONCRETE 16
TIM1.W430.9 ARCHITRAVES 16
FIXING SKIRTINGS **16**
TIM1.W510.9 SKIRTINGS 16

TIM1 CARPENTRY AND JOINERY

MATERIALS

GENERAL

TIM1.M010.A TIMBER QUALITY GENERALLY

To BS EN 942:2007, of mature growth, properly seasoned, sawn square and:

1. Free from wood wasp holes, large loose or dead knots, splits or other strength reducing defects;
2. The use of timber containing pin holes and worm holes will be permitted provided their extent is slight, in a small number of pieces, there is no active infestation, the strength of members is not impaired and they do not appear on the finished faces of joinery work.
3. For timber door:
    a. Formaldehyde Emission: All wood panels shall be of Class E1 under EN13986:2004+A1:2015 in respect of formaldehyde emission;
    b. The product shall not contain any heavy metals or their compounds as listed below:
        i. Arsenic;
        ii. Cadmium;
        iii. Copper;
        iv. Lead;
        v. Mercury;
    c. The following substances shall not be added during manufacturing: elemental chlorine, fluorine, PCP (pentachlorophenol) and tar oils containing benzo(a)pyrene;
    d. The product shall have no flame retardant of polybrominated biphenyl (PBB), polybrominated diphenyl ether (PBDE) or short-chain chlorinated paraffin added as formulated components;
4. For wood panel:
    a. The content of free formaldehyde in adhesives used in the product shall not exceed 0.5% by weight of the adhesive;
    b. Formaldehyde Emission: All wood panels shall be of Class E1 under EN 13986:2004+A1:2015 in respect of formaldehyde emission;
    c. The product shall not contain any heavy metals or their compounds as listed below:
        i. Arsenic;
        ii. Cadmium;
        iii. Copper;
        iv. Lead;

v. Mercury;

d. The following substances shall not be added during manufacturing: elemental chlorine, fluorine, PCP (pentachlorophenol) and tar oils containing benzo(a)pyrene;

e. The product shall have no flame retardant of polybrominated biphenyl (PBB), polybrominated diphenyl ether (PBDE) or short-chain chlorinated paraffin added as formulated components;

5. Submit manufacturer's written confirmation or manufacturer's certification to declare the timber has no active infestation by wood boring insects.

TIM1.M020.9 STORAGE

1. Store timber in a dry, well ventilated place and protected from the weather;
2. Stack timber in such a manner as to prevent distortion.

TIM1.M030.9 AVERAGE PERMISSIBLE MOISTURE CONTENT

For timber incorporated into the work:

1. The average permissible moisture content is as follows:
   a. Internal timber for use in air conditioned space: 8% to 12%;
   b. Internal timber generally: 13% to 17%;
   c. Timbers with one face to the exterior of the building and one face to the interior (e.g. window frames): 13% to 17%;
   d. External timbers (e.g. fencing etc): 13% to 19%.
2. Measure the moisture content of timber using an electrical resistance moisture meter in accordance with clause 7 of BS 1186:Part 1:1991.

TIM1.M040.9 EXPOSED GRAIN FINISH

Submit samples of timber for joinery for Approval where the grain is to be left exposed or where the surfaces are to be varnished or similarly treated.

TIM1.M050.9 SOFTWOOD FOR CARPENTRY

1. To be of Cedar, Spruce or China Fir, or other as specified on Drawings;
2. Approval to be sought before use.

TIM1.M060.9 HARDWOOD FOR CARPENTRY AND JOINERY

1. Generally, to be best quality "San Cheung" (Kapore), Ash Wood or other hardwood as approved;
2. Use is permitted of best quality "Ying Muk" (Druen) for grounds and other similar backing pieces where not exceeding 1250 mm² sectional area;
3. To have minimum average density of 620 kg/m³ at 15% moisture content.

TIM1.M070.9 TEAK

To have minimum relative density of 650 kg/m³ at 15% moisture content.

TIM1.M080.9 FIRE RATED DOOR

1. Fire rated timber doors including frames, hinges, door closers and any other hardware complied with either set of standards below:

a. BS 476: Part 20: 1987 and BS 476: Part 22: 1987; or

b. BS EN 1634: Part 1: 2008, BS EN 1634: Part 2: 2008 and BS EN 1634: Part 3: 2004.

2. Test report shall be provided to indicate that the material, product or construction is capable of resisting the action of fire for the specified period. The test shall be carried out and the test report shall be prepared by a laboratory recognised by the Hong Kong Laboratory Accreditation Scheme.

TIM1.M090.N SUBMISSION OF VOC DATA AND OTHER SUBSTANCES FOR ADHESIVES

1. Submit manufacturer's product data for adhesive and indicate the VOC limit of the product;
2. Submit document proof for compliance with Schedule 7 of Air Pollution Control (Volatile Organic Compounds) Regulation to show compliance with the maximum limit of the volatile organic compound content specified in Part 2,3,4 of Schedule 7 of Air Pollution Control (Volatile Organic Compounds) Regulation;
3. Environmental Standards for adhesives:
   a. The product shall not contain the substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride);
   b. The product shall contain no more than 0.01% by wet weight of formaldehyde;
   c. The product shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

TIMBER FLOORING

TIM1.M110.9 TIMBER STRIP FLOORING

Species and minimum finished thickness: as shown on Drawings.

TIM1.M120.9 WOOD BLOCK FLOORING

1. Species and minimum finished thickness: as shown on Drawings;
2. Block size: as shown on Drawings.

TIMBER BOARDING AND ISOLATED TRIMS

TIM1.M210.9 WOOD TRIMS

To BS 1186:Part 3:1990:

1. Timber species: as shown on Drawings.
2. Classification:
   a. Class CSH - Suitable for high quality finish or specialised trims;
   b. Classes 2 & 3 - Suitable for general purposes and a painted finish.
3. Surface category: exposed;
4. Profile sections as detailed on Drawings.

TIM1.M220.9 SKIRTINGS

1. Species and timber size: as shown on Drawings;
2. Profile: with arrised top edge.

WOOD-BASED PANEL PRODUCTS

TIM1.M310.A PLYWOOD

1. To BS EN 635 Part 1 to 3: 1995 and of the following grades, as specified:
   a. "Grade I veneer" - hardwood, teak or beech faced as specified on Drawings, for natural finish;
   b. "Grade II veneer" - lauan faced for painting.
2. Generally, the bonding adhesive between veneers to be resin adhesive classified as moisture and weather resistant (H2) in BS 1203:2001. Use resin adhesive classified as weather and boil proof (H4) in BS 1203:2001, externally or in areas of high humidity;
3. Formaldehyde emission to Class E1 under EN 13986:2004+A1:2015;
4. Nominal standard thickness of plywood are: 3, 4, 5, 6, 9, 12, 15, 18 and 25 mm.

TIM1.M320.A MARINE PLYWOOD

To BS 1088:2018, bonded quality to class 3 of BS EN 314-2.

TIM1.M330.A BLOCKBOARD

To BS 3444:1972, with Grade 1 or 2 veneer as specified, and bonded with Type MR adhesive.

TIM1.M340.A HARDBOARD

To BS EN 316:2009, BS EN 622-1:2003, BS EN 622-2:2004, Type: ”HB” or ”HB.LA”.

TIM1.M350.A INSULATING BOARD (SOFTBOARD)

To BS EN 316:2009, BS EN 622-1:2003, BS EN 622-2:2004, Type SB.

TIM1.M360.A MEDIUM DENSITY FIBREBOARD (MDF)

To BS EN 316:2009, BS EN 622-1:2003, BS EN 622-2:2004:

1. Board type: moisture resistant grade (MDF.H) with density in excess of 600 kg/m³;
2. Thickness: as shown or scheduled on Drawings;
3. Fabrication:
   a. Cut panel to size and profile edges, as shown on Drawings;
   b. Fix panel with parallel threaded screws, threaded to the head of the screw, in pre-drilled pilot holes not less than 25 mm on the face or 70 mm on the edge from the corners of panel.

TIM1.M370.9 WOOD CHIPBOARD

To BS 5669, Type I Standard, unsanded or sanded, as specified.

Veneered chipboard to be an Approved proprietary brand.

NON-TIMBER QUILT, SHEET AND BOARD PRODUCTS

TIM1.M410.9 GLASS FIBRE INSULATION QUILT

Lightweight bonded mat weighing 12 kg/m³ uncompressed.

TIM1.M420.9 GLASS FIBRE INSULATION BOARD

Semi-rigid resin-bonded glass fibre board weighing 45-48 kg/m³.

TIM1.M430.9 POLYSTYRENE BOARD

To BS 3837, Type N, unless otherwise specified.

TIM1.M440.9 EXTRUDED POLYSTYRENE INSULATION BOARD

1. To be used for domestic flats only;
2. An Approved insulation board having the following properties:
    a. Thermal conductivity (K value): 0.031 W/mº K (at 31ºC);
    b. Density: 32 (minimum) - 35 kg/m³;
    c. Coefficient of linear thermal expansion: 70 x 10-6 m/(mºC);
    d. Compressive strength: 300 kPa;
    e. Water absorption: <1 % volume;
    f. Water vapour transmission: 35 ng/Pa.sm².
3. Cell structure and properties: closed cell, maximum size 2.5 mm, resistant to heat transfer and moisture.

TIM1.M450.9 PVC AND ACRYLIC SHEET

An Approved type:

1. Material: PVC or acrylic;
2. Colour: as shown on Drawings;
3. Thickness: as shown on Drawings.

TIM1.M460.9 CEMENT BOARD

Do not use.

TIM1.M470.A LAMINATED PLASTIC SHEET

1. General application:
    a. To BS EN 438-1:2016, BS EN 438-2:2016+A1:2018 and BS EN 438-3:2016;
    b. Class:
        i. Horizontal grade (H) or Vertical grade (V);
        ii. General purpose or moderate use (G);
        iii. Postforming grade (P) when specified on Drawings.
    c. Colour / sheen: as shown on Drawings;
    d. Thickness: as shown on Drawings;

e. Submit sample for Approval;

2. Laminated plastic sheet for internal face of bathroom door to COM5.M430.

TIM1.M480.9 ACOUSTIC TILES

1. To be of an Approved proprietary brand meeting the requirements of CP 290:1973 and manufactured from the following materials:
   a. Wood or other organic fibre insulating board to BS 1142:1989, 12 mm (minimum) thick for 300 x 300 mm tiles;
   b. Mineral fibre or wool insulating board 12 mm (minimum) thick for 400 x 400 mm tiles;
   c. Approved multi-purpose, dimensionally stable building board 6 mm (minimum) thick.
2. To have a plain, perforated or fissured surface with a factory applied decorative finish. The edges to be square, bevelled, or bevelled and grooved to suit the suspension system;
3. Provide a certificate from the manufacturer confirming that the tiles are asbestos free.

FIXINGS AND FASTENINGS

TIM1.M610.9 NAILS GENERALLY

Lengths of nails:

1. To be not more than total thickness of sections to be joined less 5 mm, or not less than twice the thickness of section through which nails are driven;
2. Where the thickness of the outer section through which nails are being driven is less than half that of the section to which nailing is being done, the depth of penetration of the nails into the latter to be not less than 10 times the diameter of the nails being used.

TIM1.M620.A STEEL NAILS

1. To BS 1202:Part 1:2022, with "bright" finish, unless otherwise specified;
2. The nail and its coating shall not contain Arsenic, Cadmium, Copper, Lead or Mecury.

TIM1.M630.9 WOOD SCREWS GENERALLY

Lengths of screws:

1. To be not more than total thickness of sections to be joined, less 5 mm, or not less than one and a half times the thickness of section through which the screws are driven;
2. Where the thickness of the outer section being screwed is less than half that of the section to which screwing is being done, the depth of penetration of the screwing into the latter to be not less than the thickness of the outer section.

TIM1.M640.A WOOD SCREWS

To BS ISO 8992:2005 or tapping screws to BS 4174:1972:

1. Material: brass, stainless steel, alloy or other non-corroding metal;

2. Head shape: counter sunk, unless otherwise specified.

TIM1.M650.9 SCREW CUPS

To BS 1494:Part 2:1967:Table 13, surface pattern, brass or stainless steel, as specified.

TIM1.M660.9 MASONRY NAILS AND DRIVE PINS

1. To be as specified;
2. Obtain Approval before use.

TIM1.M670.9 EXPLOSIVE CARTRIDGE FIXINGS

1. Obtain Approval before use;
2. All fixings to be in accordance with the Factories and Industrial Undertakings (Cartridge-Operated Fixing tools) Regulations.

TIM1.M680.9 PLUGS FOR FIXINGS

1. To hard base materials: proprietary plugs of plastic, soft metal, fibre or similar;
2. To soft base materials: proprietary fixings designed specifically for the particular situation;
3. Do not use plugs containing asbestos.

TIM1.M690.9 CRAMPS FOR FIXING DOOR AND WINDOW FRAMES TO MASONRY

30 x 3 mm galvanised steel flat cramps, 250 mm girth, turned up 75 mm minimum at one end and twice drilled to suit No. 12 gauge screws and fanged at other end.

TIM1.M700.9 EXPANDING ANCHOR FOR FIXING DOOR AND WINDOW FRAMES TO CONCRETE

1. Not less than 10 mm diameter proprietary expanding anchor, consisting of zinc electro-plated steel screw and zinc electro-plated steel sleeve. The anchor and sleeve shall be from the same manufacturer and packaged and supplied as a complete unit;
2. Minimum 30 mm effective anchorage depth in concrete. Application and fixing shall be in strict compliance with the manufacturer's recommendations.

TIM1.M701.9 EXPANDING ANCHOR FOR FIXING DOOR TO PANEL WALL

1. Not less than 10 mm diameter proprietary expanding anchor, consisting of zinc electro-plated steel screw and polyamide sleeve. The anchor and sleeve shall be from the same manufacturer and packaged and supplied as a complete unit;
2. Minimum 50 mm effective anchorage depth in panel wall. Application and fixing shall be in strict compliance with the manufacturer's recommendations.

TIM1.M710.A ADHESIVES FOR WOOD

1. In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic compounds) Regulation;
2. For internal use: synthetic resin adhesive to BS EN 204:2016, grade D2 moisture resistant and moderately weather-resistant;
3. For external use and internal use under very damp conditions: synthetic resin adhesive to BS EN 204:2016, grade D4 weather-proof and boil-proof;

4. For fixing laminated plastic sheet: synthetic resin adhesive to BS 1204:Parts 1 and 2:1979, class WBP weather-proof and boil-proof;
5. Use a "warm-setting" grade of adhesive where the temperature exceeds 25ºC;
6. Do not use animal glues'
7. Formaldehyde emission shall be of Class E1 under BS EN 13986:2004+A1:2015;
8. For wood panels: the content of free formaldehyde in adhesives used in the product shall not exceed 0.5% by weight of the adhesive.

SUNDRY ITEMS

TIM1.M810.9 WOOD PRESERVATIVE AND PESTICIDAL COATING

A specified in Worksection FIN7.

TIM1.M820.9 MOSQUITO GAUZE

1. Materials:
   a. Plastic covered glass fibre;
   b. Copper wire.
2. Mesh size: as shown on Drawings.

WORKMANSHIP

GENERAL

TIM1.W010.9 GENERALLY

To BS 1186:Part 2:1988.

TIM1.W020.9 TIMBER GENERALLY

1. Cut timber to required sizes and lengths as soon as practicable after the Works are begun;
2. Store cut timber dry under cover so that the air can circulate freely around it;
3. Stack cut timber off a levelled, well-drained and maintained hard-standing ground and in such a manner as to prevent distortion.

TIM1.W030.9 TIMBER DIMENSIONS

1. Dimensions of sections shown on Drawings are finished sizes. Allow for planing and sanding faces to finished sizes;
2. Sawn timber sections must hold at least the full dimensions specified;
3. Check site dimensions before prefabrication joinery fittings.

TIM1.W040.9 FINISH TO JOINERY

1. Plane timber for joinery on all faces;
2. Finish exposed faces to a fine glass-papered surface and round arrises to 1 mm radius.

TIM1.W050.9 FRAMED JOINERY GENERALLY

1. Ensure faces of framed joints are square and driven together to give a close, accurate fit;
2. Prepare and frame up joinery work with dry joints and store until required for fixing;
3. Before fixing, open up all joints and put together with white lead and wedge up. Replace any sections that have warped or developed shakes or other defects.

TIM1.W060.9 RUNNING BONDED JOINTS

To be cross-tongued, using teak tongues. Use double tongues for work over 40 mm thick.

TIM1.W070.9 PROTECTION OF FINISHED JOINERY

Protect from damage or discolouration.

TIM1.W080.9 PROTOTYPES

Prepare prototypes and obtain Approval for repetitive fittings before starting fabrication.

TIM1.W090.9 APPLICATION OF WOOD PRESERVATIVE AND PESTICIDAL COATING

1. As specified in Worksection FIN7;

2. Apply pesticide coating to the entire surface of timber forming all parts of doors, including frames and architraves all in accordance with FIN7.M140 and FIN7.W1410.

SECURING TIMBER SECTIONS

TIM1.W110.9 GENERAL

1. Plug and screw or secure timber sections by Approved means;
2. Check location of buried services before fixing to walls and other surfaces.

TIM1.W120.9 NAILING GENERALLY

1. Nail timber sections securely to the backing and ensure nails do not split the timber. Remove and replace any split timber;
2. Punch nail heads below timber surfaces visible in the completed work.

TIM1.W130.9 NAILING TIMBER WEATHER BOARDING

Nail weather boarding to timber framing with not less than two corrosion proofed nails in the width of each board at each framing member.

TIM1.W140.9 EXPLOSIVE CARTRIDGE FIXINGS

1. Use tools only of the indirect acting type, with pins and cartridges complying with the manufacturer's tool specification;
2. Ensure tools are operated only by persons holding a certificate of competency in the use of that tool.

TIM1.W150.9 SCREWING

When specified:

1. Screw timber sections to the backing including drilling pilot holes and countersinking heads flush with timber surface;
2. Use screwdriver to insert screws to full depth. Do not insert screws by hammer;
3. Countersink screw heads, a minimum of 5 mm below timber surfaces to be left with a natural finish. Glue in timber pellets to match the colour grain of the finished surface. Finish off flush with face.

TIM1.W160.9 FIXING PLASTIC SHEETS

Ensure all wood-based core materials for fixing laminated plastic sheets to have average moisture content of 8% to 12%.

TIM1.W170.9 ACOUSTIC TILES

Fix acoustic tiles and the like:

1. To timber battens with brass or other non-ferrous lost head nails as TIM1.M610 for fixing laminated plastic sheets;
2. Direct to continuous sub-base by means of an Approved adhesive used in accordance with the manufacturer's recommendations;
3. Fix to metal frame in accordance with manufacturer's recommendations and Approved shop drawings.

LAYING FLOORING

TIM1.W210.9 LAYING BOARDED OR STRIP FLOORING ON CONCRETE SUB-BASE

1. Work to sub-base:
    a. Lay at 350 mm centres, 50 x 40 mm timber battens pre-treated with wood preservative;
    b. Fix battens to sub-base with one of the following methods as shown on the Drawings:
        i. Plug and screw;
        ii. Proprietary floor clips, to suit battern size, spaced at 400 mm centres along length of batten and levelled, aligned and fixed in accordance with the manufacturer's instructions.
2. Laying flooring:
    a. Cross-tongue heading joints and stagger not less than two board widths apart;
    b. Cramp flooring as the work proceeds, to ensure tight and accurate fit along the whole length of the joint;
    c. Fix flooring with galvanized, sheradised or cadmium-plated wire nails;
    d. Face nail square edged flooring at each support with one nail placed just above the tongue and driven on skew. Punch nail heads flush.

TIM1.W220.9 LAYING WOOD BLOCK FLOORING

1. Work to sub-base:
    a. Ensure base to receive flooring is clean and dry.
2. Laying flooring:
    a. Fix blocks to screed with an Approved cold bitumen/rubber emulsion adhesive;
    b. Lay blocks to herringbone or basket pattern, as specified, with straight border two blocks (minimum) wide;
    c. Provide 5 mm expansion gap at perimeter of areas of wood block flooring, and fill with one of the following as specified:
        i. Cork strip;
        ii. Foam rubber strip.
3. Finishing flooring:
    a. Sand surface of wood block flooring with an electric surfacing machine using various grades of abrasive paper to obtain a smooth even surface ready to receive sealer or polish;
    b. Surfacing machine to be fitted with dust bag to control release of dust.

TIM1.W230.9 LAYING MOSAIC PARQUET FLOORING

1. Work to sub-base:
    a. Wood float finish and level tolerance of screeded base as Worksection FIN3;
    b. Ensure base to receive flooring is clean and dry.
2. Laying flooring:

a. On one coat of an Approved rubber emulsion adhesive applied to the base and back of the parquet with a serrated trowel;

b. To a basket pattern with straight borders three fingers (minimum) wide at junctions with different floor finishes.

3. Finishing flooring:

a. Sand surface of parquet flooring with an electric surfacing machine using various grades of abrasive paper to obtain a smooth even surface ready to receive sealer or polish;

b. Surfacing machine to be fitted with dust bag to control release of dust.

TIMBER DOOR AND CUPBOARD CONSTRUCTION

TIM1.W310.9 LEDGED DOORS

Construct hardwood ledged doors as follows:

1. Vertical boarding: 20 mm minimum thick, tongued and grooved in about 150 mm widths, v-jointed on face side;
2. Ledges:
   a. 5 mm thicker than boarding thickness;
   b. 100 mm wide for top ledge and 175 mm wide for middle and bottom ledges.
3. Nail boarding to ledges and screw ends of ledges to boarding.

TIM1.W320.9 LEDGED AND BRACED DOORS

Construct hardwood ledged and diagonal braced doors as follows:

1. Vertical boarding: 20 mm minimum thick, tongued and grooved in about 150 mm widths, v-jointed on face side;
2. Ledges:
   a. 5 mm thicker than vertical boarding thickness;
   b. 100 mm wide for top ledge and 175 mm wide for middle and bottom ledges.
3. Braces: 5 mm thicker than boarding thickness and 100 mm wide;
4. Nail boarding to ledges and screw ends of ledges to boarding. House braces to ledges and screw ends to boarding.

TIM1.W330.9 FRAMED, LEDGED AND BRACED DOORS

Construct hardwood doors as follows:

1. Framing: 45 mm minimum thickness with
   a. 115 mm wide stiles and top rail;
   b. 225 mm wide middle and bottom rails; and
   c. 100 mm wide braces.
2. Vertical boarding: 20 mm minimum thick, tongued and grooved in about 150 mm widths, v-jointed on face side.

TIM1.W340.9 PANELLED DOORS

Construct hardwood doors as follows except where indicated otherwise on Drawings:

1. Framing: 40 mm minimum thick, with 100 mm wide stiles, top rail and muntins and, 200 mm wide middle and bottom rails;
2. Flat panels: 20 mm thick;
3. Groove, rebate or leave open framing, as detailed on the Drawings for panels or glass.

TIM1.W350.9 TIMBER FLUSH DOORS

Construct doors as follows except where indicated otherwise on Drawings:

1. Facing material and grade:
   a. 3.2 mm standard hardboard;
   b. 5 mm plywood for painting;
   c. 5 mm hardwood or teak faced plywood for natural finish;
   d. Class HG laminated plastic bonded to 5 mm plywood.
2. Timber sizes; stiles and rails: width 75 mm generally; 100 mm wide for doors exceeding 900 mm wide or 2000 mm high;
3. Core infill:
   a. Hollow core: 25 mm horizontal battens at 150 mm centres, with blocking for lock fixing, door closers, and other ironmongery as specified;
   b. Solid core: 25 mm vertical battens tightly cramped together with the door facings fully bonded both sides.
4. Door lipping:
   a. Timber species: hardwood or teak, unless otherwise specified;
   b. 12 mm thick glued to all edges, generally;
   c. 25 mm thick to meeting edges of folding doors and meeting edges and heels of swing doors, rebated or rounded as detailed on Drawings.

TIM1.W360.9 CUPBOARD DOORS

Construct doors as specified except where indicated otherwise on drawings:

1. Plywood or blockboard panel, teak lipped on all edges. Faced both sides with laminated plastic sheet or prepared for painting.

TIM1.W370.9 CUPBOARD DRAWERS

Construct drawers as detailed on Drawings and comprising unless indicated otherwise:

1. Front: 20 mm thick teak, hardwood or plywood as indicated;
2. Sides and back: 15 mm thick hardwood or plywood as indicated;
3. Bottom: 5 mm thick plywood;
4. Construction: dovetail and frame together with bottom housed on three sides. Set drawers to slide on or with 15 x 15 mm hardwood screwed runners as indicated.

TIM1.W380.9 OPENING IN FLUSH DOORS

Provide lippings to openings as follows:

1. Timber species: hardwood;
2. Timber quality: to BS 1186:Part 1:1991,

a. Class: 2 or 3;

b. Exposure: exposed.

3. Timber sizes: 13 mm minimum thickness, including after rebating for glazing, but strictly in accordance with details.

TIM1.W390.9 GLAZING BEADS

1. Timber species: hardwood;
2. Timber quality: to BS 1186:Part 1:1991,
   a. Class: 2 or 3;
   b. Exposure: exposed.
3. Timber sizes: 13 mm minimum thickness after rebating but strictly in accordance with details;
4. Construction: mitre corners and fix glazing beads with brass screw and cups where shown on Drawings.

FIXING DOOR AND WINDOW FRAMES

TIM1.W410.9 FIXING DOOR AND WINDOW FRAMES TO MASONRY

Fix cramps to frames at 900 mm maximum centres with upper and lower cramps 300 mm maximum from the end of the jamb using two 12 SG screws and build in the other end.

TIM1.W420.9 FIXING DOOR AND WINDOW FRAMES TO CONCRETE

Secure frames to concrete walls with bolts at 900 mm maximum centres with the upper and lower bolts 300 mm (maximum) centres from the ends of the jamb, and fixed in accordance with the bolt manufacturers recommendations.

TIM1.W430.9 ARCHITRAVES

Architraves to be one length between angles. Mitre architraves at angle joints.

FIXING SKIRTINGS

TIM1.W510.9 SKIRTINGS

Secure to walls on sawn hardwood grounds.

WAT WATERPROOFING

WAT1 ASPHALT WORK 7

MATERIALS 7

MASTIC ASPHALT 7

WAT1.M010.9 MASTIC ASPHALT FOR ROOFING 7
WAT1.M020.9 MASTIC ASPHALT FOR TANKING AND DAMP-PROOFING 7

ANCILLARY MATERIALS 7

WAT1.M110.9 ISOLATING MEMBRANE 7
WAT1.M120.9 BITUMEN DRESSING COMPOUND 7
WAT1.M130.9 REINFORCEMENT FOR KEYING ASPHALT 7
WAT1.M140.9 BITUMEN SOLUTION PRIMER FOR METAL 7
WAT1.M150.9 MORTAR FOR BEDDING CONCRETE ROOFING TILES 7
WAT1.M160.9 RUBBING SAND 8

SOLAR PROTECTION 8

WAT1.M210.9 GRANITE CHIPPINGS 8
WAT1.M220.9 WHITE STONE CHIPPINGS 8
WAT1.M230.9 SOLAR REFLECTIVE PAINT 8
WAT1.M240.9 INSULATION 8
WAT1.M250.9 CONCRETE ROOFING TILES 8
WAT1.M260.9 INSULATING ROOFING TILES 8

WORKMANSHIP 9

GENERAL 9

WAT1.W010.9 CODE OF PRACTICE FOR ASPHALT ROOFING 9
WAT1.W020.9 CODE OF PRACTICE FOR ASPHALT TANKING AND DAMP PROOF COURSES 9
WAT1.W030.9 SUITABILITY OF BASE 9

PREPARATION 9

WAT1.W110.9 HEATING 9
WAT1.W120.9 TRANSPORTING 9
WAT1.W130.9 LAYING ISOLATING MEMBRANE 9
WAT1.W140.9 FIXING REINFORCEMENT 10
WAT1.W150.9 PRIMING METAL SURFACES TO RECEIVE ASPHALT 10

LAYING ASPHALT 10

WAT1.W210.9 LAY ASPHALT 10
WAT1.W220.9 ASPHALT THICKNESSES AND NUMBERS OF COATS 10
WAT1.W230.9 MAKING GOOD BLOWS ETC 11
WAT1.W240.9 INTERNAL ANGLES 11
WAT1.W250.9 EXTERNAL ANGLES 11
WAT1.W260.9 SKIRTINGS 11
WAT1.W270.9 RAINWATER OUTLETS 11
WAT1.W280.9 FLASHINGS TO RAINWATER OUTLETS 11
WAT1.W290.9 PIPES PASSING THROUGH ASPHALT ROOFS 11

FINISHING ASPHALT 11

WAT1.W310.9 ROOF SURFACES 11
WAT1.W320.9 TANKING AND DAMP PROOF COURSES 12
WAT1.W330.9 DAMP PROOF COURSING WITHIN WALLS 12

SOLAR PROTECTION 12

WAT1.W410.9 STONE CHIPPINGS 12
WAT1.W420.9 SOLAR REFLECTIVE PAINT 12
WAT1.W430.9 BEDDING CONCRETE ROOFING TILES 12
WAT1.W440.9 BEDDING INSULATING ROOFING TILES 12

WAT1.W450.9 EXPANSION JOINTS 12
WAT1.W460.9 TRAFFIC ON ROOF TILING 12
LAYING ROOF INSULATION 12
WAT1.W510.9 EXTRUDED POLYSTYRENE ROOF INSULATION 12
TESTING 14
SAMPLING AND TESTING MASTIC ASPHALT 14
WAT1.T010.9 GENERAL 14
WAT1.T020.9 RESULTS 14
ON-SITE VERIFICATION TESTS 14
WAT1.T030.9 WATER FLOOD TEST TO ROOF INSTALLATION 14
WAT2 BITUMEN FELT ROOFING 15
MATERIALS 15
ROOFING FELT 15
WAT2.M010.9 UNDERLAYERS 15
WAT2.M020.9 TOP LAYER (CAP SHEET) 15
WAT2.M030.9 CERTIFICATION 15
ANCILLARY MATERIALS 15
WAT2.M105.9 ADHESIVE AND ADHESIVE PRIMER GENERALLY 15
WAT2.M110.9 PRIMER 15
WAT2.M120.9 BONDING COMPOUND 16
WAT2.M130.9 COMPOUND FOR BEDDING CHIPPINGS 16
WAT2.M140.9 NAILS 16
WAT2.M150.9 ROOF VENTS 16
WAT2.M160.9 RAINWATER OUTLETS 16
WAT2.M170.9 EDGE TRIM 16
WAT2.M180.9 PIPE SLEEVES 16
WAT2.M190.9 MASTIC ASPHALT FOR FILLETS 16
SOLAR PROTECTION 16
WAT2.M210.9 STONE CHIPPINGS 16
SAMPLES 17
WAT2.M410.9 SAMPLES 17
WORKMANSHIP 18
GENERAL 18
WAT2.W010.9 STANDARD 18
PREPARATION FOR LAYING 18
WAT2.W110.9 CONDITION OF BASE 18
WAT2.W120.9 SETTING OUT FLAT ROOFS 18
WAT2.W130.9 SETTING OUT PITCHED ROOFS 18
WAT2.W140.9 MASTIC ASPHALT FILLETS 18
LAYING FELT 18
WAT2.W210.9 NUMBER OF LAYERS 18
WAT2.W220.9 LAPS 18
WAT2.W230.9 APPLYING BONDING COMPOUND 18
WAT2.W240.9 LAYING PROCEDURE FOR CONCRETE ROOFS 19
WAT2.W250.9 LAYING PROCEDURE FOR TIMBER ROOFS 19
WAT2.W260.9 SKIRTINGS ON CONCRETE ROOFS 19
WAT2.W270.9 SKIRTINGS ON TIMBER ROOFS 19
WAT2.W280.9 VERGES AND GUTTERS 19
WAT2.W290.9 RAINWATER OUTLETS 19
WAT2.W300.9 PIPES PASSING THROUGH ROOF 20

SOLAR PROTECTION **20**
WAT2.W410.9 APPLYING CHIPPINGS 20

WAT3 SINGLE PLY ROOFING **21**

MATERIAL **21**

GENERAL **21**
WAT3.M010.9 CONTRACTOR'S RESPONSIBILITIES 21
WAT3.M020.9 MEMBRANE TYPE 21
WAT3.M030.9 DESIGN LIFE 21
WAT3.M050.9 FIRE PERFORMANCE 21
WAT3.M060.9 THERMAL INSULATION 21
WAT3.M070.9 WIND UPLIFT 21
WAT3.M080.9 CHEMICAL RESISTANCE 22

SHEET MEMBRANES **22**
WAT3.M110.9 REINFORCED POLYVINYL CHLORIDE (PVC) 22
WAT3.M120.9 CHLORINATED POLYETHYLENE (CPE) 22
WAT3.M130.9 FLEXIBLE CHLOROSULPHONATED POLYETHYLENE (CSM) 22
WAT3.M140.9 POLYVINYL CHLORIDE/ETHYLENE VINYL-ACETATE TERPOLYMER (FLEXIBLE VET) 23
WAT3.M150.9 ETHYLENE PROPYLENE DIENE MONOMER (EPDM) 23

ANCILLARY MATERIALS **24**
WAT3.M210.9 GENERAL 24
WAT3.M220.9 ISOLATION QUILT 24
WAT3.M230.9 BALLAST GRAVEL 24
WAT3.M240.9 PAVERS 24
WAT3.M250.9 THERMAL INSULATION FOR INVERTED ROOF 24
WAT3.M260.9 CEMENT 24
WAT3.M270.9 SAND 24
WAT3.M280.9 MORTAR FOR BEDDING CONCRETE ROOFING TILES 24

SAMPLES **25**
WAT3.M310.9 SAMPLES 25

WORKMANSHIP **26**

GENERAL **26**
WAT3.W010.9 APPROVED FIXING SUB-CONTRACTOR 26
WAT3.W020.9 SURVEY 26
WAT3.W030.9 HANDLING AND STORAGE OF MATERIALS 26
WAT3.W040.9 SUBSTRATE PREPARATION 26
WAT3.W050.9 FIXING GENERALLY 26
WAT3.W060.9 PLACING BALLAST LAYER 27
WAT3.W070.9 PROTECTION OF THE COMPLETED MEMBRANE 27
WAT3.W080.9 BEDDING CONCRETE ROOFING TILES 27
WAT3.W090.9 TRAFFIC ON ROOF TILING 27
WAT3.W100.9 MAINTENANCE MANUAL 27

TESTING **28**

ON-SITE VERIFICATION TESTS **28**
WAT3.T010.9 WATER FLOOD TEST TO ROOF INSTALLATION 28

WAT4 FLASHINGS **29**

MATERIALS **29**

METAL SHEET **29**
WAT4.M010.9 LEAD SHEET 29
WAT4.M020.9 ALUMINIUM SHEET 29
ANCILLARY MATERIALS **29**
WAT4.M110.9 BITUMINOUS PAINT 29
WAT4.M120.9 ISOLATING TAPE 29
SAMPLES **29**
WAT4.M210.9 SAMPLES 29
WORKMANSHIP **30**
FIXING METAL FLASHINGS **30**
WAT4.W010.9 LEAD FLASHINGS 30
WAT4.W020.9 ALUMINIUM FLASHINGS 30
WAT4.W030.9 ALUMINIUM IN CONTACT WITH CEMENTITIOUS MATERIALS 30
WAT4.W040.9 PREVENTION OF ELECTROLYTIC CORROSION 30

WAT5 SEALANTS **31**

MATERIALS **31**
JOINT FILLERS **31**
WAT5.M010.9 JOINT FILLER 31
WAT5.M020.9 BACK-UP MATERIAL 31
WAT5.M030.9 BOND BREAKER 31
WAT5.M040.9 BACKING RODS FOR PRECAST FACADE UNITS 31
SEALANTS **31**
WAT5.M110.A GENERAL 31
WAT5.M120.9 TWO PART POLYSULPHIDE BASED SEALANT 32
WAT5.M130.9 ONE PART GUN GRADE POLYSULPHIDE BASED SEALANT 32
WAT5.M140.9 BUTYL MASTIC 32
WAT5.M150.9 ONE PART POLYURETHANE SEALANT 32
WAT5.M160.9 ONE PART GUN GRADE SILICONE BASED SEALANT 32
WAT5.M170.9 ONE PART GUN GRADE SILICONE BASED SEALANT 32
WAT5.M180.9 JOINT SEALANT FOR PRECAST FACADE UNITS 32
WAT5.M190.9 PRIMER FOR SEALANTS 32
WAT5.M195.9 SEALANTS FOR PORTABLE WATER INSTALLATIONS 32
WAT5.M200.9 FIRE RATED SEALANTS 32
SAMPLES **34**
WAT5.M210.9 SAMPLES 34
SCHEDULE OF SEALANTS **35**
WAT5.M310.9 SCHEDULE OF SEALANTS 35

WORKMANSHIP **36**
FORMING JOINTS IN CONCRETE CONSTRUCTION **36**
WAT5.W010.9 GENERAL 36
WAT5.W020.9 PREPARATION OF JOINT 36
WAT5.W030.9 PLACING CONCRETE AROUND JOINTS 36
WAT5.W040.9 JOINT FILLER IN CONCRETE 36
WAT5.W050.9 JOINTS AT FIRE RATED WALL 36
APPLYING SEALANTS **36**
WAT5.W110.9 GENERAL 36
WAT5.W120.9 PRIMING 36
WAT5.W130.9 BOND BREAKERS 36
WAT5.W140.9 MIXING TWO PART SEALANTS 37
WAT5.W150.9 APPLYING FIRE RATED SEALANTS 37

APPLYING SEALANTS TO PRECAST FACADE UNITS 37
WAT5.W210.9 GENERAL 37
WAT5.W220.9 TWO STAGE JOINTS 37
WAT5.W230.9 JOINT WIDTH 37
WAT5.W240.9 SEALANT DEPTH 37

WAT6 PROPRIETARY WATERPROOFING SYSTEMS 38

MATERIALS 38
COLD LIQUID APPLIED FLEXIBLE WATERPROOFING SYSTEM 38
WAT6.M010.9 COLD LIQUID APPLIED FLEXIBLE WATERPROOFING SYSTEM FOR BATHROOM, KITCHEN AND REFUSE STORAGE AND MATERIAL RECOVERY ROOM 38
CEMENTITIOUS WATERPROOFING SYSTEM 44
WAT6.M110.9 CEMENTITIOUS WATERPROOFING SYSTEM FOR HARDENED CONCRETE 44
WAT6.M150.N CEMENTITIOUS ELASTOMERIC WATERPROOFING SYSTEM FOR BATHROOM AND KITCHEN 45
SHEET OR LIQUID MEMBRANE WATERPROOFING SYSTEMS 50
WAT6.M220.9 SHEET OR LIQUID MEMBRANE WATERPROOFING SYSTEMS FOR ROOFING, LIFT PIT AND EXTERNAL TANKING 50
WAT6.M230.9 SHEET MEMBRANE WATERPROOFING SYSTEM FOR BASEMENT AND SEMI-BASEMENT EXTERNAL TANKING 52
WAT6.M240.A ANCILLARY MATERIALS 56
WAT6.M250.A INSULATION MATERIALS 56
WAT6.M260.9 ROOFING TILES AND OTHER FINISHING MATERIALS 57
WAT6.M270.9 MAINTENANCE MANUAL 57
WAT6.M280.9 COMPOSITE DRAINAGE LAYER 57

WORKMANSHIP 58
APPLYING COLD LIQUID APPLIED FLEXIBLE WATERPROOFING SYSTEM 58
WAT6.W010.9 GENERAL 58
WAT6.W012.9 CONSTRUCTION MOCK-UP 58
WAT6.W015.9 STORAGE 58
WAT6.W020.9 PREPARATION 58
WAT6.W025.9 COATS OF APPLICATION 58
WAT6.W030.9 OVERCOAT 58
WAT6.W040.9 LAYING FINISHES 59
WAT6.W050.9 HEALTH AND SAFETY 59
WAT6.W060.9 COLOUR 59
MIXING AND APPLYING CEMENTITIOUS WATERPROOFING SYSTEM 59
WAT6.W110.9 GENERAL 59
WAT6.W120.9 CURING AND PROTECTION 59
APPLYING SHEET OR LIQUID MEMBRANE WATERPROOFING SYSTEMS 59
WAT6.W210.9 GENERAL 59
WAT6.W215.9 CONSTRUCTION MOCK-UP 59
WAT6.W220.9 SURFACES PREPARATION 60
WAT6.W230.9 FREE OF MOISTURE 60
WAT6.W240.9 COMPATIBILITY 60
WAT6.W250.9 PROTECTION OF EXISTING ROOF 60
WAT6.W255.9 APPLYING PROPRIETARY WATERPROOFING SYSTEMS 60
WAT6.W260.9 ADHESIVE 60
WAT6.W270.9 BUBBLES 61

WAT6.W280.9 FINISHES TO ACCESSIBLE ROOFS (MAINTENANCE & PUBLIC TRAFFIC)....61
WAT6.W290.9 FINISHES TO NON-ACCESSIBLE ROOFS (MAINTENANCE TRAFFIC)....61
WAT6.W300.9 PROTECTION OF ROOFING AND EXTERNAL TANKING SYSTEM....61
WAT6.W305.9 PROTECTION OF BENTONITE FROM PREMATURE HYDRATION....61
WAT6.W310.9 ROOF VENT....61
WAT6.W320.9 INSULATION....61
WAT6.W330.9 INSPECTION OF ROOFING....61
WAT6.W340.9 INSPECTION OF BASEMENT / SEMI-BASEMENT TANKING....61
WAT6.W350.9 LAPPING....62
WAT6.W360.9 OPEN BURNING....62

TESTING....63

ON-SITE VERIFICATION TESTS....63

WAT6.T010.A WATER SPRAY TEST TO INTERNAL INSTALLATIONS....63
WAT6.T020.N WATERTIGHTNESS TEST TO PIPE SLEEVES AT EXTERNAL WALLS....64
WAT6.T125.9 WATER FLOOD TEST TO ROOF INSTALLATIONS....65
WAT6.T130.9 TESTING TO BASEMENT / SEMI-BASEMENT EXTERNAL TANKING INSTALLATIONS....66

WAT1 ASPHALT WORK

MATERIALS

MASTIC ASPHALT

WAT1.M010.9 MASTIC ASPHALT FOR ROOFING

To BS 6925:1988, Type R988 with limestone aggregate and manufactured with asphaltic cement specified under Table 1:

1. Column B (bitumen); or
2. Column T25 (25% ± 5% refined lake asphalt).

WAT1.M020.9 MASTIC ASPHALT FOR TANKING AND DAMP-PROOFING

To BS 6925:1988, Type T1097 with limestone aggregate and manufactured with asphaltic cement specified under Table 1:

1. Column B (bitumen); or
2. Column T25 (25% ± 5% refined lake asphalt).

ANCILLARY MATERIALS

WAT1.M110.9 ISOLATING MEMBRANE

Black sheathing felt to BS 747:1994:

1. Class: 4A(i);
2. Minimum weight: 17 kg per 810 mm wide by 25 m long roll.

WAT1.M120.9 BITUMEN DRESSING COMPOUND

Cut-back bitumen to BS 3690:Part 1:1989, Grade: 50 sec. at 40°C or other Approved grade.

WAT1.M130.9 REINFORCEMENT FOR KEYING ASPHALT

Plain expanded metal lath to BS 1369:Part 1:1987:

1. Thickness of lath: minimum 0.46 mm;
2. Size: minimum 10 mm across short way of mesh;
3. Weight: not less than 2.25 kg/m² ± 15%;
4. Coating: zinc.

WAT1.M140.9 BITUMEN SOLUTION PRIMER FOR METAL

A proprietary type of thin black bitumen priming solution designed to provide a base for bituminous waterproofing coatings.

WAT1.M150.9 MORTAR FOR BEDDING CONCRETE ROOFING TILES

Cement and sand, 1 : 3, as Worksection MAS3.

WAT1.M160.9 RUBBING SAND

Clean sand passing a 600 micron BS Test Sieve but retained on one of 300 microns.

SOLAR PROTECTION

WAT1.M210.9 GRANITE CHIPPINGS

Best quality grey granite, free from brown and partially decomposed stone, graded to pass a BS Test Sieve of mesh size 5 mm but be retained on a sieve of mesh size 2.36 mm.

WAT1.M220.9 WHITE STONE CHIPPINGS

Baak Shek chippings, graded to pass a BS Test Sieve of mesh size 5 mm but be retained on a sieve of mesh size 2.36 mm.

WAT1.M230.9 SOLAR REFLECTIVE PAINT

1. An Approved bituminous based, aluminium paint; or
2. An Approved paint compatible with bituminous surfaces;
3. Do not used in dirty atmospheres which require periodical renewal.

WAT1.M240.9 INSULATION

Extruded polystyrene board to BS 3837:Part 2:1990 and:

1. CFC and HCFC free Zero Ozone Depletion Factor type;
2. Thermal conductivity (k): within range 0.025 to 0.034 W/mK;
3. Minimum compressive strength: 300 kPa;
4. With rebated edges;
5. Thickness: as indicated in the Drawings.

WAT1.M250.9 CONCRETE ROOFING TILES

1. Precast, vibrated concrete of cement, sand and dust-free aggregate, graded from 10 mm to 5 mm, mixed in the proportions of 1 : 2 : 4, cast into flat tiles;
2. Size: as shown on Drawings.

WAT1.M260.9 INSULATING ROOFING TILES

1. 300 mm or 400 mm square by 40 mm thick;
2. Density: 1250 kg/m³ ± 10%;
3. With a hard upper surface, suited to foot traffic;
4. Not five legged tiles.

WORKMANSHIP

GENERAL

WAT1.W010.9 CODE OF PRACTICE FOR ASPHALT ROOFING

Comply with CP 144: Part 4:1970.

WAT1.W020.9 CODE OF PRACTICE FOR ASPHALT TANKING AND DAMP PROOF COURSES

Comply with CP 102:1973, BS 8102:1990 and BS 8215:1991.

WAT1.W030.9 SUITABILITY OF BASE

Before laying asphalt ensure that:

1. The base is to even falls with no areas which will pond;
2. Surfaces to be covered are firmly fixed, clean, dry, smooth, free from contaminants, voids and protrusions;
3. All service pipes, pipe ducts, fittings, etc. which will penetrate the asphalt are in place and have been prepared as specified;
4. All cut and preformed chases are complete and not less than 25 mm x 25 mm in size;
5. External angles are chamfered where required to maintain the thickness of the asphalt coating.

PREPARATION

WAT1.W110.9 HEATING

1. Break blocks into pieces of suitable size, carefully stack in the cauldron or mixer, and gradually heat to a temperature not exceeding 230°C;
2. Agitate the asphalt continuously to prevent local overheating;
3. Provide suitable thermometers to ensure that the asphalt is heated to the correct temperature.

WAT1.W120.9 TRANSPORTING

1. Ensure asphalt is free from contamination;
2. Transport asphalt from the cauldron or mixer in buckets which have been coated with a fine, inert dust or cement;
3. Do not use ashes or oil to coat buckets.

WAT1.W130.9 LAYING ISOLATING MEMBRANE

On all surfaces less than 30° from the horizontal:

1. Loose lay black sheathing felt without sealing to the structure immediately prior to laying asphalt;
2. Lap 75 mm at joints.

WAT1.W140.9 FIXING REINFORCEMENT

Securely fix expanded metal lathing reinforcement with plugs and galvanized staples at 150 mm centres in both directions to:

1. Any vertical surface exceeding 300 mm in height;
2. Sloping surfaces exceeding 30° from the horizontal;
3. All timber surfaces to receive asphalt. Fix lathing to timber over the isolating layer;
4. Fixing lathing with long side of diamond horizontal, pitch of horizontal strands inclined upwards and butt jointed to continue mesh pattern;
5. Fix edges and stitch butt joints with staples at 75 mm centres.

WAT1.W150.9 PRIMING METAL SURFACES TO RECEIVE ASPHALT

1. Ensure surfaces are dry, clean, and free from dust, dirt, grease or other material which may affect adhesion;
2. Apply one coat of black bitumen priming solution as recommended by the manufacturer.

LAYING ASPHALT

WAT1.W210.9 LAY ASPHALT

1. To falls where indicated on the Drawings;
2. With separate coats breaking joint by at least 150 mm for horizontal work and 75 mm for vertical work;
3. To wood or metal gauges on horizontal surfaces to ensure the correct thickness of each coat;
4. Finish asphalt to a smooth flat surface, free from lipping, scars and other imperfections.

WAT1.W220.9 ASPHALT THICKNESSES AND NUMBERS OF COATS

1. Lay asphalt in accordance with the following table:

Situation		Number of Coats	Minimum Total Thickness
a.	Horizontal roof surfaces and slopes not exceeding 30°	2	20 mm
b.	Skirtings, upstands, drips and on slopes exceeding 30°	2	13 mm
c.	Horizontal tanking or damp proof courses (except in the thickness of walls)	3	30 mm
d.	Skirtings, upstands and drips greater than 300 mm in height and vertical tanking.	3	20 mm
e.	Damp proof course in the thickness of walls.	1	15 mm

2. Situations 1 and 3: apply specified number of coats of equal thickness;

3. Situations 2 and 4: apply first coat thinly by metal trowel, in small dabs to completely cover surface and ensure full adhesion. Succeeding coat(s) to be applied by float.

WAT1.W230.9 MAKING GOOD BLOWS ETC

Pierce any blows formed during laying by the entrapment of air or moisture, and make good the affected part whilst the asphalt is still hot.

WAT1.W240.9 INTERNAL ANGLES

Form asphalt fillets at internal angles between horizontal and vertical surfaces as follows:

1. Applied in two coats of equal thickness;
2. Not less than 50 mm wide on face;
3. Continuous with the surfaces.

WAT1.W250.9 EXTERNAL ANGLES

Maintain the full thickness of asphalt specified at external angles between horizontal and vertical surfaces or between sloping surfaces.

WAT1.W260.9 SKIRTINGS

Unless shown otherwise on Drawings, form skirtings to a height above the finished roof level of 150 mm, with the top edge weathered and tucked into a groove with minimum dimensions of 25 mm deep × 25 mm.

WAT1.W270.9 RAINWATER OUTLETS

1. Prime flanges of roof outlets with bitumen solution prior to applying asphalt;
2. Neatly dress asphalt into rainwater outlets and seal as required.

WAT1.W280.9 FLASHINGS TO RAINWATER OUTLETS

Carefully embed flashings into the first coat of asphalt and dress the second over it.

WAT1.W290.9 PIPES PASSING THROUGH ASPHALT ROOFS

1. Spot weld expanded metal lathing reinforcement to the sleeves of pipes passing through roofs and thoroughly clean and prime metal surfaces with bitumen solution;
2. Neatly dress asphalt around sleeves to a minimum height of 150 mm;
3. Form an asphalt angle fillet not less than 50 mm wide on face at the bottom.

FINISHING ASPHALT

WAT1.W310.9 ROOF SURFACES

Immediately on completion of laying and while the asphalt is still warm:

1. Rub sand well into the surface of the asphalt, using a clean, wooden float. Do not use a brush or broom to spread the sand;
2. Ensure that the entire horizontal surface of asphalt is treated. Do not sand-rub vertical surfaces or the finished surface of roofing asphalt which is to be surfaced with paving asphalt;

3. Prevent sand from spreading over exposed edges of bay.

WAT1.W320.9 TANKING AND DAMP PROOF COURSES

Finish with a light dusting of cement.

WAT1.W330.9 DAMP PROOF COURSING WITHIN WALLS

Embed granite chippings in the surface of the asphalt, whilst it is still hot, and leave proud of the surface to form a key.

SOLAR PROTECTION

WAT1.W410.9 STONE CHIPPINGS

1. Dress surface with bitumen compound applied at the rate of 3 kg/m²;
2. Spread stone chippings immediately at the rate of 15 kg/m² and lightly roll in. Remove any surplus chippings.

WAT1.W420.9 SOLAR REFLECTIVE PAINT

To unprotected surfaces:

1. Apply two coats at rates recommended by the manufacturer;
2. Allow the first coat to dry thoroughly before application of the second coat;
3. Maintain free from damage and other surface defects.

WAT1.W430.9 BEDDING CONCRETE ROOFING TILES

Bed tiles in mortar, thickness as indicated on drawings.

WAT1.W440.9 BEDDING INSULATING ROOFING TILES

Loose lay the tiles, pour hot bitumen between the joints and point.

WAT1.W450.9 EXPANSION JOINTS

Allow for expansion with:

1. A 75 mm space around perimeters, filled with bitumen;
2. 25 mm joints every 9 m² or per smalller area as shown on Drawings, filled with hot bitumen.

WAT1.W460.9 TRAFFIC ON ROOF TILING

Do not allow traffic on newly laid roofs until four days have elapsed since the completion of laying. Permit only light traffic for further period of ten days.

LAYING ROOF INSULATION

WAT1.W510.9 EXTRUDED POLYSTYRENE ROOF INSULATION

1. Support slab on both sides of cut whilst cutting to size;
2. Apply hot bitumen bonding compound to asphalt surface;
3. Allow bonding compound to become cool and tacky before laying insulation;

4. Lay insulant with staggered butt joints and apply pressure to ensure a continuous bond. Leave a 75 mm wide gap at abutment of insulant with vertical surfaces.

TESTING

SAMPLING AND TESTING MASTIC ASPHALT

WAT1.T010.9 GENERAL

1. Sampling and testing of mastic asphalt to be in accordance with BS 5284:1993;
2. Take a minimum 3 kg sample from each 10 tonnes of block material delivered to site and deliver to an Approved testing laboratory, as directed by the CM.

WAT1.T020.9 RESULTS

Ensure results are in accordance with BS 6925:1988. In the event of any asphalt failing to meet the specified requirements submit for CM's agreement detailed proposals for taking up and replacing defective material.

ON-SITE VERIFICATION TESTS

WAT1.T030.9 WATER FLOOD TEST TO ROOF INSTALLATION

As WAT6.T125.

WAT2 BITUMEN FELT ROOFING

MATERIALS

ROOFING FELT

WAT2.M010.9 UNDERLAYERS

One of the following:

1. Bitumen felt to BS 747:1994
    a. Type: 3B;
    b. Nominal weight: 1.8 kg/m².
2. An Approved high performance elastomeric felt:
    a. With polyester reinforcement;
    b. Minimum core weight: 125 g/m²;
    c. With sanded finish.

WAT2.M020.9 TOP LAYER (CAP SHEET)

An Approved high performance elastomeric felt:

1. With polyester reinforcement;
2. Minimum core weight: 250 g/m²;
3. Finish:
    a. With mineral self finish where chippings are not required to be used;
    b. With sanded finish, where chippings are required to be used.

WAT2.M030.9 CERTIFICATION

Ensure that all rolls of felt delivered to site bear the manufacturer's trade mark and certification of their BS Type where applicable.

ANCILLARY MATERIALS

WAT2.M105.9 ADHESIVE AND ADHESIVE PRIMER GENERALLY

In compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic compounds) Regulation.

WAT2.M110.9 PRIMER

Unless otherwise recommended by the manufacturer of the bonding compound, cut-back bitumen with:

1. Maximum volatile solvent content: 60% by weight;
2. Maximum viscosity (Redwood No 2 at 21°C): 25 seconds.

WAT2.M120.9 BONDING COMPOUND

Bitumen based adhesive for hot application and with the following softening points and penetration classifications:

1. For roofs with slopes up to and including 5°: 85/25 or 95/25;
2. For roofs with slopes over 5°: 115/15.

WAT2.M130.9 COMPOUND FOR BEDDING CHIPPINGS

Hot applied cut-back bitumen to BS 3690:Part 1:1989: Table 2; Grade: 50 sec at 40°C.

WAT2.M140.9 NAILS

For fixing felt to timber decks:

1. Material: galvanized steel or non-ferrous metal;
2. Length: 20 mm;
3. Shank diameter: 3 mm;
4. Head diameter: 11 mm.

WAT2.M150.9 ROOF VENTS

Plastic or non-ferrous metal of a proprietary type.

WAT2.M160.9 RAINWATER OUTLETS

1. A proprietary type; or
2. 450 mm x 450 mm x 1.8 mm thick lead slate perforated for and soldered to a 150 mm long outlet pipe of 1.8 mm thick lead to suit the internal bore of the rainwater downpipe.

WAT2.M170.9 EDGE TRIM

Non-ferrous trim pre-drilled for fixing with screws or nails.

WAT2.M180.9 PIPE SLEEVES

Comprising:

1. 450 mm x 450 mm x 1.8 mm thick lead slate perforated for and soldered to 150 mm high by 1.8 mm thick lead to clear the external diameter of the pipe;
2. Proprietary moulded plastic or rubber collar.

WAT2.M190.9 MASTIC ASPHALT FOR FILLETS

To BS 6925:1988, Type R988 with limestone aggregate and manufactured with asphaltic cement specified under Table 1, column T25 (25% ± 5%) refined lake asphalt.

SOLAR PROTECTION

WAT2.M210.9 STONE CHIPPINGS

1. Light coloured, hard and free from brown or partially decomposed stone;
2. Graded from 5 mm to 3 mm.

SAMPLES

WAT2.M410.9 SAMPLES

Submit samples of the following for Approval in accordance with the requirements of PRE.B9.410:

1. Elastomeric felts;
2. Roof vents;
3. Bonding compound;
4. Rainwater outlets;
5. Edge trims;
6. Pipe sleeves;
7. Stone chippings.

WORKMANSHIP

GENERAL

WAT2.W010.9 STANDARD

Lay bitumen felt roofing generally in accordance with BS 8217:1994.

PREPARATION FOR LAYING

WAT2.W110.9 CONDITION OF BASE

Before starting work, ensure that the base is clean and dry.

WAT2.W120.9 SETTING OUT FLAT ROOFS

1. Lay the first layer of felt at and parallel to the lower edge or eaves;
2. Lay subsequent layers in a similar manner to ensure that the laps do not obstruct the flow of water.

WAT2.W130.9 SETTING OUT PITCHED ROOFS

1. Lay felt in the direction of the slope;
2. Lay sheets with the exposed edges away from the prevailing wind.

WAT2.W140.9 MASTIC ASPHALT FILLETS

Form asphalt fillets in accordance with CP 144: Part 4:1970.

LAYING FELT

WAT2.W210.9 NUMBER OF LAYERS

Provide:

1. Two underlayers;
2. One top layer;
3. A surface dressing when not self finished.

WAT2.W220.9 LAPS

1. Lap felt 75 mm at side joints;
2. Lap felt 100 mm at end of each length;
3. Lay successive layers to break joint.

WAT2.W230.9 APPLYING BONDING COMPOUND

1. Do not heat bonding compound to a temperature greater than 220°C and provide thermometers to ensure accurate control of temperature;

2. Lay compound evenly at a temperature sufficient to ensure a satisfactory bond (180°C minimum unless stated otherwise by the manufacturer's site work instructions).

WAT2.W240.9 LAYING PROCEDURE FOR CONCRETE ROOFS

1. Brush apply one coat of bitumen primer at the rate recommended by the manufacturer and allow to dry for at least 24 hours;
2. Partially bond first layer of felt to the base with bonding compound applied at the perimeter and in spots or strips at a rate of 0.5 kg/m²;
3. Roll first layer with a roller of 70 kg minimum weight, whilst the bonding compound is still hot and remove any compound squeezed out at the edges;
4. Fully bond subsequent layers in a continuous, even coating of bonding compound, applied at the rate of 1.5 kg/m² to the layer below;
5. Roll in accordance with sub-clause (3).

WAT2.W250.9 LAYING PROCEDURE FOR TIMBER ROOFS

1. Nail the first layer at 50 mm centres along all laps at a distance of 20 mm from the edge and elsewhere in rows 150 mm apart, in a staggered pattern at 300 mm centres;
2. Fully bond subsequent layers in a continuous, even coating of bonding compound, applied at the rate of 1.5 kg/m² to the layer below;
3. Roll bonded layers with a roller of 70 kg minimum weight whilst the bonding compound is still hot and remove any compound squeezed out at the edges.

WAT2.W260.9 SKIRTINGS ON CONCRETE ROOFS

1. Form 75 mm wide mastic asphalt fillet at base of skirting in two coats;
2. Carry up felt underlayers to form an upstand a minimum of 150 mm above the level of the roof;
3. Cover upstand with a mineral faced felt skirting of same weight and type as capping sheet;
4. Provide and fix a lead apron flashing over the felted upstand in accordance with Worksection WAT4 and as detailed on the Drawings.

WAT2.W270.9 SKIRTINGS ON TIMBER ROOFS

1. Provide a 200 mm timber upstand and fix securely to the roof deck with a timber angle fillet, measuring 75 mm on its exposed face, at its base;
2. Dress each layer of roofing felt over the upstand;
3. Provide and fix a lead apron flashing over the felted upstand in accordance with Worksection WAT4 and as detailed on the Drawings.

WAT2.W280.9 VERGES AND GUTTERS

1. Provide and fix a non-ferrous metal trim with compatible screws or nails and bond between layers of felt. Form a drip or dress into gutters as shown on Drawings; or
2. Form a welted drip.

WAT2.W290.9 RAINWATER OUTLETS

1. Lay roofing so that all falls and currents are directed towards rainwater outlets;

2. For proprietary rainwater outlet, dress all layers into the outlet and seal with bonding compound;
3. For perforated lead slate, dress flange of fabricated lead slate in between layers of felt, prime and seal with bonding compound.

WAT2.W300.9 PIPES PASSING THROUGH ROOF

1. Cut and fit roofing around pipes;
2. Dress flange of sleeve between second and third layers, prime and seal in hot bonding compound;
3. Fit plastic or rubber collar with a 75 mm minimum lap over the upstand of the pipe sleeve.

SOLAR PROTECTION

WAT2.W410.9 APPLYING CHIPPINGS

To areas without mineralised self finish:

1. Dress surface with bitumen compound at the rate of 3 kg/m²;
2. Evenly spread chippings at the rate of 15 kg/m² immediately after applying bitumen compound and lightly roll in;
3. Remove any loose chippings.

WAT3 SINGLE PLY ROOFING

MATERIAL

GENERAL

WAT3.M010.9 CONTRACTOR'S RESPONSIBILITIES

Take responsibility for the supply, delivery and fixing of single ply roofing membrane system including:

1. Satisfying the performance requirements of this Worksection;
2. Selecting, in conjunction with manufacturers and their licenced specialist fixing contractors, the most appropriate system for the proposed structure and conditions of operation for the specified life of the membrane;
3. The method and frequency of attachment where ballasting is not required, taking into account all predictable conditions of wind uplift, calculated in accordance with WAT3.M070;
4. Insulation layers where indicated in the Drawings;
5. Ballasting layers, where indicated in the Drawings.

WAT3.M020.9 MEMBRANE TYPE

The Contractor may tender for and supply any of the membrane types specified in this Worksection. If an alternative type of material is proposed, then it must comply with the general requirements of this Worksection and be Approved.

WAT3.M030.9 DESIGN LIFE

The roof membrane is required to remain watertight, under its original service conditions, for a period of not less than 20 years.

WAT3.M050.9 FIRE PERFORMANCE

The required fire performance classification (when tested in accordance with BS 476:Part 3:1975) of the membrane when applied to the substrates and in the circumstances that apply to this Contract is specified in Project Specific Specification.

WAT3.M060.9 THERMAL INSULATION

Incorporate a CFC and HCFC free Zero Ozone Depletion Factor type thermal insulation layer to produce a minimum U value for the roof area as specified in Project Specific Specification.

WAT3.M070.9 WIND UPLIFT

Comply with the Code of Practice on Wind Effects in Hong Kong. The proposed methods of securing the membrane must ensure that the membrane and any other part of the roofing system, will not be damaged or dislodged by any predictable wind condition.

WAT3.M080.9 CHEMICAL RESISTANCE

When the membrane is likely to come into contact with chemicals, it must be resistant to chemicals throughout its anticipated life.

SHEET MEMBRANES

WAT3.M110.9 REINFORCED POLYVINYL CHLORIDE (PVC)

An Approved proprietary product and as specified from the following:

1. Minimum thickness: 1.2 mm;
2. Minimum cover to reinforcement fabric: 0.4 mm;
3. Colour: light grey;
4. Finish: smooth and free of creases, folds, tears and other visible defects which may adversely affect the watertightness of the membrane;
5. Reinforcement fabric:
    a. Unwoven polyester or glass fibre for adhesive fixed and ballasted systems;
    b. Woven polyester for mechanically fixed systems.
6. Method of jointing: solvent or hot air welding;
7. Method of attachment:
    a. Full or partial bonding to the substrate;
    b. Loose laid and ballasted;
    c. Mechanically fixed.

WAT3.M120.9 CHLORINATED POLYETHYLENE (CPE)

An Approved proprietary product and as specified from the following:

1. Minimum thickness: 1.2 mm;
2. Minimum thickness of polyester backing fleece (where provided): 0.9 mm;
3. Colour: light grey;
4. Finish: free of creases and other surface defects which may adversely affect the watertightness of the membrane;
5. Reinforcement fabric (where provided): woven polyester;
6. Method of jointing: hot air or solvent welding;
7. Method of attachment:
    a. Full or partial bonding to the substrate;
    b. Loose laid and ballasted;
    c. Mechanically fixed.

WAT3.M130.9 FLEXIBLE CHLOROSULPHONATED POLYETHYLENE (CSM)

An Approved proprietary product, reinforced with woven polyester scrim for mechanically attached and ballasted systems or with a backing laminated for fully adhered systems, and as specified from the following:

1. Minimum thickness: 1.15 mm for mechanical attachment and 0.9 mm for fully adhered;

2. Minimum thickness of cover to fabric reinforcement, where provided: 0.3 mm;
3. Colour: white or light grey;
4. Finish: smooth and free of creases, folds, tears and other visible defects which may adversely affect the watertightness of the membrane;
5. Method of jointing: hot air welding only;
6. Method of attachment:
    a. Full or partial bonding to the substrate;
    b. Loose laid and ballasted;
    c. Mechanically fixed.

WAT3.M140.9 POLYVINYL CHLORIDE/ETHYLENE VINYL-ACETATE TERPOLYMER (FLEXIBLE VET)

An Approved proprietary product, homogeneous or reinforced with fleece backing, and as specified from the following

1. Minimum thickness:
    a. Unbacked, homogeneous: 1.2 mm;
    b. With backing: 2.2 mm.
2. Minimum cover to reinforcement, when provided: 0.4 mm;
3. Colour: white or light grey;
4. Finish: smooth and free of creases, folds, tears and other visible defects which may adversely affect the watertightness of the membrane;
5. Method of jointing: solvent or hot air welding;
6. Method of attachment:
    a. Full or partial bonding to the substrate;
    b. Loose laid and ballasted;
    c. Mechanically fixed.

WAT3.M150.9 ETHYLENE PROPYLENE DIENE MONOMER (EPDM)

An Approved proprietary product, unreinforced and as specified from the following:

1. Minimum thickness: 1.0 mm;
2. Colour: black;
3. Finish: smooth and free of creases, folds, tears and other visible defects which may adversely affect the watertightness of the membrane;
4. Method of jointing: solvent based adhesives, proprietary adhesive tapes or hot-melt adhesive systems as appropriate;
5. Method of attachment:
    a. Full or partial bonding to substrate;
    b. Loose laid and ballasted;
    c. Mechanically fixed.

ANCILLARY MATERIALS

WAT3.M210.9 GENERAL

1. Ancillary materials, including adhesives, sealants, solvents, preformed corners, flashing materials, pipe sleeves and collars etc, must either be a part of the selected membrane system or be fully compatible with it and recommended for their intended use by the membrane manufacturer;
2. Adhesives, adhesive primer, sealant, and sealant primer shall be in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compound) Regulation.

WAT3.M220.9 ISOLATION QUILT

For isolating the membrane from possible physical damage from the substrate or from ballasting layers:

1. Material: needled, non-woven polyester;
2. Minimum weight: 200 g/m².

WAT3.M230.9 BALLAST GRAVEL

Clean, large, well rounded stones, in the range 20 mm to 40 mm, without fines or sharps.

WAT3.M240.9 PAVERS

Precast concrete:

1. Size: 600 mm × 600 mm × 50 mm minimum thickness;
2. Weight: 110 kg/m² ± 10%.

WAT3.M250.9 THERMAL INSULATION FOR INVERTED ROOF

Extruded polystyrene board to BS 3837:Part 2:1990 and:

1. CFC and HCFC free Zero Ozone Depletion Factor type;
2. Thermal conductivity (k): within range 0.025 to 0.034 W/mK;
3. Minimum compressive strength: 300 kPa;
4. With rebated edges;
5. Thickness: as indicated in the Drawings.

WAT3.M260.9 CEMENT

Portland cement type CEM I in BSEN 197-1:2000.

WAT3.M270.9 SAND

As specified in MAS3.M110.

WAT3.M280.9 MORTAR FOR BEDDING CONCRETE ROOFING TILES

Cement and sand, 1: 4 mix.

SAMPLES

WAT3.M310.9 SAMPLES

Submit samples of the following for Approval in accordance with the requirements of PRE.B9.410:

1. Sheet membrane;
2. Adhesives;
3. Mechanical fixings;
4. Isolation quilt;
5. Ballast;
6. Thermal insulant.

WORKMANSHIP

GENERAL

WAT3.W010.9 APPROVED FIXING SUB-CONTRACTOR

Employ a specialist sub-contractor, for the fixing of single ply roofing, who is:

1. Licenced by the membrane manufacturer to fix his material and whose operatives are appropriately trained in all aspects of the work;
2. Operating a Quality Assurance system certified under ISO 9001 or an Approved equivalent scheme.

WAT3.W020.9 SURVEY

Ensure that the Approved specialist sub-contractor carries out a survey of the roof area prior to the commencement of fixing for the purpose of confirming the surfaces are acceptable and comply with the manufacturers recommendations for the application of the membrane. Submit such confirmation to the CM, in writing, at least 7 days before laying of the membrane starts on Site.

WAT3.W030.9 HANDLING AND STORAGE OF MATERIALS

Handle and store materials strictly in accordance with the manufacturer's recommendations and:

1. Keep sheeting rolls in clean, dry, cool accommodation, clear of the ground;
2. Store solvents, adhesives and any other material having a low flashpoint in secure, well ventilated accommodation which will ensure that there is no danger of accidental or deliberate ignition.

WAT3.W040.9 SUBSTRATE PREPARATION

1. Ensure that all substrates on which membranes are to be directly laid, have a smooth, even surface, free of protrusions, oil and grease and are dry and free of dust;
2. Remove all nibs of concrete and cement;
3. Carry out priming, sealing, crack filling and other preparation where necessary all in accordance with manufacturer's instructions;
4. Insulation must be lightly butted and any fasteners brought level to the surface.

WAT3.W050.9 FIXING GENERALLY

Fix roofing materials:

1. Strictly in accordance with the manufacturer's recommendations;
2. In accordance with this Specification except where this Specification is over-ridden by the manufacturer's recommendations, which must be regarded as paramount;
3. Ensure all junctions, joint details such as skirtings, coverings to kerbs, edges, expansion joints etc., and the joints around pipes, rainwater outlets and the like are properly executed;
4. Before commencing work, demonstrate on site compatibility of all adhesives and materials which must be certified as compatible by the supplier/manufacturer in writing;

5. Inform the CM upon completion of each layer of roofing system for inspection before execution of next layer.

WAT3.W060.9 PLACING BALLAST LAYER

Place isolation quilt over the roofing membrane, where required, and:

1. Carefully distribute gravel ballast, over areas as shown on Drawings, in a layer not less than 50 mm thick;
2. Place precast concrete pavers, on areas as shown on Drawings, taking care not to damage the membrane;
3. Commence placing the ballast layer concurrently with laying of the roofing membrane, ensuring that sufficient ballast is in place at the end of each day's work to prevent the dislodgement of any previously laid area of membrane.

WAT3.W070.9 PROTECTION OF THE COMPLETED MEMBRANE

Protect the completed membrane and:

1. Do not use the roof as a working platform and do not use the roof surface for the storage or mixing of materials;
2. Exercise care when handling builder's plant and scaffolding in the vicinity of the membrane;
3. Ensure that paint, oil, fuel, solvents or any other material, which may damage the membrane, do not come into contact with it.

WAT3.W080.9 BEDDING CONCRETE ROOFING TILES

As WAT1.W430.

WAT3.W090.9 TRAFFIC ON ROOF TILING

Do not allow traffic on newly laid roofs until four days have elapsed since completion of laying. Permit only light traffic for a further period of ten days.

WAT3.W100.9 MAINTENANCE MANUAL

Upon completion of work, submit one maintenance manual identifying:

1. Protect name;
2. Location and date;
3. Type of coating system applied;
4. Surfaces to which applied including sketches where necessary;
5. Recommendations for periodic inspections, care and maintenance;
6. Common causes of damage;
7. Instructions for temporary patching until permanent repair can be made.

TESTING

ON-SITE VERIFICATION TESTS

WAT3.T010.9 WATER FLOOD TEST TO ROOF INSTALLATION

As WAT6.T125.

WAT4 FLASHINGS

MATERIALS

METAL SHEET

WAT4.M010.9 LEAD SHEET

To BS 1178:1982, code number: 4.

WAT4.M020.9 ALUMINIUM SHEET

To BS 1470:1987:

1. Thickness: 0.9 mm;
2. Grade: 1050A;
3. Temper grade: O.

ANCILLARY MATERIALS

WAT4.M110.9 BITUMINOUS PAINT

To BS 6949:1991, Type 1.

WAT4.M120.9 ISOLATING TAPE

Self adhesive plastic tape.

SAMPLES

WAT4.M210.9 SAMPLES

Submit samples of the following for Approval in accordance with the requirements of PRE.B9.410:

1. Metal sheet;
2. Bituminous paint;
3. Isolating tape.

WORKMANSHIP

FIXING METAL FLASHINGS

WAT4.W010.9 LEAD FLASHINGS

1. Form from sheets not more than 1500 mm long;
2. Let flashings into walls a minimum of 25 mm;
3. Secure with lead wedges and point with cement mortar;
4. Form 100 mm laps at joints in flashing;
5. Secure the lower edge with lead tacks at 750 mm minimum centres.

WAT4.W020.9 ALUMINIUM FLASHINGS

1. Form from sheets not more than 2000 mm long;
2. Let flashings into walls a minimum of 25 mm;
3. Secure with aluminium wedges and point with cement mortar;
4. Form a lap and a single lock welt at all joints;
5. Fold the lower edge under to provide additional stiffness.

WAT4.W030.9 ALUMINIUM IN CONTACT WITH CEMENTITIOUS MATERIALS

Coat with bituminous paint after forming any bends.

WAT4.W040.9 PREVENTION OF ELECTROLYTIC CORROSION

1. Prevent contact in the completed work between aluminium alloys and copper alloys, nickel, lead or stainless steel;
2. Where such contact is unavoidable, coat the contact surfaces with bituminous paint, isolating tape or other Approved means.

WAT5 SEALANTS

MATERIALS

JOINT FILLERS

WAT5.M010.9 JOINT FILLER

A waterproof, compressible, non-extruding, pre-moulded type, with a high recovery factor after compression, at temperatures below 50°C and Approved.

WAT5.M020.9 BACK-UP MATERIAL

Approved preformed cellular strip material which may also act as a bond breaker.

WAT5.M030.9 BOND BREAKER

Proprietary tape or similar strip material, as recommended by the sealant manufacturer, for use where a back-up material is either not used or does not perform as a bond breaker.

WAT5.M040.9 BACKING RODS FOR PRECAST FACADE UNITS

Polyethylene foam or Approved equivalent.

SEALANTS

WAT5.M110.A GENERAL

1. Sealants, sealant primers and caulking compound shall be in compliance with the prescribed limit of VOC content as set out in the Air Pollution Control (VOC) Regulation;
2. All sealants are subject to Approval, as specified in WAT5.M210;
3. VOC data submission:
    a. Submit manufacturer's product data for sealant and indicate the VOC limit of the product;
    b. Submit document proof showing compliance with the maximum limit of the volatile organic compound content specified in Part 5 of Schedule 7 of Air Pollution Control (Volatile Organic Compounds) Regulation;
    c. Environmental Standards for sealants:
        i. The product shall not contain the substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride);
        ii. The product shall contain no more than 0.01% by wet weight of formaldehyde;
        iii. The product shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

WAT5.M120.9 TWO PART POLYSULPHIDE BASED SEALANT

To BS 4254:1983.

WAT5.M130.9 ONE PART GUN GRADE POLYSULPHIDE BASED SEALANT

To BS 5215:1986.

WAT5.M140.9 BUTYL MASTIC

Proprietary product.

WAT5.M150.9 ONE PART POLYURETHANE SEALANT

To BS 4254:1983, BS 5215:1986 and BS 5889:1989:

1. Grade: 1-part polyurethane or Approved equivalent;
2. Colour: standard grade or to Approval;
3. Elongation at break: to ISO 8339;
4. Paintability: well paintable;
5. Joint movement capacity: ±25%.

WAT5.M160.9 ONE PART GUN GRADE SILICONE BASED SEALANT

To BS 5889:1989, Type A satisfying the test for adhesion and tensile modulus after heat ageing specified in BS 4254:1983 and BS 5215:1986.

WAT5.M170.9 ONE PART GUN GRADE SILICONE BASED SEALANT

To BS 5889:1989, Type B.

WAT5.M180.9 JOINT SEALANT FOR PRECAST FACADE UNITS

Unless otherwise approved, construction sealant (Type F), design and selection to follow BS 6093:1993 and BS 6213:1982, and offering the following properties:

1. Movement capability of 25% (Class 25) in accordance with ISO 11600;
2. Tensile modules not exceeding 0.4 N/mm² at 23°C.

WAT5.M190.9 PRIMER FOR SEALANTS

As supplied and recommended by the sealant manufacturer.

WAT5.M195.9 SEALANTS FOR PORTABLE WATER INSTALLATIONS

Approved proprietary WRAS-approved products when sealant is in contact with portable water.

WAT5.M200.9 FIRE RATED SEALANTS

1. Submission Requirements:
    a. At sample submission and approval stage, submit a sample of the proposed fire rated sealant for CM's approval together with all the following substantiation for CM's information:
        i. Catalogue, brand name / model name and job reference of the material;
        ii. Name, address and contact person of the local supplier / distributor;
        iii. Name, address and contact person of the manufacturer.

b. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS;

c. Either:

i. Certified true copy of certificate for a third party product conformity scheme such as CE Marking (CE), FM Approvals, Underwriters Laboratories (UL), Certifire or an equivalent scheme showing full compliance of the proposed product with the requirements of sub-clause (2)(b). The date of tests under the scheme shall be within five years prior to the notified date for commencement of the Works; or

ii. Certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance of the proposed product with the requirements of sub-clause (2)(b). The date of the test shall be within three years prior to the notified date for commencement of the Works.

d. Shop drawings showing details of the fire rated sealants including manufacturers' recommendations for the application for CM's approval prior to commencement of work;

e. A sample of the ancillary material such as the backing material to achieve the required sealant depth.

2. Quality Requirements:

a. An Approved proprietary one part sealant suitable for the installed locations and capable of maintaining an effective barrier against flame, smoke and gases, fixed in accordance with the manufacturer’s recommendations to achieve the statutory required fire resistance performance;

b. Tested to BS 476-Part 20:1987 or BS EN 1366-Part 3:2009 and certified as being capable of resisting the action of fire for the specified periods by a laboratory accredited for the specific test by HKAS under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS with appropriate qualifications and experience in fire resisting construction;

c. Comply with the latest Code of Practice for Fire Safety in Buildings and the applicable Fire Services Department Circular Letter requirements and guidelines;

d. Backing material to achieve the sealant depth to be of mineral wool or close cell polyethylene foam rod or as shown in the relevant fire test report.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1);

ii. For products with a third part product conformity scheme as per sub-clause (1)(c)(ii) requirements, submit a Manufacturer Certificate from the local supplier / distributor as per sub-clause (1)(a)(ii) confirming the products delivered to Site comply with the third party product conformity scheme requirements;

iii. Delivery notes for all materials delivered to Site, including the following:

- Confirmation in writing on the serial number of the fire rated sealants delivered to Site; confirmation to be from the local supplier / distributor;
- Copy of docket showing the serial number of the fire rated sealants delivered to Site; copy to be provided by the manufacturer at sub-clause (1)(b).

b. Carry out and submit report on the following verifications upon delivery on Site. Prior to carrying out the verifications, inform the CM who may be present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Delivery Note with content at sub-clause (3)(a)(iii)	Document check	Material delivered is from the manufacturer in sub-clause (1)(b); Serial number same as sub-clause (3)(a)(iii)
Package	Visual	As per Approved sample

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Delivery Note Package, Serial number	1 sample from each batch	Individual

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate sets of samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

SAMPLES

WAT5.M210.9 SAMPLES

1. Submit samples of the following for Approval in accordance with the requirements of PRE.B9.410:

   a. Joint fillers, bond breakers and back-up materials;

   b. Sealants.

2. Do not confirm orders until Approval has been obtained. Keep Approved samples at the place agreed by the CM for comparison with materials used in the works, which must conform with the samples set aside. Where there is a choice of material, colour or texture, submit samples for Approval. When Instructed, submit technical literature for materials specified.

SCHEDULE OF SEALANTS

WAT5.M310.9 SCHEDULE OF SEALANTS

Sealant	Clause Numbers	General Use	Location
Butyl mastic	WAT5.M140	Bedding	Bedding window and door frames and glazing.
Two part polysulphide	WAT5.M120	High movement joints resistant to ageing and damage by acids and alkalis.	Joints in walls and floors. Sealing to precast units other than precast facade panels.
One part polysulphide	WAT5.M130	High movement joints resistant to ageing and damage by acids and alkalis.	Joints in cladding panels, pointing aluminium windows, glazing.
One part polyurethane	WAT5.M150	High movement joints resistant to ageing and damage by acids and alkalis.	Joints in cladding panels, pointing aluminium windows, glazing.
Silicone	WAT5.M160	High movement joints extremely resistant to ageing.	Pointing between differing materials e.g. around window and door frame.
	WAT5.M170	High movement joints extremely resistant to ageing.	Pointing glazing and sanitary ware.
Construction sealant (Type F)	WAT5.M180	-	Joints around precast facade panels.

WORKMANSHIP

FORMING JOINTS IN CONCRETE CONSTRUCTION

WAT5.W010.9 GENERAL

Construct joints strictly in accordance with Drawings and manufacturer's recommendations.

WAT5.W020.9 PREPARATION OF JOINT

Keep edges true, free from cracks, spalling or other imperfections. Ensure that edges of joints are clean, dry and free from dust or grease.

WAT5.W030.9 PLACING CONCRETE AROUND JOINTS

Do not place concrete on both sides of a movement joint simultaneously.

WAT5.W040.9 JOINT FILLER IN CONCRETE

1. Fix to concrete with bituminous adhesive before casting the adjoining bay;
2. Form the joint sealing slot by casting in a removable former.

WAT5.W050.9 JOINTS AT FIRE RATED WALL

Form joints in full compliance with fire rated sealant manufacturer’s recommendations.

APPLYING SEALANTS

WAT5.W110.9 GENERAL

Apply sealants in accordance with BS 6213:1982 and:

1. Surfaces must be dry, clean and free of dust and oil. Application temperature between +5ºC to 80ºC;
2. Ensure that they are properly pressed home;
3. Finish with a smooth, regular surface;
4. Mask adjoining surfaces which would be impossible to clean if smeared with sealant;
5. Remove all excess sealant and smears caused by sealants, solvents, primers etc; used in sealing works, immediately and entirely from adjacent materials as the work proceeds.

WAT5.W120.9 PRIMING

Treat surfaces with a primer where recommended by the sealant manufacturer.

WAT5.W130.9 BOND BREAKERS

Apply bond breakers and back-up material where necessary to control the depth of the sealant, to facilitate tooling of the sealant and to prevent bonding to the back of the joint.

WAT5.W140.9 MIXING TWO PART SEALANTS

Mix according to the manufacturer's instructions and until colour is uniform throughout.

WAT5.W150.9 APPLYING FIRE RATED SEALANTS

In accordance with shop drawings specified in sub-clause (1)(d) of WAT5.M200 and apply in full compliance with sealant manufacturer’s recommendations.

APPLYING SEALANTS TO PRECAST FACADE UNITS

WAT5.W210.9 GENERAL

Comply with other applicable requirements of this Worksection.

WAT5.W220.9 TWO STAGE JOINTS

When a two-stage joint is adopted, protect all sealant materials used in areas accessible to the public with non-shrink mortar or other Approved methods.

WAT5.W230.9 JOINT WIDTH

Unless otherwise Approved, the installed joint width must not be less than 6 mm nor greater than 30 mm.

WAT5.W240.9 SEALANT DEPTH

Joints	Sealant Depth
Joints up to 13 mm wide:	Equal to the joint width;
Joints over 13 mm wide:	Equal to one-half the width, but not less than 13 mm

WAT6 PROPRIETARY WATERPROOFING SYSTEMS

MATERIALS

COLD LIQUID APPLIED FLEXIBLE WATERPROOFING SYSTEM

WAT6.M010.9 COLD LIQUID APPLIED FLEXIBLE WATERPROOFING SYSTEM FOR BATHROOM, KITCHEN AND REFUSE STORAGE AND MATERIAL RECOVERY ROOM

1. Submission Requirements:
    a. At sample submission and approval stages, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:
        i. Catalogue, brand name / model name and job reference of the material;
        ii. Name, address and contact person of the local supplier;
        iii. Name, address and contact person of the manufacturer;
        iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
        v. Detailed Method Statement for the installation of the cold liquid applied flexible waterproofing system, showing all work procedures from the preparation of background through to the completion of the overlaid finishes;
        vi. Data sheet for minimum coverage rate of the waterproofing system and product identification number;
        vii. When the cold liquid applied flexible waterproofing systems are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:
            - Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
    b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(f) for CM's information:
        i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Suitable for use in the intended areas of application;

b. Compatible with all surfaces and materials, including ancillary materials, in contact with the waterproofing system as WAT6.M240;

c. Crack-bridging capability up to 2mm;

d. All components of the waterproofing system are non-toxic and do not cause any hazard or injury to operatives and occupants or to others in the vicinity of the Site;

e. In compliance with the prescribed limit of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation;

f. Applicable in a cold liquid form;

g. The properties requirements are as follows:

Properties	Acceptance Standards	Remarks
Waterproofing Quality	No sign of leakage or anomalies	Refer sub-clause (h) for method.
Compatibility with Approved Tile Adhesive	>= 950 N for 14 days in laboratory condition.	Refer sub-clause (i) for method.
	>= 560 N for 7 days in laboratory condition followed by immersion in water for 7 days.	
Compatibility with Approved Panel Wall Partition System	>= 0.168 N/mm².	Refer sub-clause (j) for method.
Pull-Off Strength	>= 0.8 N/mm².	Refer sub-clause (k) for method.
Elongation Property	>= 250% for ultimate elastic elongation.	Refer sub-clause (l) for method.

h. Waterproofing quality test:

i. Fabricate a carton box of size approximately 300mm x 300mm x 250mm high without a top. Use a piece of 400mm long x 72mm wide adhesive tape at the bottom to seal the box. The carton box should be strong enough to stand in its own weight;

ii. Apply the number of coats of waterproofing material, with a minimum of two coats, and in thickness(es) (record in the test report), both in accordance with the manufacturer's recommendation, to the inside surface of the carton box;

iii. Allow to cure under conditions at 23 ± 2ºC with 50 ± 5% relative humidity for 7 days or at such a period recommended by the waterproofing membrane manufacturer (record in the test report);

iv. Upon expiration of the curing period, pour approximately 150mm depth of 3% sodium chloride solution into the carton box and maintain for 60 minutes;

v. Examine the bottom and sides of the carton box for any sign of leakage and other anomalies.

i. Compatibility test with Approved tile adhesive:

To BS5980:1980 Appendix D with the following modifications:

i. Level a jig as stated in BS5980:1980, Appendix D.2.1 on a firm surface by the levelling screws in the base and spirit level;

ii. Place a 101mm x 101mm x 9mm standard test piece tile, biscuit face uppermost, into the jig located against the outer L-shaped stop;

iii. Bond it to one side of a 75mm x 75mm x 8mm test piece tile in the jig with epoxy, use a spirit level and apply light pressure to level the top face, and ensure that the smaller tile is located against its inner L-shaped stop;

iv. Remove the jig and allow the epoxy to cure;

v. Apply the number of coats of waterproofing material, with a minimum of two coats, and in thickness(es), both in accordance with the manufacturer's recommendation, on the standard test piece tiles;

vi. Allow the waterproofing membrane to cure at 23 ± 2ºC with 50 ± 5% relative humidity for 7 days or at such a period recommended by the waterproofing membrane manufacturer;

vii. A layer of Approved tile adhesive in thickness as recommended by the tile adhesive manufacturer shall be applied over the cured waterproofing membrane which have been embedded in standard test piece tiles. The final bed thickness of tile adhesive and waterproofing membrane (record in the test report) shall be the aggregate total of the required thicknesses of the both materials;

viii. Prepare 10 of such assembled samples and cure them for 14 days under laboratory condition i.e. 23 ± 2ºC with 45% to 70% relative humidity. Prepare 10 more samples and cure them for 7 days under laboratory condition followed by immersing the samples in water for 7 days;

ix. Upon expiration of the curing (and immersion) period, insert the sample in the test unit holder mounted in the tensile testing machine, and subject the unit to a tensile stress at a crosshead speed of 5mm to 6mm/minute until failure occurs.

j. Compatibility test with Approved panel wall partition system:

i. Apply the moisture sealer to four pieces of 390 mm x 390 mm Approved panel wall partitions as recommended by the manufacturer of the panel wall partitions;

ii. Apply the number of coats of waterproofing material, with a minimum of two coats, and in thickness(es), both in accordance with the manufacturer's recommendation, on the surface of each panel wall partition with moisture sealer;

iii. Allow the waterproofing membrane to cure at 23 ± 2ºC with a relative humidity of 50 ± 5% for 14 days or at such period recommended by the manufacturer;

iv. Attach a 200mm x 200mm pull head onto the surface of the waterproofing membrane by a suitable adhesive resin;

v. Connect the pull head to a pull-off testing equipment. The pull-off equipment shall be capable of increasing the load steadily without jerking at a rate of 5 to 6mm/minute, and must be provided with a measurement device which shall retain the maximum load to the nearest 10N. The measurement inaccuracy of the equipment must be less than 2%, in accordance with the accuracy Grade 2 of BS 1610:Part 1:1985;

vi. Apply a tensile force gradually by the pull-off equipment;

vii. Repeat the steps iv to vi until the pull-off test to all four tiles are completed.

k. Pull-off strength test:

To BS 8204:Part 3:1993 Annex B.3 with modifications to determine the bonding strength of the waterproofing material by means of pull-off test:

i. Test apparatus:

- Metal disc of steel or aluminium alloy measured 50 ± 0.5 mm in diameter and not less than 15 mm thick, and with a means of connecting its center to the loading device as stated in sub-clause below;
- Loading device which is capable of applying a gradually increasing load at a rate of 1.5 kN to 2.5 kN per minute up to 10 kN;
- Measuring instrument which is readable to the nearest 25N and capable of measuring the magnitude of the applied load to an accuracy of ± 3%;
- Ring mould measured 52 mm to 57 mm in outside diameter, 15 ± 5 mm high and 1 mm to 3 mm in wall thickness;
- Conditioning room at 20 ± 3ºC and 55 ± 5% relative humidity;
- Coring machine with 50 mm diameter core bit;
- Equipment for mixing and casting of a concrete panel;
- Plywood mould of 700 mm x 300 mm x 200 mm for casting the concrete panel;
- Epoxy resin for fixing the disc to the surface of flooring mix;
- Mould oil.

ii. Preparation of concrete panel:

- Paint the mould oil properly on all internal surfaces of the plywood mould by means of paintbrush;
- Mix a batch of about 0.05m³ concrete using a pan mixer;

- Use the scoop to place the concrete in the mould in four approximately equal layers and compact each layer by means of compacting bar. The direction of casting is perpendicular to the length of the mould;
- After completion of compaction, the excessive concrete shall be removed and the top surface shall be trowelled using a scraper;
- The trowelled surface of the panel shall be wrapped completely with polythene;
- Demould the concrete panel after 24 hours;
- By means of coring machine, drill a 50mm diameter core hole into a mould face of panel to the depth of 15mm;
- Remove any loose material and dry the concrete surface using a hair dryer;
- Use epoxy resin to glue the 50 mm diameter disc to the cored surface;
- Connect the loading device perpendicular to the disc and carry out the test by applying a steadily increasing load at the rate of 1.5kN to 2.5kN per minute until failure occurs. If the tensile strength is greater than 2N/mm², the panel would be applicable for the subsequent testing mentioned in sub-clause (2)(j)(iii) below.

iii. Determination of bonding strength:

- Brush the concrete test surface vigorously with a wire brush under a stream of water and leave to dry for 24 hours;
- Apply the number of coats of waterproofing material, with a minimum of two coats, and in thickness(es) (record in the test report), both in accordance to manufacturer's recommendation, onto the concrete surface and leave to cure;
- During the procedure of making and testing of test samples, the environmental condition should be controlled at 20 ± 3ºC and 55 ± 5% relative humidity;
- Use epoxy resin to glue the 50mm diameter disc to the waterproofing membrane;
- Test 6 samples after the waterproofing membrane has been laid for at least 14 days;
- Connect the loading device perpendicular to the disc and apply a steadily increasing load at the rate of 1.5kN to 2.5kN per minute until failure occurs.

iv. Results:

- Divide the maximum load by the test area, i.e. the area of the waterproofing membrane in contact with the flooring mix and concrete surface, and express the results to the nearest 0.1N/mm²;
- Calculate the mean values for the six samples tested.

l. Elongation property test:

To BS 903:Part A2:1995;

m. In compliance with the prescribed limit of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

3. On Site Delivery Verification:
   a. At delivery stage, submit the following documents:
      i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all material delivered to Site.
   b. Carry out and submit report on the following verifications for waterproofing material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:
      i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Batch / Lot No.	Document Check and on packaging	Same as the delivery note
Expiry Date	Check information printed on the packaging	Minimum 6 months from the date of delivery

      ii. Frequency:

      Carry out verification for one sample per every delivery of cold liquid applied flexible waterproofing material delivered to Site under each delivery note submitted in sub-clause (3)(a).
   c. Where any of the verifications fail to meet the Acceptance Standards, either:
      i. Remove the representative batch off Site; or
      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.
4. Delivery Verification at the manufacturer's factory of precast concrete components for volumetric precast kitchens and bathrooms:
   a. At delivery stage, submit the following documents to the CM or his representatives resident at the manufacturer's factory:
      i. Written confirmation that the material delivered to the manufacturer's factory conforms with the Approved sample submitted under sub-clause (1)(a);
      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;
      iii. Delivery notes for all materials delivered to the manufacturer's factory.

b. Carry out and submit report on the following verifications for waterproofing materials upon delivery to the manufacturer's factory and in the presence of the CM or his representatives resident at the factory.

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Batch / Lot No.	Document Check and on packaging	Same as the delivery note
Expiry Date	Check information printed on the packaging	Minimum 6 months from the date of delivery

ii. Frequency:

Carry out verification for one sample per every delivery of cold liquid applied flexible waterproofing material delivered to the manufacturer's factory under each delivery note submitted in sub-clause (4)(a).

c. Where any of the verifications fail to meet the Acceptance Standards, either:

i. Remove the representative batch off the manufacturer's factory; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off the manufacturer's factory, bear all associated costs, and no extension of time will be allowed.

CEMENTITIOUS WATERPROOFING SYSTEM

WAT6.M110.9 CEMENTITIOUS WATERPROOFING SYSTEM FOR HARDENED CONCRETE

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed material for the CM's approval together with all the following substantiation for the CM's information:

i. Catalogue, brand name / model name, job reference and original manufacturer's technical data of materials and system;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agents / distributors in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. Detailed method statement and the project specific shop drawings for the application of the waterproofing system.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(f) for the CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material to Site;

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Proprietary hydrophobic waterproofing system for application to hardened concrete;

b. Capable of waterproofing static cracks and capillaries;

c. Compatible with host concrete and all surfaces and materials, including ancillary materials, in contact with the waterproofing system as WAT6.M240;

d. Non-toxic;

e. Suit the situation on which it is to be used;

f. The materials used in the proprietary tanking system shall withstand the project specific sub-surface water conditions.

WAT6.M150.N CEMENTITIOUS ELASTOMERIC WATERPROOFING SYSTEM FOR BATHROOM AND KITCHEN

1. Submission Requirements:

a. At sample submission and approval stages, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. Detailed Method Statement for the installation of the cementitious elastomeric waterproofing system, showing all work procedures from the preparation of background through to the completion of the overlaid finishes;

vi. Data sheet for minimum coverage rate of the waterproofing system and product identification number;

vii. When the cementitious elastomeric waterproofing systems are supplied for domestic blocks, except for the ancillary facilities at lower floors, also include the following in the submission:

- Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(g) for the CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iii. In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and any extra time required.

c. Before commencing application of cementitious waterproofing on the Site, submit a confirmation letter to confirm compatibility of the cementitious waterproofing with the liquid applied waterproofing for the flooring and the tile adhesive for the wall tiling works.

2. Quality Requirements:

a. Proprietary cementitious elastomeric waterproofing system applied in two coats, minimum 1mm thick overall, or to minimum thickness and number of coats as recommended by the manufacturer;

b. For application to wall surface and is suitable for use in the intended areas of application;

c. Compatible with all surfaces and materials, including ancillary materials, in contact with the waterproofing system as WAT6.M240;

d. All components of the waterproofing system are non-toxic and do not cause any hazard or injury to operatives and occupants or others in the vicinity of the Site;

e. In compliance with the prescribed limit of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation, with VOC data submission as FIN7.M010;

f. Bonding is to achieve minimum 0.5 N/mm^2 tensile pull off strength when tested to FIN5.T150 at the interphase between –

i) cementitious waterproofing and cement sand render, with or without the bond coat recommended by the cement sand render supplier, and

ii) cementitious waterproofing and the cold applied waterproofing at WAT6.M010;

g. Performance requirements are as follows:

Properties	Acceptance Standards	Testing Method

Hydrostatic Pressure test	No penetration at 5 bar pressure for 72 hours	DIN 1048 Part 5:1991 or CS1:2010-13 Section 18
Pull-Off Strength on concrete substrate with or without bond coat	>= 0.5 N/mm² Apply waterproofing to concrete substrate in method and thickness according to manufacturer's recommendations	BS EN ISO 4624:2016 (8.4.2 Method B)
Elongation at break	>= 250%	ASTM D412-16
Tensile strength	>= 1.0 N/mm²	ASTM D412-16
Crack bridging (2mm width)	No cracking, splitting, pinholes or any other condition within the area of the joint in the test specimens	ASTM C836-18
Compatibility with Approved Tile Adhesive	>= 0.5 N/mm² at 7 days	Refer sub-clause (h) for method.
Compatibility with Approved Panel Wall Partition System	>= 0.168 N/mm² at 14 days	Refer sub-clause (i) for method.

h. Compatibility test with Approved tile adhesive:

To BS EN 12004-2:2017 with the following modifications:

i. Apply the number of coats of waterproofing material, with a minimum of two coats, and in thickness(es), both in accordance with the manufacturer's recommendation, on the standard test piece tiles;

ii. Allow the waterproofing membrane to cure at 23 ± 2ºC with 50 ± 5% relative humidity for 7 days or at such a period recommended by the waterproofing material manufacturer;

iii. A layer of Approved tile adhesive in thickness as recommended by the tile adhesive manufacturer shall be applied over the cured waterproofing material which have been embedded in standard test piece tiles. The final bed thickness of tile adhesive and waterproofing material (record in the test report) shall be the aggregate total of the required thicknesses of the both materials;

i. Compatibility test with Approved panel wall partition system:

i. Apply the moisture sealer to four pieces of 390 mm x 390 mm Approved panel wall partitions as recommended by the manufacturer of the panel wall partitions;

ii. Apply the number of coats of waterproofing material, with a minimum of two coats, and in thickness(es), both in accordance with the manufacturer's recommendation, on the surface of each panel wall partition with moisture sealer;

iii. Allow the waterproofing membrane to cure at 23 ± 2ºC with a relative humidity of 50 ± 5% for 14 days or at such period recommended by the manufacturer;

iv. Attach a 200 mm x 200 mm pull head onto the surface of the waterproofing material by a suitable adhesive resin;

v. Connect the pull head to a pull-off testing equipment. The pull-off equipment shall be capable of increasing the load steadily without jerking at a rate of 5 to 6mm/minute, and must be provided with a measurement device which shall retain the maximum load to the nearest 10N. The measurement inaccuracy of the equipment must be less than 2%;

vi. Apply a tensile force gradually by the pull-off equipment;

vii. Repeat the steps iv to vi until the pull-off test to all four tiles are completed.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for waterproofing material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Batch / Lot No.	Document Check and on packaging	Same as the delivery note
Expiry Date	Check information printed on the packaging	Minimum 6 months from the date of delivery

ii. Frequency:

Carry out verification for one sample per every delivery of cementitious elastomeric waterproofing material delivered to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the Acceptance Standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs and any extra time required.

4. Delivery Verification at the manufacturer's factory of precast concrete components for volumetric precast bathrooms or kitchens:

   a. At delivery stage, submit the following documents to the CM or his representatives resident at the manufacturer's factory:

      i. Written confirmation that the material delivered to the manufacturer's factory conforms with the Approved sample submitted under sub-clause (1)(a);

      ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

      iii. Delivery notes for all materials delivered to the manufacturer's factory.

   b. Carry out and submit report on the following verifications for waterproofing materials upon delivery to the manufacturer's factory and in the presence of the CM or his representatives resident at the factory.

      i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Batch / Lot No.	Document Check and on packaging	Same as the delivery note
Expiry Date	Check information printed on the packaging	Minimum 6 months from the date of delivery

      ii. Frequency:

      Carry out verification for one sample per every delivery of cementitious elastomeric waterproofing material delivered to the manufacturer's factory under each delivery note submitted in sub-clause (4)(a).

   c. Where any of the verifications fail to meet the Acceptance Standards, either:

      i. Remove the representative batch off the manufacturer's factory; or

      ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off the manufacturer's factory, bear all associated costs and any extra time required.

SHEET OR LIQUID MEMBRANE WATERPROOFING SYSTEMS

WAT6.M220.9 SHEET OR LIQUID MEMBRANE WATERPROOFING SYSTEMS FOR ROOFING, LIFT PIT AND EXTERNAL TANKING

1. This clause is applicable to waterproofing systems for roofing, lift pit and external tanking in general. The specification for sheet membrane waterproofing system for use in basement and semi-basement external tanking is covered under WAT6.M230;
2. Submission Requirements:
    a. At sample submission and approval stage, submit a sample of the proposed material for CM's approval together with all the following substantiation for CM's information:
        i. Catalogue, brand name / model name, job reference and original manufacturer's technical data of materials and system;
        ii. Name, address and contact person of the local supplier;
        iii. Name, address and contact person of the manufacturer;
        iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agents / distributors in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
        v. Detailed method statement and the project specific shop drawings for the installation of proprietary waterproofing system for roofing and external tanking, showing all work procedures of the proposed system;
        vi. When the systems are supplied for domestic blocks also include the following in the submission:
            - Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.
    b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (3)(b) for CM's information:
        i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;
        ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (2)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (4)(a);
        iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.
3. Quality Requirements:

a. Proprietary sheet membrane waterproofing systems for use in roofing, lift pit external tanking and other external tanking (excluding basement and semi-basement) as well as proprietary liquid membrane waterproofing systems for use in lift pit external tanking and other external tanking (excluding basement and semi-basement) shall:

i. Remain intact and waterproof throughout the warranty period;

ii. Provide with adequate means of dealing with condensation and thermal movement;

iii. Suit the types of roof access without impairment of performance; and

iv. Include the proprietary sheet or liquid membrane waterproofing materials and all ancillary materials, insulation materials, screeding, roofing tiles and other protective treatments necessary to satisfactorily complete the roofing and external tanking systems. All materials to be in accordance with manufacturer's specification unless otherwise specified.

b. The materials used in the proprietary tanking system shall withstand the project specific sub-surface water conditions as follows:

Performance		Standards	Minimum requirements when the Ground Water Level is permanently above or fluctuates at ground	Minimum requirements when the Ground Water Level is permanently below ground
i	Hydrostatic Pressure Resistance	ASTM D5385	65m	45m
ii	Puncture Resistance	ASTM E154	400N	200N
iii	Permeance	ASTM E96	1.0 ng/Pa.m2.s (max.)	3.0 ng/Pa.m2.s (max.)
iv	Lap Adhesion	ASTM D1876	1.0kN/m	nil

c. Compatible with all surfaces and materials, including ancillary materials in contact with the waterproofing system as WAT6.M240;

d. In compliance with the prescribed limit of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

4. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verification for proprietary waterproofing systems upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Batch / Lot No.	Document Check and on packaging	Same as the delivery note
Expiry Date	Check information printed on the packing	Minimum 6 months from the date of delivery

ii. Frequency:

One set of verification should be carried out for every delivery of proprietary waterproofing systems for roofing and external tanking material delivered to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the Acceptance Standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

WAT6.M230.9 SHEET MEMBRANE WATERPROOFING SYSTEM FOR BASEMENT AND SEMI-BASEMENT EXTERNAL TANKING

1. Submission Requirements:

a. At sample submission and approval stage, submit material samples of the proposed waterproofing system for CM's approval. Submission should include the following substantiations:

i. Catalogue, brand name / model name, local job reference and original manufacturer's technical data of the proposed materials and system;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agents / distributors in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. Detailed method statement and project specific shop drawings for the application of the waterproofing system;

vi. Proposed testing method(s), major equipment list and programme for testing; and programme for allowing the Direct Testing Contractor (DTC) to carry out the on site verification tests or infra-red scanning, both at WAT6.T130 (3);

vii. Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS.

b. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(e) for CM's information:

i. The date of the test shall be generally within three years prior to the notified date for commencement of the Works;

ii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material to Site;

iii. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, commencement of waterproofing installation is not allowed until the relevant reports are submitted;

iv. Bear all additional time and costs arising from or in connection with non-compliance with the requirements on test report submission, including but not limited to those incurred in sub-clause (iii) above.

Option 1

2. Quality Requirements:

System -

a. The system to remain intact and waterproof throughout the warranty period. To be suitable for the situation where it is used, and include all ancillary materials complete with composite drainage layer at vertical surface.

Material -

b. Proprietary sheet membrane waterproofing material to be -

i. Modified bitumen / asphalt based; or

ii. Polymer modified bitumen / asphalt, polymer or sodium bentonite carried on a high density polyethylene (HDPE) sheet with the polymer or sodium bentonite material to be in contact with the structural concrete wall or floor (or otherwise as recommended by the Contractor).

c. Elongation by minimum 100% and has the ability to bridge a crack in the substrate;

d. Non-toxic and compatible with the host concrete, all surfaces and materials, including ancillary materials, in contact with the waterproofing system as WAT6.M240;

e. Satisfy the following performance requirements:

Performance		Standards	Minimum Requirements
i	Hydrostatic Pressure Resistance	ASTM D5385	45m
ii	Puncture Resistance	ASTM E154	200N
iii	Permeance	ASTM E96	3.0 ng/Pa.m2.s

			(max.)

f. In compliance with the prescribed limit of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for waterproofing material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may be present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Batch / Lot No.	Document Check and on packaging	Same as the delivery note
Expiry Date	Check information printed on the packaging	Minimum 6 months from the date of delivery

ii. Frequency:

One set of verification should be carried out for every delivery of the waterproofing material delivered to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the Acceptance Standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site;

iii. Bear all additional time and costs arising from or in connection with failure to meet the Acceptance Standards, including but not limited to those incurred in sub-clause (i) and (ii) above.

Option 2

2. Quality Requirements:

System -

a. The system to remain intact and waterproof throughout the warranty period. To be suitable for the situation where it is used, and include all ancillary materials complete with composite drainage layer at vertical and horizontal surfaces.

Material -

b. Proprietary sheet membrane waterproofing material to be -

i. Modified bitumen / asphalt based; or

ii. Polymer modified bitumen / asphalt, polymer or sodium bentonite carried on a high density polyethylene (HDPE) sheet with the polymer or sodium bentonite material to be in contact with the structural concrete wall or floor (or otherwise as recommended by the Contractor).

c. Elongation by minimum 100% and has the ability to bridge a crack in the substrate;

d. Non-toxic and compatible with the host concrete, all surfaces and materials, including ancillary materials, in contact with the waterproofing system as WAT6.M240;

e. Satisfy the following performance requirements:

Performance		Standards	Minimum Requirements
i	Hydrostatic Pressure Resistance	ASTM D5385	65m
ii	Puncture Resistance	ASTM E154	400N
iii	Permeance	ASTM E96	1.0 ng/Pa.m2.s (max.)
iv	Lap Adhesion	ASTM D1876	1.0kN/m

f. In compliance with the prescribed limit of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each delivery note;

iii. Delivery notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for waterproofing material upon delivery on Site. Prior to carrying out the verifications, inform the CM who may be present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Manufacturer's Certificate of Origin & delivery note	Document Check	From an Approved origin
Batch / Lot No.	Document Check and on packaging	Same as the delivery note
Expiry Date	Check information printed on the packaging	Minimum 6 months from the date of delivery

ii. Frequency:

One set of verification should be carried out for every delivery of the waterproofing material delivered to Site under each delivery note submitted in sub-clause (3)(a).

c. Where any of the verifications fail to meet the Acceptance Standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site;

iii. Bear all additional time and costs arising from or in connection with failure to meet the Acceptance Standards, including but not limited to those incurred in sub-clause (i) and (ii) above.

WAT6.M240.A ANCILLARY MATERIALS

1. Ensure ancillary materials including plastic water bars, hydrophilic water stops, adhesives, sealants, solvents, preformed corners, flashing materials, pipe sleeves and collars, ballast, gravels, isolation quilt, protective coatings etc., must be either a part of the waterproofing membrane system or fully compatible with it and recommended for their intended use by the membrane manufacturer;
2. Adhesives, adhesive primer, sealant, and sealant primer shall be in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compound) Regulation.
   a. VOC data submission of adhesives in compliance with TIM1.M090;
   b. VOC data submission of sealants in compliance with WAT5.M110.
3. Submit written confirmation from the supplier or authorised agent or authorised applicator that the waterproofing system is compatible with all materials in contact with the waterproofing system.

WAT6.M250.A INSULATION MATERIALS

1. Submit manufacturer's written confirmation to declare the following:
   a. Emission rate: Discharge of VOCs shall not exceed 500 $\mu m/m^2/hr$;
   b. The levels of the following hazardous substances as impurities shall not exceed the following:
      i. Arsenic: 50 ppm;
      ii. Cadmium: 10 ppm;
      iii. Hexavalent chromium: 10 ppm;
      iv. Lead: 300 ppm;
      v. Mercury: 10 ppm;
      vi. Selenium: 20 ppm;
      vii. PBDEs (polybrominated diphenyl ether): 100 ppm;
      viii. PBBs (polybrominated byphenyls): 100 ppm.
2. Obtain extruded polystyrene board with rebate edges, CFC and HCFC free zero Ozone Depletion Factor type to BS EN 13164:2012+A1:2015;

3. Ensure insulation materials to be extra high duty grade with minimum compressive strength at 300kPa, thermal conductivity (k) within the range 0.025 to 0.034 W/mK and in thickness to the requirement as indicated in the Drawings to complete system installation and to meet minimum insulation value for the roof as required;
4. Notwithstanding WAT6.M220 (2)(a), insulation materials can be obtained from other suppliers but must be certified as fully compatible to the system by the membrane manufacturer.

WAT6.M260.9 ROOFING TILES AND OTHER FINISHING MATERIALS

1. For accessible roof of public emergency and maintenance and where specified in drawings, use concrete roofing tiles and fittings to BS 473,550:1990. Size and thickness to finishing schedule of drawings;
2. For accessible roof as podium / garden and general public access and where specified in drawings, use tiles or other finishing materials as stated in finishing schedule of drawings;
3. For non-accessible roof: as WAT6.W290;
4. Notwithstanding WAT6.M220 (2)(a), insulation materials, roofing tiles and other finishing materials for accessible roof can be obtained from other suppliers but must be certified as fully compatible to the system by the membrane manufacturer.

WAT6.M270.9 MAINTENANCE MANUAL

Upon completion of the work, submit 2 copies (1 hard copy and 1 soft copy at PDF format in CD) of maintenance manual identified with project name, location and date and containing the following:

1. Type of system applied;
2. Surface to which the system was applied;
3. Shop drawings of the waterproofing works for the particular project;
4. Recommendations for periodic inspections, care and maintenance;
5. Identification of common cause of damage with instructions for temporary patching until permanent repair can be made.

WAT6.M280.9 COMPOSITE DRAINAGE LAYER

1. A 3-dimensional high compressive strength polymeric drainage core layer pre-bonded with a geotextile resistant to common ground water contaminants;
2. Materials of the composite drainage layer shall meet the following requirements:

Performance		Standards	Minimum Requirements
i	Thickness	-	9.5mm
ii	Core compressive Strength	ASTM D1621	550kPa (vertical) 700kPa (horizontal)
iii	Core Flow Rate	ASTM D4716	150L/min/m
iv	Fabric Flow Rate	ASTM D4491	5000L/min/m^2

WORKMANSHIP

APPLYING COLD LIQUID APPLIED FLEXIBLE WATERPROOFING SYSTEM

WAT6.W010.9 GENERAL

Prepare and apply the Approved cold liquid applied flexible waterproofing system strictly in accordance with the manufacturer's recommendations.

WAT6.W012.9 CONSTRUCTION MOCK-UP

1. Prior to commencing installation of the cold liquid applied flexible waterproofing system to typical domestic floors, construct a full size construction mock-up on actual working surface of a bathroom and kitchen in accordance with PRE.B9.440 showing:
    a. Background preparation strictly in accordance with the manufacturer's recommendation on all types of substrates;
    b. All layers of the waterproofing system up to and including the finishes;
    c. Junction details with adjacent construction complete with sealant works etc.
2. Obtain Approval before commencement of installation;
3. Maintain the Approved construction mock-up as a workmanship benchmark. Obtain CM's agreement before dismantling the construction mock-up.

WAT6.W015.9 STORAGE

Store the Approved waterproofing material on Site or in the Contractor's workshops etc in a cool, well ventilated, and covered storage accommodation, or in a manner in accordance with the manufacturer's recommendations.

WAT6.W020.9 PREPARATION

Ensure surfaces to receive the Approved waterproofing system are:

1. Finished with a power-floated or steel-trowelled finish for concrete floor, or an equivalent acceptable to the waterproofing manufacturer;
2. Free of dirt, dust, oil, excessive moisture and other contaminants prior to application;
3. Free of holes, gaps or cracks;
4. Formed with non-shrink cement-sand angle fillet at junctions of walls and floors before application of waterproofing materials.

WAT6.W025.9 COATS OF APPLICATION

Apply a minimum of two coats, or more in accordance with the manufacturer's recommendations, with the thickness of each coat strictly in accordance with the manufacturer's recommendations.

WAT6.W030.9 OVERCOAT

Allow a minimum of 24 hours, or longer period in accordance with the manufacturer's recommendations from the completion of the first coat for drying. Ensure the first film shows no crissing, crawling, sinking, lifting or wrinkling before second coat application.

WAT6.W040.9 LAYING FINISHES

Inspect the cured waterproofing layers prior to laying finishes. Lay finishes or protective layer without delay after the inspection to prevent damage to the cured waterproofing system.

WAT6.W050.9 HEALTH AND SAFETY

Do not use materials or working practices which would result in any hazard or injury to operatives or to others in the vicinity of the Site.

WAT6.W060.9 COLOUR

Apply each coat of the waterproofing material in a different colour as directed by the CM where a range of colours is available from the waterproofing system.

MIXING AND APPLYING CEMENTITIOUS WATERPROOFING SYSTEM

WAT6.W110.9 GENERAL

Engage Applicator, corresponding to the proposed proprietary cementitious waterproofing system to prepare, mix and apply the system in accordance with the manufacturer's specifications and recommendations.

WAT6.W120.9 CURING AND PROTECTION

In accordance with manufacturer's instructions.

APPLYING SHEET OR LIQUID MEMBRANE WATERPROOFING SYSTEMS

WAT6.W210.9 GENERAL

1. Engage Applicator, corresponding to the proposed proprietary waterproofing systems, to install the proprietary waterproofing systems for roofing and external tanking comprising of the proprietary waterproofing materials, insulation and roofing finishes including priming, sealing, crack filling and other necessary materials, flashings etc, with details all in accordance with manufacturer's specifications and recommendations;
2. Obtain CM's consent prior to application;
3. Obtain CM's consent prior to laying finishes on waterproofing materials;
4. Take particular care to ensure that all junctions, expansion joints, penetration around pipes, rainwater outlets, gutters and the like are properly executed;
5. Comply with the proprietary roofing and external tanking systems' requirements according to the manufacturer's instruction.

WAT6.W215.9 CONSTRUCTION MOCK-UP

1. Prior to commencing installation of the sheet membrane waterproofing system to the basement or semi-basement, construct a Construction Mock-up in accordance with PRE.B9.440 showing:
    a. Background preparation strictly in accordance with the manufacturer's recommendations on all types of substrates;

b. All layers of the waterproofing system including the composite drainage layer and/or protection board;

c. Typical junction details such as internal and external corners, lappings, edge terminations, patch ups to utilities and ELSW penetrations, composite drainage layer at corners, etc..

2. Maintain the Construction Mock-up as a workmanship benchmark. Obtain CM's agreement before dismantling the Construction Mock-up.

WAT6.W220.9 SURFACES PREPARATION

1. Prior to laying of the roofing and external tanking system, inspect, repair and prime as required to provide proper substrate surfaces to receive waterproofing materials in accordance with the waterproofing manufacturer's recommendations;
2. Remove protrusions and contaminants such as grease, oil, etc. from the surfaces;
3. For roofing, ensure the base is to even falls to the rainwater outlets with no area which will pond;
4. Complete all cuts and preformed chases, external angles chamfered and internal angles fillet including all fixings that will penetrate the roofing or external tanking membrane are in place unless otherwise specified in details of shop drawings.

WAT6.W230.9 FREE OF MOISTURE

For roofing and external tanking systems:

1. Do not carry out any work when there is surface moisture;
2. Take all necessary precautions to ensure the integrity of the proposed system is maintained;
3. Comply with the proprietary roofing and external tanking systems' requirements as stated in the manufacturer's instruction.

WAT6.W240.9 COMPATIBILITY

Before commencing work, demonstrate on Site that all adhesives and materials, including sealants, insulation and subsequent laid on materials, are fully compatible and certified by the Agent / Applicator in writing to CM.

WAT6.W250.9 PROTECTION OF EXISTING ROOF

1. Protect all roofing outlets to prevent debris falling into rainwater pipes;
2. Open and clear the outlets at the end of the working day and sweep the roof clean to ensure effective drainage;
3. Protect all pipeworks, ducting and other services running on top of existing roof including pipe supports.

WAT6.W255.9 APPLYING PROPRIETARY WATERPROOFING SYSTEMS

Ensure the spreading rate of the proprietary materials is in accordance with the manufacturer's instruction.

WAT6.W260.9 ADHESIVE

1. Where required, apply adhesive strictly in accordance with the waterproofing manufacturer's recommendations. All manufacturer's data about the shelf-life of adhesives must be noted, and no attempt should be made to use materials which are no longer fit for use;

2. Prohibit the spreading of adhesive over excessive large areas and / or subsequent over setting before placing of sheets.

WAT6.W270.9 BUBBLES

If bubbles formed in the membrane, submit the proprietary manufacturer's repair method for Approval before repairing. Otherwise, strip and clear the whole area and prepare the surface again and re-execute the work.

WAT6.W280.9 FINISHES TO ACCESSIBLE ROOFS (MAINTENANCE & PUBLIC TRAFFIC)

When indicated as accessible roof on Drawings, design the roofing system to allow for increased wear due to frequent foot traffic and protect the roofing system by finishing materials as specified.

WAT6.W290.9 FINISHES TO NON-ACCESSIBLE ROOFS (MAINTENANCE TRAFFIC)

When indicated as non-accessible roof on Drawings and as exposed system, protect roofing with a solar protection "light-reflective" paint or other protective finishes applicable to the particular proprietary roofing system except where it is a self-finished material or otherwise specified.

WAT6.W300.9 PROTECTION OF ROOFING AND EXTERNAL TANKING SYSTEM

1. Do not allow traffic on roof until 4 days after completion of tiling and permit only light traffic for a further 10 days;
2. Protect all completed tanking system during backfilling operation.

WAT6.W305.9 PROTECTION OF BENTONITE FROM PREMATURE HYDRATION

For waterproofing system using sodium bentonite carried on high density polyethylene sheet laid at horizontal position, immediately after testing, protect the bentonite granules from premature hydration due to weather conditions.

WAT6.W310.9 ROOF VENT

When specified, install approved proprietary roof vents in accordance with the manufacturer's recommendations and make good the roof covering up to and around the vents.

WAT6.W320.9 INSULATION

Ensure insulation board shall either have integrally bonded hard surfaces on both sides or be protected by inert hard sheeting or screed in accordance with the proprietary waterproofing system.

WAT6.W330.9 INSPECTION OF ROOFING

Inform the CM or his representatives for inspection upon the completion of each layer of the roofing system and prior to commencing installation of the next layer of construction including screed, insulation and finishes etc..

WAT6.W340.9 INSPECTION OF BASEMENT / SEMI-BASEMENT TANKING

Inform the CM or his representatives for inspection when details demonstrated at the Construction Mock Up at WAT6.W215 are completed on site for the first time.

WAT6.W350.9 LAPPING

Width of lapping to be strictly in accordance with the waterproofing manufacturer's recommendations, or minimum 75mm if there is no recommendation.

WAT6.W360.9 OPEN BURNING

Open burning of asphalt is prohibited except where approval has already obtained from Environmental Protection Department.

TESTING

ON-SITE VERIFICATION TESTS

WAT6.T010.A WATER SPRAY TEST TO INTERNAL INSTALLATIONS

1. Testing Arrangements
   a. Carry out water spray test to all completed internal waterproofed areas after application of finishes. Tests to be witnessed and endorsed by the Contractor's representative and the CM or his representatives;
   b. Carry out joint inspection at the location being tested and at the floor below to check there is no seepage on the soffit within half an hour to two hours after the test;
   c. Submit three copies of the test reports, or other number of copies as required by the CM for the water spray tests for record.
2. Testing Locations:
   a. Test to the following percentages:
      i. 100% to all areas or rooms installed with waterproofing such as bathrooms, changing rooms, balconies etc.;
      ii. 100% or other percentage as approved by the CM for other areas or rooms such as kitchens, refuse rooms etc..
3. Testing Methods:
   a. Use a common domestic telephone type shower head fitted to a 13 mm diameter supply pipe delivering a water pressure of 210 to 240 kPa (30 to 35 psi). Locate the pressure gauge at a distance not exceeding 1500 mm from the shower head;
   b. Apply water by moving shower head to and fro along test surface at a perpendicular distance of between 300 mm and 600 mm;
   c. Carry out the following water spray test to walls and floors at the shower area after application of finishes:

Location	Area to be Tested	Test Method	Acceptance Criteria
Bathroom shower area	Walls and floor at shower area.	Spray water evenly for 5 minutes to the walls surrounding the shower area up to the second last roll of wall tiles from the top.	- no ponding; - Water falls towards the floor drain; - no seepage through wall or floor; - no seepage at pipe sleeves; - no seepage at traps, connectors and outlets.

   d. Carry out the following water spray test which applies to all waterproofed walls and floors after application of finishes. Include those in the bathrooms, toilets, kitchens, balconies, refuse rooms etc, but exclude those at shower areas in sub-clause (3)(c), roofs and lift pits (refer to other relevant clauses in WAT6).

Location	Area to be Tested	Testing Method	Acceptance Criteria
Bathroom, Kitchen, Refuse room etc	Walls, floors, floor drains and pipe sleeves.	Spray water evenly for 2 minutes to the walls up to the top of the waterproofing membrane and to any pipe sleeves that are installed at a higher level. Spray water for a further 1 minute directly onto the non cast-in floor drain (if provided).	- no ponding. - falls towards the floor drain. - no seepage through the wall or floor; - no seepage at pipe sleeves; - no seepage at trap, connectors and outlets.

4. Non-compliance:
   a. In the event that any test fails to meet the requirements:
      i. Carry out remedial works subject to Approval and re-test until all the criteria specified has been satisfied;
      ii. Bear all costs and any extra time required of remedial works and the re-test.

WAT6.T020.N WATERTIGHTNESS TEST TO PIPE SLEEVES AT EXTERNAL WALLS

1. Testing Arrangements
   a. Carry out watertightness test to properly filled and caulked pipe sleeves at external walls of domestic flats;
   b. Carry out joint inspection to check there is no seepage to indoor within half an hour after the test;
   c. Submit three copies of the test reports, or other number of copies as required by the CM for the watertightness tests for record.
2. Testing Locations:
   a. 100% of properly filled and caulked pipes sleeves at external walls in accordance with the procedures as specified in sub-clauses (3)(a) to (3)(e).
3. Testing Methods:
   a. Use brass nozzle comprising:
      i. 13 mm diameter outlet fitted with diffuser connected to a 20 mm garden hose; and
      ii. A control valve and a pressure gauge as illustrated at Appendix COM2/I to Worksection COM2.
   b. Carry out the test with the water jet from the outside;
   c. Spray a continuous jet of water, at a nozzle pressure of between 210 kPa and 240 kPa, at approximately 300 mm from the pipe sleeves of bathroom and kitchen of a domestic flat for a period of 5 minutes;
   d. Observe any sign of seepage to indoor within half an hour after the test;

e. All watertightness tests must be witnessed by the Contractor or his representative and the CM or his representatives;

4. Non-compliance:

a. The pipe sleeves will be deemed to have failed where there are signs of water seeping to indoor;

b. In the event that any test failed to meet the requirements:

i. Carry out remedial works subject to the approval of the CM and re-test until the pipe sleeves meet the specified criteria;

ii. Bear all cost and any extra time required of remedial works and the re-test.

WAT6.T125.9 WATER FLOOD TEST TO ROOF INSTALLATIONS

1. Testing Arrangements:

a. Carry out water flood test to roofing at CM's direction;

b. Allow a Direct Testing Contractor (DTC) to carry out non-destructive tests to verify the watertightness of the roofing system;

d. Provide all necessary attendance on the DTC including the requirements stated in sub-clause (3);

e. Allow the DTC access to carry out infra-red scanning testing during the 24 to 48 hour period immediately following the draining of the roof area under test;

f. Obtain from DTC test reports for the water flood test for record. The original report including the infra-red scanning results shall be sent directly by the DTC to the CM.

2. Testing Samples:

a. Entire installed roofing system including canopy unless Instructed otherwise.

3. Testing Methods:

a. Seal all outlets and construct suitable dam walls to compartmentalize large roof areas. Do not permit any debris to enter into drainage pipeworks;

b. Carefully flood the roofs to levels agreed with the CM, generally no less than 150 mm, but in no case higher than existing curb levels and maintain for 24 hours;

c. Mark the top water level at clearly visible locations and regularly inspect for leaks;

d. Slowly drain roofs and remove all outlet blockages and dam walls.

4. Non-compliance:

a. In the event of test failure:

i. Submit to CM detailed proposals for remedial measures;

ii. Carry out subsequent repairs and flood tests and further infra-red scanning tests until the roof is watertight;

iii. Bear all associated costs and expense of any subsequent flood testing including subsequent infra-red scanning tests. No extension of time will be allowed.

WAT6.T130.9 TESTING TO BASEMENT / SEMI-BASEMENT EXTERNAL TANKING INSTALLATIONS

1. Testing Arrangements:
    a. Carry out tests to tanking at CM's direction after all penetrations through the waterproofing layers (e.g. tie rods or struts from the ELSW) are patched up;
    b. Submit three copies of the test reports, or other number of copies as required by the CM for the tests carried out for record;
    c. Allow a Direct Testing Contractor (DTC) to carry out non-destructive tests or infra-red scanning to verify the watertightness of the tanking system;
    d. Provide all necessary attendance on the DTC including the requirements stated in sub-clause (3);
    e. Obtain from DTC test reports for record. The original report including the infra-red scanning results, if any, shall be sent directly by the DTC to the CM.
2. Testing Locations:
    a. Entire installed tanking system unless instructed otherwise.
3. Testing Methods:
    a. Propose testing method(s) compatible with the type of waterproofing system installed. A mix of test methods may be used;
    b. Water Test -
        i. Carry out water spray tests;
        ii. Spray water with water jets fitted to 13mm diameter supply pipes delivering a water pressure of 210 to 240kPa (30-35psi). Locate the pressure gauge at a distance not exceeding 1500mm from the water jet and apply water evenly to the test surface for 2 consecutive hours, maximum area per test to be 100m2;
        iii. Carry out infra-red scanning test to 50% of the waterproofed area proposed using this test method during the 24 to 48 hour period immediately following the water spray test;
        iv. Arrange and allow access for the DTC to carry out infra-red scanning test to the remaining 50% area using this test method during the 24 to 48 hour period immediately following the water spray test. Jointly inspect with the CM or his representatives to ensure thorough dryness and readiness for infra-red scanning.
    c. Spark Test -
        i. Carry out spark tests to 80% of the waterproofed area proposed using this test method;
        ii. Arrange and allow access for the DTC to carry out spark tests to the remaining 20% area using this test method; jointly inspect with the CM or his representatives to ensure thorough dryness and readiness for the test;
        iii. Not suitable at waterproofing applied to basement wall with steel ELSW as its struts would affect the testing result;
        iv. Test by using a portable DC high voltage test detector. Test equipment used is to be the same type as per that used by DTC;

v. Move the broad brush probe of the detector across the surface of the installed waterproofing membrane to locate the flaw; once identified, move the probe across the flaw again to reconfirm the leak location;

vi. Fault at the waterproofing installation is identified by means of one of the following at the portable detector:

- an audible alarm; or
- an illumination indicator; or
- a visual spark from the search electrode; or
- a drop in the pre-set test voltage as shown on the output meter.

d. Smoke Test -

i. Carry out smoke tests to 80% of the waterproofed area proposed using this test method;

ii. Arrange and allow access for the DTC to carry out smoke tests to the remaining 20% area using this test method; jointly inspect with the CM or his representatives to ensure readiness for the test;

iii. Test by using smoke generator / blower system. Test equipment used is to be the same type as per that used by DTC;

iv. Obtain written confirmation from the waterproofing manufacturer that the smoke proposed for the test will not cause adverse effect to the installed waterproofing; only inert, non-toxic smoke to be used;

v. Test by injecting smoke into the inter-phase between the waterproofing installation and substrate. For horizontal installations, the blinding layer is the substrate. For vertical installations, in the case of sheet or pipe pile installations, the furring wall to the sheet or pipe pile wall is the substrate; in the case of open cut excavation, the concrete wall structure is the substrate;

vi. Activate smoke generator / blower system at nominal 150 cf/min to 450 cf/min flow rate and 250 pascal. Continue to purge system for 60 seconds after smoke begins to emerge from temporary vent outlet(s). Cap the temporary vent outlet(s). Adjust control valve to maintain 250-500 pascal. Monitor membrane for lifting. Reduce pressure if excessive lifting occurs;

vii. Visually identified smoke leakage locations indicate leakage points in the waterproofing installation.

4. Non-compliance:

a. In the event of test failure:

i. Submit to the CM detailed proposals for remedial measures;

ii. Carry out subsequent repairs and tests and further retests until the basement / semi-basement is watertight;

iii. Bear all additional time and costs arising from or in connection with failure to meet the testing requirements, including but not limited to those incurred in sub-clause (ii) above and subsequent tests by the DTC.

AP1.PLU APPENDIX 1 - PLU

APP1 APPENDIX PLU1/I..... 2

AP1.PLU1.APPEND1.A LIST OF TECHNICAL STANDARDS 2

APP1 APPENDIX PLU1/I

AP1.PLU1.APPEND1.A LIST OF TECHNICAL STANDARDS

Standard	Year of Standards	Description	Clause no.
ASTM A536	2019 2014	Standard Specification for Ductile Iron Castings	PLU1.M180
ASTM D395	2018 2016	Standard Test Methods for Rubber Property - Compression Set	PLU1.M180
ASTM D412	2021 2016	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension	PLU1.M180
ASTM D573	2019 2015	Standard Test Method for Rubber - Deterioration in an Air Oven	PLU1.M180
ASTM D2240	2021 2015	Standard Test Method for Rubber Property - Durometer Hardness	PLU1.M180
AS 3688	2016	Water supply and gas systems - Metallic fittings and end connectors	PLU1.M191
AS/NZS 4020	2018	Testing of products for use in contact with drinking water	PLU1.M010
BS EN ISO 15877-1	2009+A1:2010	Plastic piping system for hot and cold water installations. Chlorinated poly (vinyl chloride) (PVC-C) – General	PLU1.M240
BS EN ISO 15877-2	2009+A1:2010	Plastic piping system for hot and cold water installations. Chlorinated poly (vinyl chloride) (PVC-C) – Pipes	PLU1.M240
BS EN ISO 15877-3	2010	Plastic piping system for hot and cold water installations. Chlorinated poly (vinyl chloride) (PVC-C) - Fittings	PLU1.M240
ASTM F1498	08(2020)	Standard Specification for Taper Pipe Threads 60 ° for Thermoplastic Pipe and Fittings	PLU1.W294
BS 143 and 1256	2000	Threaded pipe fittings in malleable cast iron and cast copper alloy	PLU1.M180
BS 336	2010	Specification for fire hose couplings and ancillary equipment	PLU1.M1220
BS 476-20	1987	Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)	PLU1.M430
BS 1042	-	Measurement of fluid flow in closed conduits.	PLU1.M1210
BS 1212-3	1990	Float operated valves. Specification for diaphragm type float operated valves (plastics bodied) for cold water services only (excluding floats)	PLU1.M690
BS 3412	1992	Methods of specifying general purpose	PLU1.M120

Standard	Year of Standards	Description	Clause no.
		polyethylene materials for moulding and extrusion	PLU1.M140
BS 3416	1991	Specification for bitumen-based coatings for cold application, suitable for use in contact with potable water	PLU1.M1220 PLU1.W1030
BS 3505	1986	Specification for unplasticized polyvinyl chloride (PVC-U) pressure pipes for cold potable water	PLU1.M200 PLU1.M320
BS 4346-1	1969	Joints and fittings for use with unplasticized PVC pressure pipes. Injection moulded unplasticized PVC fittings for solvent welding for use with pressure pipes, including potable water supply	PLU1.M200
BS 5154	1991	Specification for copper alloy globe, globe stop and check, check and gate valves	PLU1.M610
BS 5163-1	2004	Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice	PLU1.M610
BS 6920	2014	Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water	PLU1.M170 PLU1.M191 PLU1.M610 PLU1.M620 PLU1.W130
BS 7786	2006	Specifications for unsintered PTFE tapes for general use	PLU1.M250
BS EN 200	2008	Sanitary tapware. Single taps and combination taps for water supply systems of type 1 and type 2. General technical specification.	PLU1.M680
BS EN 545	2010	Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods	PLU1.M170 PLU1.M180 PLU1.M320 PLU1.M430
BS EN 681-1	1996	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Vulcanized rubber	PLU1.M620 PLU1.M630 PLU1.M1220
BS EN 806-4	2010	Specifications for installations inside buildings conveying water for human consumption. Installation	PLU1.W030
BS EN 1057	2006+A1:2010	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications	PLU1.M120
BS EN 1074-1	2000	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. General requirements	PLU1.M610

Standard	Year of Standards	Description	Clause no.
BS EN 1074-2	2000	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Isolating valves	PLU1.M610
BS EN 1092-1	2018	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges	PLU1.M210 PLU1.M220 PLU1.M230 PLU1.M310 PLU1.M320 PLU1.M640 PLU1.M920
BS EN 1092-2	1997	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges	PLU1.M170 PLU1.M230 PLU1.M310 PLU1.M320 PLU1.M510 PLU1.M610 PLU1.M640 PLU1.M920 PLU1.M1220
BS EN 1092-3	2003	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges	PLU1.M130 PLU1.M310 PLU1.M640
BS EN 1254-1	1998	Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes	PLU1.M130 PLU1.M150 PLU1.M160
BS EN 1254-2	1998	Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes	PLU1.M130 PLU1.M191
BS EN 1254-4	1998	Copper and copper alloys. Plumbing fittings. Fittings combining other end connections with capillary or compression ends	PLU1.M130
BS EN 1254-5	1998	Copper and copper alloys. Plumbing fittings. Fittings with short ends for capillary brazing to copper tubes	PLU1.M130
BS EN 1515-1	2000	Flanges and their joints. Bolting. Selection of bolting	PLU1.M610 PLU1.M920
BS EN 1561	2011	Founding. Grey cast irons	PLU1.M510 PLU1.M610 PLU1.M620 PLU1.M630

Standard	Year of Standards	Description	Clause no.
			PLU1.M1220
			PLU1.W050
BS EN 1563	2018	Founding. Spheroidal graphite cast irons	PLU1.M180
			PLU1.M510
			PLU1.M610
			PLU1.M620
			PLU1.M630
			PLU1.M1220
BS EN 1567	1999	Building valves. Water pressure reducing valves and combination water reducing valves. Requirements and tests	PLU1.M930
BS EN 1982	2017	Copper and copper alloys. Ingots and castings	PLU1.M510
			PLU1.M620
			PLU1.M630
			PLU1.M920
			PLU1.M1220
BS EN 10029	2010	Hot-rolled steel plates 3 mm thick or above. Tolerances on dimensions and shape	PLU1.M220
BS EN 10048	1997	Hot rolled narrow steel strip. Tolerances on dimensions and shape	PLU1.M220
BS EN 10051	2010	Continuously hot-rolled strip and plate / sheet cut from wide strip of non-alloy and alloy steels. Tolerances on dimensions and shape	PLU1.M220
BS EN 10088-1	2014	Stainless steels. List of stainless steels	PLU1.M190
			PLU1.M191
			PLU1.M210
			PLU1.M320
			PLU1.M430
			PLU1.M510
BS EN 10088-3	2014	Stainless steels. Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes	PLU1.M170
			PLU1.M410
			PLU1.M620
			PLU1.M630
			PLU1.M920
			PLU1.M1120
			PLU1.M1130
			PLU1.M1220
			PLU1.W050
			PLU1.W230
BS EN 10095	1999	Heat resisting steels and nickel alloys	PLU1.M220

Standard	Year of Standards	Description	Clause no.
BS EN 10162	2003	Cold rolled steel sections. Technical delivery conditions. Dimensional and cross-sectional tolerances	PLU1.M180
BS EN 10217-1	2019	Welded steel tubes for pressure purposes. Technical delivery conditions. Electric welded and submerged arc welded non-alloy steel tubes with specified room temperature properties	PLU1.M430
BS EN 10217-7	2014	Welded steel tubes for pressure purposes. Technical delivery conditions. Stainless steel tubes	PLU1.M190
BS EN 10226-1	2004	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation	PLU1.M180 PLU1.M210 PLU1.M510 PLU1.M610 PLU1.M920 PLU1.W220
BS EN 10226-2	2005	Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation	PLU1.M210 PLU1.M510 PLU1.M610 PLU1.M920 PLU1.W220
BS EN 10226-3	2005	Pipes threads where pressure-tight joints are made on the threads. Verification by means of limit gauges	PLU1.M210 PLU1.M510 PLU1.M610 PLU1.M920 PLU1.W220
BS EN 10241	2000	Steel threaded pipe fittings	PLU1.M180
BS EN 10242	1995	Threaded pipe fittings in malleable cast iron	PLU1.M180
BS EN 10255	2004	Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions	PLU1.M180 PLU1.M430
BS EN 10283	2019	Corrosion resistant steel castings	PLU1.M630 PLU1.M920
BS EN 10300	2005	Steel tubes and fittings for onshore and offshore pipelines. Bitumen hot applied materials for external coating	PLU1.M1220
BS EN 10312	2002	Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions	PLU1.M190
BS EN 10346	2015	Continuously hot-dip coated steel flat products. Technical delivery conditions	PLU1.M430

Standard	Year of Standards	Description	Clause no.
BS EN 12163	2016	Copper and copper alloys. Rod for general purposes	PLU1.M620
BS EN 12164	2016	Copper and copper alloys - Rod for free machining purposes	PLU1.M620
BS EN 12167	2016	Copper and copper alloys – Profiles and bars for general purposes	PLU1.M620
BS EN 12288	2010	Industrial valves. Copper alloy gate valves	PLU1.M610
BS EN 13789	2010	Industrial valves. Cast iron globe valves	PLU1.M610
BS EN 13923	2005	Filament-wound FRP pressure vessels. Materials, design, manufacturing and testing	PLU1.M1120
BS EN 14901-1	2014+A1:2019	Ductile iron pipes, fittings and accessories. Requirements and test methods for organic coatings of ductile iron fittings and accessories. Epoxy coating (heavy duty).	PLU1.M170
BS EN 16767	2016	Industrial valves. Steel and cast iron check valves	PLU1.M610
BS EN ISO 1127	1997	Stainless steel tubes. Dimensions, tolerances and conventional masses per unit length	PLU1.M190
BS EN ISO 1452-2	2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC-U). Pipes	PLU1.M200 PLU1.M320 PLU1.M430
BS EN ISO 1452-3	2010	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC-U). Fittings	PLU1.M200
BS EN ISO 1452-4	2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Valves	PLU1.M610 PLU1.M660
BS EN ISO 3506-1	2020	Fasteners. Mechanical properties of corrosion-resistant stainless steel fasteners. Bolts, screws and studs with specified grades and property classes	PLU1.M170 PLU1.M191
BS EN ISO 3506-2	2020	Fasteners. Mechanical properties of corrosion-resistant stainless steel fasteners. Nuts with specified grades and property classes	PLU1.M170 PLU1.M191
BS EN ISO 9445-2	2010	Continuously cold-rolled stainless steel. Tolerances on dimensions and form. Wide strip and plate / sheet	PLU1.M220
BS EN ISO 9453	2014	Soft solder alloys - Chemical compositions and forms	PLU1.M160
BS EN ISO 17672	2010	Brazing. Filler metals	PLU1.M150

Standard	Year of Standards	Description	Clause no.
BS ISO 2028	2015	Synthetic rubber latex. Preparation of dry polymer	PLU1.W310

HONG KONG HOUSING AUTHORITY

SPECIFICATION LIBRARY 2022 (BATCH 4) EDITION

Drainage and ExternalWorks Specification

DRA DRAINAGE

DRA1 DRAINAGE ABOVE GROUND 8

MATERIALS 8

PIPES AND FITTINGS FOR SURFACE WATER DRAINAGE 8

DRA1.M010.9 CAST IRON RAINWATER PIPES, GUTTERS AND FITTINGS 8
DRA1.M020.9 PLASTIC RAINWATER PIPES, GUTTERS AND FITTINGS 8
DRA1.M030.9 RAINWATER OUTLETS 8

PIPES AND FITTINGS FOR FOUL WATER DRAINAGE 9

DRA1.M110.9 CAST IRON SOIL, WASTE AND VENTILATING PIPES AND FITTINGS 9
DRA1.M115.B EPOXY COATED CAST IRON PIPES AND FITTINGS 9
DRA1.M120.9 SPIGOT SPUN PIPES 14
DRA1.M150.A PLASTIC PIPES AND FITTINGS 14
DRA1.M160.9 BALLOON GRATING / VENT COWL 24
DRA1.M170.9 PLASTIC VERTICAL GRATINGS 24
DRA1.M171.9 STAINLESS STEEL VERTICAL GRATINGS 24
DRA1.M180.9 UPVC TWO-WAY FLOOR DRAIN OUTLET 24
DRA1.M190.9 SMALL DIAMETER UPVC PIPES 25

BRACKETS AND FIXINGS 25

DRA1.M210.A PIPE BRACKETS 25
DRA1.M220.9 BOLTS FOR CAST IRON AND STEEL PIPEWORKS 25
DRA1.M230.9 BOLTS FOR SOIL STACK ACCESS DOORS FOR CAST IRON AND STEEL PIPEWORKS 25
DRA1.M240.9 WOOD SCREWS 25
DRA1.M250.9 PLUGS 25
DRA1.M260.N COATING OF PIPE BRACKETS FOR PIPEWORKS INSTALLED IN INDOOR AREAS OF DOMESTIC BLOCK 26

PIPE SLEEVES AND COVER PLATES 27

DRA1.M310.A UPVC PIPE SLEEVES FOR CASTING OR BUILDING IN 27
DRA1.M320.9 FIRE RESISTING PIPE SLEEVES 27
DRA1.M330.9 CAST IRON OR MILD STEEL PIPE SLEEVES 27
DRA1.M340.9 PIPE SLEEVES FOR BASEMENT WALLS 27
DRA1.M350.9 PROTECTIVE TAPE 27
DRA1.M360.9 FIRE RESISTANT BANDAGE AND WRAP 27
DRA1.M370.9 FIRE RESISTING PIPE COLLAR 29

JOINTING MATERIALS 31

DRA1.M405.9 GENERAL 31
DRA1.M410.9 JOINTING RINGS, COUPLINGS AND ADAPTORS GENERALLY 31
DRA1.M420.9 GASKIN 31
DRA1.M430.9 COLD CAULKING COMPOUND 31
DRA1.M450.9 MORTAR 31
DRA1.M460.9 JOINTING COMPOUND FOR SCREWED JOINTS 31
DRA1.M470.9 PIPE THREAD TAPE 31
DRA1.M480.9 PRIMER FOR THREADED JOINT TO STEEL PIPES 31

SUNDRIES MATERIALS 32

DRA1.M510.9 FIRE SEALING SYSTEM FOR UPVC PIPES PASSING THROUGH FIRE RESISTING STRUCTURES 32
DRA1.M520.9 PRECAST CONCRETE WEDGE SUPPORT TO PIPES 32

WORKMANSHIP 33

GENERAL 33

DRA1.W002.9 APPROVED CONTRACTOR FOR DRAINAGE WORKS ABOVE GROUND 33

DRA1.W010.9 INSPECTION OF PIPES AND FITTINGS....33
DRA1.W020.9 HANDLING AND STORAGE....33
FIXING PIPES....33
DRA1.W110.9 GENERAL....33
DRA1.W120.9 INSTALLING FOUL DRAINAGE ABOVE GROUND....33
DRA1.W130.9 THERMAL MOVEMENT....33
DRA1.W140.9 PIPES ACCESSIBLE TO VERMIN....33
DRA1.W150.9 PROVISION FOR ACCESS FOR CAST IRON AND STEEL PIPEWORKS....34
DRA1.W160.9 SPACING OF PIPE SUPPORTS....34
DRA1.W170.9 EMBEDDED PIPES....34
DRA1.W180.9 PIPES ON FLAT ROOFS AND CANOPIES....34
DRA1.W190.9 FIXING CAST IRON GUTTERS....34
DRA1.W200.9 FIXING PLASTIC GUTTERS....34
DRA1.W210.9 FIXING UPVC TWO-WAY FLOOR DRAIN OUTLET....35
DRA1.W220.A INSTALLATION OF EPOXY COATED CAST IRON PIPES AND FITTINGS....35
JOINTING PIPES AND FITTINGS....35
DRA1.W310.9 JOINTING PIPES AND FITTINGS GENERALLY....35
DRA1.W320.9 CUTTING PIPES AND GUTTERS....35
DRA1.W330.9 JOINTS BETWEEN DISSIMILAR METALS....35
DRA1.W340.9 PIPES REQUIRING CORROSION PROTECTION....36
DRA1.W350.9 CAST IRON SPIGOT AND SOCKET PIPES....36
DRA1.W360.9 CAST IRON SPUN SPIGOT PIPES....36
DRA1.W370.9 JOINTING STEEL PIPES GENERALLY....36
DRA1.W380.9 JOINTING STEEL PIPES TO CAST IRON PIPES....36
DRA1.W390.9 JOINTING PIPES TO CLAY PIPE SOCKETS....36
DRA1.W400.9 JOINTING PLASTIC PIPES TO OTHER MATERIALS....36
PIPES PENETRATING THE BUILDING STRUCTURE....36
DRA1.W510.9 PIPES PASSING THROUGH WALLS AND FLOORS....36
DRA1.W520.9 PIPES PASSING THROUGH FIRE RESISTING STRUCTURES....37
DRA1.W530.9 UPVC PIPES PASSING THROUGH FIRE RESISTING STRUCTURES....37
DRA1.W540.9 PIPES PASSING THROUGH BASEMENT WALLS....37
DRA1.W550.N PIPES PASSING THROUGH EXTERNAL WALLS....37
PROTECTION....38
DRA1.W610.9 SEALING THE SYSTEM....38
TOLERANCES....38
DRA1.W710.9 GENERAL....38
PIPELINE CONNECTION IDENTIFICATION....38
DRA1.W810.9 PIPEWORK CONNECTION IDENTIFICATION....38
TESTING....39
ON-SITE VERIFICATION TESTS....39
DRA1.T110.9 TESTING FOR SURFACE WATER DRAINAGE....39
DRA1.T210.9 TESTING FOR FOUL WATER DRAINAGE....39
DRA1.T220.9 REPETITIVE FLUSHING TEST (RFT) FOR COMMON W-TRAP SYSTEM....41
DRA1.T230.9 MULTIPLE FLUSHING TEST (MFT) FOR COMMON W-TRAP SYSTEM....43
SURVEILLANCE TESTS FOR UPVC DRAINAGE PIPES AND FITTINGS....45
DRA1.T310.A SURVEILLANCE TESTS....45
SURVEILLANCE TESTS FOR EPOXY COATED CAST IRON PIPES AND FITTINGS....46
DRA1.T410.A SURVEILLANCE TESTS....46

DRA2 DRAINAGE BELOW GROUND 48

MATERIALS 48

GENERAL 48

DRA2.M010.9 APPLICATION OF OTHER WORKSECTIONS 48
DRA2.M020.9 DEFINITIONS 48

PIPES AND FITTINGS 48

DRA2.M110.A PRECAST CONCRETE PIPES AND FITTINGS 48
DRA2.M120.A VITRIFIED CLAY PIPES AND FITTINGS 48
DRA2.M130.A DUCTILE IRON PIPES AND FITTINGS 48
DRA2.M140.A FLEXIBLE JOINTS FOR DUCTILE IRON PIPES AND FITTINGS 48
DRA2.M150.A FLANGED JOINTS FOR DUCTILE IRON PIPES AND FITTINGS 49
DRA2.M160.9 DUCTILE IRON PIPES TO BE BUILT IN 49
DRA2.M170.A GREY IRON PIPES AND FITTINGS 49
DRA2.M180.9 SUB-SOIL PIPES AND FITTINGS 49
DRA2.M190.A UPVC GRAVITY SEWAGE AND SURFACE WATER PIPES AND FITTINGS 49
DRA2.M200.9 JOINTING SYSTEM FOR UPVC PIPES AND FITTINGS 50
DRA2.M210.9 JOINTING SYSTEM FOR UPVC PIPES AND FITTINGS 50
DRA2.M220.A UPVC PRESSURE PIPES AND FITTINGS 50
DRA2.M230.9 CAST IRON PIPES AND FITTINGS 50
DRA2.M240.N PE PIPES AND FITTINGS 50

JOINTING MATERIALS 50

DRA2.M305.9 GENERAL 50
DRA2.M310.9 SOLVENT CEMENT FOR UPVC PRESSURE PIPES 50
DRA2.M320.A ELASTOMERIC JOINT RINGS 50
DRA2.M330.A ELASTOMERIC GASKETS FOR FLANGED PIPES 51
DRA2.M340.9 DETACHABLE COUPLINGS AND FLANGE ADAPTERS 51
DRA2.M350.9 JOINTING RINGS 51
DRA2.M370.9 GASKIN 51
DRA2.M380.9 COLD CAULKING COMPOUND 51
DRA2.M390.9 LUBRICANT 51

BOLTS, NUTS AND WASHERS 51

DRA2.M410.A GENERAL 51
DRA2.M420.A FLANGED JOINTS, DETACHABLE COUPLINGS AND FLANGE ADAPTORS 52
DRA2.M430.A STAINLESS STEEL 52
DRA2.M440.A SPHEROIDAL GRAPHITE IRON BOLTS 52

BEDDING, HAUNCHING AND SURROUNDING MATERIALS 52

DRA2.M510.A AGGREGATES FOR GRANULAR BED AND GRANULAR FILL 52
DRA2.M520.A JOINT FILLER 52
DRA2.M530.9 COMPRESSIBLE PADDING 53
DRA2.M540.A CONCRETE 53

MANHOLES, CHAMBERS, GULLIES AND CHANNELS 54

DRA2.M610.A PRECAST CONCRETE MANHOLES 54
DRA2.M620.A PRECAST CONCRETE CHAMBERS AND GULLIES 54
DRA2.M630.A VITRIFIED CLAY GULLIES 54
DRA2.M640.A STEP IRONS 54
DRA2.M630.A VITRIFIED CLAY GULLIES 54
DRA2.M640.A STEP IRONS 54
DRA2.M650.A CAST IRON MANHOLE COVERS, GULLY GRATINGS AND OVERFLOW WEIRS 54
DRA2.M660.9 DUCTILE IRON MANHOLE COVERS AND FRAMES 56

DRA2.M670.9 RECESSED MANHOLE COVERS AND FRAMES....56
DRA2.M680.9 CAST IRON CHANNEL GRATINGS AND FRAMES....57
DRA2.M690.9 PRECAST CONCRETE CHANNEL COVERS....57
DRA2.M695.9 PRECAST CONCRETE SURFACE CHANNEL....57

VALVES....57
DRA2.M710.A GENERAL....57
DRA2.M720.A GATE VALVES....58
DRA2.M730.A CHAINS FOR CHAIN OPERATED GATE VALVES....58
DRA2.M740.A FLAP VALVES....58
DRA2.M750.A FLANGE MOUNTING FLAP VALVES....58
DRA2.M760.A SLUDGE VALVES....58
DRA2.M770.A AIR VALVES....59
DRA2.M780.9 BOLTS AND NUTS FOR SECURING VALVES....59

ANCILLARY MATERIALS....59
DRA2.M810.9 ANTI-CORROSION TAPE....59
DRA2.M820.9 PRIMER AND MASTIC FILLER FOR USE WITH ANTI-CORROSION TAPE....60
DRA2.M830.A BITUMINOUS COATINGS FOR HOT APPLICATION....60
DRA2.M840.A BLACK BITUMEN COATING FOR COLD APPLICATION....60
DRA2.M850.9 BITUMINOUS COATINGS FOR REPAIRS....60
DRA2.M860.9 POLYETHYLENE SHEETING....60
DRA2.M870.9 GROUT FOR FILLING REBATES AND BOX-OUTS....60
DRA2.M880.9 FOAM CONCRETE FILLING FOR ABANDONED SYSTEMS....60
DRA2.M890.9 GROUT FILLING FOR ABANDONED SYSTEMS....60
DRA2.M900.9 CONCRETE FOR THRUST AND ANCHOR BLOCKS....60
DRA2.M910.9 MORTAR....60
DRA2.M920.9 MARKER BLOCKS....60

SUBMISSIONS....61
DRA2.M1010.9 PIPES, JOINTS AND FITTINGS....61
DRA2.M1020.9 ANTI-CORROSION TAPE AND JOINT FILLER....61
DRA2.M1030.9 AGGREGATES FOR GRANULAR BED....61

MANHOLES, CHAMBERS, GULLIES AND CHANNELS....61
DRA2.M1035.9 DESIGN RESPONSIBILITY FOR PRECAST MANHOLES....61
DRA2.M1040.9 MANHOLES, CHAMBERS, GULLIES AND CHANNELS....61
DRA2.M1050.9 VALVES....62
DRA2.M1060.9 CONCRETE AND GROUT FILLING FOR ABANDONED INSTALLATIONS....62

WORKMANSHIP....63

GENERAL....63
DRA2.W010.9 DIVERSIONS OF FLOW....63

TRANSPORT, HANDLING AND STORAGE....63
DRA2.W110.9 PIPES, JOINTS AND FITTINGS GENERALLY....63
DRA2.W120.A PE PIPES, UPVC PIPES AND THEIR JOINTS AND FITTINGS....63
DRA2.W130.9 BOLTS AND NUTS....63
DRA2.W140.9 ELASTOMERIC JOINT RINGS....63
DRA2.W150.9 STORING PIPES....63
DRA2.W160.9 STORING ANTI-CORROSION TAPE AND JOINT FILLER....64
DRA2.W170.9 GRANULAR BEDDING MATERIALS....64
DRA2.W180.9 MANHOLES, CHAMBERS AND GULLIES....64
DRA2.W190.9 STORING COVERS, GRATINGS AND KERB OVERFLOW WEIRS....64

EXCAVATION....64
DRA2.W210.9 GENERAL....64

DRA2.W220.9 TRENCH WIDTH 64

LAYING AND BEDDING PIPES 65
DRA2.W310.9 GENERAL 65
DRA2.W320.9 INSPECTION 65
DRA2.W330.9 CLEANLINESS 65
DRA2.W340.9 FLOTATION 65
DRA2.W350.9 LAYING PIPES 65
DRA2.W360.9 BEDDING PIPES 65
DRA2.W370.9 BLANK ENDS 66

CUTTING PIPES 66
DRA2.W410.9 GENERAL 66
DRA2.W420.9 ELASTOMERIC JOINTS 66
DRA2.W430.9 CLOSING LENGTHS 66
DRA2.W440.9 PRECAST CONCRETE PIPES 66

JOINTING PIPES AND FITTINGS 66
DRA2.W510.9 GENERAL 66
DRA2.W520.9 FLANGED JOINTS 67
DRA2.W530.9 FLEXIBLE COLLAR JOINTS 67
DRA2.W540.9 PUSH-IN JOINTS 67
DRA2.W550.9 DETACHABLE JOINTS 67
DRA2.W560.9 FLANGE ADAPTERS 67
DRA2.W570.9 SOLVENT WELDED JOINTS 68
DRA2.W580.9 ELECTROCHEMICAL INSULATION 68
DRA2.W590.9 PROTECTION OF FLANGED JOINTS, DETACHABLE COUPLINGS AND FLANGE ADAPTERS 68
DRA2.W600.9 CAST IRON PIPES 68
DRA2.W610.N SCREW JOINTS 68
DRA2.W620.N BUTT FUSION JOINTS 69
DRA2.W630.N ELECTROFUSION JOINTS 69

REPAIRS TO COATINGS AND LININGS 69
DRA2.W710.9 GENERAL 69

THRUST AND ANCHOR BLOCKS 69
DRA2.W810.9 GENERAL 69
DRA2.W820.9 EXCAVATION 69
DRA2.W830.9 APPLYING PRESSURE 69

BED, HAUNCH AND SURROUND 69
DRA2.W910.9 GRANULAR BED 69
DRA2.W920.9 CONCRETE BED, HAUNCH AND SURROUND 70
DRA2.W930.9 PIPES UNDER ROADS 70
DRA2.W940.9 FILL MATERIAL SURROUND 70

TOLERANCES 70
DRA2.W1010.9 GENERAL 70

CONNECTIONS 70
DRA2.W1110.9 CONNECTIONS TO STRUCTURES 70
DRA2.W1120.9 SADDLE CONNECTIONS TO CONCRETE AND CLAY PIPES 71
DRA2.W1130.9 SPLAY CUT CONNECTIONS TO CONCRETE AND CLAY PIPES 71
DRA2.W1140.9 SADDLE CONNECTIONS TO UPVC PIPES 71
DRA2.W1145.N SADDLE CONNECTIONS TO PE PIPES 71
DRA2.W1150.9 BRANCH PIPELINES 71
DRA2.W1160.9 RECORDING POSITIONS OF JUNCTIONS 72
DRA2.W1170.9 CONNECTING PIPES NOT REQUIRED FOR IMMEDIATE USE 72

MANHOLES, CHAMBERS, GULLIES AND CHANNELS 72
DRA2.W1210.9 MANHOLES, CHAMBERS AND GULLIES 72
DRA2.W1220.9 FILLING AROUND MANHOLES AND CHAMBERS 72
DRA2.W1230.9 CONCRETE OPEN CHANNELS 72
INSTALLING VALVES 72
DRA2.W1310.9 GENERAL 72
DRA2.W1320.9 BOX-OUTS AND REBATES 72
DRA2.W1330.9 CLEANING AND CHECKING 72
DRA2.W1340.9 AIR VALVES 73
PIPES AND MANHOLES TO BE ABANDONED 73
DRA2.W1410.9 INSTALLATIONS NOT EXCEEDING 1.2M DEEP BENEATH CARRIAGEWAYS OR NOT EXCEEDING 1M DEEP BENEATH OTHER AREAS 73
DRA2.W1420.9 INSTALLATIONS EXCEEDING 1.2M DEEP BENEATH CARRIAGEWAYS OR EXCEEDING 1M DEEP BENEATH OTHER AREAS 73
CLEANING PIPELINES 73
DRA2.W1510.9 TIMING 73
DRA2.W1520.A PROCEDURE 73
INSPECTION OF PIPELINES 74
DRA2.W1610.9 GENERAL 74
DRA2.W1620.9 TEMPORARY COLOUR IDENTIFICATION 74
CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION 74
DRA2.W1710.9 SCOPE 74
DRA2.W1720.9 SUBMISSIONS 75
DRA2.W1730.9 EQUIPMENT 75
DRA2.W1740.9 PROCEDURE 75
DRA2.W1750.A RECORDING RESULTS 76
DRA2.W1760.9 VIDEO AND PHOTOGRAPHS 76
PROTECTION 76
DRA2.W1805.9 HOT DIP GALVANIZING 76
DRA2.W1810.9 ANTI-CORROSION TAPE 77
WORKS OUTSIDE SITE BOUNDARY 77
DRA2.W1910.9 APPROVED CONTRACTOR FOR PUBLIC WORKS 77
DRA2.W1920.A SPECIFICATION 77
DRA2.W1930.9 INSPECTION 77
DRA2.W1940.9 RECORD DRAWINGS AND TEST REPORTS 78
TESTING 79
GENERAL 79
DRA2.T010.9 SUBMISSIONS 79
DRA2.T020.9 QUALITY ASSURANCE SCHEMES 79
TESTING PIPES 79
DRA2.T110.9 DEFINITION OF 'BATCH' 79
DRA2.T120.9 SAMPLES 79
DRA2.T130.A TESTING PROCEDURES 79
DRA2.T140.9 NON-COMPLIANCE 80
TESTING AGGREGATES FOR GRANULAR BED 80
DRA2.T210.9 DEFINITION OF 'BATCH' 80
DRA2.T220.A SAMPLES 80
DRA2.T230.A TEST FOR PARTICLE SIZE DISTRIBUTION 80
DRA2.T240.A TEST FOR TEN PERCENT FINES VALUE 80
DRA2.T250.9 TEST FOR COMPACTION FRACTION VALUE - EQUIPMENT 80

DRA2.T260.9 TEST FOR COMPACTION FRACTION VALUE - PROCEDURE 81
DRA2.T270.9 TEST FOR COMPACTION FRACTION VALUE - CALCULATION 81
DRA2.T280.9 TEST FOR COMPACTION FRACTION VALUE - RESULTS 81
DRA2.T290.9 COMPLIANCE CRITERIA 81
TESTING PRECAST CONCRETE UNITS FOR MANHOLES, CHAMBERS AND GULLIES 82
DRA2.T310.9 DEFINITION OF 'BATCH' 82
DRA2.T320.9 SAMPLES 82
DRA2.T330.A METHODS OF TEST 82
DRA2.T340.9 NON-COMPLIANCE 82
TESTING MANHOLE COVERS, GULLY GRATINGS AND KERB OVERFLOW WEIRS 82
DRA2.T410.9 DEFINITION OF 'BATCH' 82
DRA2.T420.9 SAMPLES 82
DRA2.T430.9 PROCEDURE 82
DRA2.T440.9 EQUIPMENT FOR LOAD TESTING 83
DRA2.T450.9 LOAD TEST PROCEDURE 83
DRA2.T460.9 LOAD TEST RESULTS 83
DRA2.T470.9 COMPLIANCE CRITERION FOR RESISTANCE TO FRACTURE OF COVERS AND GRATINGS 83
DRA2.T480.9 NON-COMPLIANCE FOR MASS OF COVERS, GRATINGS AND WEIR 83
DRA2.T490.9 NON-COMPLIANCE FOR RESISTANCE TO FRACTURE OF COVERS AND GRATINGS 83
TESTING GRAVITY PIPELINES 84
DRA2.T510.9 TESTS ON SEWAGE PIPELINES GENERALLY 84
DRA2.T520.A TESTS ON SURFACE WATER PIPELINES GENERALLY 84
DRA2.T530.9 WATER AND AIR TESTS GENERALLY 85
DRA2.T540.9 INFILTRATION TESTS GENERALLY 85
DRA2.T550.9 EQUIPMENT 85
DRA2.T560.9 PREPARATION 85
DRA2.T570.9 WATER TEST PROCEDURE 85
DRA2.T580.9 WATER TEST CALCULATION 86
DRA2.T590.9 AIR TEST PROCEDURE 86
DRA2.T600.9 VISUAL INSPECTION 86
DRA2.T610.A INFILTRATION TEST PROCEDURE 86
DRA2.T620.9 REPORTING OF RESULTS 86
DRA2.T630.9 COMPLIANCE CRITERIA 87
DRA2.T640.9 NON-COMPLIANCE 87
PRESSURE PIPELINES 87
DRA2.T710.9 TIMING OF TESTS 87
DRA2.T720.9 TEST PRESSURES 87
DRA2.T730.9 SIMULTANEOUS TESTING 87
DRA2.T740.9 ALTERNATIVE TEST METHODS 87
DRA2.T750.9 EQUIPMENT 87
DRA2.T760.9 PROCEDURE 88
DRA2.T770.9 CALCULATION 88
DRA2.T780.9 REPORTING OF RESULTS 89
DRA2.T790.9 COMPLIANCE CRITERIA 89
DRA2.T800.9 NON-COMPLIANCE 89

DRA1 DRAINAGE ABOVE GROUND

MATERIALS

PIPES AND FITTINGS FOR SURFACE WATER DRAINAGE

DRA1.M010.9 CAST IRON RAINWATER PIPES, GUTTERS AND FITTINGS

1. Pipes and fittings:
   a. To BS 416:Part 1:1990;
   b. With type A or B sockets;
   c. Without ears;
   d. Suitably coated internally and externally to prevent corrosion. When cold applied bitumen-based coating is proposed, the coating material should comply with BS 3416 or other equivalent international standards. External coating should contain anti-corrosion inhibitors, and in a state to permit the application of additional external finishing coatings;
   e. Dimension and shape of access door as per relevant BS requirements. Covers of access door or rodding eye opening shall be supplied with minimum 4mm thick elastomeric gasket.
2. Gutters:
   a. To BS 416:Part 1:1990;
   b. Section: half round or ogee.

DRA1.M020.9 PLASTIC RAINWATER PIPES, GUTTERS AND FITTINGS

1. For pipes equal to and not exceeding 80 mm diameter: to BS 4576:1989 or BS EN 12200:Part1:2000 and for pipes exceeding 80 mm diameter to BS 4514:1983;
2. Use only pipes and fittings in the Works to either the specified BS standards or the specified BS EN standards, unless otherwise Approved;
3. Alternative: other Approved rainwater system;
4. Unless otherwise Approved, do not interchange individual manufacturer's plastic pipe products.

DRA1.M030.9 RAINWATER OUTLETS

1. Cast iron rainwater outlets: to BS 416:Part 1:1990 with domical grating if specified;
2. Cast aluminium rainwater side outlets:
   a. Material: LM6 aluminium silicon alloy to BS 1490:1988;
   b. Type: two-way outlet;
   c. Accessories: clamping ring, removable grating and screw thread adaptor for cast iron pipes.
3. uPVC rainwater outlet to BS 4576:1989:

An Approved proprietary type complete with sealing flange and screw fixed flat or domed grating;

4. Stainless steel rainwater outlets:
    a. Stainless steel (Grade 304) flat removable grating;
    b. Stainless steel (Grade 304) frame.

PIPES AND FITTINGS FOR FOUL WATER DRAINAGE

DRA1.M110.9 CAST IRON SOIL, WASTE AND VENTILATING PIPES AND FITTINGS

1. For pipes not exceeding and equal to 150 mm diameter:
    a. To BS 416:Part 1:1990;
    b. With Type A or B sockets;
    c. Without ears and coated.
2. For pipes of 225 mm diameter: to BS 437:2008;
3. For pipes exceeding 225 mm diameter: to BS 4622:1970;
4. Suitably coated internally and externally to prevent corrosion. When cold applied bitumen-based coating is proposed, the coating material should comply with BS 3416 or other equivalent international standards. External coating should contain anti-corrosion inhibitors. The C.I. pipes shall be in a state to permit the application of additional external finishing coatings;
5. Dimension and shape of access door as per relevant BS requirements at sub-clauses (1), (2) & (3). Covers of access door or rodding eye opening shall be supplied with minimum 4mm thick elastomeric gasket.

DRA1.M115.B EPOXY COATED CAST IRON PIPES AND FITTINGS

1. Submission requirements:
    a. At sample submission and approval stage, submit a sample of each of the components of the proposed epoxy coated cast iron pipes and fittings including pipes, fittings, couplings and grip collars for CM's approval, together with all the following substantiation for CM's information:
        i. Catalogue, brand name / model name and job reference of the material;
        ii. Name, address and contact person of the local supplier;
        iii. Name, address and contact person of the manufacturer;
        iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;
        v. Installation procedures recommended by the manufacturer and shop drawings showing connection details between epoxy coated cast iron pipes / fittings and pipes / fittings of other materials, locations of grip collars and access for inspection;

vi. Original or certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by either a certification body or the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS;

vii. Submit a sample board similar to the one maintained by the Housing Department showing the quality, detail technical information and application procedures for the proposed epoxy coated cast iron pipes and fittings. When the epoxy coated cast iron pipes and fittings are supplied for domestic blocks, submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works.

b. Submit:

i. Original or a certified true copy of product conformity certificate from an accredited third party issued by an internationally recognized certification body such as a member of the European Co-operation for Accreditation (EA) or an accreditation body which has entered into a mutual recognition agreement with EA, certifying the continuous conformance of the products to BS EN 877. If a photocopy of the certificate is submitted, it shall be certified true by either the certification body or the QCM. Submit together with the certificate a summary of the test results under the audit testing of the certification scheme. The summary shall be prepared by the accredited laboratory carrying out the testing or the certified manufacturer. If the scope of the certification scheme does not fully cover the quality requirements stated in sub-clause (2)(b), or the date of test under the audit testing of the certification scheme is more than five years prior to the notified date for commencement of the Works, submit for the CM's information test reports as prescribed in (1)(b)(ii) showing compliance with the requirements that are not covered, or the requirements in respect of the date of test under audit testing; or

ii. Original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b) for the CM's information unless the test requirements are already covered by the scope of certification in sub-clause (1)(b)(i) above:

- The date of the test shall be within five years prior to the notified date for commencement of the Works;
- The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);
- In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all delivered materials off Site, bear all associated costs and no extension of time will be allowed.

2. Quality Requirements:

a. Epoxy coated cast iron pipes and fittings utilizing coupling joint to BS EN 877: 1999 + A1: 2006:

i. Pipes shall be centrifugal spun casting;

ii. Pipes and fittings shall be from the same manufacturer;

iii. Coupling shall be of austenitic stainless steel grade 316;

iv. Grip collars shall be of hot-dip galvanized or austenitic stainless steel grade 316;

v. Elastomeric gasket used at couplings shall be ethylene propylene diene monomer (EPDM);

vi. The coupling joints shall suit and accommodate the small dimensional difference which may occur between the outside diameter of the epoxy coated cast iron pipes / fittings and the interconnecting pipes / fittings of other materials;

vii. Pipes shall be internally coated with epoxy and externally coated with anti-corrosion red brown primer or epoxy;

viii. Fittings shall be internally and externally coated with epoxy;

ix. Pipes and fittings shall be installed with provision for electrical continuity;

x. Cleaning eyes or other suitable means of access with minimum 4mm thick elastomeric gasket shall be provided:

- at or near the bend at the bottom of drainage stacks located inside premises;
- at the connection to the cast iron pipe connected to the manhole.

b. The quality and performance requirements are as follows:

Items	Testing Method	Acceptance Standards
Surface Condition	Clause 5.1 BS EN 877: 1999 + A1: 2006	No irregular surface, pinhole or surface defect which could be detrimental to the service life is allowed. Inner epoxy coating shall completely cover the cast iron pipe and be free from any defects like scratch mark, blister, peeling etc.
Dimensions		
External diameter	Clause 5.2.1 BS EN 877: 1999 + A1: 2006	Measurement shall be within the tolerance given in table 1 of BS EN 877: 1999 + A1: 2006.
Wall thickness	Clause 5.2.2 BS EN 877: 1999 + A1: 2006	Measurement shall be at least equal to the minimum wall thickness given in table 1 of BS EN 877: 1999 + A1: 2006.
Internal diameter	Clause 5.2.3 BS EN 877: 1999 + A1: 2006	The internal diameter shall be not less than: (i) 0.975 DN for nominal sizes equal to or greater than DN 70; (ii) 0.950DN for nominal sizes less than DN 70.
Ovality	Clause 5.2.4 BS EN 877: 1999 + A1: 2006	The ovality of the pipes and of the sealing zones of fittings shall: (i) remain within the tolerances on external diameter shown in table 1 of BS EN 877: 1999 + A1: 2006 for DN 40 to DN 300; (ii) not exceed 1% for DN 400 to DN 600.

Straightness of pipes	Clause 5.2.5 BS EN 877: 1999 + A1: 2006	The pipes shall be straight with a maximum deviation of: (i) 0.15% of their length for nominal sizes greater than DN 70; (ii) 0.20% of their length for nominal sizes equal to or less than DN 70.
End faces	Clause 5.2.6 BS EN 877: 1999 + A1: 2006	The maximum deviation from the right angles shall be: (i) 3º for nominal sizes DN 40 to DN 200; (ii) 2º for nominal sizes DN 250 to DN 600.
Length of pipes	Clause 5.2.7 BS EN 877: 1999 + A1: 2006	The length of all pipes shall be within a tolerance of ± 20mm.
Length of fittings and sealing zones	Clause 5.2.7 BS EN 877: 1999 + A1: 2006	The length of fittings shall be within a tolerance of ± 5mm. The length "T" of sealing zone shall comply with the values given in Table 2 of BS EN 877: 1999 + A1: 2006.
Mass	Clause 5.3 BS EN 877: 1999 + A1: 2006	The lower deviation shall not exceed 15% of the nominal mass.
Mechanical properties		
Minimum tensile strength	Clause 5.4 BS EN 877: 1999 + A1: 2006	The result of the tensile tests shall be in accordance with the requirements of table 3 of BS EN 877: 1999 + A1: 2006.
Maximum Brinell hardness	Clause 5.5 BS EN 877: 1999 + A1: 2006	The test results shall conform to table 3 of BS EN 877: 1999 + A1: 2006.
Minimum ring crush strength	Clause 5.6 BS EN 877: 1999 + A1: 2006	The average three values shall be in accordance with the requirements of table 3 of BS EN 877: 1999 + A1: 2006.
Internal coating		
Resistance to salt spray	Clause 5.7.2.1 BS EN 877: 1999 + A1: 2006 with test period revised from 350 hours to 1000 hours	Degree of blistering shall not exceed dimension 3, class 3 according to ISO 4628-2. Degree of rusting shall not exceed Ri 2 according to ISO 4628-3.
Resistance to waste water	Clause 5.7.2.2 BS EN 877: 1999 + A1: 2006	No loss of adhesion and no rusting shall be accepted.
Chemical resistance to pH 2 to pH 12	Clause 5.7.2.3 BS EN 877: 1999 + A1: 2006	The acceptable degree of blistering after immersion, being dimension 3, class 3 according to ISO 4628-2. Cross-cut test shall meet level 1 of EN ISO 2409.
Dry coating thickness	Clause 5.7.2.4 BS EN 877: 1999 + A1: 2006	The mean value of measurement shall be not less than the minimum factory applied thickness specified by the manufacturer and shall not exceed 400µm.
Adhesion	Clause 5.7.2.5 BS EN 877: 1999 + A1: 2006	In accordance with level 1 of EN ISO 2409.
Resistance to hot water	Clause 5.7.2.6 BS EN 877: 1999 + A1: 2006	Degree of blistering shall not exceed dimension 3, class 3 in accordance with ISO 4628-2.
Resistance to temperature cycling	Clause 5.7.2.7 BS EN 877: 1999 + A1: 2006	Degree of blistering shall not exceed dimension 3, class 3 according to ISO 4628-2. Degree of rusting shall not exceed Ri 2 according to ISO4628-3.

External coating		
Compatibility with other paints	Clause 5.7.3.2 BS EN 877: 1999 + A1: 2006	In accordance with level 1 of EN ISO 2409.
Ignitability	Clause 5.7.3.3 BS EN 877: 1999 + A1: 2006	Reaction to fire to Class A2 of BS EN 13501-1.
Dry coating thickness	Clause 5.7.3.4 BS EN 877: 1999 + A1: 2006	The mean value of measurement shall conform to the minimum factory applied thickness as specified by the manufacturer.
Adhesion	Clause 5.7.3.5 BS EN 877: 1999 + A1: 2006	In accordance with level 2 of EN ISO 2409.
Joint		
Dimension	Clause 5.8.1 BS EN 877: 1999 + A1: 2006	The dimensions of the couplings and their components, including the elastomeric gaskets shall be in accordance with the supplier's catalogues and with Clause 4.7.2 of BS EN 877: 1999 + A1: 2006.
Elastomeric gasket	Clause 5.8.2.1 BS EN 877: 1999 + A1: 2006	Satisfy the type test in Clause 5.8.2.1 of BS EN 877: 1999 + A1: 2006.
Suitability for use	Clause 5.8.4, test condition a) and 5.8.5 BS EN 877:1999 + A1: 2006	Couplings and clamping components shall be without any permanent changes which could impair the performance of the joint.
Water tightness	Clause 5.8.4 and 5.8.5 BS EN 877:1999 + A1: 2006	Joints shall exhibit no visible leakage.
Air tightness	Clause 5.8.6 BS EN 877:1999 + A1: 2006	All joints shall be tight against positive internal air pressure of 0 mbar to 10 mbar.
Temperature resistance	Clause 5.8.7 BS EN 877: 1999 + A1: 2006	No leakage shall occur during the test. The gaskets shall show no deterioration which may affect their performance.

c. The Contractor shall warrant the epoxy coated cast iron pipeworks in accordance with the Special Conditions of Contract.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a);

ii. Original or certified true copy of the Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each Delivery Note;

iii. Delivery Notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for epoxy coated cast iron pipes and fittings upon delivery on Site. Prior to carrying out the verifications, inform the CM who may be present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards

Manufacturer's Certificate of Origin & Delivery Note	Document check	From an Approved origin with information of product identification numbers
Dimensional check: - outside diameter - wall thickness - ovality - straightness of pipes	By measurement; Contractor shall provide precise and calibrated measuring equipment	No deviation from the permissible limit specified by BS EN 877: 1999
Surface defects	Visual check	No irregular surface, pinhole or surface defect which could be detrimental to the service life. Inner epoxy coating shall completely cover the cast iron pipe and be free from any defects like scratch mark, blister, peeling etc.

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Manufacturer's Certificate of Origin & Delivery Note	1 set of samples from each batch	Individual
Dimensional check Surface defects	No less than 3% of the pipes and fittings from each batch	Same batch of material delivered to Site under the same Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate sets of samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

DRA1.M120.9 SPIGOT SPUN PIPES

Obtain from an Approved manufacturer.

DRA1.M150.A PLASTIC PIPES AND FITTINGS

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed uPVC pipes and fittings for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. When the uPVC pipes and fittings are supplied for domestic blocks, also include the following in the submission:

- Submit a sample board similar to the one maintained by the Housing Department showing the quality, detail technical information and application procedures for the proposed uPVC pipes and fittings. Submit an additional sample board of the approved sample for keeping in the Housing Department's Sample Display Gallery if the material has not been approved for use in a public housing project in the past five years prior to the notified date for commencement of the Works;

- Original or a certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS.

b. For uPVC pipes and fittings used in domestic blocks, submit original or a certified true copy of the product conformity certificate to the "Product Conformity Certification Scheme for uPVC Pipes and Fittings for Foul Water Drainage above Ground" (PCCS-UP) published by the Hong Kong Institution of Plumbing and Drainage Limited. If there is no uPVC pipes and fittings with product conformity certificate available in the market, the CM may accept the proposed uPVC pipes and fittings without product conformity certificate provided that the Contractor shall submit the original or certified true copy of the test reports showing full compliance with the requirements of sub-clause (2)(f) for the representative items in sub-clause (1)(d)(i) for the CM's information. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM:

i. The product conformity certificate shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a) above or at a time not later than 12 months from the date of commencement of the Works;

ii. In the event that the product conformity certificate has not been submitted for CM's information, the CM may order the removal of materials or delivered products off Site. The Contractor shall bear all associated costs and no extension of time will be allowed.

c. Submit a summary of the test results under the audit testing of the PCCS-UP. The summary shall be prepared by the accredited laboratory carried out the testing or the certified manufacturer. If so directed by the CM, submit a full set of the audit test reports to the CM for record;

d. Submit original or certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(f) for the representative items in sub-clause (1)(d)(i) for CM's information unless the test requirements are covered by the scope of the PCCS-UP:

i.

- Pipes: 50 mm ∅ pipe and 100 mm ∅ pipe;
- Fittings: 32 mm ∅ 88° Bend, 40 mm ∅ 88° Bend W/I.O., 50 mm ∅ 88° Junction W/I.O., 80 mm ∅ 88° W/I.O., 100 mm ∅ 88° Bend W/I.O. and 100 mm ∅ 150 x 100 Reducer Fittings;
- Traps: 40 mm and 50 mm ∅ traps including bottle trap, U-trap and W-trap;
- Two-way floor drain;
- 100mm ∅ W.C. Connector;
- Adhesive for pipe joint.

ii. The date of the test shall be within five years prior to the notified date for commencement of the Works or at an earlier date for domestic blocks subject to CM's consideration on the track records as maintained by the Housing Department;

iii. The test reports shall either be submitted at the sample submission and approval stage as mentioned in sub-clause (1)(a), or at a time not later than the delivery of the material as mentioned in sub-clause (3)(a);

iv. In the event that no test report has been submitted for CM's information when the materials are delivered to Site, the Contractor shall remove all delivered materials off Site and bear all associated costs and no extension of time will be allowed.

e. Unless otherwise specified, pipes and fittings for use in the Works shall be to either BS standards or BS EN standards. Propose either BS standards or BS EN standards for all pipes and fittings for CM's approval. Only the Approved standards shall be used for the Works unless the piping components are not covered by the Approved standard.

2. Quality Requirements:

a. Provide from a single source;

b. uPVC pipes and fittings to:

i. BS standards BS 4514:1983, BS 5255:1989 and BS 3943:1979; or

ii. BS EN standards BS EN 1329-1:2000 and BS EN 274-1:2000.

c. uPVC W.C. connector pipes to BS 5627:1984;

d. Adhesive for pipe joint to BS 4346-3:1982;

e. Colour: to Approval;

f. The quality and performance requirements are as follows:

i. Pipes, fittings and traps to BS standards:

Items	Method	Acceptance Standards
i. Waste Pipes		

Dimensions	BS 5255:1989, Clause 5	Wall thickness t, 2.4 mm ≥ t ≥ 2 mm		
Vicat Softening Temperature (VST)	BS 5255:1989, Clause 6.1	Temperature ≥ 90°C		
Impact Resistance of Pipes	BS 5255:1989, Clause 6.2	True impact rate (TIR) < 10%, crack through the full thickness of the pipe wall		
Heat Reversion of Pipes	BS 5255:1989, Clause 6.3 BS 2782: 1981 Method 1102A	Percentage change in length ≤ 2.5% at test temperature 120°C		
Leak tightness of pipework assemblies	BS 5255:1989, Clause 7.2	No Leakage		
Elevated Temperature Cycling Test	BS 5255:1989, Clause 7.3	- No leakage; - An appropriate ball to pass freely through it; - Maximum defection at any place in the system between the two adjacent supports shall be not greater than 1/10 of the nominal bore of the pipe incorporated in the test assembly.		
ii. Soil and Ventilating Pipes				
Dimensions	BS 4514:1983, Clause 4.1	Minimum wall thickness t ≥ 3.2 mm		
Vicat Softening Temperature (VST)	BS 4514:1983, Clause 5.1	Temperature ≥ 81°C		
Tensile Properties of Pipes	BS 4514:1983, Clause 5.2	- Strength ≥ 45 MPa - Elongation at break ≥ 80%		
Impact Resistance of Pipes	BS 4514:1983, Clause 5.3	- No failure in the first 14 strikes; or - Less than five failures in the total of 42 strikes.		
Heat Reversion of Pipes	BS 4514:1983, Clause 5.4 BS 2782:1981 Method 1102A	Percentage change in length ≤ 5%		
Proof Pressure Resistance of Pipework	BS 4514:1983, Clause 5.6	No leakage		
Elevated Temperature Cycling Test	BS 4514:1983, Clause 5.7	- No leakage; - An appropriate ball to pass freely through it.		
iii. Fittings for Waste Pipes				
Dimensions	BS 5255:1989, Clause 5	Nominal Size	Minimum Wall Thickness	
			VST ≥ 90°C	90°C > VST ≥ 80°C
		32	1.8 mm	2.7 mm
		40	1.9 mm	2.7 mm
		50	2.0 mm	2.7 mm
Vicat Softening Temperature (VST)	BS 5255:1989, Clause 6.1	- Temperature ≥ 90°C for minimum wall thickness < 2.7 mm; - Temperature ≥ 80°C for minimum wall thickness ≥ 2.7 mm.		

Stress Relief Behaviour of Mould Fittings	BS 5255:1989, Clause 6.4	- No weld line splitting; - Crack penetration in the area of injection point(s) shall be not greater than 50% of the wall thickness at the point of measurement; - Crack penetration in the area of interior ring gate shall be not greater than 50% of the wall thickness at the point of measurement; - Crack penetration in the area of end ring gate shall be not greater than 25% of the socket depth.
Leak Tightness of Pipework Assemblies	BS 5255:1989, Clause 7.2	No leakage
Elevated Temperature Cycling Test	BS 5255:1989, Clause 7.3	- No leakage; - An appropriate ball to pass freely through it; - Maximum deflection at any place in the system between the two adjacent supports shall be not greater than 1/10 of the nominal bore of the pipe incorporated in the test assembly.
iv. Fittings for Soil and Ventilating Pipes		
Dimensions	BS 4514:1983, Clause 4.1	Minimum wall thickness 3.2 mm
Vicat Softening Temperature (VST)	BS 4514:1983, Clause 5.1	Temperature ≥ 79°C
Stress Relief of Mould Fittings	BS 4514:1983, Clause 5.5	- No weld line splitting; - Crack penetration in the area of injection point(s) shall be not greater than 50% of the wall thickness at the point of measurement; - Crack penetration in the area of ring gate shall be not greater than 50% of the wall thickness at the point of measurement; - Crack penetration in the area of end ring gate shall be not greater than 25% of the socket depth.
Proof Pressure Resistance of Fabricated Fittings	BS 4514:1983, Clause 5.6	No leakage
Elevated Temperature Cycling Test	BS 4514:1983, Clause 5.7	- No leakage; - An appropriate ball to pass freely through it.
v. Traps including bottle trap, U-trap and W-trap		
Internal Clearance Test	BS 3943:1979, Clause 16	An appropriate ball to pass freely through it.
Impact Test	BS 3943:1979, Clause 17	No fracture or crack through the complete wall thickness
Residual Stress Test	BS 3943:1979, Clause 18	- No crack - No leakage
External Leakage Test and Inlet Attachment Test	BS 3943:1979, Clause 19.1	No weeping or visible deformation
Water Seal Test	BS 3943:1979, Clause 19.2	No leakage
Flow of Water Test	BS 3943:1979, Clause 20	Rate of flow ≥ 50 litres/min

Elevated Temperature Cycling Test	BS 3943:1979, Clause 15	- No leakage; - An appropriate ball to pass freely through it; - Satisfy BS 3943:1979, Clause 16 & 19 after Cycling Test.
vi. Two-way floor drain		
Vicat Softening Temperature (VST)	BS 5255:1989, Clause 6.1	Temperature ≥ 80°C.
Stress Relief Behaviour of Mould Fittings	BS 5255:1989, Clause 6.4	No weld line splitting; - Crack penetration in the area of injection point(s) shall be not greater than 50% of the wall thickness at the point of measurement; - Crack penetration in the area of interior ring gate shall be not greater than 50% of the wall thickness at the point of measurement; - Crack penetration in the area of end ring gate shall be not greater than 25% of the socket depth.

ii. Pipes, fittings and traps to BS EN standards:

Items	Method	Acceptance Standards
i. Pipes		
Dimensions	BS EN 1329-1:2000 Clause 6.1 & BS 2782-11: Method 1101A:1981	BS EN 1329-1:2000 Clause 6.2
Vicat Softening Temperature (VST)	BS EN 1329-1:2000 Clause 8.1 Table 19 & BS EN 727:1995	Temperature ≥ 79°C
Impact Resistance of Pipes	BS EN 1329-1:2000 Clause 7.1.1 Table 16 & either Round-the-clock method to BS EN 744:1996 or Staircase method to BS EN 1411:1996	For round-the-clock method True impact rate (TIR) ≤ 10% For staircase method H 50 ≥ 1m and maximum 1 break below 0.5m
Longitudinal Reversion of Pipes	BS EN 1329-1:2000 Clause 8.1 Table 19 & BS EN 743:1995 Method A	Percentage change in length ≤ 5% and the pipe shall exhibit no bubbles or cracks
Resistance to dichloromethane at a specified temperature	BS EN1329-1:2000 Clause 8.1 Table 19 & BS EN 580:1994	No attack at any part of the surface of the test piece
Watertightness	BS EN 1329-1:2000 Clause 9 Table 21 & BS EN 1053:1996	No leakage
Airtightness	BS EN 1329-1:2000 Clause 9 Table 21 & BS EN 1054:1996	No leakage

Elevated Temperature Cycling Test	BS EN 1329-1:2000 Clause 9 Table 21 & BS EN 1055:1996 Figure 1 for components with nominal outside diameter equal to or greater than 40mm Figure 3 for components with nominal outside diameter smaller than 40mm	- No leakage; - Sagging for DN ≤ 50: ≤ 3mm DN > 50: ≤ 0.05dn
Weathering Resistance	BS 4514:2001 Annex A & BS 2782-11 Method 1107A:1996	No visible change in colour between the exposed and shaded parts of the specimens
ii. Fittings		
Dimensions	BS EN 1329-1:2000 Clause 6.1 & BS 2782-11: Method 1101A:1981	BS EN 1329-1:2000 Clause 6.3
Vicat Softening Temperature (VST)	BS EN 1329-1:2000 Clause 8.2 Table 20 & BS EN 727:1995	Temperature ≥ 79°C
Effects of Heating	BS EN 1329-1:2000 Clause 8.2 Table 20 & BS EN 763:1995 Method A	- Within a radius of 15 times the wall thickness around the injection point, the depth of cracks, delamination or blisters shall not exceed 50% of the wall thickness at that point; - Within a distance of 10 times the wall thickness from the diaphragm zone, the depth of cracks, delamination or blisters shall not exceed 50% of the wall thickness at that point; - Within a distance of 10 times the wall thickness from the ring gate, the length of cracks shall not exceed 50% of the wall thickness at that point; - The weld line shall not have opened more than 50% of the wall thickness at that line; - In all other parts of the surface the depth of cracks and delamination shall not exceed 30% of the wall thickness at that point. Blisters shall not exceed a length 10 times of the wall thickness; - After cutting through the fitting, the cut surfaces shall show no foreign particles, when viewed without magnification.
Watertightness	BS EN 1329-1:2000 Clause 9 Table 21 & BS EN 1053:1996	No leakage
Airtightness	BS EN 1329-1:2000 Clause 9 Table 21 & BS EN 1054:1996	No leakage

Elevated Temperature Cycling Test	BS EN 1329-1:2000 Clause 9 Table 21 & BS EN 1055:1996 Figure 1 for components with nominal outside diameter equal to or greater than 40mm Figure 3 for components with nominal outside diameter smaller than 40mm	- No leakage; - Sagging for DN ≤ 50: ≤ 3mm DN > 50: ≤ 0.05dn
Weathering Resistance	BS 4514:2001 Annex A & BS 2782-11 Method 1107A:1996	No visible change in colour between the exposed and shaded parts of the specimens
iii. Traps including bottle trap, U-trap and W-trap		
Appearance of Surfaces	Visual examination	BS EN 274-1:2000 Clause 4.2 The internal and external surfaces shall be smooth, free from grooving, blistering or any other surface defects likely to impair their functioning
Depth of Water Seal	BS EN 274-2:2002 Clause 4	Trap for waste fitment connected to waste pipe, water seal not less than 40mm Trap for waste fitment connected to soil pipe, water seal not less than 80mm
Leaktightness Test	BS EN 274-2:2002 Clause 6.2	BS EN 274-1:2002 Clause 4.7.2 No leakage
Flow Rate Test	BS EN 274-2:2002 Clauses 5.1 & 5.4	BS EN 274-1:2002 Clause 4.6 Table 3
Temperature Cycling Test	BS EN 274-2:2002 Clause 3 & Leaktightness Test shall be carried out immediately after the test	BS EN 274-1:2002 Clause 4.3 No leakage
iv. Two-way floor drain		
Vicat Softening Temperature (VST)	BS EN 1329-1:2000 Clause 8.2 Table 20 & BS EN 727:1995	Temperature ≥ 79°C.

Effects of Heating	BS EN 1329-1:2000 Clause 8.2 Table 20 & BS EN 763:1995 Method A	- Within a radius of 15 times the wall thickness around the injection point, the depth of cracks, delamination or blisters shall not exceed 50% of the wall thickness at that point; - Within a distance of 10 times the wall thickness from the diaphragm zone, the depth of cracks, delamination or blisters shall not exceed 50% of the wall thickness at that point; - Within a distance of 10 times the wall thickness from the ring gate, the length of cracks shall not exceed 50% of the wall thickness at that point; - The weld line shall not have opened more than 50% of the wall thickness at that line; - In all other parts of the surface the depth of cracks and delamination shall not exceed 30% of the wall thickness at that point. Blisters shall not exceed a length 10 times of the wall thickness; - After cutting through the fitting, the cut surfaces shall show no foreign particles, when viewed without magnification.

iii. 100mm ∅ W.C. Connector

Vicat Softening Temperature (VST)	BS 5627:1984 Clause 7a.3 Method 120B of BS 2782: Methods 120A to 120E:1976	Temperature ≥ 79°C
Stress Relief of Moulded Fittings	BS 5627:1984 Clause 7a.3 BS 2782: Method 1103A	- No blisters, delaminations, cracks or weld line splitting; - Crack penetration in the area of injection point(s) shall be not greater than 50% of the wall thickness of that point; - Crack penetration in the area of end gating shall be not greater than 25% of the corresponding socket depth.
Water Tightness Test	BS 5627:1984 Clause 9.1 & Appendix E	No leakage
Air Tightness Test	BS 5627:1984 Clause 9.2 & Appendix F	No loss of pressure
Water and Air Tightness under Deflection	BS 5627:1984 Clause 9.3	No loss of pressure

iv. Adhesive for pipe joint:

Chemical Composition	Manufacturer's certificate	Meet the stated chemical property requirements
VOC Limit	SCAQMD Method 316A as specified in the Air Pollution Control (Volatile Organic Compounds) Regulation	Comply prescribed limit stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation Schedule 7

Shear Strength	BS 4346-3:1982 Clause 5.1 & Appendix A	BS 4346-3:1982 Clause 5.1.1, 5.1.2 & 5.1.3
Film Properties	BS 4346-3:1982 Clause 5.2 & Appendix B	BS 4346-3:1982 Clause 5.2.1
Long-term Hydrostatic Pressure	BS 4346-3:1982 Clause 5.3 & Appendix C	BS 4346-3:1982 Clause 5.3

g. When the pipes and fittings are supplied for domestic blocks, standard of visual quality of pipes and fittings shall be comparable with the benchmark samples maintained by the Housing Department;

h. Anti-siphon traps are to be fitted with a one way valve disk of corrosion-resistant metal or alloy, e.g. brass or stainless steel. Corrosion resistant coating, e.g. chromium plating, is not acceptable. The one way valve disk is to be affixed with a similar metal or alloy pin complete with a rubber gasket. Ensure that pipes and fittings, including the anti-siphon traps, are suitable for their intended use, particularly where hot liquids and chemicals etc. may be discharged into the system.

3. On Site Delivery Verification:

a. At delivery stage, submit the following information for CM's approval:

i. Written confirmation that the material delivered to Site is in accordance with the Approved sample submitted under sub-clause (1)(a);

ii. Relevant import / export documents from overseas and from Mainland China, original or certified true copy of Certificate of Origin for every batch of delivery. One batch being the material quantity covered under each Delivery Note;

iii. Delivery Notes for all material delivered to Site.

b. Carry out and submit report on the following verifications for uPVC pipes and fittings upon delivery on Site. Prior to carrying out the verifications, inform the CM who may present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Diameter and Wall Thickness Check	By measurement	DRA1.M150 (2)(f) - dimensions
Surface Quality	Visual	No discolouration, no damage, no staining, no blemish, acceptable colour consistency
Logo & Label Check	Visual	Same as the CM's Approved sample.

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Diameter and Wall Thickness Check	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note

Surface Quality	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note
Logo and Label Check	1 sample from each batch	Same batch of material delivered to Site under one Delivery Note

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed..

DRA1.M160.9 BALLOON GRATING / VENT COWL

Of an Approved proprietary brand and either:

1. Galvanized steel wire or copper wire; or
2. uPVC or polypropylene, as shown on the Drawings.

DRA1.M170.9 PLASTIC VERTICAL GRATINGS

1. For non-fire protected areas such as domestic flats;
2. Approved uPVC vertical grating to BS 5255:1989 or to BS EN 1329-1:2000.

DRA1.M171.9 STAINLESS STEEL VERTICAL GRATINGS

1. For use at fire protected areas, exit routes or common areas;
2. Of an Approved proprietary brand:
   a. Minimum 1.5mm thick grade 304 stainless steel plate hairline finished;
   b. Submit shop drawings showing dimensions and fixing details for approval.

DRA1.M180.9 UPVC TWO-WAY FLOOR DRAIN OUTLET

1. Of an Approved proprietary brand comprise of the following:
   a. uPVC horizontal drain pipe with sealing flange;
   b. uPVC adaptor unit for vertical grating. The adaptor unit shall have built-in drainage fall towards downstream, and shall allow easy removal of vertical grating by unscrewing the fixing screws after the installation for maintenance purpose. Its spigot connecting to the drainpipe may also be cut short to suit the thickness of the wall finishes;
   c. uPVC adjustable horizontal grating unit with sealing flange and removable horizontal grating, and shall allow for cutting low to suit finished floor level;
   d. 2 Nos. uPVC gratings for vertical and horizontal use complete with stainless steel screws;
   e. Submission and quality requirements as per DRA1.M150.
2. Submit shop drawings showing dimensions and fixing details for approval.

DRA1.M190.9 SMALL DIAMETER UPVC PIPES

uPVC pipes of less than 30mm diameter shall be of an Approved proprietary brand to BS 3505:1986.

BRACKETS AND FIXINGS

DRA1.M210.A PIPE BRACKETS

1. Stainless steel of Grade 304;
2. Pattern and type to suit the type of pipe and the surface to which they are to be fixed, as shown on the Drawings, including where appropriate:
    a. Flanged ends for building in;
    b. Plain round ends for fixing in drilled holes with an Approved grout;
    c. Approved expanding bolts or stud anchors for fixing to concrete, brickwork, blockwork and panel wall partition etc.;
    d. Threaded ends for fixing to steelwork, or wood, or panel wall with plug as required;
    e. Countersunk-holed face plates for screwing to wood or plugs, or panel wall with plug;
    f. Brackets lined with resilient plastic at pipe clamps.
3. Be with stainless steel nuts and washers to cover the drilled holes for pipe brackets as shown on the Drawings.

DRA1.M220.9 BOLTS FOR CAST IRON AND STEEL PIPEWORKS

Brass, cadmium plated steel or other non-corrodible metal.

DRA1.M230.9 BOLTS FOR SOIL STACK ACCESS DOORS FOR CAST IRON AND STEEL PIPEWORKS

Gunmetal or a material compatible with the cast iron pipework system recommended / supplied by the same supplier / manufacturer.

DRA1.M240.9 WOOD SCREWS

Brass to BS 1210:1963, with countersunk heads and of a length sufficient to ensure a secure fixing.

DRA1.M250.9 PLUGS

1. For fixing to:
    a. Hard materials: proprietary plastic, fibre, soft metal or similar;
    b. Friable materials, plasterboard and the like: proprietary fixings specially designed for the purpose.
2. Do not use wooden plugs or plugs containing asbestos.

DRA1.M260.N COATING OF PIPE BRACKETS FOR PIPEWORKS INSTALLED IN INDOOR AREAS OF DOMESTIC BLOCK

1. All stainless steel pipe brackets for pipeworks installed in indoor areas including but not be limited to indoor communal areas where they can be accessed by the public, water meter cabinets, pipe duct rooms, etc. of domestic block, shall be applied with the Approved coating to the requirements of FIN7.M584 on the surface to maintain the measured insulation resistance between the coated pipe brackets and the main earthing terminal at not less than 45,000 Ohm even under the worst conditions of high environmental moisture such that the pipe bracket can be considered as a non-extraneous conductive part for effective insulation in accordance with the Code of Practice for The Electricity (Wiring) Regulations subject to sub-clause (2);
2. Conditions of pipe brackets required for coating application:
    a. The pipe brackets are installed within 2m from any exposed conductive parts or other extraneous conductive parts;
    b. The pipe brackets can be gripped or contacted by a major surface of human body in excess of 50mm x 50mm.
3. Coating application:
    a. Apply the Approved coating on the stainless steel pipe bracket in factory;
    b. Test each coated pipe bracket in factory by applying 500V D.C. test voltage using a suitably calibrated D.C. insulation tester to verify compliance with the minimum insulation resistance of 45,000 Ohm prior to delivery to Site.
4. Prior to mass application of coating to the pipe brackets, submit the following for approval by the CM:
    a. A sample of the stainless steel pipe bracket with the Approved coating applied in accordance with the paint manufacturer's recommendations;
    b. A Type Testing Report of Insulation Resistance Test for the submitted sample of pipe bracket in sub-clause (4)(a), demonstrating a measured insulation resistance of not less than 45,000 Ohm.
5. On Site Delivery Verification:
    a. For each batch of coated pipe brackets required to achieve the insulation resistance performance, submit a confirmation letter to declare that the coated pipe brackets delivered complied with sub-clause (3) requirements;
    b. Carry out testing with a suitably calibrated D.C. insulation tester in the presence of CM's representative on random samples of one in every 100 for each batch of coated pipe brackets delivered to verify that the measured insulation resistance achieved not less than 45,000 Ohm, prior to mass installation;
    c. When any of the verifications fail to meet the acceptance standards, either:
        i. Remove the representative batch off Site; or
        ii. When agreed by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and the extra time required.
6. Verification at Sample Floors

a. Carry out testing with a suitably calibrated D.C. insulation tester in the presence of the CM's representative on mock up installations for all coated pipe brackets at sample floor(s) or other locations selected by the CM's representative to verify that the measured insulation resistance achieved not less than 45,000 Ohm even under the worst conditions of high environmental moisture, prior to mass installation;

b. The testing method for measurement in sub-clause (6)(a) shall be proposed by the Contractor and agreed by the CM.

7. If there is any damage to the paintwork due to transportation from factory to site, improper handling or storage on site, subsequent touching up works with Approved paint or replacement works and re-measurement of the insulation resistance shall be carried out. Bear all associated costs and the extra time required.

PIPE SLEEVES AND COVER PLATES

DRA1.M310.A UPVC PIPE SLEEVES FOR CASTING OR BUILDING IN

To BS 3505:1986 or BS EN ISO 1452-2:2009 and with minimum 8.5 mm clearance to allow for expansion and movement of pipe and filling works for the annular space between the pipe sleeve and the pipe.

DRA1.M320.9 FIRE RESISTING PIPE SLEEVES

Medium duty galvanized mild steel pipe sleeve to BS 1387:1985 with 20 mm clearance.

DRA1.M330.9 CAST IRON OR MILD STEEL PIPE SLEEVES

Cast iron or 2.5 mm thick mild steel sleeve galvanized after fabrication with 2 - 12 mm clearance.

DRA1.M340.9 PIPE SLEEVES FOR BASEMENT WALLS

For pipes passing through external basement walls where ground water pressure is significant, provide:

1. A short length of cast iron pipe as sleeve with split bolt on puddle flange and with socket on outside;
2. A cast iron plug drilled to take long screw and back nuts as necessary.

DRA1.M350.9 PROTECTIVE TAPE

An Approved petroleum based tape.

DRA1.M360.9 FIRE RESISTANT BANDAGE AND WRAP

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample board of the proposed bandage and wrap including fittings and accessories for CM's approval together with all the following substantiation for CM's information:
      i. Catalogue, brand name / model name and job reference of the material;
      ii. Name, address and contact person of the local supplier / distributor;
      iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. Certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS.

b. Test report or product certificate:

i. Certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b). Test shall be carried out within 3 years from the notified date for commencement of the Works; or

ii. Certified true copy of certificate for an accredited third party product conformity scheme issued by an internationally recognized certification body such as CE Making (CE), FM Approvals, Underwriters Laboratories (UL), Certifire, or equivalent, showing full compliance with the requirements of sub-clause (2)(b) for the proposed product; validity period of tests at the scheme shall be within 5 years from the notified date for commencement of the Works.

c. Shop drawings including manufacturers' recommendations for the fire stopping system installation for CM's approval prior to commencement of work.

2. Quality Requirements:

a. An Approved proprietary flexible intumescent graphite impregnated band or wrap fixed in accordance with the manufacturer’s recommendations to achieve the required fire resistance performance;

b. To BS 476:Part20:1987 or BS EN 1366:Part3:2009 and certified as being capable of resisting the action of fire for the specified periods by a laboratory which must be accredited for the specific test by HKAS under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS with appropriate qualifications and experience in fire resisting construction.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a) and (b);

ii. For products with a third part product conformity scheme submitted as per sub-clause (1)(c)(ii), submit a Manufacturer Certificate from the local supplier / distributor at sub-clause (1)(a)(ii) confirming the products delivered to Site comply with the third party product conformity scheme requirements;

iii. Delivery Notes for all material delivered to Site, including the following:

- Confirmation in writing on the serial number of the fire resistant bandage and wrap delivered to Site; confirmation to be from the local supplier / distributor;

- Copy of docket showing the serial number of the fire resistant bandage and wrap delivered to Site; copy to be provided by the manufacturer at sub-clause (1)(a)(v).

b. Carry out and submit report on the following verifications upon delivery on Site. Prior to carrying out the verifications, inform the CM who may be present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards
Delivery Note with content at sub-clause (3)(a)(iii)	Document check	Material delivered is from the manufacturer in sub-clause (1)(a)(v); Serial number same as sub-clause (3)(a)(iii)
Width of wrap	Measurement	As per Approved sample

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Delivery Note	1 sample from each batch	Individual

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate sets of samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

DRA1.M370.9 FIRE RESISTING PIPE COLLAR

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample board of the proposed fire resisting fire collar including fittings and accessories for CM's approval together with all the following substantiation for CM's information:

i. Catalogue, brand name / model name and job reference of the material;

ii. Name, address and contact person of the local supplier / distributor;

iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent / distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product;

v. A certified true copy of the ISO 9001 certificate for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by a certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS.

b. Test report or product certificate:

i. Certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of the test reports showing full compliance with the requirements of sub-clause (2)(b). Test shall be carried out within 3 years from the notified date for commencement of the Works; or

ii. Certified true copy of certificate for an accredited third party product conformity scheme issued by an internationally recognized certification body such as CE Marking (CE), FM Approvals, Underwriters Laboratories (UL), Certifire, or equivalent, showing full compliance with the requirements of sub-clause (2)(b) for the proposed product; validity period of tests for the scheme shall be within 5 years after the notified date for commencement of the Works.

c. Shop drawings including manufacturers' recommendations for the fire stopping system installation for CM's approval prior to commencement of work.

2. Quality Requirements:

a. An Approved proprietary surface mount pipe collar of metal enclosure containing intumescent material mechanically fixed to substrate in accordance with the manufacturer's recommended installation methods to achieve the required fire resistance performance;

b. To BS 476:Part20:1987 or BS EN 1366:Part3:2009 and certified as being capable of resisting the action of fire for the specified periods by a laboratory which must be accredited for the specific test by HKAS under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS with appropriate qualifications and experience in fire resisting construction.

3. On Site Delivery Verification:

a. At delivery stage, submit the following documents:

i. Written confirmation that the material delivered to Site conforms with the Approved sample submitted under sub-clause (1)(a) and (b);

ii. For products with a third part product conformity scheme as per sub-clause (1)(b)(ii) requirements, submit a Manufacturer Certificate from the local supplier / distributor at sub-clause (1)(a)(ii) confirming the products delivered to Site comply with the third party product conformity scheme requirements;

iii. Delivery Notes for all material delivered to Site, including the following:

- Confirmation in writing on the serial number of the fire resisting pipe collar delivered to Site; confirmation to be from the local supplier / distributor;

- Copy of docket showing the serial number of the fire resisting pipe collar delivered to Site; copy to be provided by the manufacturer at sub-clause (1)(a)(v).

b. Carry out and submit report on the following verifications upon delivery on Site. Prior to carrying out the verifications, inform the CM who may be present to witness the verifications:

i. Method:

Verification Items	Method	Acceptance Standards

Delivery Note with content at sub-clause (3)(a)(iii)	Document check	Material delivered is from the manufacturer in sub-clause (1)(a)(v); Serial number same as sub-clause (3)(a)(iii)
Collar dimensions	Measurement	As per approved sample

ii. Frequency:

Items	Sampling Frequency	Representative Batch
Delivery Note	1 sample from each batch	Individual

c. Where any of the verifications fail to meet the acceptance standards, either:

i. Remove the representative batch off Site; or

ii. When agreed by the CM, repeat all verification items on three separate sets of samples selected by the CM. In case of failure of any verification to any one sample, remove the representative batch off Site, bear all associated costs, and no extension of time will be allowed.

JOINTING MATERIALS

DRA1.M405.9 GENERAL

Primer, caulking compound and all materials for jointing uPVC pipes shall be in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compound) Regulation.

DRA1.M410.9 JOINTING RINGS, COUPLINGS AND ADAPTORS GENERALLY

Of types recommended by the manufacturer of the pipes being jointed.

DRA1.M420.9 GASKIN

Tarred spun yarn or hemp.

DRA1.M430.9 COLD CAULKING COMPOUND

An Approved proprietary brand.

DRA1.M450.9 MORTAR

Cement and sand, 1 : 2, mixed in accordance with Worksection MAS3.

DRA1.M460.9 JOINTING COMPOUND FOR SCREWED JOINTS

An Approved proprietary brand compatible with the pipes and fittings and recommended by the pipe supplier.

DRA1.M470.9 PIPE THREAD TAPE

Unsintered polytetrafluroethylene (PTFE) tape to BS 7786:2006 of an Approved proprietary brand.

DRA1.M480.9 PRIMER FOR THREADED JOINT TO STEEL PIPES

An Approved non-toxic anti-corrosion epoxy base polyamide primer.

SUNDRIES MATERIALS

DRA1.M510.9 FIRE SEALING SYSTEM FOR UPVC PIPES PASSING THROUGH FIRE RESISTING STRUCTURES

In accordance with WAT5.M200.

DRA1.M520.9 PRECAST CONCRETE WEDGE SUPPORT TO PIPES

In accordance with DRA2.M540.

WORKMANSHIP

GENERAL

DRA1.W002.9 APPROVED CONTRACTOR FOR DRAINAGE WORKS ABOVE GROUND

The drainage works above ground required under the Contract shall be carried out by the plumbing installation sub-contractor employed by the Contractor under PLU1.G012 (1).

DRA1.W010.9 INSPECTION OF PIPES AND FITTINGS

Inspect pipes and fittings inside and out before fixing, reject any which appears defective.

DRA1.W020.9 HANDLING AND STORAGE

1. Store rubber jointing rings in protective bags and do not expose them to sunlight. Avoid any deformation;
2. Store pipes and fittings under cover and clear of a levelled, well-drained and maintained hard-standing ground;
3. Stack pipes without resting them on their sockets.

FIXING PIPES

DRA1.W110.9 GENERAL

1. Fix pipes and fittings securely with fixings and fastenings appropriate to the location and the material;
2. Do not use branch pipes that connect to vertical pipes as pipe supports;
3. Avoid pipe runs above electrical switchgear and at locations which may cause obstruction inside pump rooms.

DRA1.W120.9 INSTALLING FOUL DRAINAGE ABOVE GROUND

To BS 5572:1994 in general and with reference to BS EN 12056-2:2000.

DRA1.W130.9 THERMAL MOVEMENT

1. Make adequate provision to control and/or allow for thermal movement in the length of pipes and gutters depending on material specified and in accordance with details shown on the Drawings;
2. Provide expansion joints in plastic pipes by means of loops or other methods in accordance with the manufacturer's recommendations.

DRA1.W140.9 PIPES ACCESSIBLE TO VERMIN

Place vertical pipes in situations which are accessible to rodents at least 100 mm away from any adjacent wall or pipe, to a minimum height from ground level of 1500 mm.

DRA1.W150.9 PROVISION FOR ACCESS FOR CAST IRON AND STEEL PIPEWORKS

Provide bolted access doors or inspection units to all branches and bends (other than ventilating and anti-syphon pipes) and at the foot of main soil stacks. Fit access doors to cast iron soil stacks with gunmetal bolts and rubber gaskets.

DRA1.W160.9 SPACING OF PIPE SUPPORTS

Space pipe supports as follows and in all cases, use not less than one fixing per length of pipe or as approved by CM:

Pipes	Nominal size (mm)	Maximum spacing (mm)	
		Vertical pipes	Horizontal pipes
Cast iron	51 76 and 102 152	1800 2700 3600	1800 2700 3600
Steel	15 20 and 25 32 40 and 50 80 100 150	2400 3000 3000 3600 4500 4500 5400	1800 2400 2700 3000 3600 3900 4500
uPVC	up to 25 32 to 40 50 75 to 100 150	1200 1200 1200 2000 2000	500 500 600 1000 1200

DRA1.W170.9 EMBEDDED PIPES

Do not cast in or build pipes into chases in walls and floors unless this is unavoidable or directed, in which case:

1. Coat all pipes which come into direct contact with concrete with an Approved petroleum based tape;
2. Ensure that there are no joints in straight pipes built in other than elbows.

DRA1.W180.9 PIPES ON FLAT ROOFS AND CANOPIES

Support pipes on flat roofs and canopies at least 150 mm above roof and canopy finish on concrete blocks with pipe clamps.

DRA1.W190.9 FIXING CAST IRON GUTTERS

1. Fix cast iron gutters with screwed brackets at 1000 mm (maximum) centres to falls of 1 in 300 (minimum);
2. Joint gutters with jointing compound and bolt together.

DRA1.W200.9 FIXING PLASTIC GUTTERS

Fix gutters with screwed gutter brackets:

1. At 1000 mm (maximum) centres;
2. Generally to falls of 1 in 300 (minimum).

DRA1.W210.9 FIXING UPVC TWO-WAY FLOOR DRAIN OUTLET

1. Cast in uPVC horizontal drain pipe at the correct level fall and alignment as shown on the Drawings and to suit the thickness of wall and floor finishes;
2. Fix uPVC adaptor unit to the horizontal drain pipe. Cut the length of spigot if necessary where it connects onto the hopper of the drainpipe to suit the thickness of wall finishes, and ensure to maintain a minimum 8 mm of overlap between the spigot and the connecting hopper of the drainpipe;
3. Fix uPVC adjustable horizontal grating unit to the adaptor. Cut down the height of the unit if necessary to suit the finished floor level;
4. Ensure the fixing as mentioned in sub-clauses (2) and (3) above are to manufacturer's recommendations and all joints are watertight;
5. Seal the joints between the adaptor unit and wall tiles, and the joints between adjustable horizontal grating unit and floor tiles;
6. Install gratings to adaptor unit and adjustable horizontal grating unit with stainless steel screws.

DRA1.W220.A INSTALLATION OF EPOXY COATED CAST IRON PIPES AND FITTINGS

1. The installation shall be carried out in strict compliance with the manufacturer’s recommendations. Particular attention shall be paid to the proper tightening of the bolts at the coupling joints;
2. The spacing and location of stainless steel brackets supports or hangers shall not deviate from the instructions of the manufacturer and in no case exceed 2m between pipes or 0.75m from couplings;
3. For bends at the bottom of stack and other locations subject to high hydraulic thrust, grip collars and additional bracket / hanger shall be installed in strict compliance with the manufacturer’s recommendation to counterbalance the high hydraulic thrust;
4. Pipes shall be cut to the required length with the suitable tools in accordance with the manufacturer’s recommendation. All cut ends and areas where epoxy coating is damaged shall be touched up with epoxy resin as supplied or recommended by the manufacturer prior to installation;
5. After installation, any adjacent connecting pipes or fittings shall not have an angular deflection greater than 3 degree or over the maximum permissible limit as recommended by the manufacturer of the proposed epoxy coated cast iron pipes and fittings.

JOINTING PIPES AND FITTINGS

DRA1.W310.9 JOINTING PIPES AND FITTINGS GENERALLY

Carry out all pipe joints in accordance with the manufacturer's instructions and do not allow jointing material to project into bore of pipes or fittings.

DRA1.W320.9 CUTTING PIPES AND GUTTERS

Cut ends of pipes and gutters clean and square, chamfering internally or externally if required using equipment appropriate to the material.

DRA1.W330.9 JOINTS BETWEEN DISSIMILAR METALS

1. Make joints between different metals with proper adaptors;

2. Avoid contact between certain dissimilar metals as follows:
   a. Aluminium alloys with copper alloys, nickel, lead or stainless steel;
   b. Iron and steel with copper alloys;
   c. Zinc with copper alloys. In particular avoid the direct contact of copper with galvanized iron or steel pipes;
   d. If unavoidable, use gunmetal joints between the dissimilar metals.

DRA1.W340.9 PIPES REQUIRING CORROSION PROTECTION

Fix pipes requiring protection against corrosion with a 40 mm (minimum) clearance between pipe, structure and adjacent surfaces. Avoid fixing such pipes at internal angles.

DRA1.W350.9 CAST IRON SPIGOT AND SOCKET PIPES

1. Joint pipes with cold caulking compound in accordance with manufacturer's instruction;
2. Do not allow the jointing material projecting into bore of pipes or fittings.

DRA1.W360.9 CAST IRON SPUN SPIGOT PIPES

1. Joint pipes with flexible joints in accordance with the manufacturer's recommendations;
2. Do not joint the pipes with molten lead.

DRA1.W370.9 JOINTING STEEL PIPES GENERALLY

Joint steel pipes with screwed sockets:

1. With jointing compound or pipe thread tape;
2. Cutting threads with a tapered die. Threads found to be cut too deep will be rejected;
3. Paint all threaded surfaces with one coat of non-toxic anti-corrosion epoxy base polymide primer as DRA1.M480 and one coat compatible finish.

DRA1.W380.9 JOINTING STEEL PIPES TO CAST IRON PIPES

Joint steel pipes to sockets of cast iron pipes with cold caulking compound in accordance with manufacturer's instruction.

DRA1.W390.9 JOINTING PIPES TO CLAY PIPE SOCKETS

Joint pipes to clay spigot and socket pipes with gaskin and mortar.

DRA1.W400.9 JOINTING PLASTIC PIPES TO OTHER MATERIALS

Joint plastic pipes to pipes of other materials with proprietary adaptors.

PIPES PENETRATING THE BUILDING STRUCTURE

DRA1.W510.9 PIPES PASSING THROUGH WALLS AND FLOORS

Cast or build in uPVC sleeves as detailed on the Drawings, and:

1. Finish sleeves flush with the finished face of walls and ceilings and projecting 100 mm above finished floor level;
2. Point with Approved mastic sealant if required to be watertight;

3. Do not split uPVC sleeves.

DRA1.W520.9 PIPES PASSING THROUGH FIRE RESISTING STRUCTURES

Where pipes pass through fire rated walls or floors:

1. Cast or build in galvanized mild steel pipe sleeve with 20 mm clearance;
2. Finish sleeves flush with the finished face of walls and ceilings. Projection above finished floor level according to manufacturer's instruction;
3. Well caulk void between pipe and sleeve for the full length with non-flammable mineral wool or other products having equivalent functions or performance, point with Approved fire-rated sealant to maintain the required FPR of the wall/floor slab.

DRA1.W530.9 UPVC PIPES PASSING THROUGH FIRE RESISTING STRUCTURES

Where uPVC pipes pass through fire rated walls or floors:

1. Cast or build in galvanized mild steel pipe sleeve as shown on the Drawings;
2. Finish sleeves flush with the finished face of walls and ceilings. Projection above finished floor level according to manufacturer's instruction;
3. Well caulk void between pipe and sleeve for the full length with mineral wool and point with Approved fire-rated sealant, or pipe wrap or collar, all in accordance with manufacturer's recommendation;
4. Install the fire sealing system in accordance with manufacturer's instruction to maintain the required FPR of the wall / floor slab.

DRA1.W540.9 PIPES PASSING THROUGH BASEMENT WALLS

1. Where pipes pass through external basement walls:
   a. Cast or build in with 2-12 mm clearance, a cast iron or mild steel sleeve;
   b. Caulk space and point both ends with Approved mastic sealant.
2. Where pipes pass through external basement walls and ground water pressure is significant:
   a. Cast or build in short length of cast iron pipe as sleeve with split bolt on puddle flange and with socket on outside;
   b. Well caulk socket around pipe with yarn and lead including providing a cast iron plug drilled to take long screw and back nuts if necessary;
   c. Point inside with an Approved mastic sealant.

DRA1.W550.N PIPES PASSING THROUGH EXTERNAL WALLS

Where pipes pass through external walls:

1. Cast or build in uPVC pipe sleeves as shown on the Drawings;
2. Fill the annular space between the pipe sleeve and the pipe with proprietary waterproof filling mortar or polyurethane foam;
3. Caulk both ends with mastic sealant.

PROTECTION

DRA1.W610.9 SEALING THE SYSTEM

Prevent entry of foreign matter into any system by sealing off ends of pipes and openings during construction.

TOLERANCES

DRA1.W710.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

PIPELINE CONNECTION IDENTIFICATION

DRA1.W810.9 PIPEWORK CONNECTION IDENTIFICATION

1. Provide a temporary colour band around the circumference of the open end(s) of installed aboveground pipes to be connected to the underground pipes which discharge to manholes and back inlet gully trap. The colour and width of the band are as follows:

Type of Drain Pipe	Colour	Width of Colour Band
Storm water	White	75 mm
Waste water	Yellow	75 mm
Soil water	Green	75 mm

2. Upon the completion of drainage works, provide attendance and materials to facilitate inspection by CM's representatives of the connection of aboveground pipes to manholes and back inlet gully trap.

TESTING

ON-SITE VERIFICATION TESTS

DRA1.T110.9 TESTING FOR SURFACE WATER DRAINAGE

1. Testing Arrangements:
    a. Carry out test in the presence of the CM's respresentatives;
    b. Provide clean water and appropriate apparatus for testing.
2. Testing Samples
    a. Test pipes as soon as practical after the completion of each section of pipework and before any work is concealed.
3. Testing Methods:
    a. Ensure that all pipe runs are clear of obstructions by visual examination, or by throwing a ball into the pipework or other method Approved by CM before testing;
    b. For internal pipes, pour water into the pipes and check for water leakage;
    c. Acceptance standard: no visual sign of leakage can be observed;
    d. Submit three copies, or other number of copies as directed by the CM, of the testing reports for the tests carried out, in a format to be agreed with the CM, within 1 week upon completion of testing for Approval.
4. Non-compliance:
    a. In the event that any test fails to meet the requirements:
        i. Locate and make good all defects;
        ii. Re-test to satisfaction of the CM;
        iii. Bear all costs of remedial works and the re-test. No extension of time will be allowed.

DRA1.T210.9 TESTING FOR FOUL WATER DRAINAGE

1. Testing Arrangements:
    a. Carry out test to the installed foul water drainage pipework. Test to be carried out in the presence of the CM or his representatives;
    b. Submit method statements for testing, together with details of appropriate type of testing equipment, for Approval by the CM;
    c. Provide clean water, colour solution and appropriate apparatus for testing;
    d. Ensure colour solution do not stain or damage the installed permanent work including tile, tile grout, pipe and fittings etc.. Clean and remove water stain on the surface of the finishes and pipework, caused by the test if any, carefully.
2. Testing Samples:
    a. Test pipes as soon as practical after the completion of each section of pipework and before the installation of the kitchen sinks, wc pans, wash hand basins and the associated bottle traps in accordance with the following requirements:

i. For foul water drainage pipe above the level of the lowest sanitary appliance, one test for every 50 domestic flats or part thereof;

ii. For foul water drainage pipe below the level of the lowest sanitary appliance, one test for every 20 pipes or part thereof.

b. Each test section and the exact extent of the pipework arrangement for each test shall be determined by the CM.

3. Testing Methods:

a. Ensure that all pipe runs are clear of obstructions by visual examination, or by throwing a ball into the pipework or other method Approved by the CM before testing;

b. Test foul water drainage pipe above the level of the lowest sanitary appliance in accordance with either air test or water test as follows:

i. Air Test to BS 5572:1994, in particular:

- Fully charge water seals of all sanitary appliances;
- Insert test plugs in open ends of pipework being tested;
- Test with air using Approved testing equipment, at a pressure equal to 38 mm water gauge;
- Acceptance standard: the testing pressure specified above can be maintained for 3 minutes;

ii. Water Test:

- Maximum height of each test section to be one storey high;
- Disconnect P-traps from the floor drains and insert plugs to the open ends of the P-traps;
- Insert upstand pipes to extend the w.c. soil pipe, the washing machine P-trap, the wash hand basin and the kitchen sink bottle traps, such that the tops of the extended pipes are about 150 mm higher than the top of the horizontal anti-syphonage pipe (asp) installed at the external wall;
- Plug the lower end of both the soil and waste pipe and the main ventilating pipe being tested;
- Fill pipework with coloured waterup to the tops of the upstand pipes;
- Acceptance standard: no visual sign of leakage shall be observed within 5 minutes after the coloured water has topped the upstand pipes;
- Make good the pipework after testing in accordance with method Approved by the CM, e.g. using slip or plain coupling fittings.

c. Water test foul water drainage pipe below the level of the lowest sanitary appliance up to the first underground manhole to be generally in accordance with BS 5572:1994 and as follows:

i. Inspect the whole section of pipework to ensure no visual defects are found;

ii. Insert test plug in the lower end of pipe within the first underground manhole;

iii. Fill pipe with water up to flood level of lowest sanitary appliance or to a maximum static head of 5 m measured from the plugged end;

iv. Acceptance standard: no visual sign of leakage can be observed within 15 minutes after the filling of water.

d. Submit three copies, or other number of copies as directed by the CM, of the testing reports for the tests carried out, in a format to be agreed with the CM, within 1 week upon completion of testing for Approval.

4. Non-compliance:

a. In the event that any one set of the test as specified in sub-clauses (3)(b) & (3)(c) above fails to meet the requirements:

i. Take three separate samples for re-test of the same type of pipework arrangement that failed the test;

ii. In the event of any failure on the re-test, take 3 additional samples of the same type of pipework arrangement for further re-tests. Repeat the re-test until all samples are tested satisfactorily to the acceptance standards of the air test as stated in (3)(b)(i) or the water test as stated in (3)(b)(ii) of (3)(c)(iv) as appropriate;

iii. Rectify all pipeworks that failed the tests;

iv. Re-test all rectified pipeworks to satisfaction of the CM;

v. Bear all associated costs, including re-tests and rectification works, and no extension of time will be allowed.

DRA1.T220.9 REPETITIVE FLUSHING TEST (RFT) FOR COMMON W-TRAP SYSTEM

1. Testing Arrangements:

a. Carry out test to the installed foul water drainage pipework at sample flat(s) / mock-up flat(s) fitted with sanitary fitments in accordance with sub-clause (3) below, and in the presence of the CM. The sample flat(s) / mock-up flat(s) shall be selected by the CM;

b. Prepare the result for CM's submission to ICU for record;

c. Provide clean water, detergent and appropriate apparatus for testing. Submit the details of the appropriate type of testing equipment to the CM for approval;

d. Clean and remove dirts / blockage on the pipework and fitments, which may affect the test result.

2. Testing Samples:

a. Test the pipes and fitments connected to the common W-trap system as soon as practical after the completion of the pipework installation for shower areas and wash hand basins of the various flat types of selected sample flat(s) / mock-up flat(s) including the installation of the wash hand basins completed with the associated bottle traps;

b. One test for each W-trap connected to the floor drain in bathroom / kitchen of each flat type of selected sample flat(s) / mock-up flat(s);

c. One set of tests for each flat type of drainage arrangement for the selected sample flat(s) / mock-up flat(s). The number of selected sample flat(s) / mock-up flat(s) shall be determined by the CM.

3. Testing Methods:

a. Ensure that all pipe runs are clear of obstructions by visual examination or other method. Obtain CM's approval before commencing the test;

b. Carry out test to the 40 mm diameter W-trap connected to wash hand basin as follows:

i. Measure and mark the water level of the wash hand basin filled up with approximate 6 litres of water;

ii. Measure and control the speed of water flowing from the tap of the wash hand basin at 0.15 litre per second;

iii. Fill the wash hand basin with water to reach the marked level;

iv. Add 10 gram of detergent into the water and stir it well to form a soap solution. Do not beat up the soap solution to create a large amount of foam;

v. Unplug the outlet of the wash hand basin and turn on the tap to flush all the residual foam (if any) out of the wash hand basin simultaneously. The time taken to flush out all the residual foam should be from 30 seconds to 1 minute;

vi. Observe and record any overflowing of foam from the floor drain;

vii. Repeat the test cycle as described in sub-clauses (b)(i) to (b)(vi) above for 7 times and observe any foam flooding from the floor drain;

viii. Acceptance standard: no visual sign of overflowing of foam from the floor drain is observed throughout the 7 test cycles. If any foam discharges outside the vertical grating and floods the bathroom or kitchen floor in any one test cycle, it is not required to continue with the remaining test cycles and the test is deemed to be failed.

c. Carry out test to the 50 mm diameter W-trap connected to the shower area as follows:

i. Measure and control the speed of water flowing from the shower head at 0.1 litre per second;

ii. Fill the shower area with water to reach approximate 40 mm deep measured at lowest point;

iii. Add 10 gram of detergent into the water and stir it well to form a soap solution. Do not beat up the soap solution to create a large amount of foam;

iv. Unplug the outlet of the shower area and flush all the residual foam with water from shower head (if any) out of the shower area simultaneously. The time taken to flush out all the residual foam should be from 1 minute to 2 minutes;

v. Observe and record any overflowing of foam from the floor drain;

vi. Repeat the test cycle as described in sub-clauses (c)(i) to (c)(v) above for 10 times and observe any foam flooding from the floor drain;

vii. Acceptance standard: no visual sign of overflowing of foam from the floor drain is observed throughout the 10 test cycles. If any foam discharges outside the vertical grating and floods the bathroom or kitchen floor in any one test cycle, it is not required to continue with the remaining test cycles and the test is deemed to be failed.

d. Within one week upon completion of the tests, submit for Approval three copies of test reports or other number of copies of test reports as directed by the CM. Agree with the CM the format of the test report.

4. Non-compliance:

a. In the event that any one set of the test as specified in sub-clauses (3)(b) and (3)(c) above has failed to meet the requirements, carry out re-testing as follows:

i. Record the no. of the test cycle for which the test has failed;

ii. Clean out the pipeworks and check the pipe alignment and arrangement;

iii. Take the same pipework arrangement that has failed the test for re-test in accordance with sub-clause (3) above.

b. In the event that the same pipework arrangement has failed the re-test, carry out further tests as follows:

i. Take the pipework arrangement of other selected flats for testing;

ii. Carry out the tests in accordance with sub-clause (3) until all selected samples have satisfactorily fulfilled the acceptance standards stated in sub-clauses (3)(b)(viii) or (3)(c)(vii) as appropriate;

iii. Rectify all pipeworks that have failed the tests as instructed by the CM;

iv. Re-test all rectified pipeworks to satisfaction of the CM;

v. Bear all associated costs including costs for carrying out re-tests and rectification works, and no extension of time will be allowed.

DRA1.T230.9 MULTIPLE FLUSHING TEST (MFT) FOR COMMON W-TRAP SYSTEM

1. Testing Arrangements:

a. Carry out test to the installed foul water drainage pipework fitted with sanitary fitments and connected to the manholes in accordance with sub-clause (3) below, and in the presence of the CM or his representatives;

b. Carry out the test procedure simultaneously in each flat served by the same soil and waste stack at 6 selected floors as determined by the CM;

c. Provide clean water, detergent and appropriate apparatus for testing. Submit the details of the appropriate type of testing equipment to the CM for approval;

d. Clean and remove dirts / blockage on the pipework and fitments, which may affect the test result.

2. Testing Samples:

a. Test the pipes and fitments connected to common W-trap system as soon as practical after the completion of the installation of the pipework and fitments of all the flats served by the selected soil and waste stack(s);

b. Only one set of tests for the selected soil and waste stack as determined by the CM;

c. One test for each W-trap connected to the floor drain in bathroom / kitchen of each flat at the 6 selected floors as determined by the CM. The selected floors shall include the lowest 2 floors served by soil and waste stack, 3 other consecutive floors share the same cross vent / balancing pipe of the soil and waste stack and one extra floor from other levels of the same soil and waste stack.

3. Testing Methods:

a. Ensure that all pipe runs are clear of obstructions by visual examination or other method. Obtain CM's approval before commencing the test;

b. Carry out test to the 40 mm diameter W-trap connected to wash hand basin as follows:

i. Measure and mark the water level of the wash hand basin filled up with approximate 6 litres of water;

ii. Measure and control the speed of water flowing from the tap of the wash hand basin at 0.15 litre per second;

iii. Ensure sufficient supply of flush water is available for refilling the cistern of water closet after flushing;

iv. Fill the wash hand basin with water to reach the marked level;

v. Add 10 gram of detergent into the water and stir it well to form a soap solution. Do not beat up the soap solution to create a large amount of foam;

vi. Unplug the outlet of the wash hand basin and turn on the tap to flush all the residual foam (if any) out of the wash hand basin and flush the water closet simultaneously at all 6 selected floors. The time taken to flush out all the residual foam in wash hand basin should be from 30 seconds to 1 minute;

vii. Observe any abnormal flow speed of discharge from wash hand basins and record any overflowing of foam from the floor drain and any bubbling / flooding from the water closet;

viii. Repeat the test cycles as described in sub-clauses (b)(i) to (b)(vii) for 3 times and observe any foam flooding from the floor drain and any bubbling / flooding from the water closet;

ix. Acceptance standard: no visual sign of overflowing of foam from the floor drain or bubbling / flooding from the water closet can be observed throughout the 3 test cycles. If any foam discharges outside the vertical grating and floods the bathroom or kitchen floor in any one test cycle, or there is bubbling / flooding from the water closet in any one test cycle, it is not required to continue with the remaining test cycles and the test is deemed to be failed.

c. Carry out test to the 50 mm diameter W-trap connected to shower area as follows:

i. Measure and control the speed of water flowing from the shower head at 0.1 litre per second;

ii. Ensure sufficient supply of flush water is available for refilling the cistern of water closet after flushing;

iii. Fill the shower area with water to reach approximate 40 mm deep measured at lowest point;

iv. Add 10 gram of detergent into the water and stir it well to form a soap solution. Do not beat up the soap solution to create a large amount of foam;

v. Unplug the outlet of the shower area and flush all the residual foam with water from shower head (if any) out of the shower area and flush the water closet simultaneously. The time taken to flush out all the residual foam from the shower area should be from 1 minute to 2 minutes;

vi. Observe any abnormal flow speed of discharge from shower areas and record any overflowing of foam from the floor drain and any bubbling / flooding from the water closet;

vii. Repeat the test cycle as described in sub-clause (c)(i) to (c)(vi) for 3 times and observe any foam overflowing from the floor drain and any bubbling / flooding from the water closet;

viii. Acceptance standard: no visual sign of overflowing of foam from the floor drain is observed throughout the 3 test cycles. If any foam discharges outside the vertical grating and floods the bathroom or kitchen floor in any one test cycle, or there is any bubbling / flooding from the water closet in any one test cycle, it is not required to continue with the remaining test cycles and the test is deemed to be failed.

d. Within one week upon completion of the tests, submit for Approval three copies of test reports or other number of copies of test reports as directed by the CM. Agree with the CM the format of the report;

e. Prepare the findings for the CM's submission to ICU for record.

4. Non-compliance:

a. In the event that any one set of the test as specified in sub-clauses (3)(b) and (3)(c) above has failed to meet the requirements, carry out re-testing as follows:

i. Record the no. of test cycle for which the test has failed;

ii. Clean out the pipeworks and check the pipe alignment and arrangement;

iii. Take the same selected soil and waste stack that has failed the test for re-test in accordance with sub-clause (3) above.

b. In the event that the same selected soil and waste stack has failed the re-test, carry out further tests as follows:

i. Take the pipework arrangement of other selected soil and waste stack for testing;

ii. Carry out the tests in accordance with sub-clause (3) above until all selected samples have satisfactorily fulfilled the acceptance standards stated in sub-clauses (3)(b) (ix) or (3)(c)(viii) as appropriate;

iii. Rectify all pipeworks that have failed the tests as instructed by the CM;

iv. Re-test all rectified pipeworks to satisfaction of the CM;

v. Bear all associated costs including costs for carrying out re-tests and rectification works, and no extension of time will be allowed.

SURVEILLANCE TESTS FOR UPVC DRAINAGE PIPES AND FITTINGS

DRA1.T310.A SURVEILLANCE TESTS

1. Testing Arrangements:

a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;

b. Comply with the following pertaining to surveillance tests:

i. Provide attendance on the Site;

ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.

2. Testing Samples:

   a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified in DRA1.M150 (3)(a)(ii) or as instructed by the CM;

   b. One set of test sample shall consist of pipes and fittings sufficient to carry out test in DRA1.M150 (2)(f)(i) and (iii) or (2)(f)(ii) and (iii) or as instructed by the CM.

3. Testing methods:

   As per DRA1.M150 (2)(f);

4. Non-compliance:

   a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:

      i. Remove the representative batch off Site; or

      ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.

   b. When the representative batch of uPVC pipes and fittings is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);

   c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

SURVEILLANCE TESTS FOR EPOXY COATED CAST IRON PIPES AND FITTINGS

DRA1.T410.A SURVEILLANCE TESTS

1. Testing Arrangements:

   a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Testing Contractor;

   b. Comply with the following pertaining to the surveillance tests:

      i. Provide attendance on the Site;

      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.

2. Test Samples:

   a. Provide one set of test sample from the batch of material delivered to Site under the delivery note as specified DRA1.M115 (3)(a) (hereinafter referred to as the “representative batch”) selected and as instructed by the CM;

   b. One set of test sample shall consist of three sections of pipes or fittings or as instructed by the CM.

3. Testing methods:

a. As per DRA1.M115 (2)(b) for resistance to salt spray test on internal epoxy coating;

b. As per DRA1.M115 (2)(b) for resistance to temperature cycling test on internal epoxy coating;

c. As per DRA1.M115 (2)(b) for dry coating thickness test on internal epoxy coating and external coating;

d. As per DRA1.M115 (2)(b) for adhesion test on internal epoxy coating and external coating.

4. Non-compliance:

a. In the event that the any of the test samples fails to meet the test requirements, follow either one of the following actions:

i. Remove the representative batch off Site; or

ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.

b. When the representative batch of epoxy coated cast iron pipes and fittings is removed off Site, replace with another new batch (hereinafter referred to as the "replacement batch"). Carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one set of samples selected by the CM from the replacement batch. In case any one sample fails the test, follow action stated in sub-clause (4)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

DRA2 DRAINAGE BELOW GROUND

MATERIALS

GENERAL

DRA2.M010.9 APPLICATION OF OTHER WORKSECTIONS

The following works and materials must comply with the following Worksections:

1. Handrailing, ladders, stairs, metal flooring, toe plates and safety chains:
    a. Worksection MEW for works carried out under site formation / road and drainage works and slopeworks contracts; or
    b. Worksection MET1 for all other works not mentioned in sub-clause (1)(a) above.
2. Earthworks: Worksection EAR1;
3. Concrete and reinforcement: Worksections CON1 and CON3 respectively;
4. Formwork: Worksection FOR;
5. Grouting materials: Worksection CON1.

DRA2.M020.9 DEFINITIONS

In this Section, pipes for drainage works are defined as pipes for conveying sewage or surface water.

PIPES AND FITTINGS

DRA2.M110.A PRECAST CONCRETE PIPES AND FITTINGS

Complying with BS EN 1916 for nominal sizes of 225 mm or above and BS 5911: Part 1 for nominal size of 150 mm, having flexible, spigot and socket joints.

DRA2.M120.A VITRIFIED CLAY PIPES AND FITTINGS

Complying with BS EN 295 and:

1. Of the normal glazed, chemical resistant type;
2. With flexible mechanical joints.

DRA2.M130.A DUCTILE IRON PIPES AND FITTINGS

Complying with BS EN 545 and BS EN 598 and:

1. Lined internally with cement mortar;
2. Coated externally with a bituminous coating.

DRA2.M140.A FLEXIBLE JOINTS FOR DUCTILE IRON PIPES AND FITTINGS

Push-in type and capable of withstanding:

1. A required minimum angular deflection of 4º;

2. Axial movements and shall allow a minimum withdrawal of 38 mm when there is no deflection of the joint.

DRA2.M150.A FLANGED JOINTS FOR DUCTILE IRON PIPES AND FITTINGS

PN 16 rating, complying with BS EN 1092-1.

DRA2.M160.9 DUCTILE IRON PIPES TO BE BUILT IN

Provide puddle flanges by welding to pipes which are to be built into structures.

DRA2.M170.A GREY IRON PIPES AND FITTINGS

Complying with BS 4622.

DRA2.M180.9 SUB-SOIL PIPES AND FITTINGS

1. Vitrified clay pipes and fittings complying with BS 65:1991 and of the normal glazed, chemical resistant type with plain ends and flexible sleeved joints;
2. Precast porous concrete pipes complying with BS 5911 Part 114:1992;
3. Perforated plastic pipes conforming to BS 4962:1989.

DRA2.M190.A UPVC GRAVITY SEWAGE AND SURFACE WATER PIPES AND FITTINGS

1. uPVC pipes and fittings shall comply with the relevant British Standard stated in the following Table;
2. uPVC pipes and fittings above ground shall have solvent welded spigot and socket joints. uPVC pipes and fittings below ground shall have either solvent welded spigot and socket joints or flexible spigot and socket joints with elastomeric joint rings as stated in the Contract;
3. Fittings for uPVC pressure pipes complying with BS 3506 shall comply with the following:
   a. Injection moulded uPVC fittings for solvent welding : BS 4346 Part 1;
   b. Fittings for uPVC pressure pipes : BS EN ISO 1452-3.
4. Adhesives for uPVC pressure pipes shall comply with BS EN 14814;
5. The Class of uPVC pressure pipes complying with BS 3506 shall depend on the pressure rating.

Table : uPVC pipes and fittings

Use	Nominal size (mm)	Standard
Gravity sewage pipes and fittings above ground	32 - 50	BS 5255 BS EN 1329-1
	82 - 160	BS 4514 BS EN 1329-1
Gravity surface water pipes and fittings above ground	50 - 160	BS EN 12200-1 BS EN 607 BS EN 1462
Gravity sewage and storm water pipes and fittings below ground	110 - 1000	BS EN 1401-1 (Fittings also refer to BS 4660 and BS EN 13598-1)

Pressure pipes and fittings above and below ground	10 - 600	BS 3506

DRA2.M200.9 JOINTING SYSTEM FOR UPVC PIPES AND FITTINGS

Solvent welded, spigot and socket joints.

DRA2.M210.9 JOINTING SYSTEM FOR UPVC PIPES AND FITTINGS

Flexible spigot and socket joints with elastomeric joint rings.

DRA2.M220.A UPVC PRESSURE PIPES AND FITTINGS

Complying with BS 3506:

1. Class: dependant on the pressure rating;
2. With joints and fittings complying with the following:
   a. Injection moulded uPVC fittings for solvent welding: to BS 4346: Part 1;
   b. Mechanical joints, principally of uPVC: to BS EN ISO 1452-3.

DRA2.M230.9 CAST IRON PIPES AND FITTINGS

Complying with BS 437:1978.

DRA2.M240.N PE PIPES AND FITTINGS

1. PE compounds used for manufacturing PE pipes and fittings shall conform to BS EN 12201-1 and meet the requirements of PE 100-RC as defined in Clause 3.1 of PAS 1075. PE compounds shall also be 100% virgin, pre-coloured compounds. No re-processed, recycled or own reprocessed materials shall be used in the manufacturer of any pipes or fittings;
2. PE pipes shall comply with BS EN 12201-2;
3. PE fittings shall comply with BS EN 12201-3 and have a material designation of PE 100.

JOINTING MATERIALS

DRA2.M305.9 GENERAL

Caulking compound and all solvent cement for jointing uPVC pressure pipes shall be in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compound) Regulation.

DRA2.M310.9 SOLVENT CEMENT FOR UPVC PRESSURE PIPES

To BS 4346: Part 3:1982.

DRA2.M320.A ELASTOMERIC JOINT RINGS

To BS EN 681-1, Type WC and:

1. Compatible with the type of joint;
2. Unless otherwise Approved, obtained from the same manufacturer as the joint.

DRA2.M330.A ELASTOMERIC GASKETS FOR FLANGED PIPES

Of the inside diameter, bolt circle type, and:

1. Natural rubber to BS EN 681-1;
2. Minimum thickness of 3 mm, with other dimensions in accordance with BS EN 1514-1.

DRA2.M340.9 DETACHABLE COUPLINGS AND FLANGE ADAPTERS

Approved proprietary type in compliance with clause 5.3.3 and Table 10(b) of Sewerage Manual (Part 1) – Key Planning Issues and Gravity Collection System (3rd Edition) published by the Drainage Services Department and capable of accommodating the angular deflection and straight draw stated in the following table:

Angular Deflection and Straight Draw				
Nominal Diameter of Pipe	Detachable Coupling		Flange Adapter	
	Angular Deflection	Straight Draw	Angular Deflection	Straight Draw
Not exceeding 450 mm	±6º	±10 mm	±3º	±5 mm
Exceeding 450 mm and not exceeding 600 mm	±5º		±2.5º	
Exceeding 600 mm and not exceeding 750 mm	±4º		±2º	
Exceeding 750 mm and not exceeding 1200 mm	±3º		±1.5º	
Exceeding 1200 mm and not exceeding 1800 mm	±2º		±1º	
Exceeding 1800 mm	±1º		±0.5º	

DRA2.M350.9 JOINTING RINGS

Of types recommended by the manufacturer of the pipes being jointed.

DRA2.M370.9 GASKIN

Tarred spun yarn or hemp.

DRA2.M380.9 COLD CAULKING COMPOUND

An Approved proprietary brand.

DRA2.M390.9 LUBRICANT

Compatible with the elastomeric joint ring to be applied on.

BOLTS, NUTS AND WASHERS

DRA2.M410.A GENERAL

1. Ensure that all bolts and nuts are compatible with the type of joint and, unless otherwise Approved, obtained from the same manufacturer as the joint;
2. Bolts, nuts and washers shall be insulated from electrochemically dissimilar metal by non-metallic washers and sleeves.

DRA2.M420.A FLANGED JOINTS, DETACHABLE COUPLINGS AND FLANGE ADAPTORS

Complying with the following:

1. ISO metric, black, hexagon bolts, screws and nuts: BS 4190;
2. Metal washers: BS 4320;
3. Coating to bolts, nuts and washers: hot dip galvanised in accordance with BS EN ISO 1461, or treated as otherwise Approved.

DRA2.M430.A STAINLESS STEEL

1. Bolts and nuts: to BS EN ISO 3506-1 and BS EN ISO 3506-2, Steel grade A4 and property Class 80;
2. Washers: Grade A4 to the standards stated in Clause 5.6.9.1 of BS EN 1090: Part 2.

DRA2.M440.A SPHEROIDAL GRAPHITE IRON BOLTS

Grade EN-GJS-500-7, complying with BS EN 1563.

BEDDING, HAUNCHING AND SURROUNDING MATERIALS

DRA2.M510.A AGGREGATES FOR GRANULAR BED AND GRANULAR FILL

1. Granular bed to be Type A material and granular fill to be Type B material;
2. Type A or Type B material to be hard, clean, crushed slag, gravel, crushed rock, crushed concrete or crushed inert demolition material and:
   a. Having the ten percent fines values of at least 50 kN;
   b. Material passing the 425 µm BS test sieve to be non-plastic when tested in accordance with Model Specification for Soil Testing (Geospec 3);
   c. Having a grading within the limits of the following table:

Range of grading of Type A and Type B materials		
BS test sieve	Percentage by mass passing	
Metric	Type A	Type B
63 mm	-	100
37.5 mm	100	85 - 100
20 mm	-	0 - 20
10 mm	45 - 100	0 - 5
3.35 mm	25 - 80	-
600 µm	8 - 45	-
75 µm	0 -10	-

   d. Obtained from an Approved source.
3. Aggregates for granular bed to have the compaction fraction values stated in DRA2.T290.

DRA2.M520.A JOINT FILLER

For joints in concrete bed, haunch and surround:

1. A firm, compressible, single thickness, non-rotting filler;
2. Unless otherwise specified in the Drawings, the thicknesses of joint filler are shown in the following table:

Joint Filler for Concrete Bed, Haunch and Surround	
Nominal Diameter of Pipe	Thickness of Joint Filler (mm)
less than 450 mm	18
450 mm – 1200 mm	36
exceeding 1200 mm	54

DRA2.M530.9 COMPRESSIBLE PADDING

For insertion between pipes and supports: bitumen damp-proof sheeting to BS 743: 1970.

DRA2.M540.A CONCRETE

1. Concrete grade 20/20 or higher strength as Worksection CON1, unless otherwise specified;
2. Polyethylene sheeting or a blinding layer shall be placed on the trench bottom before concreting;
3. Pipes shall be supported at the required level by Grade 20 precast concrete wedges, blocks or cradles or by other methods agreed by the CM. One support shall be placed adjacent to each end of each pipe and the spacing between supports shall not exceed 3 m. Compressible sheeting shall be placed between the pipes and supports;
4. Flexible joints shall be formed in the concrete bed, haunch and surround at flexible joints in pipelines. Joint filler shall be placed next to the flexible joint in the pipeline and shall extend for the complete thickness of the bed, haunch and surround;
5. Concrete shall be placed evenly over the complete width of the bed and over the complete length of the pipe being concreted up to a level of 25 mm below the underside of the pipe. Concrete shall then be placed on one side of the pipe only and worked under the pipe until the concrete spreads under the pipe. Concrete shall then be placed equally on both sides of the pipe to the specified level;
6. Pipes for drainage works which are 1m or less below the surface of a carriageway shall be protected with Grade 20 concrete surround;
7. The aggregate for such Grade 20 or higher strength concrete to be natural stone, crushed rock, crushed concrete, or recycled aggregates if available and if proposed by the Contractor. Such Grade 20 concrete shall have the following minimum cementitious content:

Exposure condition (as stated in the Contract)	Minimum cementitious content (kg/m^3)
Moderate	280
Severe	330

MANHOLES, CHAMBERS, GULLIES AND CHANNELS

DRA2.M610.A PRECAST CONCRETE MANHOLES

To BS EN 1917 and BS 5911: Part 3, with cover slabs and reducing slabs reinforced as required to comply with the load test requirements stated in BS 5911: Part 3 and with rebated joints.

DRA2.M620.A PRECAST CONCRETE CHAMBERS AND GULLIES

To BS EN 1917 and BS 5911: Part 4 with:

1. Cover slabs reinforced as required to comply with the load test requirements stated in BS EN 1917 and BS 5911: Part 4;
2. Rebated joints between precast units;
3. Types of cement used in manufacture either:
    a. As stated in BS EN 1917 and BS 5911: Part 4; or
    b. A combination of PFA and PC or PFAC to BS EN 197-1 in which the PFA does not exceed 40% by mass of the total cementitious content.
4. Precast concrete gullies shall comply with BS 5911: Part 6.

DRA2.M630.A VITRIFIED CLAY GULLIES

To BS EN 295.

DRA2.M640.A STEP IRONS

To BS EN 13101 and:

1. Manufactured from malleable cast iron to BS EN 1562;
2. Hot dip galvanised in accordance with BS EN ISO 1461.

DRA2.M630.A VITRIFIED CLAY GULLIES

To BS EN 295.

DRA2.M640.A STEP IRONS

To BS EN 13101 and:

1. Manufactured from malleable cast iron to BS EN 1562;
2. Hot dip galvanised in accordance with BS EN ISO 1461.

DRA2.M650.A CAST IRON MANHOLE COVERS, GULLY GRATINGS AND OVERFLOW WEIRS

Grade EN-GJL-150 cast iron to BS EN 1561 and:

1. With nuts and bolts complying with BS 4190;
2. Cleanly cast, free from air holes, sand holes, voids due to shrinkage, gas inclusions or other causes, cold shuts and chill and neatly dressed and fettled. Bolts and nuts shall not be over-tightened;
3. With dimensions as indicated on the Drawings;
4. With manufacturer's name cast integrally with the unit in a raised form, protected with bituminous coating. Covers shall have the raised design as shown on the Drawings;

5. Capable of withstanding the minimum test loads and having the minimum masses given in the following tables as appropriate:

Details of manhole covers and frames				
Type of Manhole Cover and Frame	Minimum Mass (kg)	Grade (duty)	Test Requirements	
			Diameter of Block (mm)	Test Load (t)
Double triangular manhole cover and frame	180	Medium	100	5
Double triangular manhole cover for sewers	130	Heavy	300	30
Frame	105	Heavy	300	30
Double triangular desilting manhole cover for sewers	290	Heavy	300	30
Frame	165	Heavy	300	30
Double seal terminal manhole cover for sewers				
- Type MA2-29/29A & B	-	Heavy	300	20
- Type MA2-45/45A & B	-	Heavy	300	20
- Type MC2-29/29A & B	-	Medium	100	5
- Type MC2-45/45A & B	-	Medium	100	5

Details of gully gratings and frames				
Type of Gully Grating and Frame	Minimum Mass (kg)	Grade (duty)	Test Requirements	
			Diameter of Block (mm)	Test Load (t)
Grating for hinged gully grating Type GA2-325	28.0	Heavy	300	20
Frame	24.5	Heavy	300	20
Grating for double triangular gully grating Type GA1-450	57.5	Heavy	300	20
Shallow frame				
- Adjacent to kerb	33.5	Heavy	300	20
- Away from kerb	36.5	Heavy	300	20
Deep frame				
- Adjacent to kerb	40.5	Heavy	300	20
- Away from kerb	44.0	Heavy	300	20
Grating for hinged gully grating Type GA2-450	61.5	Heavy	300	20
Frame	37.0	Heavy	300	20

Details of kerb overflow weirs	
Type	Minimum mass (kg)
1-325	39.5
3-325	31.5

1-450	44.0
3-450	36.5
4-450	33.0

DRA2.M660.9 DUCTILE IRON MANHOLE COVERS AND FRAMES

Spheroidal graphite cast iron (ductile iron) of grades EN-GJS-500-7 to BS EN 1563:1997 and:

1. Conform to the relevant requirements of BS EN 124:1994;
2. Bolts for loosely coupling separate sections of covers shall be stainless steel hexagon headed complete with hexagon nuts, of grade 302 or 304 to BS 970:Part 1:1996 with dimensions complying with BS 4190:2001;
3. Cleanly cast, free from air holes, sand holes, voids due to shrinkage, gas inclusions or other causes, cold shuts, chill and any surface defects and neatly dressed and fettled;
4. With dimensions as indicated on the Drawings and have sharp edges removed;
5. Covers shall have the raised design as shown on the Drawings with manufacturer's name cast integrally with the unit in a raised form. All markings shall be clearly legible;
6. Coated with 2 layers of black non-toxic water-based bituminous coating to BS 3416:1991 after thoroughly cleaned to remove moulding sands, rust or any other impurity. The coating shall be free of bare patches or lack of adhesion;
7. Compatible with their seatings which shall be manufactured in such a way to ensure stability and quietness in use;
8. Bedding material for manhole frames shall be non-shrinkage with compressive strength exceeding 30 N/mm²;
9. Capable of withstanding the minimum test loads as per BS EN 124:1994 and having the minimum masses given in the following table:

Details of manhole cover and frame			
Designation	Minimum Mass (kg)	Test Requirements	
		Diameter of Block (mm)	Test Load (kN)
Class E600 standard 675 square double triangular D.I. Manhole cover	110	250	600
Frame	58	250	600

DRA2.M670.9 RECESSED MANHOLE COVERS AND FRAMES

1. All steel members shall be of Grade 43 steel to BS EN 10029:1991, BS EN 10113:1993 Parts 1 to 3 and BS EN 10210-1:1994;
2. Cover and frame shall be hot-dip galvanized to BS EN ISO 1461:2009. All welds shall be 4mm continuous fillet weld complying with BS 4872;
3. Other materials of better corrosion resistance or durability, such as stainless steel, with equivalent strength may be used if approved by the CM;

4. The external edges of the cover and internal faces of the frame shall be coated with a non-setting, thick lubricant, such as petroleum gel, in order to prevent jamming the cover and frame due to sand grains entering the gap after final fixing;
5. The recessed cover shall be designed to accommodate paving block up to a maximum thickness of 80mm. For areas used by pedal cyclists (i.e. light duty), the infilling shall be 10mm wearing course bituminous materials, unless otherwise approved by the CM;
6. The paving block within the recessed cover shall be bedded on cement mortar. Jointing sand shall be applied to the whole cover with compaction;
7. Bedding material for manhole frames shall be of non-shrinkage type with compressive strength exceeding 30 N/mm²;
8. Capable of withstanding the minimum test loads as per BS EN 124:1994 given in the following table:

Designation	Test Requirements	
	Diameter of Block (mm)	Test Load (kN)
Light Duty (A15)	250	15
Medium Duty (B125)	250	125

DRA2.M680.9 CAST IRON CHANNEL GRATINGS AND FRAMES

Grade EN-GJL-150 cast iron to BS EN 1561:1997 and:

1. All cast units shall be coated with a bituminous coating in accordance with clause DRA2.M830 or DRA2.M840;
2. All grating corners shall be rounded to approximately 2mm;
3. Manufacturers should cast their trademarks and grating reference number for identification on the upper face of grating. Logos, letters, numerals, etc. shall not exceed 15mm height and 1mm proud of grating surface. Housing Logo shall be cast embossed on upper face of grating, minimum 30x30x1mm.

DRA2.M690.9 PRECAST CONCRETE CHANNEL COVERS

1. Concrete grade 30/20 or higher strength as Worksection CON1, unless otherwise specified;
2. All exposed formed surface finishes to be fair-faced and worked surface finishes to be steel trowel.

DRA2.M695.9 PRECAST CONCRETE SURFACE CHANNEL

1. Concrete grade 30/20 or higher strength as Worksection CON1, unless otherwise specified;
2. All exposed formed surface finishes to be fair-faced and worked surface finishes to be steel trowel.

VALVES

DRA2.M710.A GENERAL

Ensure:

1. Handwheels and tee keys turn in a clockwise direction to close the valve;
2. Handwheels have a smooth rim with the direction of opening and closing clearly cast in;
3. The opening effort required at any point on the handwheel does not exceed 250 N when operated against the full unbalanced pressure;
4. Extension stems are of the same grade of stainless steel as the stems and are connected by muff couplings;
5. Handwheels, tee keys, headstocks, guide brackets for stems, supporting brackets, surface boxes and other fittings are cast iron to BS EN 1561.

DRA2.M720.A GATE VALVES

Double flange ended, solid wedge type, to BS EN 1171 and with:

1. A nominal pressure designation of PN 16 and PN 16 flanges to BS EN 1092-1;
2. Bodies and wedges of cast iron to BS EN 1561, grade EN-GJL-250 with renewable seat rings made from gunmetal to BS EN 1982, grade CC491K;
3. Stem nuts made from gunmetal to BS EN 1982, grade CC491K;
4. Stems of aluminium bronze to BS EN 12163 and BS EN 12167, grade CW307G;
5. Stainless steel assembly bolts, as DRA2.M430;
6. Outside screw rising stems with perspex protection tubes and open/close indicators;
7. A fitted plate showing the position of the valve in the closed, quarter closed, half closed, three quarters closed and fully open positions.

DRA2.M730.A CHAINS FOR CHAIN OPERATED GATE VALVES

Continuous chains from mild steel, to BS EN 10084, BS EN 10085, BS EN 10087, BS EN 10088-1, BS EN 10095, BS EN 10250-4 and PD 970 and hot dip galvanised in accordance with BS EN ISO 1461.

DRA2.M740.A FLAP VALVES

With the following:

1. Frames and flaps of cast iron to BS EN 1561, grade EN-GJL-250;
2. Sealing faces and hinge pins of gunmetal to BS EN 1982, grade CC491K;
3. The flap hung with double hinges, secured with hinge pins.

DRA2.M750.A FLANGE MOUNTING FLAP VALVES

With flanges PN 16 to BS EN 1092-1.

DRA2.M760.A SLUDGE VALVES

With the following:

1. Bodies and valve sections of cast iron to BS EN 1561, grade EN-GJL-250;
2. Sealing faces and stem nuts of gunmetal to BS EN 1982, grade CC491K;
3. Stems of aluminium bronze to BS EN 12163 and BS EN 12167, grade CW307G, operating through non-rising stem nuts, housed in bridges bolted over the body sections;
4. Outlet flanges: PN 16 to BS EN 1092-1.

DRA2.M770.A AIR VALVES

Dual orifice elongated body type, with a small orifice valve for releasing air at working pressure, a large orifice valve for allowing air to pass at atmospheric pressure during emptying and filling of the pipework and:

1. A pressure rating to 3 bars;
2. The bodies and covers of small and large orifice valves in cast iron to BS EN 1561, grade EN-GJL-250;
3. The trim and float in stainless steel to BS EN 10084, BS EN 10085, BS EN 10087, BS EN 10095, BS EN 10088-1, BS EN 10250-4 and PD 970, Grade 1.4401;
4. Small orifice valves with an adjustable Viton orifice button to ensure positive sealing and:
    a. Valve inlet size: 75 mm;
    b. Valve outlet size: 25 mm;
    c. Venting orifice size: 5 mm.
5. Large orifice valves with a Buna-N seat and a valve inlet and outlet size of 75 mm;
6. Air valves shall be provided with isolating gate valves.

DRA2.M780.9 BOLTS AND NUTS FOR SECURING VALVES

Indented stainless steel foundation bolts, as DRA2.M430.

ANCILLARY MATERIALS

DRA2.M810.9 ANTI-CORROSION TAPE

Approved proprietary type of a rubber/bitumen compound with a fabric reinforcement, backed with a PVC film, and:

1. With a high resistance to cathodic disbonding, acids and alkalis;
2. Having the minimum properties stated in the following table:

Properties of Anti-corrosion Tape		
Property	Minimum Value (except where stated)	
	Type 1 (for pipes below 700 mm diameter)	Type 2 (for pipes over 700 mm diameter)
Thickness of PVC backing (µm)	85	500
Tensile strength (N/mm)	8	10
Elongation (%)	≤ 26	≤ 26
Tear strength (N)	20	36
Adhesion strength (N/mm)	2	2
Holiday test voltage (kV) -single layer -double layer	 10 15	 10 15
Impact strength (J)	3.5	8
Temperature range (°C)	5 - 60	8 - 60

Total thickness (mm)	1.6	2.0
Mass (kg/m²)	1.8	2.4

DRA2.M820.9 PRIMER AND MASTIC FILLER FOR USE WITH ANTI-CORROSION TAPE

An Approved type recommended by the tape manufacturer and compatible with the tape.

DRA2.M830.A BITUMINOUS COATINGS FOR HOT APPLICATION

For the protection of iron and steel, including suitable primers where required: to BS EN 10300.

DRA2.M840.A BLACK BITUMEN COATING FOR COLD APPLICATION

To BS 3416, Type II.

DRA2.M850.9 BITUMINOUS COATINGS FOR REPAIRS

Compatible with the adjacent coating.

DRA2.M860.9 POLYETHYLENE SHEETING

Impermeable sheeting, 0.125 mm thick.

DRA2.M870.9 GROUT FOR FILLING REBATES AND BOX-OUTS

An Approved proprietary type containing a non-shrink additive.

DRA2.M880.9 FOAM CONCRETE FILLING FOR ABANDONED SYSTEMS

Composed of PC (or PFAC), fine aggregate obtained from natural or recycled aggregate, water, admixtures for accelerating or retarding the setting time and a foaming agent to reduce the density and to produce a flowing, self levelling material.

DRA2.M890.9 GROUT FILLING FOR ABANDONED SYSTEMS

A mixture of one part PC, 15 parts PFA and the minimum of water necessary to achieve a consistency suitable for flowing into pipes, culverts, manholes and voids, without the addition of sand or admixtures unless otherwise Approved.

DRA2.M900.9 CONCRETE FOR THRUST AND ANCHOR BLOCKS

In accordance with clause DRA2.M540.

DRA2.M910.9 MORTAR

Consisting of (by mass):

1. 1 part cement (complying with CON1); to
2. 3 parts of fine aggregate (sand or crushed rock to BS 1200:1967 and passing a 5 mm BS Test Sieve); with
3. The minimum amount of water to achieve a consistency suited to the required work.

DRA2.M920.9 MARKER BLOCKS

Precast in grade 20/20 concrete as Worksection CON1 and:

1. Size: 150 mm × 150 mm × 150 mm;
2. With the letters 'CD' marked on the upper surface;

3. With a hook cast into the lower surface.

SUBMISSIONS

DRA2.M1010.9 PIPES, JOINTS AND FITTINGS

Submit the following to the CM at least 14 days before the first delivery of the material to the Site:

1. Manufacturer's literature including details of:
   a. Manufacturing process;
   b. Pressure and temperature ratings;
   c. Permissible values of straight draw and angular deflection of flexible joints;
   d. Recommendations for handling, storage, laying, jointing and repair;
   e. Drilling and tapping equipment for connections to pipes.
2. A certificate showing the manufacturer's name, the date and place of manufacture and showing that the material complies with the requirements of this specification and including the results of any tests specified. Submit such a certificate for each batch of material delivered to Site.

DRA2.M1020.9 ANTI-CORROSION TAPE AND JOINT FILLER

Submit the following to the CM at least 14 days before the first delivery of the material to the Site:

1. Manufacturer's literature for anti-corrosion tape;
2. Certificates for anti-corrosion tape and joint filler delivered to Site showing the manufacturer's name, the date and place of manufacture and showing that the material complies with the requirements of this specification and including the results of any tests specified. Submit such certificates for each batch of material delivered to Site.

DRA2.M1030.9 AGGREGATES FOR GRANULAR BED

At least 14 days before the first delivery of any aggregate to the Site and thereafter each time the source is changed, submit to the CM, a certificate for each type of aggregate showing its source and that it complies with the requirements of this specification and including the results of any tests specified.

MANHOLES, CHAMBERS, GULLIES AND CHANNELS

DRA2.M1035.9 DESIGN RESPONSIBILITY FOR PRECAST MANHOLES

1. All structural drawings, layouts, details and calculations for precast manholes submitted including those submitted with tender, must be prepared and signed by the Registered Structural Engineer;
2. The Registered Structural Engineer is registered under Buildings Department of the Government of Hong Kong Special Administrative Region.

DRA2.M1040.9 MANHOLES, CHAMBERS, GULLIES AND CHANNELS

At least 14 days before the first delivery of the material to the Site and thereafter, with each batch delivered to the Site, submit the following to the CM:

1. A certificate for each type of manhole, chamber unit and typical section of channel, and for each type of gully, showing the manufacturer's name, the date and place of manufacture and showing that the material complies with the requirements of this specification and including the results of any tests specified;
2. A certificate for step irons, showing the manufacturer's name, the date and place of manufacture and showing that they comply with the requirements of this specification and including the results of any tests specified;
3. A certificate for each type of manhole cover, gully grating, kerb overflow weir and channel cover, showing the manufacturer's name, the date and place of manufacture and showing that the material complies with the requirements of this specification and including the results of any tests specified.

DRA2.M1050.9 VALVES

Submit the following particulars to the CM at least 28 days before the first delivery of the material to the Site:

1. Manufacturer's literature, including details of:
   a. Materials;
   b. Pressure ratings;
   c. Recommendations for handling, storage and installation;
2. Drawings showing details of the valves, including lengths of stems and details of handwheels. tee keys, extension stems, headstocks, guide brackets for stems, supporting brackets, surface boxes and other fittings, and positions and sizes of rebates and box-outs.

DRA2.M1060.9 CONCRETE AND GROUT FILLING FOR ABANDONED INSTALLATIONS

At least 7 days before grouting starts, submit to the CM, the following particulars of the foam concrete and grouting procedure for filling abandoned pipes, culverts, manholes and voids:

1. Proportions of each constituent;
2. Source of supply;
3. Details of mixing;
4. Setting time;
5. Strength;
6. Shrinkage expected (for PC/PFA grout);
7. Details of mixing and grouting equipment;
8. Method of grouting including details of trials.

WORKMANSHIP

GENERAL

DRA2.W010.9 DIVERSIONS OF FLOW

Unless otherwise permitted by the CM, submit particulars of any proposed procedures for the diversion of any existing flows, at least 14 days before the diversion starts.

TRANSPORT, HANDLING AND STORAGE

DRA2.W110.9 PIPES, JOINTS AND FITTINGS GENERALLY

Transport, handle and store pipes, joints and fittings in accordance with the manufacturer's recommendations and:

1. In a manner which will not result in their damage, deformation or contamination;
2. Protect pipes, joints and fittings from damage;
3. Do not use any damaged pipes, joints and fittings in the permanent work unless otherwise Approved;
4. Handle pipes and fittings manually or by using lifting appliances or chains, wire rope or canvas slings of a type recommended by the manufacturer and agreed by the CM and:
    a. Do not use hooks;
    b. Place slings around the pipes and fittings and provide padding at the points of contact between pipes and fittings and metal lifting appliances and slings;
    c. Do not handle pipes by means of metal slings passed through the pipes.
5. Do not subject pipes and fittings to rough handling, shock loading, or dropping and do not roll down ramps unless otherwise Approved, in which case the ramps must be padded.

DRA2.W120.A PE PIPES, UPVC PIPES AND THEIR JOINTS AND FITTINGS

Protect from exposure to conditions which may affect the material.

DRA2.W130.9 BOLTS AND NUTS

Ensure bolts and nuts are packed in sealed metal containers.

DRA2.W140.9 ELASTOMERIC JOINT RINGS

1. Ensure elastomeric joint rings are packed in bags and that lubricant for joints is stored in sealed containers, marked to identify the contents;
2. Protect the rings and lubricant from conditions which may affect the material.

DRA2.W150.9 STORING PIPES

1. Store pipes horizontally at least 75 mm above the ground on wedged timber bearers. Securely wedge the bottom layers and the outer pipes in each layer to prevent sideways movement;

2. Store spigot and socket pipes with the sockets alternating and in such a manner that loads are not applied to the sockets;
3. Do not allow the stacks to exceed 2 m in height unless recommended by the manufacturer or otherwise Approved;
4. Do not string pipes out along the route of the pipeline unless otherwise approved.

DRA2.W160.9 STORING ANTI-CORROSION TAPE AND JOINT FILLER

Store in accordance with the manufacturer's recommendations in a dry, weatherproof store with a raised floor.

DRA2.W170.9 GRANULAR BEDDING MATERIALS

Do not handle aggregates for granular bedding in a manner which will result in the mixing of the different types and sizes, or in contamination of the aggregates. Store different types and sizes of aggregates in separate stockpiles.

DRA2.W180.9 MANHOLES, CHAMBERS AND GULLIES

1. Lift units for manholes, chambers and gullies only at the lifting points recommended by the manufacturer and do not subject them to rough handling, shock loading or dropping;
2. Store units off the ground on level supports which will not result in their damage, deformation or contamination. Protect all units from damage and do not use damaged units in the permanent work unless otherwise Approved.

DRA2.W190.9 STORING COVERS, GRATINGS AND KERB OVERFLOW WEIRS

Store manhole covers, gully gratings, kerb overflow weirs and valves, including fittings, off the ground on level supports which will not result in their damage, deformation or contamination. Protect all units from damage and do not use damaged units in the permanent work unless otherwise Approved.

EXCAVATION

DRA2.W210.9 GENERAL

Only commence the excavation of a trench when the nature, location and size of existing utilities which may be affected by the excavation have been ascertained and the setting out details have been Approved.

DRA2.W220.9 TRENCH WIDTH

Do not exceed the relevant effective trench widths stated in the following table for the different diameters of pipe:

Effective Trench Widths			
Nominal Diameter of Pipe (mm)	Effective Trench Width (mm)	Nominal Diameter of Pipe (mm)	Effective Trench Width (mm)
100	550	1125	2200
150	600	1200	2300
225	700	1350	2450
300	750	1500	2600
375	1050	1650	2800

450	1150	1800	2950
525	1200	1950	3150
600	1350	2100	3350
675	1450	2250	3400
750	1500	2400	3500
825	1600	2550	3650
900	1900	2700	3800
975	2000	2850	3950
1050	2050	3000	4150

Measure the effective trench width as stated in the Contract.

LAYING AND BEDDING PIPES

DRA2.W310.9 GENERAL

Allow the CM to inspect the trenches, bedding, pipes, joints, fittings and valves before pipelaying for drainage works starts. Inform the CM 24 hours, or such shorter period as may be agreed by the CM, before pipelaying starts in any part of the permanent work and obtain his permission to commence.

DRA2.W320.9 INSPECTION

Inspect pipes, joints, fittings and valves, including internal and external coatings, immediately before and after pipelaying. Inspect valves to ensure that they are in working order and are capable of being fully opened and closed. Remove all deleterious material and repair all damage immediately before and after pipelaying.

DRA2.W330.9 CLEANLINESS

Keep the inside of pipelines clean and free from water, dirt, stones, debris and other deleterious material. Except when pipes are being jointed, seal the open ends of pipelines with a wooden plug or by other Approved methods.

DRA2.W340.9 FLOTATION

Undertake measures to prevent the flotation of pipes.

DRA2.W350.9 LAYING PIPES

Lay, test and backfill to follow as closely as possible on the excavation of the trench and:

1. Unless otherwise permitted by the CM, lay pipelines in an uphill direction with the sockets facing uphill;
2. Lay pipes in such a manner that water will not pond in locations with zero or shallow gradients and such that the pipes will comply with the specified tolerances.

DRA2.W360.9 BEDDING PIPES

1. Clean surfaces on which pipes will be laid and remove any objects which may damage the pipes before they are laid;
2. Shape the bottoms of trenches on which pipes will be laid directly, to support the pipes uniformly along the length of the barrel;

3. Dig holes to prevent pipes from resting on their sockets and to allow the pipes to be jointed.

DRA2.W370.9 BLANK ENDS

Mark the ends of pipes which do not terminate at a manhole, chamber, gully or structure with marker blocks, and:

1. Connect the marker block to the plug at the end of the pipe with a wire;
2. Set the marker block flush with the surface of the adjacent permanent works.

CUTTING PIPES

DRA2.W410.9 GENERAL

Cut pipes and prepare ends in accordance with the manufacturer's recommendations, using purpose made equipment recommended by the manufacturer or otherwise Approved for cutting the pipes and:

1. Cut ends of pipes square or to the correct angle;
2. Do not damage the pipe coatings;
3. Trim and chamfer the cut ends to suit the type of joint;
4. Cut pipes which terminate at the inside face of underground structure such that the end of the pipe is flush with the face.

DRA2.W420.9 ELASTOMERIC JOINTS

Trim and chamfer cut ends in such a manner that elastomeric joint rings will not be damaged by them.

DRA2.W430.9 CLOSING LENGTHS

Do not cut pipes requiring to be cut to form closing lengths until adjacent pipes have been laid and jointed and the length to be cut can be accurately measured.

DRA2.W440.9 PRECAST CONCRETE PIPES

Cut reinforcement in precast concrete pipes which are to be cut, back flush with the concrete and protect with epoxy resin or by other Approved methods.

JOINTING PIPES AND FITTINGS

DRA2.W510.9 GENERAL

Joint pipes in accordance with the manufacturer's recommendations, using Approved equipment and materials recommended by the manufacturer and:

1. Inspect the pipes, joints, fittings and valves, including internal and external coatings, immediately before and after jointing. Remove deleterious material and repair any damage immediately before and after jointing. Clean surfaces which are to be jointed immediately before jointing and clean out pipes with clean water;
2. Ensure all joints in pipelines are watertight;

3. Ensure the width of gaps at joints are in accordance with the manufacturer's recommendations and achieved by marking the outside of the pipe, by using metal feelers or by other Approved methods. Check the position of elastomeric joint rings with by using metal feelers after jointing;
4. Protect gaps at joints in pipes, after jointing, using Approved methods, to prevent dirt, stones or other material from entering the joint.

DRA2.W520.9 FLANGED JOINTS

Correctly orientate bolt holes in flanged joints and joints incorporating bolted components before the bolts are tightened and:

1. Orient holes in flanged joints symmetrically about the vertical diameter, with no bolt holes on the vertical diameter;
2. Position elastomeric joint rings so they will not protrude into the bore of the pipe, temporarily fixing to the face of the flange using the minimum amount of adhesive of a type recommended by the manufacturer. Do not use jointing compound or paste for this purpose;
3. Use the correct size of bolts and nuts and lubricate the threads before tightening using the correct size of spanner. Tighten the bolts to the torque recommended by the manufacturer in diametrically opposite pairs, working around the bolt circle.

DRA2.W530.9 FLEXIBLE COLLAR JOINTS

1. Place elastomeric joint rings in position inside the grooves of the sleeve;
2. Mark each pipe with a location mark at a distance of half the length of the sleeve, minus 3 mm from the end;
3. Smear the ends of the pipes well with lubricant over a distance of at least 100 mm from the end of the pipe;
4. Place the sleeve on the end of the laid pipe and push home to the location mark on the pipe;
5. Place the pipe which is to be jointed to the laid pipe in the sleeve and push home to the location mark.

DRA2.W540.9 PUSH-IN JOINTS

Make push-in joints by smearing the elastomeric joint ring with lubricant and placing the ring in position on the spigot end of the pipe. Place the spigot in the socket of the laid pipe and push home.

DRA2.W550.9 DETACHABLE JOINTS

1. Place both cast iron flanges, the elastomeric joint rings and the central collar over the ends of the pipes before the pipes are placed to the required line and level, leaving a gap of between 5 mm and 6 mm between the ends of the pipes;
2. Move the flanges, elastomeric joint rings and central collar into position at the ends of the pipes, the central collar being placed centrally over the gap between the ends of the pipes before the bolts are tightened.

DRA2.W560.9 FLANGE ADAPTERS

Make joints by placing the flange adapter on the plain end of the pipe before tightening the bolts.

DRA2.W570.9 SOLVENT WELDED JOINTS

Make solvent welded joints by applying solvent cement to the pipes to be jointed, pushing the pipes home and:

1. Do not apply excess solvent and remove surplus cement after jointing;
2. Do not place in the trench, solvent welded pipes jointed outside the trench, until the solvent setting period recommended by the manufacturer has elapsed;
3. Additionally, do not allow any material or thing, contaminated by the solvent to remain in the pipe or in the trench.

DRA2.W580.9 ELECTROCHEMICAL INSULATION

Insulate all bolts, nuts and washers from electrochemical interaction with dissimilar metals by non-metallic washers and sleeves.

DRA2.W590.9 PROTECTION OF FLANGED JOINTS, DETACHABLE COUPLINGS AND FLANGE ADAPTERS

1. Clean the joint, including bolts and nuts, to remove all moisture, dust, oil grease and deleterious material;
2. Paint nuts and bolts with two coats of bituminous paint and coat the joint with primer;
3. Apply mastic filler in such a manner that all depressions, corners and voids between the bolts and the nuts are filled and a smooth surface is available on which to apply the anti-corrosion tape;
4. Apply at least two layers of anti-corrosion tape to all parts of the joint and to the adjacent pipe for at least 200 mm beyond each end of the joint. Apply the tape in accordance with the manufacturer's recommendations, wrapping it spirally around the joint and the pipe with at least 55% overlap per spiral;
5. Mould the tape manually after application to take up the contours of the parts being protected.

DRA2.W600.9 CAST IRON PIPES

Join pipes with either of the following:

1. Cold caulking compound:

   Carry out all pipe joints in accordance with the manufacturer's instructions and do not allow jointing material to project into the bore of pipes or fittings.

2. Flexible joints of Approved type:

   Carry out all pipe joints in accordance with the manufacturer's recommendations.

DRA2.W610.N SCREW JOINTS

Screw joints in pipes for drainage works shall be made using a threaded coupler. The threaded surfaces of the pipes and coupler shall be cleaned and the threads shall be painted with two coats of bituminous paint. The pipe thread shall be wrapped with three turns of spun yarn or other material approved by the CM and the joint tightened using purpose-made tools. Coal tar compounds or white lead paint shall not be used. Locking nuts to branch connections shall be tightened. Branch connections shall not protrude inside the pipe.

DRA2.W620.N BUTT FUSION JOINTS

The butt fusion welding parameters for welding PE pipes to pipes and PE pipes to spigot fittings shall be recommended by the manufacturer. Site PE fusion jointing shall be made in accordance with WIS No. 4-32-08 using automatic equipment with data printout facilities.

DRA2.W630.N ELECTROFUSION JOINTS

The electrofusion joints used in PE electrofusion fittings, including couplers, reducers, socket ends, tees, etc. shall comply with BS EN 12201-3. The electrofusion welding parameters shall be recommended by the manufacturer. Site fusion jointing shall be made in accordance with WIS No. 4-32-08 using automatic equipment with data printout facilities.

REPAIRS TO COATINGS AND LININGS

DRA2.W710.9 GENERAL

Do not repair damage to coatings and linings unless permitted by the CM. If permitted, carry out repairs using Approved materials recommended by the manufacturer.

THRUST AND ANCHOR BLOCKS

DRA2.W810.9 GENERAL

Use thrust and anchor blocks to resist forces at bends, branches and stopends in pressure pipelines, except where self anchoring joints are used.

DRA2.W820.9 EXCAVATION

Cast the bearing faces or other faces as indicated on the drawings, directly against undisturbed ground and:

1. Trim the faces of excavations to remove all loose material before concreting;
2. Carry out any excavation required for the block beyond the trench width after the pipe or fitting has been jointed;
3. Fill any excess excavation beyond the face of the block with concrete of the same grade as the block.

DRA2.W830.9 APPLYING PRESSURE

Do not apply internal pressure to the pipeline until thrust and anchor blocks have developed the specified grade strength.

BED, HAUNCH AND SURROUND

DRA2.W910.9 GRANULAR BED

1. Deposit aggregates for granular bed in the trench in layers not exceeding 150 mm thick for the complete width of the trench. Compact each layer using a plate vibrator or by other Approved methods;
2. Dig holes in the granular bed to prevent pipes resting on the sockets and to allow the pipes to be jointed. Lay the pipes directly on the granular bed without using any form of temporary support;

3. After the pipes have been jointed, deposit aggregate in layers not exceeding 150 mm thick, equally on both sides of the pipe to the level indicated on the drawings for the complete width of the trench. Compact each layer using a plate vibrator or by other Approved methods.

DRA2.W920.9 CONCRETE BED, HAUNCH AND SURROUND

1. Place polyethylene sheeting or a blinding layer on the trench bottom before concreting;
2. Support pipes at the required level by grade 20/20 as Worksection CON1, precast concrete wedges, blocks or cradles or by other Approved methods. Place one support adjacent to each end of each pipe and at intervals between these supports not exceeding 3 m. Place compressible sheeting between pipes and the supports;
3. Form flexible joints in the concrete bed, haunch and surround at flexible joints in pipelines. Place joint filler next to the flexible joint in the pipeline to extend for the complete thickness of the bed, haunch and surround;
4. Place concrete evenly over the complete width of the bed and over the complete length of the pipe being concreted up to a level of 25 mm below the underside of the pipe. Then place concrete on one side of the pipe only and work it under the pipe until the concrete spreads under it. Then place concrete equally on both sides of the pipe to the level indicated on the drawings.

DRA2.W930.9 PIPES UNDER ROADS

Protect pipes which are 1 m or less below the surface of a carriageway by concrete surround.

DRA2.W940.9 FILL MATERIAL SURROUND

Deposit fill material surround to pipelines as EAR1.W1410 and EAR1.W1420.

TOLERANCES

DRA2.W1010.9 GENERAL

Refer to Appendix H " Schedule of Tolerances" to this Specification.

CONNECTIONS

DRA2.W1110.9 CONNECTIONS TO STRUCTURES

1. Ensure that the joints between pipes and structures into which they are built are watertight. Remove protective coatings over the length to be built in and do not build pipe collars and sockets into structures;
2. Provide two flexible joints in pipelines adjacent to the outside faces of the structures into which they are built, with the distances from the outside face of the structure to the first joint and from the first joint to the second joint as specified in the following table:

Flexible Joints at Structures			
Diameter of Pipe	Position of First Flexible Joint from Structure		Distance of Second Flexible
	Minimum	Maximum	Joint from First Flexible Joint
Not exceeding 450 mm	150 mm	500 mm or diameter of pipe whichever is less	450 mm - 800 mm
Exceeding 450 mm but not exceeding 1050 mm			900 mm - 1200 mm
Exceeding 1050 mm			1500 mm - 1800 mm

3. Temporarily seal the ends of pipes which are built in to structures with a blank flange, brickwork or timber boarding as instructed by the CM. The temporary seals shall be left in position until the CM instructs their removal.

DRA2.W1120.9 SADDLE CONNECTIONS TO CONCRETE AND CLAY PIPES

Connect the saddle to concrete and vitrified clay pipes by bedding the saddle on a cement mortar bed and forming a cement mortar fillet to provide at least 50 mm cover to the base of the saddle.

DRA2.W1130.9 SPLAY CUT CONNECTIONS TO CONCRETE AND CLAY PIPES

Where pipes are to be connected to concrete or clay pipes without a Y-junction or purpose made pipe saddle:

1. Cut the pipe on the splay to form a junction such that the incoming pipe is at an angle of between 30° and 60° to the main pipe, upstream of the joint. Cut the hole in the main pipe to an elliptical shape suited to the cut end of the branch pipe. Cut the branch pipe to a length such that:
   a. The cut end of the pipe rests on the outside barrel of the main pipe; and
   b. The cut pipe does not project inside the main pipe.
2. Seal the joint between the cut pipe and the main pipe externally and unless otherwise Approved, internally flush with the main pipe, with mortar.

DRA2.W1140.9 SADDLE CONNECTIONS TO UPVC PIPES

Fix uPVC pipe saddles to uPVC pipes using a purpose-made mechanical clip or solvent cement of a type recommended by the manufacturer and Approved.

DRA2.W1145.N SADDLE CONNECTIONS TO PE PIPES

PE pipe saddles shall be fixed to PE pipes by means of electrofusion as recommended by the manufacturer and approved by the CM.

DRA2.W1150.9 BRANCH PIPELINES

Unless otherwise Approved, connect branch pipelines to main pipelines using Y-junctions of the same type and strength as the stronger of the pipes being jointed and of an angle between 30° and 45°.

DRA2.W1160.9 RECORDING POSITIONS OF JUNCTIONS

Measure the positions of pipe junctions relative to the manhole or structure immediately downstream and record before backfilling.

DRA2.W1170.9 CONNECTING PIPES NOT REQUIRED FOR IMMEDIATE USE

Seal the ends of connecting pipes not required for immediate use with a blank flange, brickwork or other Approved methods and measure and record their positions before backfilling.

MANHOLES, CHAMBERS, GULLIES AND CHANNELS

DRA2.W1210.9 MANHOLES, CHAMBERS AND GULLIES

1. Construct bases, inverts and benching for precast concrete manholes using grade 20/20 as in Worksection CON1 unless otherwise specified in Drawings;
2. Set precast concrete units for manholes and chambers vertically with step irons staggered and vertically aligned above each other. Seal joints between precast units and lifting holes with cement mortar, removing any excess and pointing the joints;
3. Fill concrete surround to gullies up to the sides of the excavation;
4. Set the frames for manhole covers and gully gratings to the same level of the surrounding surface, allowing for falls and cambers, using brickwork or concrete as shown on the drawings; and
    a. Do not exceed three courses of brickwork below frames;
    b. Use concrete of a minimum grade of 20/20 as in Worksection CON1.

DRA2.W1220.9 FILLING AROUND MANHOLES AND CHAMBERS

1. Fill excavations around manholes and chambers in carriageways using grade 10/40 concrete as Worksection CON1;
2. Fill around other manholes and chambers with fine fill material.

DRA2.W1230.9 CONCRETE OPEN CHANNELS

Construct the top surfaces of side walls of concrete open channels to the same levels as the adjoining permanent works. Fill any excess excavation beyond the channel walls with grade 10/40 concrete, as Worksection CON1.

INSTALLING VALVES

DRA2.W1310.9 GENERAL

Install valves in accordance with the manufacturer's recommendations and in the closed position.

DRA2.W1320.9 BOX-OUTS AND REBATES

Fill box-outs and rebates for valve frames and other gaps between frames and concrete surfaces with cement mortar.

DRA2.W1330.9 CLEANING AND CHECKING

After installation, clean valves, lightly grease moving parts and check for ease of operation. Leave valves in the closed position.

DRA2.W1340.9 AIR VALVES

Provide air valves with isolating gate valves.

PIPES AND MANHOLES TO BE ABANDONED

DRA2.W1410.9 INSTALLATIONS NOT EXCEEDING 1.2M DEEP BENEATH CARRIAGEWAYS OR NOT EXCEEDING 1M DEEP BENEATH OTHER AREAS

If the top of a pipe or culvert, or the bottom of a manhole, chamber or gully, which is to be abandoned is at a depth not exceeding 1.2 m below the finished ground level for carriageways or not exceeding 1.0 m below the finished ground level for areas other than carriageways whichever is applicable, remove and dispose of the pipe, manhole, chamber or gully unless otherwise Approved. Fill the void with foam concrete, granular fill material or special fill material as directed by the CM. Recycled aggregate may be used for filling the void subject to CM's Approval.

DRA2.W1420.9 INSTALLATIONS EXCEEDING 1.2M DEEP BENEATH CARRIAGEWAYS OR EXCEEDING 1M DEEP BENEATH OTHER AREAS

If the top of a pipe or culvert, or the bottom of a manhole, chamber or gully, which is to be abandoned is at a depth exceeding 1.2 m below the finished ground level for carriageways or exceeding 1.0 m below the finished ground level for areas other than carriageways whichever is applicable:

1. Demolish the manholes, chambers and gullies to at least 1.2 m and 1.0 m below the finished ground level for carriageways and areas other than carriageways respectively unless otherwise indicated on the drawings;
2. Seal the lowest points of abandoned pipelines with concrete, bricks or other Approved methods;
3. Fill abandoned pipes, culverts, manholes, chambers and gullies with foam concrete or grout, by pumping or by gravity, starting from the lowest point on the system and continuing until all voids are completely filled.

CLEANING PIPELINES

DRA2.W1510.9 TIMING

Carry out cleaning:

1. After the pipeline has been tested;
2. After temporary works required for testing have been removed and any parts of the pipeline removed for testing have been reconnected;
3. Not more than 7 days before the pipeline is handed over.

DRA2.W1520.A PROCEDURE

1. Clean pipelines by high pressure water jetting, pigging or by other Approved methods and clean and wash manholes and chambers;
2. Materials excavated / cleared from pipelines shall be handled in an environmentally responsible manner without causing pollution or nuisance to the public as far as possible. In particular:

a. Materials excavated / cleared shall either be placed in bags as soon as possible after excavation or, if they are temporarily stockpiled on roads / footpaths or areas close to the public, be covered and underlain by tarpaulin sheets to minimize fouling of the ground and escape of odour. The ground shall be cleansed after removal of the materials;

b. The materials shall be dewatered before disposal in accordance with the requirements of the dumping site if necessary. During transportation of the materials, measures shall be taken to prevent leakage of foul water onto roads and public areas and escape of odour.

INSPECTION OF PIPELINES

DRA2.W1610.9 GENERAL

Unless otherwise permitted by the CM, check the cleanliness, bore, linearity and joints of pipelines of 450 mm diameter or less by pulling a mandrel through the completed pipeline, or parts of the pipeline if so Approved. The mandrel must be 750 mm long and 12 mm less in diameter than the nominal diameter of the pipe.

DRA2.W1620.9 TEMPORARY COLOUR IDENTIFICATION

1. Provide a temporary colour band around the circumference of the open end(s) of installed underground pipes to be terminated at a manhole, chamber, gully or structure which cannot be cast before or when the pipes are laid. The colour and width of the band are as follows:

Type of Drain Pipe	Colour	Width of Colour Band
Storm water	White	75 mm
Waste water	Yellow	75 mm
Foul water	Green	75 mm

2. Paint identification colour mark on the top and the edge of the access opening of the manhole and back inlet gully trap to which one or more pipe(s) cannot be connected when the manhole is cast. The colour and size of the mark are as follows:

Type of Manhole / Back Inlet Gully Trap (B.I.G.T.)	Colour	Size of Each Colour Mark
Storm water (manhole)	White	200 mm x 100 mm
Foul water (manhole)	Green	200 mm x 100 mm
Storm water (B.I.G.T.)	White	200 mm x 100 mm
Waste water (B.I.G.T.)	Yellow	200 mm x 100 mm

CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION

DRA2.W1710.9 SCOPE

Carry out CCTV inspection for the pipelines as listed below, in accordance with the remaining clauses in this sub-section:

1. Horizontal underground pipelines;
2. Vertical and horizontal pipelines up to first domestic floor level of the buildings including the easy bends underground and above ground;

3. Manholes, gullies, inspection chambers and catchpits;
4. Pipelines as shown on Drawings.

DRA2.W1720.9 SUBMISSIONS

At least 28 days before the inspection starts, submit the following particulars of the proposed procedure for CCTV inspections to the CM:

1. Name of the CCTV survey contractor and experience of his staff delegated to carry out or supervise the inspections;
2. Details of equipment;
3. Details of the format of the report;
4. Examples of video films, compact disc - recordable and photographs obtained from inspections employing the same equipment.

DRA2.W1730.9 EQUIPMENT

Provide the following equipment:

1. A CCTV colour camera with integral lighting unit. The camera must be of a type designed and constructed for the specified purpose, capable of operating in 100% relative humidity and fitted with a rotating mirror for complete circumferential viewing. The system must be capable of producing an accurate, clear, high quality picture of the entire periphery of the pipe on the monitor screen and recording tape. The camera and lighting unit must be mounted on a self-propelled crawler or on skids linked to a manual or power operated winch;
2. A monitor screen which displays the camera view during the inspection and which is housed in covered accommodation with facilities for inspection by the CM and others;
3. A screen writer which displays, on the monitor screen, details of the inspection, including the date, location, pipe material, pipe diameter, direction of view and comments on the condition of the pipe;
4. A measuring device which displays the camera location automatically on the monitor screen and is capable of measuring to within an accuracy of 0.1% of the length of the pipeline or to ±0.3 m, whichever is the greater;
5. A control unit which controls the camera movement, lighting intensity, focusing and recording;
6. A video recording system approved by the CM to record the inspection and information displayed on the monitor screen;
7. A digital camera capable of producing photographs with a superimposed date.

DRA2.W1740.9 PROCEDURE

1. Move the camera through the pipeline at the following speed:
   a. Not exceeding 0.1 m/s for pipes of diameter less than or equal to 200 mm;
   b. Not exceeding 0.15 m/s for pipes of diameter exceeding 200 mm; or
   c. Such speed as agreed by the CM to enable all details to be extracted from the video recording system.
2. If the camera cannot pass through the complete pipeline in one operation, carry out the inspection from both ends of the pipeline;
3. Stop the camera whenever instructed to do so by the CM to allow his inspection;

4. Ensure that the video recording system is operated during the complete inspection to provide a continuous record of the inspection and information on the monitor screen. Record in the video record a location signboard supported at each end of the pipeline;
5. Take photographs of the monitor screen for continuing and point defects, blocked areas of pipelines and whenever instructed;
6. Submit a duplicate copy of the video and a preliminary report recording the work done of the day and defects identified to the CM at end of each day;
7. Rectify all identified blocked or defective pipelines. Re-inspect the rectified pipelines with video record.

DRA2.W1750.A RECORDING RESULTS

Keep a record of the inspections on Site and submit 3 copies of the report to the CM, within 7 days of the completion of the inspection and same for the re-inspection, containing the following details:

1. A key map showing the pipelines inspected and associated manholes, chambers and structures;
2. Tables listing details of inspection, including date, location, pipe material, pipe diameter, chainage, manholes, junctions and other features and the condition of the pipes and joints, illustrated by a coding system in accordance with the "Manual of Sewer Condition Classification" 5th Edition (2013), published by the UK National Water Council;
3. A summary showing the number, position and type of defects in each pipeline inspected. The summary shall include photographs to illustrate degree of mortar loss, size of a crack / fracture, size of a void or any other quantifiable defect. A suitable metric scale shall be included and be clearly visible and in focus within the photograph.

DRA2.W1760.9 VIDEO AND PHOTOGRAPHS

Submit 3 copies, to the CM, at the same time as the report:

1. Video providing a continuous record of the inspection and information on the monitor screen. The media shall be of high quality, new and unused before recording and shall be of a digital format (DVD+/-R or CD-R) or Video Home System (VHS) format, subject to approval of the CM; and
2. 3R size photographs of the monitor screen, including the date and the chainage, mounted in photograph albums.

PROTECTION

DRA2.W1805.9 HOT DIP GALVANIZING

1. Unless otherwise specified, galvanized coatings to be applied by hot-dip galvanizing to be in accordance with BS EN ISO 1461:2009 with minimum mean coating thickness of 45 microns to 85 microns depending on thickness of article as stipulated in Table 3 of BS EN ISO 1461:2009, unless otherwise specified. The coating thickness to comply with the following Table:

Article Thickness	Minimum Mean Coating Thickness
> 6 mm	85 µm
> 3 mm to ≤ 6 mm	70 µm

≥ 1.5 mm to ≤ 3 mm	55 µm
< 1.5 mm	45 µm

2. Unless Approved, all components are to be galvanized after welding, drilling and cutting operations are complete;
3. All hot dip galvanizing, including the galvanizing work specified in other Worksections, is to be carried out by galvanizers with ISO 9001 certification. Submit the name of galvanizer for Approval;
4. Submit original invoice/delivery note and galvanizing certification for each delivery. These documents shall include the following information:
   a. Project title/number;
   b. Name of galvanizer;
   c. Types and dimensions of articles;
   d. Quantities.
5. Attach a durable identification tape to each batch of galvanized articles indicating the project title, galvanizing certification number and name of galvanizer.

DRA2.W1810.9 ANTI-CORROSION TAPE

Apply anti-corrosion tape to all valves, flanged joints, slip-on couplings and flange adapters.

WORKS OUTSIDE SITE BOUNDARY

DRA2.W1910.9 APPROVED CONTRACTOR FOR PUBLIC WORKS

Underground drainage works required to be carried out by a contractor or sub-contractor who is on the current List of Approved Contractors for Public Works for Roads and Drains are specified in Project Specific Specification.

DRA2.W1920.A SPECIFICATION

Carry out the works specified under DRA2.W1910 in accordance with Sections 5, 6, 13, 14, 16, 19 and 23 of the Hong Kong Government General Specification for Civil Engineering Works (2020 Edition) and its amendments published 42 days prior to the date for the return of tenders unless otherwise specified.

DRA2.W1930.9 INSPECTION

1. Initial Site Inspection
   a. Notify the CM to arrange with Drainage Services Department for an initial site inspection of the works before backfilling to pipelines or covering up. Allow the CM to give one week advance notice by fax for this inspection.
2. Handing Over Inspection
   a. Notify the CM to arrange with Drainage Services Department for a handing over inspection when all works for the drainage connections are completed and ready for handing over. Allow the CM to give one week advance notice by fax for this inspection.

DRA2.W1940.9 RECORD DRAWINGS AND TEST REPORTS

Provide the following as-constructed records to the CM for submitting to Drainage Services Department:

1. Material quality records (brand name, grade, class etc.);
2. Acceptance test records (water test etc.);
3. Colour closed circuit television survey report; and
4. As-built record drawings.

TESTING

GENERAL

DRA2.T010.9 SUBMISSIONS

At least 14 days before the start of testing, submit the following details relating to pipeline testing to the CM:

1. Name of testing laboratory accredited by HOKLAS for the relevant tests, if available;
2. Test equipment and method of setting up the equipment;
3. Calibration certificates for pressure gauges;
4. Procedure for carrying out the test;
5. Programme for testing.

DRA2.T020.9 QUALITY ASSURANCE SCHEMES

Tests stated in this Worksection may be reduced in number as agreed by the CM if such materials or articles delivered to Site satisfy the following conditions:

1. To bear the stamps of the registered certification trade mark of the BA Institution, known as the BS Kitemark; or
2. To be covered by a manufacturer's quality assurance scheme stated in the Contract or approved by the CM.

TESTING PIPES

DRA2.T110.9 DEFINITION OF 'BATCH'

A batch of pipes or fittings is any quantity of pipes or fittings of the same type and nominal diameter, manufactured by the same manufacturer, covered by the same certificates as stipulated under DRA2.M1010 delivered to the Site.

DRA2.T120.9 SAMPLES

Provide one sample of pipe or fitting from each 50 pipes or fittings or part thereof in a batch unless:

1. Such materials or articles delivered to Site satisfy the conditions stipulated in DRA2.T020 (1) & (2); and
2. Smaller quantities are agreed by the CM.

DRA2.T130.A TESTING PROCEDURES

Unless otherwise Approved, test each sample of pipes and fittings in accordance with the relevant British Standard, as follows:

1. Concrete pipes and fittings: BS EN 1916 and BS 5911: Part 1;
2. Vitrified clay pipes, fittings and joints: BS EN 295;
3. Ductile iron pipes and fittings: BS EN 545 and BS EN 598;
4. Grey iron pipes and fittings: BS 4622;

5. uPVC pipes for industrial purposes: BS 3506;
6. uPVC soil and ventilation pipes, fittings and accessories: BS 4514 for DN/OD 82 (if adopted by industry); BS EN 1329-1 (for others);
7. uPVC gravity surface water pipes and fittings above ground: BS EN 12200-1, BS EN 607 and BS EN 1462;
8. uPVC storm water pipes and fittings below ground: BS 4660 and BS EN 13598-1;
9. uPVC pipes and fittings for gravity sewage pipes above ground: BS 5255, BS EN 1329-1;
10. uPVC pipes and fittings for gravity sewage pipes below ground: BS EN 1401-1;
11. PE compounds: BS EN 12201-1;
12. PE pipes: BS EN 12201-2;
13. PE fittings: BS EN 12201-3;
14. Cast iron pipes and fittings: BS 437.

DRA2.T140.9 NON-COMPLIANCE

1. If the result of any test required in accordance with the relevant British Standard does not comply with the specified requirements for the test, provide one additional sample from the same batch and carry out additional tests for the property;
2. The batch will be considered as not complying with the specified requirements for the property if the result of any additional test does not comply with the specified requirements for the property.

TESTING AGGREGATES FOR GRANULAR BED

DRA2.T210.9 DEFINITION OF 'BATCH'

Any quantity of aggregates for granular bed of the same type, produced at the same time, in the same place, covered by the same certificates and delivered to the Site at any one time.

DRA2.T220.A SAMPLES

Unless otherwise permitted by the CM, provide one sample of aggregates for granular bed from each batch delivered to Site as follows:

1. Size: 40 kg;
2. Method of sampling: in accordance with CS3;
3. With a moisture content representative of the moisture content of the batch.

DRA2.T230.A TEST FOR PARTICLE SIZE DISTRIBUTION

Test each sample in accordance with CS3.

DRA2.T240.A TEST FOR TEN PERCENT FINES VALUE

Test each sample in accordance with CS3.

DRA2.T250.9 TEST FOR COMPACTION FRACTION VALUE - EQUIPMENT

Provide the following equipment:

1. A steel open-ended cylinder, 150 mm internal diameter by 250 mm high, with a wall thickness of not less than 3.5 mm;
2. A steel rammer of 40 mm diameter weighing approximately 1 kg;
3. A steel rule calibrated to 1 mm.

DRA2.T260.9 TEST FOR COMPACTION FRACTION VALUE - PROCEDURE

1. Place the sample on a clean surface and divide by quartering or by using a riffle box to obtain a specimen weighing approximately 10 kg;
2. Place the cylinder on a firm, level surface and fill, without tamping, with material taken from the sample. Strike off surplus material level with the top of the cylinder and clear from the area around the cylinder;
3. Lift the cylinder clear of the contents and place it alongside the material;
4. Replace approximately one quarter in the cylinder and compact using the rammer until no further compaction can be achieved. Repeat this procedure for each of the remaining three quarters of the material and compact the top of the material as level as possible;
5. Measure the distance from the top of the cylinder to the top surface of the material to the nearest 1 mm.

DRA2.T270.9 TEST FOR COMPACTION FRACTION VALUE - CALCULATION

Calculate the compaction fraction value of the material from the following equation:

Compaction fraction value = d/h

where:

d is the distance from the top of the cylinder to the top surface of the material (mm);

h is the height of the cylinder (mm).

DRA2.T280.9 TEST FOR COMPACTION FRACTION VALUE - RESULTS

Report the following:

1. Identification of sample;
2. The compaction fraction value to the nearest 0.01;
3. The source and type of material;
4. Date of the test;
5. That the test method used was in accordance with this specification.

DRA2.T290.9 COMPLIANCE CRITERIA

The results of tests for compaction fraction value tests must comply with the following requirements:

1. Maximum compaction fraction value for bed for pipes not exceeding 300 mm nominal diameter: 0.3;
2. Maximum compaction fraction value for bed for pipes exceeding 300 mm nominal diameter: 0.15.

TESTING PRECAST CONCRETE UNITS FOR MANHOLES, CHAMBERS AND GULLIES

DRA2.T310.9 DEFINITION OF 'BATCH'

Any quantity of precast concrete units for manholes, chambers or gullies of the same type and size, manufactured by the same manufacturer, covered by the same certificates as stipulated under DRA2.M1040 (1) delivered to the Site.

DRA2.T320.9 SAMPLES

Unless otherwise permitted by the CM, provide one sample of precast units for manholes, chambers or gullies from each 50 precast concrete units, or part thereof, in a batch.

DRA2.T330.A METHODS OF TEST

Unless otherwise permitted by the CM, test each sample of the precast concrete units for manholes, chambers and gullies in accordance with the relevant British Standard as follows:

1. Precast concrete units for manholes: BS EN 1917 and BS 5911: Part 3;
2. Inspection chambers: BS EN 1917 and BS 5911-4;
3. Precast concrete gullies: BS 5911: Part 6;
4. Vitrified clay gullies: EN 295.

DRA2.T340.9 NON-COMPLIANCE

1. If the result of any test required in accordance with the relevant British Standard does not comply with the specified requirements for the test, provide one additional sample from the same batch and carry out additional tests for the property;
2. The batch will be considered as not complying with the specified requirements for the property if the result of any additional test does not comply with the specified requirements for the property.

TESTING MANHOLE COVERS, GULLY GRATINGS AND KERB OVERFLOW WEIRS

DRA2.T410.9 DEFINITION OF 'BATCH'

Any quantity of manhole covers, gully gratings and kerb overflow weirs of the same type, manufactured by the same manufacturer, covered by the same certificates as stipulated under DRA2.M1040 (3) delivered to the Site.

DRA2.T420.9 SAMPLES

Provide one sample of manhole covers, gully gratings or kerb overflow weirs from each 20 covers, gratings or weirs, or part thereof in a batch.

DRA2.T430.9 PROCEDURE

Weigh each sample of manhole covers, gully grating and kerb overflow weirs and load test manhole covers and, gully gratings by the method described in the remainder of this Sub-section, to the loads stated in the tables in clause DRA2.M650.

DRA2.T440.9 EQUIPMENT FOR LOAD TESTING

Provide the following equipment:

1. The manufacturer's recommended for the manhole cover or gully grating or a fabricated test frame of an Approved type which will simulate the normal conditions of use of the cover or grating;
2. A circular hardwood bearing block faced with hard rubber or other resilient material, the diameter of which is as stated in the relevant table in clause DRA2.M650 and which is sufficiently rigid to ensure that the load is equally distributed over the whole area of the block;
3. Test loads;
4. Equipment for measuring the loads applied, readable and accurate to 0.05t or 2% of the specified test load, whichever is greater.

DRA2.T450.9 LOAD TEST PROCEDURE

1. Rigidly support the full bearing area of the frame;
2. Place the cover or grating in the frame and place the bearing block centrally on the cover or grating;
3. Apply the specified test load without shock;
4. Maintain the specified test load for at least 30 seconds and then remove it.

DRA2.T460.9 LOAD TEST RESULTS

Report the following:

1. Identification of sample;
2. The load applied to the nearest 0.05t or 2% of the specified test load, whichever is the greater;
3. Details of any fracture or cracks;
4. That the test method used was in accordance with this specification.

DRA2.T470.9 COMPLIANCE CRITERION FOR RESISTANCE TO FRACTURE OF COVERS AND GRATINGS

Manhole covers and gully gratings must withstand the specified test load without fracture or cracking.

DRA2.T480.9 NON-COMPLIANCE FOR MASS OF COVERS, GRATINGS AND WEIR

If any manhole cover, gully grating or kerb overflow weir does not comply with the specified requirements for mass:

1. Weigh every cover, grating and weir in the batch to determine its mass;
2. Do not use any cover, grating and weir not complying with the specified requirement for mass in the permanent work.

DRA2.T490.9 NON-COMPLIANCE FOR RESISTANCE TO FRACTURE OF COVERS AND GRATINGS

If any manhole cover or gully grating does not comply with the specified requirements for resistance to fracture:

1. Provide two additional samples from the same batch and test to determine their resistance to fracture;

2. The batch will be considered as not complying with the specified requirements for resistance to fracture if the result of any additional test does not comply with the specified requirements for resistance to fracture.

TESTING GRAVITY PIPELINES

DRA2.T510.9 TESTS ON SEWAGE PIPELINES GENERALLY

Test gravity pipelines for sewage by the methods and at the times stated in the following table:

Testing Gravity Sewage Pipelines		
Diameter of Pipe	Time of Test	Method of Test
Not exceeding 900 mm	As sub-clause (1) Note	Water test or air test
	As sub-clause (2)	Water test or air test
	As sub-clause (3)	Infiltration test
Exceeding 900 mm	As sub-clause (1)	Visual inspection
	As sub-clause (2)	Water test or air test
	As sub-clause (3)	Infiltration test

Note: Applicable to pipe section laid in a depth > 4.5 m. Pipe sections laid in a depth ≤ 4.5 m are not required to be tested at this stage with the specified method.

1. After the pipes have been jointed and the bedding has been placed and immediately before haunch or surround is placed or fill material is deposited;
2. After haunch and surround has been placed and fill material has been deposited and compacted;
3. Test to the following details:
   a. Not more than 7 days before the pipeline is to be handed over to other departments as specified by the CM; or
   b. Not more than 7 days before the pipeline is to be handed over when required by the CM pursuant to BS 8301:1985, clause 25.7.2.

DRA2.T520.A TESTS ON SURFACE WATER PIPELINES GENERALLY

Test gravity pipelines for surface water by the methods and at the times stated in the following table:

Testing Gravity Surface Water Pipelines		
Diameter of Pipe	Time of Test	Method of Test
Not exceeding 900 mm	As sub-clause (1) or As sub-clause (2)	Water test or air test
Exceeding 900 mm	As sub-clause (1)	Visual inspection
	As sub-clause (2)	Water test or air test

1. After the pipes have been jointed and the bedding has been placed and immediately before haunch or surround is placed or fill material is deposited;
2. After haunch and surround has been placed and fill material has been deposited and compacted.

DRA2.T530.9 WATER AND AIR TESTS GENERALLY

Carry out the tests on the complete pipeline between manholes, chambers and structures and do not test pipelines in parts unless Approved or unless the specified test pressure would otherwise be exceeded. Test short branch pipelines with the main pipeline and long branch pipelines separately.

DRA2.T540.9 INFILTRATION TESTS GENERALLY

Carry out tests on the complete pipeline between manholes, chambers and structures, including manholes, chambers and branches within the system unless otherwise agreed by the CM.

DRA2.T550.9 EQUIPMENT

Provide the following:

1. Expanding disc stoppers, air bags or other Approved methods of sealing pipes;
2. Struts and wedges;
3. Force pump for water test;
4. Standpipe for water test;
5. Measuring vessel for water test, readable and accurate to 0.01 litre;
6. U-tube for air test;
7. Trolleys to obtain access inside pipelines for visual inspections and mechanical fans to ensure that an adequate air supply is available. Provide engine driven fans with a flexible exhaust or other methods of keeping exhaust fumes clear of the fresh air intake.

DRA2.T560.9 PREPARATION

Before tests and inspections:

1. Remove debris and water from the pipeline;
2. Seal openings to the pipeline using expanding disc stoppers, air bags or other Approved methods and secure seals against movement.

DRA2.T570.9 WATER TEST PROCEDURE

1. Test pipe of diameter up to and including 300 mm in accordance with BS 8301:1985, clause 25.6.2; or
2. For pipe of diameter larger than 300 mm or works to be handed over to other departments as specified by the CM, carry out the test as follows:
    a. Fill the pipeline with water and keep it filled for two hours before testing starts to allow absorption to take place;
    b. Apply a test pressure at the standpipe of 1.2 m head above the soffit of the pipe, at the high end, and maintain it for 30 minutes. Do not exceed a 6 m head of water at the invert of the low end of the pipe;
    c. Top up the head of water at the standpipe at 5-minute intervals during the test and fill to the specified head at the end of the test period. Measure the amounts of water added to the standpipe using the measuring vessel;
    d. Measure the leakage of water from the pipeline by the amount of water added to maintain the specified head of water.

DRA2.T580.9 WATER TEST CALCULATION

Calculate the permitted leakage of water from the pipeline from the equation:

$$\text{permitted leakage} = d \times l \times \frac{t}{60} \text{ litre}$$

where:

d. is the internal diameter of the pipe (m);

l. is the length of the pipeline tested (m);

t. is the test period (min).

DRA2.T590.9 AIR TEST PROCEDURE

Carry out the test as follows:

1. Pump air into the pipeline until a test pressure of slightly more than 100 mm is registered on a U-tube manometer connected to the pipeline. Allow five minutes for the stabilisation of the air temperature and then adjust the air pressure to 100 mm of water;
2. Read the pressure from the U-tube at the end of a five-minute period, without further pumping.

DRA2.T600.9 VISUAL INSPECTION

Examine the inside of the pipeline visually and record infiltration or damage to pipes.

DRA2.T610.A INFILTRATION TEST PROCEDURE

The procedures for the infiltration test shall be in accordance with the following:

1. After backfilling has been completed and the ground water level has stabilized, the sewer should be checked for infiltration. All live inlets should be sealed and the line inspected from the manholes. Any flow from the pipeline coming into the manholes or within the manholes themselves should be investigated to establish its source. In small pipes the point of infiltration may be located visually with light and mirror or with an inflated rubber plug. When conditions justify it a video camera can be used;
2. The sewer may normally be acceptable if the infiltration does not exceed 1 litre per hour per meter diameter per metre of pipe run, although this will depend on the judgement of the CM and the extent of exfiltration shown by the water test.

DRA2.T620.9 REPORTING OF RESULTS

Report the following:

1. The nominal internal diameter of the pipe;
2. The location and the length of the pipeline tested to the nearest 0.3 m;
3. The test pressure applied during the water test to the nearest 0.01 m and during the air test to the nearest 1 mm head of water;
4. The test period to the nearest 1 minute;
5. The leakage and permitted leakage for the water test to the nearest 0.1 litre;
6. The amount of infiltration for the infiltration test to the nearest 0.1 litre;
7. Details of any discernible leakage of water from the pipe or from any joint during the water test;

8. That the test method used was in accordance with this specification.

DRA2.T630.9 COMPLIANCE CRITERIA

The results of tests on gravity pipelines must comply with the following requirements:

1. The leakage of water from the pipeline, determined by the water test must not exceed the permitted leakage calculated in accordance with clause DRA2.T580;
2. There must be no discernible leakage from the pipe or from any joint during the water test;
3. The air pressure must remain above 75 mm head of water at the end of the air test;
4. There must be no infiltration or damage to the pipes or joints as determined by the visual inspection.

DRA2.T640.9 NON-COMPLIANCE

If the result of any test on gravity pipelines does not comply with the specified requirements for the test, investigate the reason and carry out the necessary Approved replacement or remedial work. Retest the pipeline.

PRESSURE PIPELINES

DRA2.T710.9 TIMING OF TESTS

1. Test the pipeline at the following times:
   a. After the pipes have been jointed and the bedding has been placed and immediately before haunch or surround is placed or fill material is deposited;
   b. After haunch and surround has been placed and fill material has been deposited and compacted.
2. Do not carry out the tests covered in sub-clause (1)(a) above on parts of a pipeline unless permitted by the CM or unless the specified test pressure would otherwise be exceeded. Carry out the test covered by sub-clause (1)(b) above on the complete pipeline.

DRA2.T720.9 TEST PRESSURES

Carry out tests to 1.5 times the maximum working pressure in the part of the pipeline being tested unless otherwise specified in the Drawings.

DRA2.T730.9 SIMULTANEOUS TESTING

Do not carry out testing on more than one pipeline in the same trench.

DRA2.T740.9 ALTERNATIVE TEST METHODS

Do not substitute tests on individual joints for the tests required by this specification unless permitted by the CM, in which case the CM will approve the method of testing and the compliance criteria.

DRA2.T750.9 EQUIPMENT

Provide the following:

1. Blank flanges or caps;
2. Struts and wedges;

3. Temporary concrete blocks or other anchors;
4. Force pump;
5. Pressure gauge, readable and accurate to 0.01 m head of water and either the conventional circular type of at least 300 mm diameter or a digital indicator type;
6. Measuring vessel, readable and accurate to 0.01 litre.

DRA2.T760.9 PROCEDURE

Carry out the test as follows:

1. Clean pipes and valves and check the operation of the valves. Isolate air valves;
2. Fix blank flanges or caps to the ends of the pipeline or to the part of the pipeline to be tested. Do not make tests against closed valves unless otherwise Approved;
3. Secure blank flanges and end caps and closed valves against which tests are to be made with struts and wedges against temporary concrete blocks or other anchors. Ensure the blocks are completed and sufficiently hardened and that thrust and anchor blocks, pipe straps and other devices required too prevent movement of the pipes and fittings are completed, before testing begins;
4. Fill the pipeline with water and remove all the air, taking measures during filling to provide free outlets for air and to prevent water hammer;
5. Increase the pressure in the pipeline to working pressure and allow it to remain filled at this pressure for 2 hours to allow absorption to take place and to achieve conditions which are as stable as practicable;
6. Increase the pressure in the pipeline slowly by pumping water into the pipeline using a force pump until the specified test pressure is reached at the lowest part of the pipeline being tested;
7. Maintain the specified test pressure in the pipeline, using the force pump if necessary, for a period of at least one hour;
8. At the end of the one hour period, increase the pressure, if necessary, to the specified test pressure and disconnect pumps and water supply points;
9. Leave the pipeline in this condition for a test period of one hour, no water being allowed to enter the pipeline during the test period;
10. Record the pressure in the pipeline at the end of the test period;
11. Reconnect the pumps and water supply points and increase the pressure to the specified test pressure;
12. Draw water from the pipeline until the pressure in the pipeline is the same as at the end of the test period. Measure the leakage of water from the pipeline as the amount of water drawn off.

DRA2.T770.9 CALCULATION

1. Calculate the average test pressure (P) as the average of the specified test pressure and the pressure at the end of the test period;
2. Calculate the permitted leakage of water from the pipeline during the pressure test from the equation:

$$\text{permitted leakage} = d \times l \times \frac{t}{120} \text{ x P litre}$$

where:

d. is the nominal internal diameter of the pipe (m);

l. is the length of the pipeline tested (km);

t. is the test period (hr);

P. is the average test pressure (m).

DRA2.T780.9 REPORTING OF RESULTS

Report the following:

1. The nominal internal diameter of the pipe;
2. The location and length of the pipeline to the nearest 0.3 m;
3. The test period to the nearest one minute;
4. The specified test pressure to the nearest 0.01 m head of water;
5. The pressure at the end of the test period to the nearest 0.01 m head of water;
6. The average test pressure to the nearest 0.01 m head of water;
7. The leakage and permitted leakage to the nearest 0.1 litre;
8. Details of any discernible leakage of water from the pipeline during the test;
9. That the test method used was in accordance with this specification.

DRA2.T790.9 COMPLIANCE CRITERIA

The results of tests on pressure pipelines must comply with the following requirements:

1. The leakage of water from the pipeline, determined by the pressure test, must not exceed the permitted leakage calculated in accordance with clause DRA2.T770;
2. There must be no discernible leakage of water from the pipeline or from any joint during the pressure test.

DRA2.T800.9 NON-COMPLIANCE

If the result of any test on pressure pipelines does not comply with the specified requirements for the test, investigate the reason and carry out the necessary Approved replacement or remedial work. Retest the pipeline.

EXT EXTERNAL AND LANDSCAPE WORKS

EXT1 SUB-BASES, BITUMINOUS ROADWAYS AND RELATED FOOTPATHS 21

DESIGN 21

DESIGN PARAMETERS 21

EXT1.D010.9 SUB-BASE AND BITUMINOUS ROADBASE MATERIALS 21

EXT1.D020.9 BITUMINOUS MATERIALS 22

MATERIALS 24

DEFINITIONS 24

EXT1.M010.9 NORMINAL MAXIMUM AGGREGATE SIZE 24

SUBMISSIONS 24

EXT1.M110.9 DETAILS OF AGGREGATES, FILLER, BITUMEN, BITUMINOUS EMULSION AND BITUMINOUS PRIMING MATERIAL FOR BITUMINOUS MATERIALS 24

EXT1.M120.9 DETAILS OF MIXES FOR SUB-BASE AND BITUMINOUS MATERIALS 25

EXT1.M130.9 PARTICULARS OF VIRGIN SUB-BASE MATERIAL AND RECYCLED SUB-BASE MATERIAL 26

EXT1.M140.9 DETAILS OF SUPPLIER 26

EXT1.M150.9 METHOD OF LAYING AND COMPACTING 26

SAMPLES 27

EXT1.M210.9 SUB-BASE MATERIAL, AGGREGATE, FILLER AND BITUMEN 27

SUB-BASE MATERIALS 27

EXT1.M310.9 SUB-BASE USING VIRGIN MATERIAL 27

EXT1.M320.9 RECYCLED SUB-BASE MATERIAL 27

BITUMINOUS MATERIALS 28

EXT1.M410.9 AGGREGATES FOR BITUMINOUS MATERIALS 28

EXT1.M420.A FILLER 30

EXT1.M430.9 BITUMEN 30

EXT1.M440.A EMULSION 30

EXT1.M450.9 PRIMER 30

WORKMANSHIP 31

GENERAL 31

EXT1.W010.9 USE OF APPROVED MIX 31

EXT1.W020.9 HANDLING AND STORAGE 31

EXT1.W030.9 TRANSPORTING 31

MIXING 31

EXT1.W110.9 PLANT 31

EXT1.W120.9 SUB-BASE AND BITUMINOUS MATERIALS 32

PRELIMINARY WORK 33

EXT1.W210.9 INSTALLATION OF UTILITIES 33

LAYING AND COMPACTING 33

EXT1.W310.9 SUB-BASE MATERIAL USING VIRGIN MATERIAL 33

EXT1.W320.9 RECYCLED SUB-BASE MATERIAL 33

EXT1.W330.A BITUMINOUS MATERIALS 34

EXT1.W340.9 LAYING BY PAVING MACHINE 35

EXT1.W350.9 LAYING BY MANUAL METHODS 35

EXT1.W360.9 COMPACTING 35

EXT1.W370.9 JOINTING BITUMINOUS MATERIALS 36

PERMISSIBLE TOLERANCES 36
EXT1.W410.9 CARRIAGEWAY ALIGNMENT 36
EXT1.W420.9 CARRIAGEWAY LEVELS 36
EXT1.W430.9 COVERS, FRAMES AND OTHER HARDWARE 36
PROTECTION 37
EXT1.W510.9 SURFACES OF SUB-BASES AND BITUMINOUS CARRIAGEWAYS 37
WORKS OUTSIDE SITE BOUNDARY 37
EXT1.W610.9 APPROVED CONTRACTOR FOR PUBLIC WORKS 37
EXT1.W620.9 SPECIFICATION 37
EXT1.W630.9 HANDING OVER INSPECTION 37
EXT1.W640.9 RECORD DRAWINGS AND TEST REPORTS 37
TESTING 38
BITUMINOUS CARRIAGEWAY TRIALS 38
EXT1.T010.9 TRIAL AREAS 38
EXT1.T020.9 SAMPLES OF MATERIALS USED IN TRIAL AREAS 38
EXT1.T030.9 SAMPLING AND TEST METHODS FOR TRIAL AREAS 38
EXT1.T040.9 COMPLIANCE CRITERIA 39
EXT1.T050.9 NON-COMPLIANCE 39
EXT1.T060.9 APPROVED MIX FOR BITUMINOUS MATERIALS OTHER THAN BITUMINOUS ROADBASE MATERIAL 39
SUB-BASE MATERIALS 40
EXT1.T110.9 BATCHES FOR TESTING 40
EXT1.T120.9 SAMPLES FOR TESTING 40
EXT1.T130.9 TEST METHODS 40
EXT1.T140.A TEST METHODS - RECYCLED SUB-BASE MATERIAL 41
EXT1.T150.9 DETERMINATION OF RELATIVE COMPACTION 42
EXT1.T160.9 COMPLIANCE CRITERIA FOR RELATIVE COMPACTION 42
EXT1.T170.9 NON-COMPLIANCE OF RELATIVE COMPACTION 42
BITUMINOUS MATERIALS OTHER THAN POLYMER MODIFIED FRICTION COURSE MATERIAL 42
EXT1.T310.9 BATCHES FOR TESTING 42
EXT1.T320.9 SAMPLES FOR TESTING 42
EXT1.T330.A TEST METHODS 43
EXT1.T340.9 COMPLIANCE CRITERIA 43
POLYMER MODIFIED FRICTION COURSE MATERIAL 43
EXT1.T410.9 BATCHES FOR TESTING 43
EXT1.T420.9 SAMPLES FOR TESTING 43
EXT1.T430.A TEST METHODS 44
EXT1.T440.9 COMPLIANCE CRITERIA 44
EXT1.T450.N DETERMINATION OF BINDER CONTENT AND PARTICLE SIZE DISTRIBUTION OF POLYMER MODIFIED FRICTION COURSE MATERIAL 44
CORES FROM BITUMINOUS ROADWAYS 45
EXT1.T510.9 SAMPLE LOCATIONS AND METHODOLOGY 45
EXT1.T520.9 TEST METHOD 46
EXT1.T530.9 COMPLIANCE CRITERIA 46
EXT1.T540.9 NON-COMPLIANCE 46
SURFACE REGULARITY 47
EXT1.T610.9 DEFINITION AND TEST METHODS 47
EXT1.T620.9 COMPLIANCE CRITERIA 47
TEXTURE DEPTH AND PERMEABILITY 48
EXT1.T710.9 TEST LOCATIONS AND METHODOLOGY 48

EXT1.T720.9 COMPLIANCE CRITERIA FOR TEXTURE DEPTH....50
EXT1.T730.9 COMPLIANCE CRITERIA FOR PERMEABILITY....50

EXT2 CONCRETE CARRIAGEWAYS....51

MATERIALS....51

GENERAL....51
EXT2.M010.9 APPLICATION OF OTHER WORKSECTIONS....51

CONCRETE....51
EXT2.M110.9 CONCRETE FOR CARRIAGEWAY CONSTRUCTION....51

ANCILLARY MATERIALS....51
EXT2.M205.9 GENERAL....51
EXT2.M210.A REINFORCEMENT....51
EXT2.M220.9 DOWEL BARS, TIE BARS, CRADLES AND TIE BARS FOR CRADLES....51
EXT2.M230.A CEMENT MORTAR....52
EXT2.M240.9 FINE AGGREGATE FOR CONCRETE....52
EXT2.M250.9 COARSE AGGREGATE FOR CONCRETE....52
EXT2.M260.9 POLYETHYLENE SHEETING....52
EXT2.M270.9 JOINT FILLER....52
EXT2.M280.A JOINT SEALANT....52
EXT2.M290.9 BOND BREAKER TAPE....52
EXT2.M300.9 GROOVE FORMING STRIP....52
EXT2.M310.9 ADHESIVE FOR GROOVE FORMING STRIP....52
EXT2.M320.9 SLEEVES FOR DOWEL BARS AND TIE BARS....52
EXT2.M330.9 EPOXY RESIN GROUT....53

SUBMISSIONS....53
EXT2.M410.9 GENERAL....53
EXT2.M420.9 JOINT FILLER....53
EXT2.M430.9 JOINT SEALANT....53
EXT2.M440.9 GROOVE FORMING STRIP....53
EXT2.M450.9 JOINT SEALANT PRIMER....53
EXT2.M460.9 SAMPLES....54

WORKMANSHIP....55

MATERIAL....55
EXT2.W010.9 SUBMISSION FOR APPROVAL....55

STORAGE OF MATERIALS....55
EXT2.W110.9 JOINT SEALANT ETC....55
EXT2.W120.9 POLYETHYLENE SHEETING ETC....55

PRELIMINARY WORK....55
EXT2.W210.9 INSTALLATION OF UTILITIES....55
EXT2.W220.9 BOX-OUT CONSTRUCTION....55
EXT2.W230.9 FORMATION AND SUB-BASE....55
EXT2.W240.9 CONCRETING PERMANENT CARRIAGEWAY....55
EXT2.W250.9 CHANGES IN MATERIALS AND METHODS OF CONSTRUCTION....56
EXT2.W260.9 LAYING POLYTHENE SHEETING....56

FORMWORK....56
EXT2.W310.9 FORMWORK....56
EXT2.W320.9 FINISHES....56
EXT2.W330.9 REMOVAL OF FORMWORK....56

PLACING AND COMPACTING CONCRETE....56
EXT2.W410.9 GENERAL....56

EXT2.W420.9 UNREINFORCED SLABS 56
EXT2.W430.9 REINFORCED SLABS 56
EXT2.W440.9 INFILL SLABS 57
CONSTRUCTION JOINTS 57
EXT2.W510.9 GENERAL 57
EXT2.W520.9 TRANSVERSE CONSTRUCTION JOINTS 57
SURFACE FINISH 57
EXT2.W610.9 STRIKING OFF 57
EXT2.W620.9 REGULATING MACHINES 57
EXT2.W630.9 VIBRATING BEAMS 57
EXT2.W640.9 SCRAPING STRAIGHT-EDGES 57
EXT2.W650.9 REGULATION OF SMALL AREAS 58
SURFACE TEXTURING 58
EXT2.W710.9 GENERAL 58
EXT2.W720.9 WIRE BROOMS FOR SURFACE TEXTURING 58
EXT2.W730.9 PROCEDURE 58
CURING CONCRETE 58
EXT2.W810.9 CURING METHODS 58
FORMING MOVEMENT JOINTS 58
EXT2.W910.9 GENERAL 58
EXT2.W920.9 FIXING DOWEL BARS 58
EXT2.W930.9 FIXING JOINT FILLER 59
EXT2.W940.9 TRANSVERSE JOINTS GENERALLY 59
EXT2.W950.9 FORMING TRANSVERSE JOINTS 59
EXT2.W960.9 LONGITUDINAL JOINTS 59
EXT2.W970.9 ISOLATION JOINTS 59
EXT2.W980.9 FORMING GROOVES GENERALLY 59
EXT2.W990.9 TRANSVERSE EXPANSION AND ISOLATION JOINT GROOVES 59
EXT2.W1000.9 TRANSVERSE CONTRACTION JOINT GROOVES 59
EXT2.W1010.9 GROOVES AT TRANSVERSE CONSTRUCTION JOINTS 60
EXT2.W1020.9 PROTECTION OF GROOVES 60
EXT2.W1030.9 GROOVE CONDITION PRIOR TO SEALING 60
EXT2.W1040.9 SEALING JOINTS 60
EXT2.W1050.9 FINISHING JOINTS 60
PROTECTION 60
EXT2.W1110.9 PEDESTRIAN LOADS 60
EXT2.W1120.9 LOADS FROM PLANT AND MATERIALS 60
TOLERANCES 61
EXT2.W1210.9 GENERAL 61
WORKS OUTSIDE SITE BOUNDARY 61
EXT2.W1310.9 APPROVED CONTRACTOR FOR PUBLIC WORKS 61
EXT2.W1320.A SPECIFICATION 61
EXT2.W1330.9 HANDING OVER INSPECTION 61
EXT2.W1340.9 RECORD DRAWINGS AND TEST REPORTS 61
TESTING 62
TRIAL MIX CONCRETE 62
EXT2.T010.9 WORKABILITY 62
TRIAL LENGTH OF CARRIAGEWAY 62
EXT2.T110.9 GENERAL 62
EXT2.T120.9 LOCATION 62
EXT2.T130.9 NOTIFICATION 62
EXT2.T140.9 COMPLETION 62

EXT2.T150.9 PROTECTION....62
TESTS ON THE TRIAL LENGTH....62
EXT2.T210.9 ALIGNMENT, LEVEL, SURFACE REGULARITY AND TEXTURE DEPTH....62
EXT2.T220.9 CONCRETE CORES....62
EXT2.T230.9 COMPLIANCE CRITERIA....63
EXT2.T240.9 NON-COMPLIANCE....63
EXT2.T250.9 FAILED TRIAL LENGTHS....63
TESTING CORES FROM TRIAL LENGTHS....63
EXT2.T310.9 TAKING CORES....63
EXT2.T320.9 REINSTATEMENT....63
EXT2.T330.9 INSPECTION....63
EXT2.T340.9 COMPLIANCE CRITERIA....63
CONCRETE....64
EXT2.T410.9 GENERAL....64
EXT2.T420.9 COMPLIANCE CRITERIA - WORKABILITY....64
EXT2.T430.9 SAMPLING FOR COMPRESSIVE STRENGTH TESTING....64
MATERIALS FOR JOINTS....64
EXT2.T510.9 DEFINITION OF "BATCH"....64
EXT2.T520.9 SAMPLING....64
TESTING JOINT FILLER....64
EXT2.T610.9 TESTING LABORATORY....64
EXT2.T620.9 SCOPE OF TESTS....64
EXT2.T630.9 APPARATUS....64
EXT2.T640.9 COMPRESSION AND RECOVERY TEST....65
EXT2.T650.9 EXTRUSION TEST....65
EXT2.T660.9 CALCULATION....65
EXT2.T670.9 TEST RESULTS....65
EXT2.T680.9 COMPLIANCE CRITERIA....66
TESTING SEALANTS....66
EXT2.T710.A TEST METHOD....66
SURFACE REGULARITY....66
EXT2.T810.9 GENERAL....66
EXT2.T820.9 SCOPE OF THE TEST....66
EXT2.T830.9 TEST METHODS....66
EXT2.T840.9 PROCEDURE....66
EXT2.T850.9 COMPLIANCE CRITERIA....67
TEXTURE DEPTH....67
EXT2.T910.9 GENERAL....67
EXT2.T920.9 SCOPE OF THE TEST....67
EXT2.T930.9 TIMING OF THE TEST....67
EXT2.T940.9 TEST LOCATIONS....67
EXT2.T950.9 PROVISION OF TEST APPARATUS AND MATERIALS....67
EXT2.T960.9 SAND FOR THE TEST....68
EXT2.T970.9 APPARATUS....68
EXT2.T980.9 PROCEDURE....68
EXT2.T990.9 CALCULATION....68
EXT2.T1000.9 TEST REPORT....69
EXT2.T1010.9 COMPLIANCE CRITERIA....69
EXT3 PATHS AND PAVED AREAS....70
MATERIALS....70

GENERAL **70**
EXT3.M010.9 APPLICATION OF OTHER SECTIONS 70
EXT3.M020.9 DEFINITION 70
EXT3.M030.B DETAILS OF UNITS 70
EXT3.M040.B SAMPLES 71
PAVING MATERIAL **71**
EXT3.M110.9 CONCRETE 71
EXT3.M120.9 BITUMINOUS MATERIALS 71
EXT3.M130.A INTERLOCKING CONCRETE BLOCKS 71
EXT3.M140.A PRECAST CONCRETE PAVING SLABS 73
EXT3.M150.A CLAY BRICK PAVERS 74
BEDDING, POINTING AND SEALING MATERIALS **74**
EXT3.M210.9 BEDDING SAND 74
EXT3.M220.9 JOINT FILLING SAND 75
EXT3.M230.A CEMENT MORTAR SEALING 75
EXT3.M240.9 POLYTHENE SHEETING 75
ACCURACY AND TOLERANCES **75**
EXT3.M310.9 GENERAL 75
WORKMANSHIP **76**
HANDLING AND STORAGE **76**
EXT3.W010.9 PRECAST UNITS 76
EXT3.W020.9 SAND 76
LAYING IN-SITU CONCRETE PAVING **76**
EXT3.W110.9 LAYING 76
EXT3.W120.9 FINISH 76
LAYING BITUMINOUS PAVING **76**
EXT3.W210.A LAYING 76
LAYING CLAY BRICK PAVERS **77**
EXT3.W310.9 LAYING 77
LAYING PRECAST CONCRETE UNITS **77**
EXT3.W410.9 LAYOUT 77
EXT3.W420.9 KERBS AND EDGINGS 77
EXT3.W430.9 PRECAUTIONARY MEASURES FOR DRAINAGE 78
EXT3.W440.9 FORMATION LEVEL 78
EXT3.W450.9 INTERLOCKING BLOCK PATTERN 78
EXT3.W460.9 CUTTING UNITS 78
EXT3.W470.9 BEDDING LAYER 78
EXT3.W480.9 BEDDING PAVING SLABS 78
EXT3.W490.9 BEDDING INTERLOCKING BLOCKS 78
EXT3.W500.9 JOINT FILLING AND COMPACTION OF UNITS 79
EXT3.W510.9 SEALING AT ABUTMENTS 79
EXT3.W520.9 REINSTATEMENT 79
PROTECTION **79**
EXT3.W610.9 PAVED AREA SURFACES 79
ACCURACY AND TOLERANCES **79**
EXT3.W710.9 GENERAL 79
WORKS OUTSIDE SITE BOUNDARY **80**
EXT3.W810.9 APPROVED CONTRACTOR FOR PUBLIC WORKS 80
EXT3.W820.A SPECIFICATION 80
EXT3.W830.9 HANDING OVER INSPECTION 80
EXT3.W840.9 RECORD DRAWINGS AND TEST REPORTS 80

TESTING **81**
GENERAL **81**
EXT3.T010.9 QUALITY ASSURANCE SCHEMES 81
CHARACTERISTIC COMPRESSIVE STRENGTH OF INTERLOCKING BLOCKS **81**
EXT3.T110.9 DEFINITION OF 'BATCH' 81
EXT3.T120.9 SAMPLES FOR TESTING 81
EXT3.T130.9 TEST PROCEDURE 81
EXT3.T140.9 CALCULATIONS 82
EXT3.T150.9 REPORTING 82
EXT3.T160.9 COMPLIANCE CRITERIA 83
TRANSVERSE BREAKING LOAD OF CLAY BRICK PAVERS **83**
EXT3.T210.9 DEFINITION OF "BATCH" 83
EXT3.T220.A SAMPLES FOR TESTING 83
EXT3.T230.A TEST PROCEDURE 83
EXT3.T240.9 CALCULATIONS 83
EXT3.T250.9 REPORTING 83
EXT3.T260.9 COMPLIANCE CRITERIA 83
BENDING STRENGTH OF PRECAST CONCRETE PAVING SLABS **84**
EXT3.T310.9 DEFINITION OF "BATCH" 84
EXT3.T320.9 SAMPLES FOR TESTING 84
EXT3.T330.B TEST PROCEDURE 84
EXT3.T340.9 CALCULATIONS 84
EXT3.T350.9 REPORTING 84
EXT3.T360.A COMPLIANCE CRITERIA 84
ADDITIONAL TESTS FOR GRADE A PAVING UNITS **84**
EXT3.T410.9 DEFINITION OF "BATCH" 84
EXT3.T420.9 SAMPLES FOR TESTING 85
EXT3.T430.B DIMENSIONAL DEVIATION 85
EXT3.T440.A SLIP / SKID RESISTANCE 85
EXT3.T450.A WATER ABSORPTION VALUE 85
SURVEILLANCE TESTS FOR TACTILE BLOCKS AND PAVING SLABS **85**
EXT3.T510.A SURVEILLANCE TEST FOR TACTILE INTERLOCKING CONCRETE BLOCKS 85
EXT3.T520.A SURVEILLANCE TEST FOR TACTILE PRECAST CONCRETE PAVING SLABS 86

EXT4 ROUTE INDICATORS **88**
MATERIALS **88**
GENERAL **88**
EXT4.M010.9 STATUTORY REQUIREMENTS 88
EXT4.M020.9 DESIGN 88
EXT4.M030.9 COMPATIBILITY OF MATERIALS 88
SUBMISSIONS **88**
EXT4.M110.9 TRAFFIC SIGNS 88
EXT4.M120.9 ILLUMINATION OF SIGNS 88
MATERIALS FOR TRAFFIC SIGNS **88**
EXT4.M210.A STANDARDS 88
EXT4.M220.9 GENERAL 88
EXT4.M230.A HOT FINISHED SEAMLESS TUBES 88
EXT4.M240.B HOT ROLLED SECTIONS 88
EXT4.M250.A HOT ROLLED STRUCTURAL STEEL SECTIONS 89
EXT4.M260.A WELDABLE STRUCTURAL STEELS 89

EXT4.M270.A STAINLESS STEEL ... 89
EXT4.M280.A STAINLESS STEEL TUBES ... 89
EXT4.M290.A ALUMINIUM ALLOY ... 89
EXT4.M300.A WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS SUITABLE FOR GENERAL ENGINEERING PURPOSES ... 89
EXT4.M310.A FACES FOR TRAFFIC SIGNS ... 89
EXT4.M320.9 BACKING PLATES AND SPILL SCREENS ... 90
EXT4.M330.B RETROREFLECTIVE SHEETING ... 90
EXT4.M340.A NON-RETROREFLECTIVE SHEETING ... 90
EXT4.M350.9 PLASTIC SHEETING ... 90

FIXINGS FOR TRAFFIC SIGNS ... 90
EXT4.M410.9 GENERAL ... 90
EXT4.M420.A ISO METRIC BLACK HEXAGON BOLTS, SCREWS AND NUTS ... 90
EXT4.M430.A ISO METRIC BLACK CUP AND COUNTERSUNK HEAD BOLTS AND SCREWS WITH HEXAGON NUTS ... 90
EXT4.M440.9 METAL WASHERS ... 90
EXT4.M450.A RIVETS ... 90
EXT4.M460.9 BANDING ... 91
EXT4.M470.9 WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS ... 91
EXT4.M480.B CARBON, CARBON MANGANESE AND STAINLESS STEELS ... 91
EXT4.M490.9 BOLT LENGTH ... 91
EXT4.M500.9 RAG AND INDENTED BOLTS ... 91
EXT4.M510.9 EXPANSION AND RESIN BONDED BOLTS ... 91

PAINT TO TRAFFIC SIGN FACES ... 91
EXT4.M610.B GENERAL ... 91
EXT4.M620.A PAINTED FINISH ... 91

MATERIALS FOR ROAD STUDS ... 92
EXT4.M710.A ROAD STUDS ... 92
EXT4.M720.9 BITUMEN GROUT FOR ROAD STUDS ... 92

WORKMANSHIP ... 93

DELIVERY AND STORAGE OF MATERIALS ... 93
EXT4.W010.9 TRAFFIC SIGNS ... 93

FABRICATION OF TRAFFIC SIGNS ... 93
EXT4.W110.9 POSTS ... 93
EXT4.W120.A BACKING PLATES ... 93
EXT4.W130.9 SPILL SCREENS ... 93
EXT4.W140.9 FACES FOR TRAFFIC SIGNS ... 93
EXT4.W150.9 LACQUER COATINGS ... 93
EXT4.W160.9 PAINT TO TRAFFIC SIGN FACES ... 94

ASSEMBLY OF TRAFFIC SIGNS ... 94
EXT4.W210.9 JOINTS ... 94
EXT4.W220.A FIXINGS ... 94
EXT4.W230.9 COVER PLATES FOR FIXINGS ... 94
EXT4.W240.9 CONNECTIONS TO ROAD LIGHTING COLUMNS ... 94
EXT4.W250.A BACKING PLATES ... 94
EXT4.W260.9 LACQUER COATINGS ... 94

COVERING OF TRAFFIC SIGNS ... 94
EXT4.W310.9 GENERAL ... 94
EXT4.W320.9 METHOD OF COVERING ... 94
EXT4.W330.9 FIXING COVER SHEETS ... 95
EXT4.W340.9 PLASTIC FILM ... 95
EXT4.W350.9 LOOSE COVERS ... 95

INSTALLATION OF ROAD STUDS **95**
EXT4.W410.9 ROAD STUDS 95
EXT4.W420.9 DEPRESSIBLE ROAD STUDS 95
EXT4.W430.N LAYING OF THERMOPLASTIC ROAD STUDS 95
EXT4.W440.N TEST CERTIFICATE 95

TESTING **96**
TESTING TRAFFIC SIGNS **96**
EXT4.T010.A TESTING 96
EXT4.T020.A COMPLIANCE CRITERIA 96

EXT5 KERBS, EDGINGS AND QUADRANTS **97**
MATERIALS **97**
KERBS, EDGINGS AND QUADRANTS **97**
EXT5.M010.9 INSITU CONCRETE 97
EXT5.M020.A PRECAST CONCRETE 97
EXT5.M030.9 GRANITE 97

WORKMANSHIP **98**
PRECAST CONCRETE AND GRANITE KERBS, EDGINGS AND QUADRANTS **98**
EXT5.W010.9 LAYING 98
EXT5.W020.9 JOINTS 98
EXT5.W030.9 RADIUS KERBS 98
INSITU KERBS, EDGINGS AND QUADRANTS **98**
EXT5.W110.9 LAYING 98
EXT5.W120.9 FINISHING 98
EXT5.W130.9 JOINTS 98
ACCURACY AND TOLERANCES **99**
EXT5.W210.9 GENERAL 99
WORKS OUTSIDE SITE BOUNDARY **99**
EXT5.W310.9 APPROVED CONTRACTOR FOR PUBLIC WORKS 99
EXT5.W320.A SPECIFICATION 99
EXT5.W330.9 HANDING OVER INSPECTION 99
EXT5.W340.9 RECORD DRAWINGS AND TEST REPORTS 99

EXT6 CONCRETE PROFILE BARRIERS **100**
MATERIALS **100**
EXT6.M010.9 CONCRETE MIX 100
EXT6.M020.9 FORMWORK 100
EXT6.M030.9 CONCRETE FINISH 100
EXT6.M040.9 JOINTS IN CONCRETE PROFILE BARRIERS 101
EXT6.M050.9 PROTECTIVE POLYTHENE SHEETING 101
EXT6.M060.9 CEMENT MORTAR 101

WORKMANSHIP **102**
CONSTRUCTION OF PROFILE BARRIERS **102**
EXT6.W010.9 SLIP-FORMED CONCRETE PROFILE BARRIERS 102
EXT6.W020.9 PRECAST CONCRETE PROFILE BARRIERS 102
SUBMISSIONS **102**
EXT6.W110.9 PARTICULARS OF CONCRETE PROFILE BARRIERS 102
PROTECTION OF WORKS **102**
EXT6.W210.9 PROTECTION 102

TOLERANCES **102**
EXT6.W310.9 GENERAL 102

TESTING **103**
TRIALS **103**
EXT6.T010.9 TRIAL LENGTHS 103
EXT6.T020.9 SAMPLING AND TEST METHODS FOR TRIAL LENGTHS 103
EXT6.T030.9 COMPLIANCE CRITERIA 103
EXT6.T040.9 NON-COMPLIANCE 103
EXT6.T050.9 USE IN THE PERMANENT WORKS 103
EXT6.T060.9 SPECIFICATION CHANGES 104
EXT6.T070.9 CONCRETE CORES FROM TRIAL LENGTHS 104

EXT7 UNTENSIONED BEAM BARRIERS **105**
MATERIALS **105**
SUBMISSIONS **105**
EXT7.M010.A DETAILS 105
EXT7.M020.9 SAMPLES 105
MATERIALS **105**
EXT7.M110.A UNTENSIONED BEAM BARRIERS 105
EXT7.M120.9 BOLT SLOTS IN BEAMS FOR CONNECTION POSTS 105
EXT7.M140.9 WELDS FOR END BEAM SECTIONS 105
EXT7.M150.9 CONCRETE FOR FOOTINGS 105
EXT7.M160.9 CONCRETE FOR ANCHOR BLOCKS 106
EXT7.M170.9 FINISH TO CONCRETE SURFACES OF ANCHOR BLOCKS 106
POSTS **106**
EXT7.M210.B POSTS FOR UNTENSIONED BEAM BARRIERS 106
EXT7.M230.9 POSTS FABRICATED FROM HOLLOW SECTIONS 106
FIXINGS **106**
EXT7.M310.B CLEATS AND STRUTS 106
EXT7.M320.B BOLTS 106
EXT7.M330.B NUTS 106
EXT7.M340.A WASHERS 107
EXT7.M350.A PLAIN WASHERS 107
EXT7.M360.A SHAPED WASHERS 107

WORKMANSHIP **108**
GENERAL **108**
EXT7.W010.A STORAGE AND PROTECTION 108
EXT7.W020.A HOT DIP GALVANIZING 108
FORMING FOOTINGS **108**
EXT7.W110.9 COMPACTED EARTH FOOTINGS 108
EXT7.W120.9 CONCRETE FOOTINGS 108
CONSTRUCTION OF BEAM BARRIERS **109**
EXT7.W210.9 GENERAL 109
EXT7.W220.9 INSTALLATION AND FIXING 109
TOLERANCES **109**
EXT7.W310.9 GENERAL 109

EXT8 ROAD MARKING **110**
MATERIALS **110**

GENERAL **110**
EXT8.M010.9 ROAD MARKING 110
EXT8.M020.A SKID RESISTANCE 110
EXT8.M030.A FUNCTIONAL LIFE 110
THERMOPLASTIC MATERIALS **110**
EXT8.M110.B HOT APPLIED THERMOPLASTIC MATERIAL 110
EXT8.M120.9 CERTIFICATION 110
PREFORMED MATERIALS **111**
EXT8.M210.B COLD APPLIED ROAD MARKINGS 111
EXT8.M250.A COLD PLASTIC ROAD MARKINGS 111
PAINT **111**
EXT8.M310.A ROAD MARKING PAINT 111
ANCILLARY MATERIALS **111**
EXT8.M410.9 TACK COAT 111
EXT8.M420.A REFLECTIVE GLASS BEADS FOR SURFACE APPLICATION 111
WORKMANSHIP **112**
PREPARATION FOR ROAD MARKING **112**
EXT8.W010.9 ROAD CONDITION 112
EXT8.W020.9 CLEANING 112
EXT8.W030.9 BITUMINOUS SURFACES 112
EXT8.W040.9 CONCRETE SURFACES 112
EXT8.W050.9 EXISTING ROAD MARKINGS 112
LAYING THERMOPLASTIC MATERIALS **112**
EXT8.W110.A SUPPLY, DELIVERY AND STORAGE 112
EXT8.W120.9 CODE OF PRACTICE 113
EXT8.W130.9 AMBIENT CONDITIONS 113
EXT8.W140.9 LAYING PLANT 113
EXT8.W150.9 THICKNESS 113
LAYING PREFORMED MATERIAL **113**
EXT8.W210.9 LAYING COLD APPLIED ROAD MARKINGS 113
APPLYING ROAD-MARKING PAINT **113**
EXT8.W240.9 APPLICATION OF ROAD-MARKING PAINT 113
PERFORMANCE REQUIREMENTS **114**
EXT8.W270.A ROAD MARKING PERFORMANCE FOR ROAD USERS 114
TEMPORARY ROAD MARKINGS **114**
EXT8.W310.9 GENERAL 114
EXT8.W320.9 DISPOSAL 114
REMOVAL OF EXISTING ROAD MARKINGS **114**
EXT8.W360.9 REMOVAL OF EXISTING ROAD MARKINGS BY SHOT-BLASTING 114
TOLERANCES **114**
EXT8.W410.9 GENERAL 114
EXT9 FENCING, GATES AND GUARDRAILS **115**
MATERIALS **115**
GENERAL **115**
EXT9.M010.9 ALTERNATIVE DESIGN 115
EXT9.M020.9 SUBMISSIONS 115
EXT9.M030.9 SAMPLES 115
FENCING **115**
EXT9.M120.9 GALVANIZED STEEL WIRE FOR FENCING 115
EXT9.M130.9 GALVANIZED WIRE NETTING FENCING 115

CONCRETE POSTS **115**
EXT9.M210.9 PRECAST CONCRETE FENCING POSTS 115

STEEL AND ALUMINIUM FOR GATES, POSTS AND GUARD RAILS **116**
EXT9.M310.9 HOT FINISHED SEAMLESS STEEL TUBES 116
EXT9.M320.9 STEEL TUBES AND TUBULARS SUITABLE FOR SCREWING TO BS 21 PIPE THREADS 116
EXT9.M330.9 HOT ROLLED STEEL SECTIONS 116
EXT9.M340.9 HOT ROLLED STRUCTURAL STEEL SECTIONS (EQUAL AND UNEQUAL ANGLES) 116
EXT9.M350.9 WELDABLE STRUCTURAL STEELS 116
EXT9.M360.9 STAINLESS STEEL 116
EXT9.M370.9 STAINLESS STEEL TUBES 116
EXT9.M380.9 ALUMINIUM 116
EXT9.M390.9 WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS SUITABLE FOR GENERAL ENGINEERING PURPOSES 116

FIXINGS **116**
EXT9.M410.9 TYPE 116
EXT9.M420.9 ISO METRIC BLACK HEXAGON BOLTS, SCREWS AND NUTS 116
EXT9.M430.9 ISO METRIC BLACK CUP AND COUNTERSUNK HEAD BOLTS AND SCREWS WITH HEXAGONAL NUTS 116
EXT9.M440.9 METAL WASHERS 117
EXT9.M450.9 RIVETS 117
EXT9.M460.9 RIVET, BOLT AND SCREW STOCK 117
EXT9.M470.9 BOLT LENGTH 117
EXT9.M480.9 RAG, INDENTED, EXPANSION AND RESIN BONDED BOLTS 117

INFILL PANELS FOR GUARD RAILINGS **117**
EXT9.M510.9 MESH INFILL PANELS 117

WORKMANSHIP **118**

ERECTING FENCING **118**
EXT9.W010.9 LOCATION 118
EXT9.W020.9 ERECTION 118
EXT9.W030.9 FIXING 118

FABRICATION, PROTECTION AND INSTALLATION OF PEDESTRIAN GUARD RAILING **118**
EXT9.W110.9 STORAGE AND PROTECTION 118
EXT9.W120.9 WELDING 118
EXT9.W130.9 HOT DIP GALVANIZING 118
EXT9.W140.9 INSTALLATION 119

ACCURACY AND TOLERANCES **119**
EXT9.W210.9 GENERAL 119

EXT10 PLAY/FITNESS EQUIPMENT AND PLAY SURFACES **120**

MATERIALS **120**

PLAY/FITNESS EQUIPMENT **120**
EXT10.M010.A PLAY / FITNESS EQUIPMENT 120
EXT10.M015.9 DESIGN SUBMISSION 121
EXT10.M020.9 WARRANTY 125

PLAY SURFACES - BALL COURT SURFACES **125**
EXT10.M110.9 BALL COURT SURFACES 125
EXT10.M120.A INDOOR BALL COURT SURFACING 125
EXT10.M130.A OUTDOOR BALL COURT SURFACING 125
EXT10.M140.X DELETED 126

EXT10.M150.N DESIGN SUBMISSION 126
EXT10.M160.N QUALITY REQUIREMENTS FOR SUBSTRATE FOR OUTDOOR BALL COURT SURFACING SYSTEM 127
EXT10.M170.N QUALITY REQUIREMENTS FOR INORGANIC SURFACE COATING SYSTEM 127
EXT10.M180.N QUALITY REQUIREMENTS FOR EPDM SYSTEM 128
EXT10.M190.N LINE MARKING FOR OUTDOOR BALL COURT SURFACING SYSTEM 129

ADHESIVE AND FIXINGS FOR BALL COURT SURFACING 130
EXT10.M210.A ADHESIVES USED IN EPDM SYSTEM 130
EXT10.M220.X DELETED 130

PLAY SURFACES - IMPACT ABSORBING SURFACING MATERIALS (IASM) 130
EXT10.M310.9 GENERAL REQUIREMENTS 130
EXT10.M320.A QUALITY REQUIREMENTS 130
EXT10.M330.9 DESIGN SUBMISSION 131
EXT10.M340.9 DELIVERY 132
EXT10.M350.9 WARRANTY 132
EXT10.M360.9 APPLICATION OF REQUIREMENTS OF OTHER WORKSECTIONS 132

WORKMANSHIP 133

GENERAL 133
EXT10.W010.9 HANDLING AND STORAGE 133
EXT10.W020.9 BUILDER'S WORK IN CONNECTION 133
EXT10.W030.9 FIXING, ASSEMBLING AND LAYING 133

INSTALLATION OF PLAY/FITNESS EQUIPMENT 133
EXT10.W110.9 GENERAL 133
EXT10.W120.9 INSTALLATION 133
EXT10.W130.9 EXISTING PLAY / FITNESS EQUIPMENT 134

LAYING OF BALL COURT SURFACES 134
EXT10.W210.A GENERAL 134
EXT10.W220.A INSPECTION PRIOR TO LAYING SURFACING MATERIALS 134
EXT10.W230.A SURFACES PREPARATION 134
EXT10.W240.A DRAINAGE 134
EXT10.W250.9 LAYING 134
EXT10.W251.N APPLICATION OF INORGANIC SURFACING SYSTEM 135
EXT10.W252.N APPLICATION OF EPDM SYSTEM 135
EXT10.W260.X DELETED 135
EXT10.W270.9 ADHESIVES 135
EXT10.W280.A LINE MARKING FOR BALL COURT SURFACES 135

INSTALLATION OF IMPACT ABSORBING SURFACING MATERIALS (IASM) 135
EXT10.W310.9 GENERAL INSTALLATION REQUIREMENTS 135
EXT10.W320.9 SAMPLES AND DATA 135
EXT10.W330.9 SURFACING MATERIAL AND ITS FOUNDATION 136
EXT10.W340.9 DRAINAGE 136

TESTING 137

ON-SITE VERIFICATION TEST - IMPACT ABSORBING SURFACING MATERIALS (IASM) 137
EXT10.T005.A VERIFICATION TESTING 137
EXT10.T010.9 IN-SITU DROP TEST 138

EXT11 EXISTING VEGETATION TREATMENT 139

MATERIALS 139

GENERAL **139**
EXT11.M010.9 ANTI-DESICCANT SPRAY 139
EXT11.M020.9 HESSIAN BINDING 139
EXT11.M030.9 JUTE STRING 139

WORKMANSHIP **140**
GENERAL **140**
EXT11.W010.9 SCOPE OF EXISTING VEGETATION TREATMENT 140
EXT11.W020.9 PRE-TENDER INSPECTION 140
EXT11.W030.9 TOOLS AND EQUIPMENT 140
EXT11.W040.9 EROSION 140
PRESERVATION OF EXISTING TREES AND SHRUBS **140**
EXT11.W052.A PROTECTION OF EXISTING VEGETATION 140
EXT11.W055.9 PROTECTION FOR PRESERVED TREES 140
EXT11.W060.9 PHOTOGRAPHIC RECORD OF EXISTING TREES 142
EXT11.W062.A RECORD OF PRESERVED AND TRANSPLANTED TREES INCLUDING OLD AND VALUABLE TREE (OVT) 143
EXT11.W075.9 WATERING EXISTING VEGETATION 144
EXT11.W085.A PRUNING OF EXISTING TREES 144
EXT11.W090.9 CONTROL OF PEST AND DISEASE FOR EXISTING TREES 145
SITE CLEARANCE **145**
EXT11.W110.9 GENERAL 145
EXT11.W120.9 UNDERGROWTH CUTTING 145
EXT11.W130.9 CREEPER CLEARANCE 145
REMOVAL OF EXISTING TREES **145**
EXT11.W210.A GENERAL 145
EXT11.W220.9 TREE REMOVAL 146
EXT11.W230.9 LARGE TREES IN CONFINED SPACES 146
EXT11.W240.9 PROTECTION MEASURES FOR TREES TO BE FELLED/TRANSPLANTED 146
TRANSPLANTING EXISTING TREES AND PALMS **146**
EXT11.W310.9 GENERAL 146
EXT11.W320.9 IMMEDIATE TRANSPLANTATION 147
EXT11.W330.9 ROOTBALLS 147
EXT11.W340.9 WATERING 147
EXT11.W350.9 CROWN THINNING 147
EXT11.W360.9 ANTI-DESICCANT SPRAY APPLICATION 147
TRANSPLANTING EXISTING SHRUBS AND BAMBOOS **147**
EXT11.W410.9 GENERAL 147
EXT11.W420.9 TRANSPLANTATION 147
EXT11.W430.9 ROOTBALLS 148
EXISTING SHRUBS **148**
EXT11.W510.9 PRUNING 148
EXISTING GRASSED AREAS **148**
EXT11.W610.9 REINSTATEMENT 148
EXT11.W620.9 CUTTING 148
TREATMENT/REPLACEMENT OF DAMAGED TREES AND SHRUBS **148**
EXT11.W710.9 RESPONSIBILITY 148
EXT11.W712.9 REPAIR OF DAMAGE TO EXISTING TREES AND OTHER AFFECTED PLANTS 148
EXT11.W714.9 AFTERCARE TO OLD AND VALUABLE TREE 150
EXT11.W716.9 ESTABLISHMENT OPERATIONS DURING AFTERCARE PERIOD 150
EXT11.W720.9 CIRCUMSTANCES FOR TREE/SHRUB REPLACEMENT 150

EXT11.W730.9 REPLACEMENT TREES/SHRUBS 151

EXT12 EARTHWORKS 152

MATERIALS 152

EXISTING SOILS 152

EXT12.M010.9 GENERAL 152
EXT12.M020.9 EXISTING SUBSOIL 152
EXT12.M030.9 DG AS PLANTING MEDIUM 152

IMPORTED SOILS 152

EXT12.M110.9 SUBSOIL 152
EXT12.M120.9 DG AS PLANTING MEDIUM 152

SOIL CONDITIONERS 152

EXT12.M210.9 MANUFACTURED SOIL CONDITIONER 152
EXT12.M220.9 CERTIFICATION 153
EXT12.M230.9 SAND 153
EXT12.M235.9 GRADED SAND FOR SAND BASED LAWN 153
EXT12.M236.9 AGGREGATE FOR SAND BASED LAWN 154
EXT12.M240.A COMPOST 154
EXT12.M245.9 ANIMAL MANURE 154
EXT12.M250.9 SYNTHETIC SOIL CONDITIONER 154
EXT12.M260.9 COCO PEAT 154
EXT12.M270.9 SOIL BINDER 154
EXT12.M280.N BIOCHAR 154

FABRICATED SOILS 155

EXT12.M310.9 GENERAL MIX 155
EXT12.M320.9 LIGHTWEIGHT MIX 155
EXT12.M330.9 SOIL FILLING MIX FOR USE IN GRASS PAVING SYSTEM 155
EXT12.M340.A ROOT ZONE MEDIUM MIX FOR USE IN SAND BASED LAWN 155

BOULDERS AND ROCKS 155

EXT12.M410.9 GRANITE 155
EXT12.M420.9 SERPENTINE 156
EXT12.M430.9 GREAT LAKE ROCK 156
EXT12.M440.9 REJECTS 156

WORKMANSHIP 157

GENERAL 157

EXT12.W010.9 STOCKPILES 157

SUBSOIL PREPARATION 157

EXT12.W110.9 GRADING 157
EXT12.W120.9 CLEANING 157
EXT12.W130.9 RIPPING 157

PREPARATION OF PLANTING MEDIA 157

EXT12.W210.9 CONTAMINATED GROUND 157
EXT12.W225.9 PREPARATION OF PLANTING MEDIUM 158
EXT12.W230.A FABRICATED SOIL MIX 158
EXT12.W240.9 POLYMER MIX 158
EXT12.W250.9 COMPOST MIX 158
EXT12.W255.9 ROOTZONE MEDIUM MIX 158
EXT12.W260.9 RAISING NITROGEN CONTENT 158
EXT12.W270.9 RAISING PH LEVEL 158
EXT12.W280.9 LOWERING PH LEVEL 158
EXT12.W290.9 INCREASING ORGANIC MATTER CONTENT 159

MAKING UP LEVELS 159
EXT12.W310.9 FABRICATED SOIL 159
EXT12.W320.9 POLYMER MIX 159
EXT12.W325.9 ROOTZONE MEDIUM MIX 159
EXT12.W330.9 GENERAL SOIL FILLING IN GRASS PAVING SYSTEM 159
DEPTHS OF PLANTING MEDIA 159
EXT12.W410.9 FABRICATED SOIL 159
FINAL GRADING 159
EXT12.W510.9 GENERAL 159
EXT12.W520.9 PLANT BEDS 159
EXT12.W530.9 BEHIND RETAINING WALLS 159
EXT12.W540.9 ADJACENT PAVED AREAS 160
EXT12.W550.9 GRASS PAVING SYSTEM 160
EXT12.W555.9 SAND BASED LAWN 160
BACKFILLING RAISED PLANTERS WITH IMPERMEABLE BASES 160
EXT12.W610.9 PROCEDURE 160
BOULDERS AND ROCKS 160
EXT12.W710.9 PLACING 160
EXT12.W720.9 FIXING GRANITE AND SERPENTINE BOULDERS 160
EXT12.W730.9 FIXING GREAT LAKE ROCKS 160
SURPLUS MATERIAL 160
EXT12.W810.9 REMOVAL 160

EXT13 DRAINAGE TO PLANTERS 161
MATERIALS 161
DRAINAGE LAYER 161
EXT13.M010.9 AGGREGATE 161
EXT13.M020.9 LIGHTWEIGHT AGGREGATE 161
FILTER LAYER 161
EXT13.M110.9 FILTER LAYER FOR PLANTERS 161
WORKMANSHIP 162
DRAINAGE LAYER 162
EXT13.W010.9 CLEANING OUT WEEPHOLES 162
EXT13.W020.9 LEVELS 162
EXT13.W030.9 PRECAST CONCRETE / PORTABLE PLANT BOXES 162
EXT13.W040.9 IN-SITU CONCRETE PLANTERS WITH IMPERMEABLE BASES 162
EXT13.W050.9 IN-SITU CONCRETE PLANTERS WITH PERMEABLE BASES 162
FILTER LAYER 163
EXT13.W110.9 APPLICATION 163

EXT14 HYDROSEEDING 164
MATERIALS 164
GENERAL 164
EXT14.M010.9 SCOPE 164
EXT14.M020.9 METHOD STATEMENT 164
SEED MIXES 164
EXT14.M110.A BASIC MINIMUM SEED MIX FOR USE BETWEEN APRIL AND AUGUST 164
EXT14.M120.A OTHER RECOMMENDED SPECIES 164
EXT14.M130.A BASIC MINIMUM SEED MIX FOR USE BETWEEN SEPTEMBER AND MARCH 164

EXT14.M145.9 SHRUB SPECIES ... 165
EXT14.M146.A FERN SPECIES ... 165
EXT14.M150.9 GERMINATION ... 165
EXT14.M160.9 PURITY ... 165
EXT14.M170.9 CERTIFICATION ... 165
ANCILLARY MATERIALS ... 166
EXT14.M210.9 FERTILIZER INCLUDED IN THE HYDROSEEDING MIX ... 166
EXT14.M220.9 DYE AND SOIL BINDER ... 166
EXT14.M230.9 MULCH FOR HYDROSEEDING ... 166
EXT14.M240.9 PROTECTIVE FABRIC MATERIAL FOR HYDROSEEDING ... 166
EXT14.M250.9 HYDROSEEDING POST-PLANTING FERTILIZER ... 166
WORKMANSHIP ... 167
GENERAL ... 167
EXT14.W010.9 PROGRAMME ... 167
EXT14.W020.9 STORING GRASS SEED ... 167
EXT14.W030.9 STORING FERTILIZER ... 167
EXT14.W040.9 HYDROSEEDING EQUIPMENT ... 167
PREPARATION ... 167
EXT14.W110.9 SURFACE FINISH ... 167
EXT14.W120.9 CULTIVATION ... 167
EXT14.W130.9 CULTIVATION ON EMBANKMENTS ... 167
EXT14.W140.9 WATERING ... 167
EXT14.W150.9 PREPARING TREE SEEDS ... 168
APPLICATION ... 168
EXT14.W210.9 MIXING ... 168
EXT14.W220.9 APPLYING SOIL BINDERS ... 168
EXT14.W230.9 SPRAYING HYDROSEEDING SOLUTION ... 168
POST APPLICATION OPERATIONS ... 168
EXT14.W310.9 PATCHING UP ... 168
EXT14.W320.9 PROTECTION OF HYDROSEEDING ... 168
EXT14.W330.9 WATERING DURING DRY WEATHER ... 169
EXT14.W340.9 APPLYING POST-PLANTING FERTILIZER ... 169
EXT14.W350.9 CUTTING ... 169
TESTING GRASS COVER ... 169
EXT14.W410.9 TESTING ... 169
EXT14.W420.9 ACCEPTANCE CRITERIA ... 169
EXT14.W430.9 NON-COMPLIANCE ... 169

EXT15 MISCELLANEOUS EXTERNAL WORKS ... 170
DESIGN ... 170
GENERAL ... 170
EXT15.D010.9 EXTERNAL FURNITURE ... 170
EXT15.D020.9 DESIGN SUBMISSION ... 170
EXT15.D030.9 SAMPLE SUBMISSION ... 171
EXT15.D040.9 DELIVERY ... 171
MATERIAL ... 172
EXTERNAL FURNITURE ... 172
EXT15.M010.9 SEATING BENCH ... 172
EXT15.M020.9 LITTER BIN ... 172
EXT15.M030.9 CHESS TABLE SET ... 172
EXT15.M040.9 BOLLARD ... 172

EXT15.M050.9 TABLE TENNIS TABLE....173
EXT15.M060.9 BICYCLE RACK....173
EXT15.M070.N MOVABLE SEATING....173
EXT15.M080.N FIBREGLASS PLANTER BOX....173
EXT15.M090.N WOOD PLASTIC COMPOSITE (WPC)....173

COMPONENTS OF EXTERNAL FURNITURE....174
EXT15.M115.9 WOOD PLASTIC COMPOSITE (WPC)....174
EXT15.M116.9 MAINTENANCE MANUAL FOR WPC....175
EXT15.M120.9 FINSIHES TO GALVANIZED MILD STEEL....175

WORKMANSHIP....176

GENERAL....176
EXT15.W010.9 HANDLING AND STORAGE....176
EXT15.W020.9 FIXING, ASSEMBLING AND LAYING....176

INSTALLATION OF EXTERNAL FURNITURE....176
EXT15.W110.9 SEATING BENCH....176
EXT15.W120.9 LITTER BIN....176
EXT15.W130.9 CHESS TABLE SET....176
EXT15.W140.9 TABLE TENNIS TABLE....176
EXT15.W150.9 BOLLARD....176
EXT15.W160.9 BICYCLE RACK....177

EXT16 ZERO IRRIGATION SYSTEM (ZIS)....178

MATERIALS....178

GENERAL....178
EXT16.M010.9 DEFINITION FOR ZIS- MODULAR TYPE....178
EXT16.M015.9 DEFNITION FOR ZIS- INSITU TYPE....178
EXT16.M020.9 COMPOSITION FOR ZIS- MODULAR TYPE....178
EXT16.M025.A COMPOSITION FOR ZIS - INSITU TYPE....178
EXT16.M030.9 APPLICATION OF OTHER WORKSECTIONS....179
EXT16.M040.9 ACCESSORIES....179
EXT16.M050.9 SHOP DRAWINGS AND MATERIAL SUBMISSIONS FOR ZIS-MODULAR TYPE....179
EXT16.M055.9 SHOP DRAWINGS AND MATERIAL SUBMISSION FOR ZIS- INSITU TYPE....180
EXT16.M060.9 METHOD STATEMENT....180
EXT16.M070.9 SAMPLES FOR ZIS- MODULAR TYPE....180
EXT16.M071.9 SAMPLES FOR ZIS- INSITU TYPE....181
EXT16.M075.9 MOCKUP FOR ZIS PLANTER....181
EXT16.M080.9 AS-BUILT RECORD FOR PLANTERS WITH ZIS....181

MAJOR COMPONENTS....181
EXT16.M110.9 SODIUM BENTONITE WATERPROOFING LAYER FOR ZIS- INSITU TYPE....181
EXT16.M115.9 WATERPROOFING MEMBRANE....182
EXT16.M120.9 FILTER LAYER....182
EXT16.M125.9 GEOTEXTILE FILTER LAYER FOR ZIS- MODULAR TYPE....182
EXT16.M130.9 WATER RETENTION BOX....182
EXT16.M131.9 PRECAST CONCRETE WATER RETENTION MODULE FOR ZIS-MODULAR TYPE....182
EXT16.M135.9 DRAINAGE CELL FOR ZIS- INSITU TYPE....183
EXT16.M140.9 MEDIUM FOR CAPILLARY ACTION– RECYCLED GLASS CULLET/ RIVER SAND....183
EXT16.M145.9 GROUND WATER RECHARGE DEVICE FOR ZIS- INSITU TYPE....183

EXT16.M146.9 PRIMARY INSPECTION CHAMBER FOR ZIS- MODULAR TYPE.....184
EXT16.M147.9 SECONDARY INSPECTION CHAMBER FOR ZIS- MODULAR TYPE ..184
EXT16.M150.A OVERFLOW PIPES FOR ZIS- INSITU TYPE.....184
EXT16.M155.9 SUB-SOIL DRAINAGE PIPES FOR ZIS- MODULAR TYPE 184
EXT16.M160.A MECHANICAL WATER LEVEL INDICATOR AND LOCK.....184
EXT16.M165.9 INTERCONNECTING PIPES FOR ZIS- MODULAR TYPE.....185
ACCESSORIES..... 185
EXT16.M200.9 SODIUM BENTONITE POWDER FOR ZIS- INSITU TYPE.....185
EXT16.M210.9 SODIUM BENTONITE STRIP FOR ZIS- INSITU TYPE.....185
WORKMANSHIP 186
GENERAL..... 186
EXT16.W010.9 HANDLING AND STORAGE.....186
EXT16.W020.9 BUILDER'S WORK IN CONNECTION 186
EXT16.W030.9 FIXING, ASSEMBLING AND LAYING.....186
INSTALLATION OF MAJOR COMPONENTS..... 186
EXT16.W110.9 INSTALLATION FOR ZIS- MODULAR TYPE.....186
EXT16.W115.9 INSTALLATION FOR ZIS- INSITU TYPE.....187
TESTING.....188
ON-SITE VERIFICATION TEST 188
EXT16.T110.9 WATER FLOOD TEST TO ZIS FOR ZIS- MODULAR TYPE 188
EXT16.T115.9 WATER FLOOD TEST TO ZIS FOR ZIS- INSITU TYPE 188
EXT16.T120.9 SUBMISSION 189
EXT17 AUTOMATIC DRIP IRRIGATION SYSTEM 190
DESIGN 190
GENERAL..... 190
EXT17.D010.9 DEFINITION.....190
EXT17.D020.9 GENERAL REQUIREMENTS 190
EXT17.D030.9 GENERAL SCOPE OF WORKS 191
EXT17.D040.9 DESIGN PARAMETERS.....191
EXT17.D050.9 WATER CONSUMPTION RATE 191
EXT17.D060.9 TECHNICAL DESIGN PROPOSAL SUBMISSION 192
EXT17.D070.9 MATERIAL SUBMISSION.....192
MATERIAL 194
GENERAL..... 194
EXT17.M010.9 GENERAL REQUIREMENTS 194
EXT17.M020.9 COMPOSITION 194
MAJOR COMPONENTS..... 194
EXT17.M030.9 BATTERY POWERED CONTROLLER UNIT 194
EXT17.M040.9 RAIN SENSOR (OPTIONAL).....195
EXT17.M050.9 SOLENOID VALVE 195
EXT17.M060.9 SCREEN FILTER.....195
EXT17.M070.9 BALL VALVE.....195
EXT17.M080.9 NON-RETURN VALVE 195
EXT17.M090.9 PRESSURE REGULATOR.....195
EXT17.M100.9 IRRIGATION VALVE BOX 195
EXT17.M110.9 IRRIGATION VALVE BOX LABEL.....196
EXT17.M120.9 DRIPLINE WITH BUILT-IN CHECK VALVE.....196
EXT17.M130.9 DISTRIBUTION TUBING.....196
EXT17.M140.9 AIR RELIEF VALVE.....196
EXT17.M150.9 FLUSH VALVE 196

EXT17.M160.9 DRIPLINE OPERATION INDICATOR 196
EXT17.M170.9 UNPLASTICIZED PVC (UPVC) PIPES AND FITTINGS 197
EXT17.M180.9 PIPE SLEEVES 197
EXT17.M190.9 SILICON SEALANT 197

WORKMANSHIP 198

GENERAL 198
EXT17.W010.9 SITE ASSEMBLY AND INSTALLATION 198
EXT17.W020.9 HANDLING AND STORAGE 198
EXT17.W030.9 BUILDER'S WORK IN CONNECTION 198
EXT17.W040.9 FIXING, ASSEMBLING AND LAYING 198

INSTALLATION OF MAJOR COMPONENTS 198
EXT17.W050.9 SEQUENCE AND GENERAL PROCEDURES 198
EXT17.W060.9 JOINTING UNPLASTICIZED PVC (UPVC) PIPES 199

TESTING 200

GENERAL 200
EXT17.T010.9 GENERAL REQUIREMENTS 200
EXT17.T020.9 TESTING AND TRAINING 200
EXT17.T030.9 OPERATION AND MAINTENANCE MANUALS 201
EXT17.T040.9 REGULAR INSPECTION REPORT DURING MAINTENANCE PERIOD 201
EXT17.T050.9 FINAL INSPECTION 201

EXT18 YARD WASTE TREATMENT AND MANAGEMENT 203

GENERAL 203
EXT18.G010.N DEFINITIONS 203
EXT18.G020.N SCOPE OF YARD WASTE TREATMENT AND MANAGEMENT 203
EXT18.G030.N SUBMISSION OF YARD WASTE TREATMENT AND MANAGEMENT PLAN AND METHOD STATEMENT 203

WORKMANSHIP 205

GENERAL 205
EXT18.W010.N HANDLING AND STORAGE 205
EXT18.W020.N HANDLING AND DELIVERING TO SHREDDING 205
EXT18.W030.N PLANTS WITH PESTS AND DISEASES 206
EXT18.W040.N QUALITY CONTROL 206

EXT19 ARTWORKS 207

MATERIALS 207

GENERAL 207
EXT19.M010.N GENERAL 207
EXT19.M020.N WOOD SCULPTURE (FREE STANDING OR WALL MURAL) 207
EXT19.M030.N TILE MOSAIC MURAL 207
EXT19.M040.N ALUMINIUM CURVED ARTWORK WALL MURAL 207
EXT19.M050.N STANDING SCULPTURE 208
EXT19.M060.N WOOD SCULPTURE WITH RESIN 208
EXT19.M070.N WALL SURFACE RESERVED FOR ART WORKS IMPLEMENTATION 208
EXT19.M080.N INSTALLATION AND DESCRIPTION PLATE FOR ART WORKS IMPLEMENTATION 208

EXT1 SUB-BASES, BITUMINOUS ROADWAYS AND RELATED FOOTPATHS

DESIGN

DESIGN PARAMETERS

EXT1.D010.9 SUB-BASE AND BITUMINOUS ROADBASE MATERIALS

1. Sub-base and bituminous roadbase materials to be recipe mixes. Laboratory design mixes other than those for sub-base and bituminous roadbase materials must be made and tested as part of the design procedure at an Approved laboratory;
2. Unless otherwise permitted by the CM, carry out mix designs and associated tests in the presence of the CM. Notify the CM at least 7 days, or a shorter period agreed with the CM, before carrying out the mix designs;
3. The Contractor shall use bituminous roadbase material incorporating reclaimed asphalt pavement (RAP) in carriageway works. The specific requirements are as follows:
    a. Roadbase incorporating RAP shall be designed, manufactured, laid and tested in accordance with the requirements for roadbase using non-recycled materials or otherwise specified by the CM. Failure in designing and manufacturer a mix satisfying such requirements shall not be accepted as a valid reason for not incorporating RAP in bituminous roadbase material;
    b. The RAP shall comply with the following:
        i. RAP shall be obtained from milling or excavation of existing bituminous pavements and return loads from site and offcuts from bituminous layer joint preparation. Return loads can include bituminous materials rejected from site. RAP shall be crushed and screened as necessary such that the maximum particle size is not greater than the nominal maximum aggregate size of the type of bituminous materials being produced and a reasonably well-graded and consistent mixture can be produced;
        ii. RAP shall be free of foreign materials such as unbound granular sub-base, broken concrete, or other contaminants;
        iii. RAP shall be stored in separate stockpiles before use. RAP that has been stockpiled for some time shall be reprocessed, where necessary, to ensure that it is in a free-flowing state at the time of use;
        iv. The amount of RAP allowable in the bituminous roadbase material shall be in the range of 10% to 15% by mass of the total mix. Separate mix designs shall be required for roadbase materials incorporating RAP.
    c. Notwithstanding the above clauses, the Contractor may propose for the CM's approval for using bituminous roadbase material without RAP when there is a shortage of supply of RAP in the market.

4. The Contractor shall appoint a Production Manager employed by the supplier as approved by the CM, certifying that the specified amount of RAP is added to the bituminous material according to the mix design. All certified documents shall be submitted bi-weekly to the CM for verification and record. The Production Manager shall be personally responsible to certify that RAP is added for the production of the recycled bituminous materials. He shall be an experienced person with at least seven years of experience in bituminous material production or having a recognized professional qualification such as MHKIE or equivalent. The bituminous materials incorporating RAP supplied by the supplier shall not be used if the Contractor fails to appoint the Production Manager;
5. The Contractor shall work out and submit to the CM for approval a method statement to ensure that the RAP generated from existing pavements are delivered, stored and used with no contamination and minimum wastage in order to produce the bituminous materials incorporated with RAP as specified. The Contractor shall at all times facilitate the inspection by the CM on the production of recycled bituminous materials, storage and sorting facilities for RAP.

EXT1.D020.9 BITUMINOUS MATERIALS

1. Consisting of
   a. Coarse and fine aggregates as EXT1.M410;
   b. Filler as EXT1.M420; and
   c. Bitumen as EXT1.M430.
2. With particle size distribution and bitumen contents within the limits stated in the table to EXT1.M410;
3. Use bituminous wearing course and base course materials incorporating reclaimed asphalt pavement (RAP) for carriageway works. The RAP and production of bituminous materials incorporating RAP shall comply with EXT1.D010 (4) and (5). The specific requirements are as follows:
   a. Wearing course and base course materials incorporating RAP shall be designed, manufactured, laid and tested in accordance with the requirements for these materials using non-recycled materials or otherwise specified by the CM. Failure in designing and manufacturing a mix satisfying such requirements shall not be accepted as a valid reason for not incorporating RAP in bituminous wearing course and base course materials;
   b. The RAP shall comply with the following:
      i. RAP shall be obtained from milling or excavation of existing bituminous pavements, and return loads from site and offcuts from bituminous layer joint preparation. Return load can include bituminous materials rejected from site. RAP shall be crushed and screened as necessary such that the maximum particle size is not greater than the nominal maximum aggregate size of the type of bituminous materials being produced and a reasonably well-graded and consistent mixture can be produced;
      ii. RAP shall be free of foreign materials such as unbound granular sub-base, broken concrete, or other contaminants;
      iii. RAP shall be stored in separate stockpiles before use. RAP that has been stockpiled for some time shall be reprocessed, where necessary, to ensure that it is in a free-flowing state at the time of use;
      iv. The amount of RAP allowable in the bituminous wearing course or base course materials shall be in the range of 20% to 30% by mass of the total mix. Separate mix designs shall be required for these materials incorporating RAP.
   c. Notwithstanding the above clauses, the Contractor may propose for the CM's approval for using bituminous wearing course or base course materials without RAP when there is a shortage of supply of RAP in the market.
3. With properties as stated in the following table:

Properties of designed bituminous materials					
Properties	Type of bituminous material				
	Base course		Wearing course		Polymer modified friction course
	Nominal maximum aggregate size (mm)				
	37.5	28	20	10	10
Minimum Marshall stability (kN)	10.0		10.0		-
Maximum flow value (mm)	4.0		4.0		-
Minimum voids in mineral aggregate as a percentage of total bulk volume	12.5	13.0	14.0	16.0	-
Air voids in mix as a percentage of total bulk volume	3.0 - 5.0		3.0 - 5.0		min 20.0

4. Design bituminous materials of all aggregate sizes, other than bituminous roadbase material, in accordance with the Marshall Method of Mix Design stated in the Asphalt Institute Handbook 'MS - 2 Mix Design Methods for Asphalt Concrete and other Hot-mix Types, Sixth Edition (1997)' with modifications only if agreed by the CM. The compaction standard must be 75 blows per side. For design of polymer modified friction course materials, the compaction standard shall be 50 blows per side unless otherwise agreed by the CM. The mixing and compaction temperatures for the mixes shall follow the recommendations of the manufacturer of the polymer modified bitumen;
5. For polymer modified friction course material, binder drainage tests in accordance with BS 594987:2015+A1:2017, Annex K shall be carried out on the proposed aggregate/modified binder combination to determine the maximum target binder content (T_{max}) of the mix. The proposed mix will be acceptable if the maximum target binder content (T_{max}) is equal to or greater than the proposed binder content.

MATERIALS

DEFINITIONS

EXT1.M010.9 NORMINAL MAXIMUM AGGREGATE SIZE

The smallest BS sieve size for which the upper limit of the percentage of the aggregate by mass passing is 100%.

SUBMISSIONS

EXT1.M110.9 DETAILS OF AGGREGATES, FILLER, BITUMEN, BITUMINOUS EMULSION AND BITUMINOUS PRIMING MATERIAL FOR BITUMINOUS MATERIALS

1. Submit details, to the CM for approval, of the following particulars of the aggregates, filler, bitumen, bituminous emulsion and bituminous priming material proposed for use in bituminous materials:
   a. A certificate from the manufacturer for each type of aggregates showing the manufacturer's name and place of manufacture and confirming that the aggregate complies with the requirement stated in this Specification;
   b. A certificate from the manufacturer for each type of filler showing the manufacturer's name, the date and place of manufacture and confirming that the filler complies with the requirements stated in this Specification and including test reports for particle size distribution;
   c. A certificate from the manufacturer for bitumen other than polymer modified bitumen, showing the manufacturer's name, the date and place of manufacture and confirming that the bitumen complies with the requirements stated in this Specification, including a temperature-viscosity relationship for the bitumen, and including test reports for:
      i. Relative density;
      ii. Softening point;
      iii. Penetration;
      iv. Ductility;
      v. Retained penetration after thin film oven test;
      vi. Solubility;
      vii. Viscosity;
      viii. Loss on heating;
   ix. Wax content.d. A certificate from the manufacturer for polymer modified bitumen showing the manufacturer's name, the date and place of manufacture and showing that the polymer modified bitumen complies with the requirements in EXT1.M430;
   e. A certificate from the manufacturer for bituminous emulsion showing the manufacturer's name, the date and place of manufacture and showing the bituminous emulsion complies with the requirements stated in the Contract; and
   f. A certificate from the manufacturer for bituminous priming material showing the manufacturer's name, the date and place of manufacture and showing the bituminous priming material complies with the requirements stated in the Contract.
2. Submit particulars, including certificates, to the CM at the time stated in EXT1.M120 (3);
3. Submit, at intervals agreed with the CM, further certificates and test reports showing material's compliance with this Specification;

4. Test reports shall show the properties of aggregates, filler and bitumen for bituminous materials as determined by the methods stated in the following table:

Testing Aggregates, Filler and Bitumen for Bituminous Materials		
Material	Property	Method of Testing
Coarse aggregate	Relative density Water absorption	CS3:2013
	Ten percent fines value	CS3:2013
	Particle size distribution	CS3:2013
	Flakiness index	CS3:2013
Fine aggregate	Relative density Water absorption	CS3:2013
	Particle size distribution	Geospec 3, Test Method 8.2
Filler	Relative density	BS EN 196-6:2010
	Particle size distribution	ASTM D 546-17 with modification(1)
Bitumen for bituminous materials other than polymer modified friction course material	Relative density	ASTM D 3289-17
	Softening point	BS EN 1427:2015
	Penetration	ASTM D 5-13
	Ductility	ASTM D 113-07
	Retained penetration after thin film oven test	ASTM D 1754-14
	Solubility	ASTM D 2042-15
	Viscosity	ASTM D 2171-10
	Loss on heating	BS EN 13303:2009
Bitumen for polymer modified friction course material	Viscosity	AASHTO Designation T316
	Dynamic Shear	AASHTO Designation T315
	Dynamic Shear after Rolling Thin-Film Oven	AASHTO Designation T315 and AASHTO Designation T240
	Flash Point	AASHTO Designation T48

Note: (1)For particle size distribution tests in accordance with ASTM D 546-17, the modification is that BS sieves are used instead of ASTM sieves.

EXT1.M120.9 DETAILS OF MIXES FOR SUB-BASE AND BITUMINOUS MATERIALS

1. Submit details to the CM for approval of the following particulars for the sub-base material and bituminous roadbase materials:
   a. Source and type of aggregates;
   b. Grading details in tabular and graphical form;
   c. Details of each mixing plant proposed for use.

2. In addition, submit to the CM for approval details of the following particulars for bituminous materials other than polymer modified friction course material:
   a. Certified copies of work sheets for mix designs that include the relative density of the mixed aggregates;
   b. Source of bitumen; and
   c. If requested by the CM, past test records of the same mix produced in the same plant.

   Submit details to the CM for approval of the following particulars for polymer modified friction course material:
   a. Polymer modified binder content % by weight of total mass;
   b. Source and type of aggregates;
   c. Certified copies of work sheets for mix designs, which shall include the relative density of the mix aggregates;
   d. Mixing temperature during production;
   e. Grading details in tabular and graphical form;
   f. Source of polymer modified bitumen;
   g. Details of each mixing plant proposed; and
   h. If requested by the CM, past test records of the same mix produced in the same plant.
3. Submit particulars to the CM at least 21 days before
   a. Trial areas are constructed; or
   b. The mix is placed in the permanent work if trial areas are not required.

EXT1.M130.9 PARTICULARS OF VIRGIN SUB-BASE MATERIAL AND RECYCLED SUB-BASE MATERIAL

1. Submit details to the CM for approval of the following particulars for the recycled sub-base material if used in lieu of virgin material:

   Details of the recycling plant, and test results for:;
   a. Soundness value;
   b. California Bearing Ratio (CBR) value;
   c. Content of contaminant in percentage by mass;
   d. Water-soluble sulphate content; and
   e. Organic material content.
2. Submit details to the CM for approval of the following particulars for the virgin sub-base material and recycled sub-base material if used in lieu of virgin material:
   a. Test results for ten per cent fines value
   b. Test results for grading details in tabular and graphical form; and
   c. A certificate from the manufacturer for each type of aggregates showing the manufacturer's name and place of manufacture and showing the aggregate complies with the requirements stated in the Contract.

EXT1.M140.9 DETAILS OF SUPPLIER

Submit the name of the supplier and the location of each plant from which it is proposed to obtain sub-base material and bituminous materials to the CM at the time stated in EXT1.M120 (3).

EXT1.M150.9 METHOD OF LAYING AND COMPACTING

Submit to the CM

1. The following particulars of the proposed methods of laying and compacting sub-bases and bituminous materials
   a. Details of constructional plant; and

b. Programme and rate of working.

2. Particulars at the time stated in EXT1.M120 (3).

SAMPLES

EXT1.M210.9 SUB-BASE MATERIAL, AGGREGATE, FILLER AND BITUMEN

Submit one sample of each type of sub-base material, and one sample of each type of aggregate, filler and bitumen for bituminous material to the CM at the same time as submission of particulars.

SUB-BASE MATERIALS

EXT1.M310.9 SUB-BASE USING VIRGIN MATERIAL

Crushed rock with the properties stated in the following table. Sub-base material passing the 425 micron BS Test Sieve, when tested in accordance with EXT1.T130 (4), shall be non-plastic.

Properties of sub-base material		
Properties	BS Test Sieve	Percentage by mass passing
Particle size distribution	75 mm	100
	37.5 mm	85 - 100
	20 mm	60 - 85
	10 mm	40 - 70
	5 mm	25 - 45
	600 microns	8 - 22
	75 microns	0 - 10
Ten percent fines value		> 50 kN

EXT1.M320.9 RECYCLED SUB-BASE MATERIAL

1. Recycled sub-base material shall be crushed rock, crushed concrete or clean crushed inert demolition material and may contain up to 12.5% by mass of natural sand, which passes the 5 mm BS test sieve. The material may lie within the grading limits of the following Table, and not be gap graded:

Recycled sub-base material - Permissible range of particle size distribution		
Properties	BS test sieve	Percentage by mass passing
Particle size distribution	75 mm	100
	37.5 mm	85 - 100
	20 mm	60 - 85
	10 mm	40 - 70
	5 mm	25 - 45
	600 µm	8 - 22
	75 µm	0 - 10

2. The material shall have a ten percent fines value of 50 kN or more when tested in accordance with EXT1.T140 (3);
3. The material passing the 425 µm BS test sieve shall be non-plastic when tested in accordance with EXT1.T140 (4);
4. The aggregate shall be considered suitable if it has a soundness value greater than 65%;

5. The material shall have a water-soluble sulphate content of less than 1.9 g of sulphate (expressed as SO_3) per litre, if used within 500 mm of cement-bound material, concrete pavements, concrete structures or concrete products;
6. The material shall have a minimum laboratory CBR value of 30% or such other higher value as specified by the Contract Manager;
7. The material shall not contain quantities of contaminants in excess of the percentages given in the following Table unless otherwise approved by the Contract Manager:

Allowable contamination of recycled sub-base material				
Sub-base type	Type of contamination			
	Maximum sulphate content by mass	Maximum metals content by mass	Maximum foreign material content e.g. glass, soft material etc. by mass	Maximum organic material content by mass
Recycled sub-base	1%	1%	1%	0.5%

8. In the event that there is a shortage of supply of recycled aggregates, virgin aggregates can be used in lieu of recycled aggregates in the sub-base material subject to CM's approval.

BITUMINOUS MATERIALS

EXT1.M410.9 AGGREGATES FOR BITUMINOUS MATERIALS

1. Coarse aggregate

   Crushed rock all retained on a 5 mm BS Test Sieve and with the properties stated in the following table:

Properties of coarse aggregate for bituminous materials				
Properties	Nominal maximum aggregate size (mm)			
	37.5	28	20	10
Flakiness Index	≤ 25.0%	≤ 26.0%	≤ 27.0%	≤ 30.0%
Ten Percent fines value	> 100 kN			
Water absorption	≤ 2.0%			

2. Fine aggregate

   Crushed rock all passing 5 mm BS test sieve. Water absorption of fine aggregate must not exceed 2.0%;

3. For mix design purposes, ensure the combined grading of aggregates for bituminous materials is such that the particle size distribution lies within the limits stated in the following table for the relevant bituminous material:

Design limits for particle size distribution and bitumen content for bituminous material							
Properties		Type of bituminous material					
		Roadbase (recipe mix)	Base course		Wearing course		Polymer modified friction course
Nominal maximum aggregate size (mm)		37.5	37.5	28	20	10	10
	BS test sieve	Percentage by mass passing					
Particle size distribution	50 mm	100	100	-	-	-	-
	37.5 mm	90-100	91-100	100	-	-	-
	28 mm	70-94	70-94	91-100	100	-	-
	20 mm	62-84	62-84	85-95	91-100	-	-
	14 mm	-	55-76	72-87	78-90	100	100
	10 mm	49-67	49-67	55-75	68-84	87-100	85-100
	5 mm	37-55	37-55	35-53	54-72	62-80	20-40
	2.36 mm	27-43	27-43	25-40	42-58	42-58	5-15
	1.18 mm	-	20-35	15-30	34-48	34-48	-
	600 microns	13-28	13-28	12-24	24-38	24-38	-
	300 microns	7-21	7-21	8-18	16-28	16-28	-
	150 microns	-	4-14	5-12	8-18	8-18	-
	75 microns	2-8	2-8	3-6	4-8	4-8	2-6
Bitumen content as percentage	min	3.0	4.0	4.5	5.0	6.0	5.5

of total mass including binder	max	4.0	4.5	5.0	5.5	7.0	7.0

EXT1.M420.A FILLER

Free-flowing, dry before addition to the bituminous mixture and

1. Type
   a. Filler for bituminous materials to be crushed rock filler, PC, PFAC, PFA or hydrated lime;
   b. Filler for polymer modified friction course material to contain hydrated lime; the amount of hydrated lime, expressed as a percentage by mass of the total aggregates, to be at least 1.5%.
2. Material
   a. PC to BS EN 197: Part 1;
   b. PFAC to BS EN 197: Part 1;
   c. PFA to BS EN 450: Part 1 except that the criterion for maximum water requirement does not apply;
   d. Crushed rock filler and hydrated lime to ASTM D 242.

EXT1.M430.9 BITUMEN

1. Bituminous materials, other than polymer modified friction course material:
   a. To ASTM D 946-15, Grade 60-70, with a softening point exceeding 44°C and less than 55°C;
   b. The wax content of the bitumen shall comply with requirements for Grade A specified in JTG F40-2004;
   c. Unless otherwise permitted by the CM, blending and mixing of bitumen must be carried out at an Approved refinery.
2. Polymer modified friction course material:
   a. A pre-blended type bitumen with Styrene-Butadiene-Styrene (SBS) polymer manufactured by the wet mix method unless otherwise approved by the CM;
   b. Dry mix method for mixing the bitumen and polymer in the batching plant shall not be allowed;
   c. The polymer modified bitumen shall have a performance grade not lower than PG 76 of the Performance Graded Asphalt Binder Specification specified by the AASHTO Designation M320.

EXT1.M440.A EMULSION

Bituminous emulsion of cationic bituminous emulsion to BS EN 13808, Class C40B4.

EXT1.M450.9 PRIMER

Bituminous priming material of medium curing-grade cutback bitumen to ASTM D 2027-13, Table 1, Class MC-30.

WORKMANSHIP

GENERAL

EXT1.W010.9 USE OF APPROVED MIX

1. Do not place bituminous material in the permanent work until the mix has been Approved;
2. Do not change the materials and methods of production used in producing the Approved mixes and the methods of construction used in trial areas unless permitted by the CM.

EXT1.W020.9 HANDLING AND STORAGE

1. Store
   a. Bagged cement in a dry, weatherproof store with a raised floor. Identify each delivery, store separately and use in order of delivery;
   b. Bulk cement and PFA in dry, weatherproof silos. Identify and store separately different types and materials from different sources. Clearly mark silos to identify contents.
2. Material handling and storage areas shall be levelled and well drained. Do not handle or store sub-base and bituminous materials in a manner that results in mixing of the different types and sizes, or in segregation or contamination of the materials. Measures to protect the materials from the effects of weather shall be submitted to the CM for approval;
3. Do not store bituminous materials in heated surge bins for more than 12 hours or in transport vehicles for more than 3 hours, unless otherwise permitted by the CM.

EXT1.W030.9 TRANSPORTING

1. Protect sub-base material and bituminous materials with covers during transportation and before laying;
2. Use heavy canvas or a similar insulating material for covering bituminous materials;
3. Completely cover the material with covers and ensure a secure fixing to minimise loss of heat and protect the materials from contamination by dust or other deleterious materials;
4. Transport sub-base material and bituminous materials in clean vehicles with smooth trays and sides;
5. The trays of vehicles transporting bituminous materials may be lubricated with soap solution or light oil sprayed on the trays.

MIXING

EXT1.W110.9 PLANT

1. Ensure
   a. The mixing plant for bituminous materials has at least four separate cold feed bins for preliminary cold batching of the coarse and fine aggregates, and a rotary drum dryer that continuously agitates the aggregates during the heating and drying process. After passing through the dryer, the aggregates must be screened into at least four hot storage bins before mixing;
   b. Bituminous heating and storage tanks are fitted with circulating pumps to ensure an even temperature throughout the tanks;
   c. The mixing plant is fitted with sampling devices to enable samples of hot aggregates, filler and bitumen to be taken before mixing;

d. Insulated surge bins, if fitted to the mixing plant, are designed and operated to prevent segregation occurring in the mix. Heating devices fitted to surge bins must be capable of maintaining the temperature of the mix to within the specified limits;

e. Measuring and weighing equipment is maintained in a clean serviceable condition. The equipment must be set to zero daily and calibrated before mixes for the permanent work are produced, and at regular intervals not exceeding 6 months.

2. Alternative methods of mixing bituminous materials may be used when Approved.

EXT1.W120.9 SUB-BASE AND BITUMINOUS MATERIALS

1. Carry out mixing of sub-base material and mixing of bituminous materials before delivery to the Site at Approved mixing plants. Plants to be designed and operated to produce uniform mixes which comply with the specified requirements;
2. Measure aggregates and filler for bituminous materials to an accuracy of ± 3.0% by mass. The aggregate moisture content after drying not to exceed 0.4% by mass;
3. Ensure that aggregates and filler are uniformly coated with bitumen by the continued mixing of the bituminous materials for the necessary period;
4. Ensure bituminous materials other than polymer modified friction course material comply with the temperature requirements as stated in the following table during and after mixing:

Type of bituminous material		Roadbase, base course and wearing course
Aggregate temperature at mixing (°C)	Min Max	130 175
Binder temperature at mixing (°C)	Min Max	135 165
Bituminous mixture temperature after mixing (°C)	Min Max	130 165
Bituminous mixture temperature at laying (°C)	Min Max	- -
Bituminous mixture temperature at start of compaction (°C)	Min	-

5. Ensure polymer modified friction course material comply with the temperature requirements as recommended by the supplier of the polymer modified bitumen during and after mixing;
6. The particulars of temperature requirements for the polymer modified friction course material shall be submitted to the CM at the time stated in EXT1.M120 (3);
7. If instructed by the CM, the Contractor shall measure in the presence of the CM's Representative the following temperatures: a. Temperature after mixing;

b. Temperature at laying; and

c. Temperature at start of compaction.

PRELIMINARY WORK

EXT1.W210.9 INSTALLATION OF UTILITIES

1. Pipes, cables, manholes, chambers, gullies and other utilities below carriageways must be completed and fill material deposited and compacted in trenches before the carriageway is constructed. Protect openings to manholes, chambers and gullies by temporary covers or by other methods agreed by the CM;
2. Do not fix in position covers, frames and other hardware that will prevent continuous laying of bituminous materials for roadbase and base course until such work is complete;
3. After the penultimate layer of bituminous material has been laid and compacted, cut out the layers of asphalt, remove temporary covers and install the permanent covers, frames and other hardware;
4. Carry out finishing around covers, frames and other hardware using bituminous material of the same type as that for adjacent surfaces, unless otherwise permitted by the CM. Compact the material in layers not exceeding 50 mm thick, using handrammers or mechanical equipment up to the underside of the wearing course if the top surfacing is wearing course, or up to the underside of the polymer modified friction course if the top surfacing is polymer modified friction course.

LAYING AND COMPACTING

EXT1.W310.9 SUB-BASE MATERIAL USING VIRGIN MATERIAL

1. Lay and compact sub-base material in a manner that does not result in segregation of the material and with a moisture content that achieves the compaction stated at sub-clause (6) below. The moisture content must not be less than 2%;
2. Lay sub-base material in layers in such a manner that the compacted thickness of each layer does not exceed 225 mm thick. If the final compacted thickness of the sub-base exceeds 225 mm, lay the material in two or more layers, with a minimum thickness for each layer of 100 mm; and if the layers are of unequal thickness, the lowest layer shall be the thickest;
3. Evenly spread each layer of sub-base material immediately after placing in position. Compact immediately after spreading;
4. As a minimum requirement use the compaction plant specified at EXT1.W360 (1) for compaction of sub-base material;
5. Obtain permission from the CM before placing the next layer on each layer of compacted sub-base material;
6. Compact sub-base material to obtain a relative compaction of at least 95% maximum dry density throughout;
7. Maintain the surface of each layer of sub-base in a compacted condition until the next layer of sub-base material or roadbase material is laid. Do not disturb the surface by the use of construction plant or other vehicles, and keep free from ridges, cracks, loose material, pot-holes, ruts or other defects.

EXT1.W320.9 RECYCLED SUB-BASE MATERIAL

1. Lay and compact in a manner which will not result in segregation of the material and at a moisture content which allows the compaction stated in sub-clause (7) to be achieved. The moisture content shall not be less than 2%;
2. The recycled sub-base shall consist of an upper layer of virgin sub-base material overlying an underlying layer of recycled sub-base material. The ratio of the thickness of the recycled sub-base layer to that of the virgin sub-base layer shall be approximately 6 to 4. During laying and compaction, the thickness of each of these two layers shall take into account the layer thickness requirements given in sub-clause (3) below;

3. Lay recycled sub-base material in layers in such a manner that the compacted thickness of each layer will not exceed 225 mm. If the specified final compacted thickness of the sub-base exceeds 225 mm, the material shall be laid in two or more layers; the minimum thickness of each layer shall be 100 mm and, if the layers are of unequal thickness, the lowest layer shall be the thickest;
4. Evenly spread each layer of recycled sub-base material immediately after placing in position. Compact immediately after spreading;
5. As a minimum requirement, use the compaction plant specified at EXT1.W360 (1) for compaction of recycled sub-base material;
6. Obtain the permission of the CM before the next layer is placed on each layer of compacted recycled sub-base material;
7. Compact recycled sub-base material to obtain a relative compaction of at least 95% maximum dry density throughout;
8. Maintain the surface of each layer of recycled sub-base in a compacted condition until the next layer of sub-base material or roadbase material is laid. Do not disturb the surface by constructional plant or other vehicles, and keep free from ridges, cracks, loose material, pot-holes, ruts or other defects.

EXT1.W330.A BITUMINOUS MATERIALS

1. Do not lay bituminous materials during periods of wet weather or when ponded water is present on the underlying surface unless in the opinion of the CM, the works will not be adversely affected;
2.
   a. Do not lay bituminous wearing course material when the ambient air temperature is below 8°C;
   b. Do not lay polymer modified friction course material when the ambient air temperature is below 10°C;
   c. Measure temperatures in the shade near to the surface on which laying is to be carried out.
3. Ensure surfaces to receive bituminous materials are clean, free from mud, grit and other deleterious material;
4. When Instructed apply a tack coat of bituminous emulsion to surfaces on or against which bituminous materials will be laid as follows:
   a. Apply tack coat evenly at a rate of between 0.4 L/m² and 0.6 L/m² using a spray machine. Other application procedures shall comply with BS 434: Part 2;
   b. Do not lay bituminous materials until the tack coat has cured;
   c. Only allow construction plant and other vehicles necessary to lay the bituminous materials to run on the tack coat.
5. When Approved, surfaces of existing carriageways may be regulated before application of overlaying bituminous material. In this case ensure:
   a. Bituminous regulating course material is Approved as complying with the requirements of the 10 mm nominal maximum aggregate size wearing course material as stated in the table to EXT1.M410 (3);
   b. Regulating course material is laid by paving machines unless laying by manual methods is Instructed.
6. Ensure bituminous materials other than polymer modified friction course material comply with the temperature requirements stated in the table to EXT1.W120 during laying and compaction;
7. Without prejudice to sub-clause (2) above, polymer modified friction course material shall comply with the temperature requirements as recommended by the manufacturer of the polymer modified bitumen during laying and compaction.

EXT1.W340.9 LAYING BY PAVING MACHINE

1. Unless otherwise permitted by the CM place and spread bituminous materials using a self-propelled paving machine with a screw auger and attached screed capable of spreading and laying the material to the full width required and of giving initial compaction to the material and finishing it to a level suitable for subsequent compacting operations;
2. Paving machines may be fitted with cut-off shoes or extensions to limit or extend the width of the screed; do not use screed extensions unless the screw auger is extended in accordance with the manufacturer's recommendations. Ensure the surface texture produced by paving machines is free from segregation and from pushing or dragging marks;
3. Place bituminous materials laid by paving machines directly from the vehicles transporting the material into the hopper of the paving machine. Ensure delivery of materials to the paving machine and laying of the materials is at a uniform rate appropriate to the capacity of the paving machine and compaction plant;
4. When any delay in laying operations occurs remove the paving machine and the uncompacted cold material and form a transverse joint as stated in EXT1.W370;
5. Ensure paving machines working in echelon are as close as practicable; machines must not be more than 30 m apart unless a longitudinal joint is formed as EXT1.W370;
6. Only use manual placing of materials on freshly laid surfaces for the purpose of locally correcting levels as paving operations proceed and before compaction by rolling is commenced.

EXT1.W350.9 LAYING BY MANUAL METHODS

Only lay bituminous materials by manual methods if in the opinion of the CM, the use of a paving machine is impracticable. If Approved, bituminous materials may be laid by manual methods in the following situations:

1. In courses of irregular shape and varying thickness;
2. In confined locations;
3. Adjacent to expansion joints, covers, frames and other hardware; and,
4. In reinstatements to trenches.

EXT1.W360.9 COMPACTING

1. As a minimum requirement use compaction plant to compact bituminous roadbase, base course, regulating course, wearing course and sub-base material as follows:
   a.
      i. A smooth three steel-wheeled roller with a mass of between 6 t and 12 t, or a vibratory tandem steel-wheeled roller with an effective mass of between 6 t and 12 t; and
      ii. A smooth pneumatic tyred-roller with a mass of between 12 t and 25 t, and with not less than seven overlapping wheels which have tyres that are capable of having pressures varying between 300 MPa and 800 MPa; and
      iii. Suitable mechanical rammers and hand tools; or
   b. Other Approved types of rollers, vibrating plates, or other similar plant necessary to produce the required degree of compaction.
2. Initially roll bituminous roadbase, base course, regulating course and wearing course materials with a steel-wheeled roller operated in a longitudinal direction along the carriageway with the driving wheels nearest the paving machine;
3. Remove all roller marks from the surface of bituminous roadbase, base course and wearing course materials with either a smooth-wheeled dead-weight roller or a smooth-wheeled vibratory roller in non-vibrating mode;
4. To ensure continuity of voids in polymer modified friction course, pneumatic-tyre roller shall not be used for compacting polymer modified friction course;

5. Do not park rollers on newly laid or compacted bituminous materials;
6. Where rollers cannot operate effectively compact bituminous materials immediately adjacent to kerbs, covers, frames and other hardware using hand-operated mechanical compaction plant.

EXT1.W370.9 JOINTING BITUMINOUS MATERIALS

1. Ensure the screed of the paving machine overlaps previously laid strips of bituminous material by at least 50 mm and is sufficiently high so that compaction produces a smooth dense flush joint. Push back bituminous materials overlapping the previously laid strip to the edge of the previously laid strip and remove excess material;
2. Form longitudinal joints in polymer modified friction or wearing courses to coincide with the position of the lane-markings unless otherwise permitted by the CM;
3. Form a prepared joint between hot bituminous material and cold material or existing bituminous material at a temperature below the minimum specified laying temperature;
4. Ensure
   a. The distance between prepared longitudinal joints in different layers is at least 150 mm;
   b. The distance between transverse joints in different layers is at least 500 mm.
5. Form prepared joints in base course and wearing course as follows:
   a. Cut back the face of the cold material or existing bituminous material for a minimum distance of twice the depth of the layer or 100 mm, whichever is greater; cut a vertical face for the full depth of the layer;
   b. Remove all loosened materials and coat with bituminous emulsion; do not apply the bituminous emulsion beyond the edges of the joint;
   c. Lay and compact the hot bituminous materials against the coated face with a joint formed as stated in this clause.
6. Unless otherwise permitted by the CM, do not coat polymer modified friction course joints with bituminous emulsion.

PERMISSIBLE TOLERANCES

EXT1.W410.9 CARRIAGEWAY ALIGNMENT

Form carriageway edgelines within the following tolerances from the dimensions indicated on the Drawings:

1. Generally within 25 mm;
2. Adjacent edges of structures within 6 mm.

EXT1.W420.9 CARRIAGEWAY LEVELS

Refer to Appendix H "Schedule of Tolerances" to this Specification.

EXT1.W430.9 COVERS, FRAMES AND OTHER HARDWARE

Set in position to ensure

1. The level of covers, frames and other hardware are not lower than, and not more than 5 mm higher than the surface of the adjacent carriageway;
2. The level of gully gratings are not higher than, and not more than 5 mm lower than the surface of the adjacent carriageway.

PROTECTION

EXT1.W510.9 SURFACES OF SUB-BASES AND BITUMINOUS CARRIAGEWAYS

1. Keep the surface of each layer of sub-base material and bituminous materials clean and free from deleterious material. When Instructed apply bituminous priming coat to the final surface of the sub-base layer at a rate of between 0.9 L/m² and 1.1 L/m²;
2. Do not permit the use of carriageway layers under construction by construction plant or vehicles other than those which in the opinion of the CM are essential for construction purposes;
3. Unless otherwise permitted by the CM, do not permit the use of bituminous courses by construction plant or other vehicles until 6 hours after the material has been laid and compacted.

WORKS OUTSIDE SITE BOUNDARY

EXT1.W610.9 APPROVED CONTRACTOR FOR PUBLIC WORKS

Road and footway works required to be carried out by a contractor or sub-contractor who is on the current List of Approved Contractors for Public Works for Roads and Drains are specified in Project Specific Specification.

EXT1.W620.9 SPECIFICATION

Carry out the works specified under EXT1.W610 in accordance with Section 9 of the Hong Kong Government General Specification for Civil Engineering Works (2020 Edition) and its amendments published 42 days prior to the date for the return of tenders unless otherwise specified.

EXT1.W630.9 HANDING OVER INSPECTION

Notify the CM to arrange with Highways Department for a joint handing over inspection. Allow the CM to give at least 2 working days advance notice for this inspection.

EXT1.W640.9 RECORD DRAWINGS AND TEST REPORTS

Provide as-built record drawings and all test reports to the CM for submitting to Highways Department.

TESTING

BITUMINOUS CARRIAGEWAY TRIALS

EXT1.T010.9 TRIAL AREAS

1. Construct trial areas of each type and layer of bituminous materials to demonstrate that the proposed materials, mixes, methods of production and methods of construction are capable of producing a carriageway which complies with the specified requirements except in the following circumstances:
   a. With approval of the CM in the case that the area of work is less than 200 m^2; or
   b. When the materials are supplied by contractors included in Development Bureau's Special Contractors List of Supply of Bituminous Pavement Materials and Construction of Special Bituminous Surfacing and paving works are carried out by contractors on the List of Approved Contractors for Public Works under the Roads and Drainage Category.
2. Unless otherwise Instructed, construct the trial areas as part of the permanent carriageway at locations agreed by the CM;
3. Trial area size:
   a. Width of each trial area not less than one lane of carriageway;
   b. Length of each trial area not less than 60 m unless otherwise approved by the CM.
4. Construct trial areas using the same materials, mixes, methods of production and methods of construction as the details submitted to the CM. Deliver materials in not less than two loads;
5. Inform the CM 48 hours before constructing trial areas, or at an interval agreed by the CM;
6. Obtain the CM's permission before each layer of material is placed in the trial area;
7. Give the CM sufficient time to determine whether the specified requirements have been produced in the trial area before further material of the same type is placed in the permanent carriageway;
8. Protect trial areas from damage and leave in position unless the CM instructs their removal. Do not remove trial areas which form part of the permanent carriageway and which comply with the specified requirements.

EXT1.T020.9 SAMPLES OF MATERIALS USED IN TRIAL AREAS

1. Provide one sample of bituminous materials, excluding bituminous roadbase materials, from each mix used in trial areas. Method of sampling as stated in the table to EXT1.T030;
2. Cut ten cores from each layer of base course and wearing course in trial areas. Method of taking core as EXT1.T510.

EXT1.T030.9 SAMPLING AND TEST METHODS FOR TRIAL AREAS

1. Test each sample of bituminous material taken as EXT1.T020 to determine the properties stated in the following table;
2. Where the layer is to form part of the permanent work, test each layer of bituminous material in trial areas, excluding bituminous roadbase material, as EXT1.W420 to determine the level of the surface;
3. Test the layer which will form the final layer of the carriageway in each trial area as EXT1.T610 and EXT1.T620 to determine the surface regularity, if the layer is to form part of the permanent work;
4. Test the friction course layer in each trial area as EXT1.T710 to EXT1.T730 to determine the texture depth and permeability;

5. Test cores as EXT1.T510 to EXT1.T540 to determine the compacted layer thickness and air void content.

Sampling and Testing Bituminous Materials			
Type of material	Properties	Methods of sampling	Methods of testing
Bituminous base course and wearing course	Particle size distribution Bitumen content Rice's specific gravity Void content	EXT1.T320 EXT1.T320 EXT1.T320 EXT1.T510	EXT1.T330 EXT1.T330 EXT1.T330 EXT1.T520
Polymer modified friction course material	Particle size distribution Bitumen content Texture depth and permeability	EXT1.T420 EXT1.T420 -	EXT1.T430 EXT1.T430 EXT1.T710

EXT1.T040.9 COMPLIANCE CRITERIA

The properties of the materials, the levels of the surface, compaction, surface regularity, texture depth and permeability of bituminous materials laid in the trial areas must comply with the specified requirements for the permanent carriageway.

EXT1.T050.9 NON-COMPLIANCE

1. In the event of non-compliance of any trial area test with the specified requirements submit details of proposed changes to the materials, mixes, methods of production or construction required to meet the compliance criteria. Construct further trial areas as necessary until the result of every test on trial areas complies with the specified requirements for the trial areas;
2. Unless otherwise permitted by the CM, remove trial areas, or parts of trial areas, which do not comply with the specified requirements for the trial area.

EXT1.T060.9 APPROVED MIX FOR BITUMINOUS MATERIALS OTHER THAN BITUMINOUS ROADBASE MATERIAL

1. A mix for bituminous materials other than bituminous roadbase material which complies with the specified requirements for designed mixes and for trial areas will be regarded as an Approved mix;
2. The Approved gradation envelope for bituminous materials other than bituminous roadbase material will be the gradation envelope found by applying the tolerances stated in the following table to the particle size distribution of the Approved mix:

Tolerances for Particle Size Distribution from Approved Mix					
BS Test Sieve	Tolerance of particle size distribution in percentage by mass of total mix passing BS Test Sieve				
	Nominal maximum aggregate size (mm)				
	37.5	28	20	10 (for mix other than polymer modified friction course material)	10 (for polymer modified friction course material)
50 mm	0	-	-	-	-
37.5 mm	± 4	0	-	-	-
28 mm	± 7	± 4	0	-	-
20 mm	± 7	± 7	± 4	-	-
14 mm	± 7	± 7	± 7	0	0
10 mm	± 7	± 7	± 7	± 4	± 4
5 mm	± 7	± 7	± 7	± 7	± 7
2.36 mm	± 7	± 7	± 7	± 7	± 7
1.18 mm	± 7	± 7	± 7	± 7	-
600 microns	± 5	± 5	± 5	± 5	-
300 microns	± 5	± 5	± 5	± 5	-
150 microns	± 3	± 3	± 3	± 3	-
75 microns	± 2	± 2	± 2	± 2	± 2

3. The Approved bitumen content range for bituminous materials other than bituminous roadbase material will be the bitumen content range formed by applying a tolerance of ±0.5% to the bitumen content of the Approved mix.

SUB-BASE MATERIALS

EXT1.T110.9 BATCHES FOR TESTING

A batch of sub-base material is a quantity not exceeding 250 m³ of sub-base material of the same type and same mix produced at the same mixing plant, and delivered to the Site at any one time.

EXT1.T120.9 SAMPLES FOR TESTING

1. Unless otherwise permitted by the CM, provide one sample of each type of sub-base material from each batch of sub-base material delivered to the Site;
2. Each sample size at least 50 kg;
3. Method of sampling to CS3:2013.

EXT1.T130.9 TEST METHODS

1. Test each sample of sub-base materials to determine the particle size distribution, ten percent fines value, maximum dry density, optimum moisture content and plasticity index of the portion passing a 425 micron BS Test Sieve;
2. Method of testing for particle size distribution to CS3:2013;

3. Method of testing for ten percent fines to CS3:2013 under a soaked condition;
4. Method of testing for plasticity index comply with Geospec 3, Test Method 6.1, except that same preparation must be by wet sieving the material over a 425 µm BS test sieve;
5. Method of testing for maximum dry density and optimum moisture content comply with Geospec 3, Test Method 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7 or 10.8 and EAR1.T310 to EAR1.T370, whichever as Instructed.

EXT1.T140.A TEST METHODS - RECYCLED SUB-BASE MATERIAL

1. Test each sample of recycled sub-base material to determine the particle size distribution, ten percent fines value, maximum dry density, optimum moisture content, plasticity index of the portion passing a 425 µm BS test sieve, CBR value, soundness value, water-soluble sulphate content and percentage of contaminants as defined in EXT1.M320 (7);
2. Method of testing for particle size distribution to CS3;
3. Method of testing for ten percent fines value to CS3 under a soaked condition;
4. Method of testing for plasticity index to be in accordance with Geospec 3, Test Method 6.1, except that sample preparation shall be by wet sieving the material over a 425 µm BS test sieve;
5. Method of testing for maximum dry density and optimum moisture content to be in accordance with Geospec 3, Test Method 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7 or 10.8, and EAR1.T310 to EAR1.T370, whichever as Instructed;
6. Soundness value to be determined in accordance with CS3;
7. Water-soluble sulphate content to be determined in accordance with BS 1377: Part 3;
8. The maximum organic material content to be determined in accordance with BS 1377: Part 3;
9. The maximum metals and foreign material content to be determined in accordance with the following procedure:
    a. Using the sampling procedure detailed in BS EN 932: Part 6, obtain a sample of the aggregate containing at least 500 particles. Sort the particles manually into the following separate fractions:
        i. Concrete and dense or normal weight aggregates;
        ii. Brick, mortar, lightweight block and lightweight aggregate;
        iii. Asphalt, bitumen, tar and mixtures of these materials with aggregate;
        iv. Wood;
        v. Glass;
        vi. Metal;
        vii. Other foreign material such as clay lumps and plastics.
    b. Because of the adherence of dust or ash, break some particles where necessary to make a positive identification. Weigh the resulting fractions and express as a percentage of the total weight of material;
    c. Note lightweight block materials as a separate category if more than 1% by volume (approx. 5 pieces in 500) is detected. Take record of ultra-lightweight materials (e.g. insulation) if more than 1% by volume (5 pieces in 500) is identified.
10. Determine CBR value in accordance with BS 1377: Part 4 with surcharge discs. Test the material at the density and moisture content likely to develop in equilibrium pavement conditions, which shall be taken as being the density relating to an uniform air voids content of 5% and the optimum moisture content determined in compliance with BS 5835: Part 1:1980.

EXT1.T150.9 DETERMINATION OF RELATIVE COMPACTION

1. Test each area of sub-base which contains sub-base material of the same type and same mix produced at the same mixing plant and which is laid and compacted in a single layer in one day to determine the relative compaction. Carry out tests after the sub-base material has been laid and compacted in the final position;
2. Carry out two tests on each area of 1000 m² or part thereof laid and compacted each day;
3. Carry out tests at positions which in the opinion of the CM are representative of the area of compacted sub-base as a whole;
4. Comply with the method of testing for relative compaction as EAR1.T530.

EXT1.T160.9 COMPLIANCE CRITERIA FOR RELATIVE COMPACTION

The results of tests for relative compaction of sub-base must comply with the requirements specified at EXT1.W310 (6).

EXT1.T170.9 NON-COMPLIANCE OF RELATIVE COMPACTION

In the event of non-compliance of any test for relative compaction of sub-base with the specified requirements, recompact the area and carry out two additional tests for relative compaction of sub-base on the area.

BITUMINOUS MATERIALS OTHER THAN POLYMER MODIFIED FRICTION COURSE MATERIAL

EXT1.T310.9 BATCHES FOR TESTING

A batch of bituminous materials other than polymer modified friction coarse material is a quantity not exceeding the limits stated in the following table of bituminous materials of the same type and same mix produced at the same mixing plant in one day:

Maximum Size of Batch for Bituminous Materials Other than Polymer Modified Friction Course Material	
Material	Maximum batch size
Wearing course	100 t
Base course	150 t
Roadbase	200 t

EXT1.T320.9 SAMPLES FOR TESTING

1. Provide one sample of bituminous materials other than polymer modified friction course material from each batch unless otherwise required by the CM;
2. Sample size of each as stated in the following table:

Size of Samples for Bituminous Materials Other than Polymer Modified Friction Course Material	
Material	Minimum size of sample (kg)
Wearing course (10 mm nominal maximum aggregated size)	10
Wearing course (20 mm nominal maximum aggregate size)	16
Base course	24
Roadbase	24

3. Take samples at the mixing plant or at the location where the bituminous material will be laid as Instructed. When applicable, take samples at the mixing plant from the delivery vehicle immediately after loading from the plant or from the surge bin. When applicable, take samples at the location where the bituminous materials will be laid from the delivery vehicle;
4. Unless otherwise agreed by the CM the method of sampling to comply with ASTM D 979-15.

EXT1.T330.A TEST METHODS

1. Test each sample of bituminous materials taken as EXT1.T320 (1) to determine the particle size distribution, bitumen content, Rice's specific gravity and bulk specific gravity;
2. The method of testing to comply with the following:
   a. Particle size distribution: ASTM D 5444 with modifications;
   b. Bitumen content: ASTM D 6307-16 or ASTM D 2172-17, Method A;
   c. Rice's specific gravity: ASTM D 2041-11, Weighing-in-water method;
   d. Bulk specific gravity: ASTM D 2726-14.
3. For particle size distribution tests in accordance with ASTM D 5444, the modifications are:
   a. Use sieves to BS ISO 3310-1:2016 and BS ISO 3310-2:2013 instead of sieves to ASTM E 11-95;
   b. The washed aggregate shall be dried at a temperature of 110±5°C.

EXT1.T340.9 COMPLIANCE CRITERIA

1. The results of tests on bituminous materials other than bituminous roadbase and polymer modified friction course materials must comply with the following requirements:
   a. The particle size distribution must be such that not more than two points on the particle size distribution curve are outside the Approved gradation envelopes determined as EXT1.T060 (2). The percentage passing the 75 micron BS test sieve must not exceed the Approved design value by more than 3%;
   b. The bitumen content must be within the Approved bitumen content range determined as EXT1.T060 (3).
2. The results of tests on bituminous roadbase material must comply with the following requirements:
   a. The particle size distribution must be such that not more than two points on the particle size distribution curve are outside the design limits as stated in EXT1.M410 (3). The percentage passing the 75 micron BS test sieve must not exceed 8% as specified in EXT1.M410 (3);
   b. The bitumen content must be within the allowable bitumen content range as specified in EXT1.M410 (3).

POLYMER MODIFIED FRICTION COURSE MATERIAL

EXT1.T410.9 BATCHES FOR TESTING

A batch of polymer modified friction course material is a quantity not exceeding 100 tonnes of polymer modified friction course material of the same mix produced at the same mixing plant in one day.

EXT1.T420.9 SAMPLES FOR TESTING

1. Provide one sample of polymer modified friction course material from each batch of polymer modified friction course material;

2. The size of each sample must be at least 15 kg;
3. Take samples from roadway prior to compaction at locations where the polymer modified friction course material will be laid or from other locations as instructed by the CM prior to compaction;
4. Unless otherwise agreed by the CM the method of sampling to comply with ASTM D 979-15.

EXT1.T430.A TEST METHODS

1. Test each sample of polymer modified friction course material to determine the particle size distribution and bitumen content;
2. The method of testing to comply with the following:
   a. Particle size distribution: as specified in EXT1.T450;
   b. Bitumen content: as specified in EXT1.T450.
3. For particle size distribution tests in accordance with ASTM D 5444, the modifications are:
   a. Use sieves to BS ISO 3310-1:2016 and BS ISO 3310-2:2013instead of sieves to ASTM E 11-95;
   b. The washed aggregate shall be dried at a temperature of 110±5°C.

EXT1.T440.9 COMPLIANCE CRITERIA

The results of test on polymer modified friction course material must comply with the following requirements:

1. The particle size distribution must be such that not more than one point on the particle size distribution curve is outside the Approved gradation envelopes as EXT1.T060 (2). Notwithstanding the above distribution, the percentage passing the 75µm BS test sieve shall not exceed the Approved design value by more than 3%;
2. The bitumen content must be within the Approved bitumen content range determined as EXT1.T060 (3).

EXT1.T450.N DETERMINATION OF BINDER CONTENT AND PARTICLE SIZE DISTRIBUTION OF POLYMER MODIFIED FRICTION COURSE MATERIAL

1. This method covers the determination of the polymer modified binder content (i.e. the total binder and polymer content) and particle size distribution of polymer modified friction course material by making use of a combination of two tests in accordance with ASTM D 2172, Method A and ASTM D 6307, ASTM D 5444 with modifications;
2. Testing on laboratory mix to determine the calibration factor shall be required. The procedure shall be as follows:
   a. For a particular mix, prepare a laboratory mix of known particle size distribution and bitumen content (A);
   b. Test the trial samples of the laboratory mix in accordance with ASTM D 2172, Method A (Centrifugal Method) to determine the polymer modified binder content (B) of the trial samples;
   c. Test the residual of the trial samples that have been tested by ASTM D 2172, Method A in accordance with ASTM D 6307 (Ignition Method) to determine the polymer modified binder content (C) of the residual;
   d. Calculate the calibration factor for that particular mix (Z) by the following formula:

      Calibration Factor (for a particular mix), Z = C - (A - B)

   e. Repeat the above steps specified in sub-clauses (2)(a) to (2)(d) above for two additional calibration samples;

f. Calculate the average calibration factor (Z) by averaging the three values obtained by formula specified in sub-clause (2)(d) above.

3. The procedure for testing polymer modified friction course material shall be as follows:
   a. Test the samples in accordance with ASTM D 2172, Method A (Centrifugal Method) to obtain the polymer modified binder content (X) of the test samples;
   b. Keep the residual (Residual 1) of the test samples that have been tested in accordance with sub-clause (3)(a) above;
   c. With the average value of the calibration factor (Z) entered into the NCAT Tester for correction purpose, test Residual 1 obtained as mentioned in accordance with sub-clause (3)(b) above in accordance with ASTM D 6307 (Ignition Method) to obtain the residual polymer modified binder content (Y) of Residual 1;
   d. Keep the residual (Residual 2) of Residual 1 that has been tested in accordance with sub-clause (3)(c) above;
   e. Determine the particle size distribution of Residual 2 in accordance with ASTM D 5444 with modifications.
4.
   a. The polymer modified binder content of the test samples shall be calculated as follows:

      Polymer modified binder content = X + Y

   b. The particle size distribution of the test samples shall be the particle size distribution of Residual 2.
5. Report test results to the CM including the following as determined by the tests:
   a. Polymer modified binder content (X);
   b. Polymer modified binder content (Y);
   c. Polymer modified binder content (total binder and polymer content);
   d. Particle size distribution.

CORES FROM BITUMINOUS ROADWAYS

EXT1.T510.9 SAMPLE LOCATIONS AND METHODOLOGY

1. Test each area of roadbase, base course and wearing course which contains bituminous material of the same type and same mix produced at the same mixing plant and which is laid and compacted in a single layer in one day to determine the compacted layer thickness;
2. Unless otherwise Approved, divide each area of bituminous material to be tested into approximately equal sub-areas as stated in the following table. Take one core at random from each sub-area:

Rate of Sampling for Bituminous Material Cores		
Area of bituminous material laid and compacted in one day	No. of sub-areas/cores	
	Roadbase	Wearing course and Base course
< 5 000 m²	4	10
5 000 - 10 000 m²	10	15
> 10 000 m²	20	20

3. Do not take cores from within 300 mm of covers, frames and other hardware, or construction joints in the bituminous material;
4. Take cores with a mechanically operated coring machine;
5. Core sizes

a. 150 mm diameter for bituminous material with a designed layer thickness of 40 mm or greater;
b. 100 mm diameter for bituminous material with a designed layer thickness of less than 40 mm.

6. Take cores as soon as practicable but not later than 48 hours after completion of the paving operation;
7. If agreed by the CM, the sampling rate for roadbase may be applied to wearing and base courses;
8. Fill holes formed by taking cores with compatible bituminous material as soon as practicable after the core has been taken.

EXT1.T520.9 TEST METHOD

1. Measure each bituminous material core to determine the compacted layer thickness of the bituminous material and test to determine the air void content;
2. Method of testing for air void content complying with ASTM D 3203-17.

EXT1.T530.9 COMPLIANCE CRITERIA

The results of tests on bituminous material cores must comply with the following requirements:

1. The average air void content of the cores taken from an area of bituminous base course or wearing course material must be not less than 3.0% and not greater than 6.0%;
2. The air void content of each core taken from an area of bituminous base course or wearing course material must be not less than 2.5% and not greater than 7.5%;
3. The air void content of each core taken from an area of bituminous roadbase material must not be not less than 3.0% and not greater than 9.0%;
4. The compacted layer thickness as measured from each core must comply with the thickness requirements and be compatible with the levels of tolerances stated in EXT1.W420.

EXT1.T540.9 NON-COMPLIANCE

1. If the result of any test for air void content of cores does not comply with the specified requirements for air void content, carry out the following procedures:
   a. Take four additional cores, from each sub-area for which the original core did not comply with the specified requirements for air void content. Take the cores at locations evenly spaced through the sub-area so that in the opinion of the CM they are representative of the sub-area as a whole;
   b. Test each additional core to determine the air void content and average the test results of the additional cores from the same sub-area;
   c. The average air void content of the sub-area thus obtained replaces the original air void content of the respective sub-area. Use the new average air void content calculation of the area of bituminous material tested for compliance checking.
2. If the air void content of any of the four additional cores determined as EXT1.T520 (2) is less than 2.5% or greater than 7.5% for bituminous base course material and bituminous wearing course material, or less than 3.0% or greater than 9.0% for bituminous roadbase material, the sub-area from which the cores were taken will be considered as not complying with the specified requirements;
3. The area of bituminous material tested will be considered as not complying with the specified requirements for average air void content if the average air void content of the cores taken from the area does not comply with the specified requirements for average air void content;

4. If the results of any tests for compacted layer thickness of cores is not compatible with the requirements as stated in the table to EXT1.W420, take four additional cores from the same sub-area and determine the average compacted layer thickness. Take the cores at locations evenly spaced throughout the sub-area so that in the opinion of the CM they are representative of the sub-area as a whole;
5. If the average compacted layer thickness determined as sub-clause (4) above is not in accordance with the permitted compacted layer thickness as EXT1.T530 (4), the sub-area from which the cores were taken will be considered as not complying with the specified requirements.

SURFACE REGULARITY

EXT1.T610.9 DEFINITION AND TEST METHODS

Carry out the following testing to determine the surface regularity:

1. The surface regularity of the final layer of the pavement will be determined by measuring the number of irregularities in the surface. An irregularity is defined as when the gap between the surface of the carriageway, and a 3 m straight-edge placed on the surface of the carriageway, exceeds the specified amount. Measured irregularities will be in millimeters perpendicular to the straight-edge;
2. The longitudinal surface regularity of carriageways with a total length of 75 m or more may be measured using a rolling straight-edge of the type designed by the UK Transport and Road Research Laboratory. The longitudinal surface regularity of carriageways, with a total length of less than 75 m, and the transverse surface regularity of carriageways will be measured using a 3 m straight-edge;
3. The longitudinal surface regularity will be measured along lines parallel to the longitudinal axis of the carriageway and approximately 1 m from the near side edge of each carriageway lane. The transverse surface regularity will be measured along lines at right angles to the longitudinal axis on the carriageway at 10 m intervals along the length of the carriageway.

EXT1.T620.9 COMPLIANCE CRITERIA

The results of tests for surface regularity of carriageways must comply with the following requirements

1. The size and number of irregularities in the longitudinal direction must not exceed the size and permitted number of irregularities stated in the following table:

Permitted Irregularities in the Longitudinal Direction			
Total length of carriageway	Size of irregularity	Permitted number of irregularities (Category A road)	Permitted number of irregularities (Category B road)
< 75 m	> 4 mm	(9 x total length)/75	(18 x total length)/75
	> 7 mm	1	2
75 m – 300 m	> 4 mm	9 in any 75 m length	18 in any 75 m length
	> 7 mm	1 in any 75 m length	2 in any 75 m length
> 300 m	> 4 mm	20 in any 300 m length	40 in any 300 m length
		9 in any 75 m length	18 in any 75 m length
	> 7 mm	2 in any 300 m length	4 in any 300 m length
		1 in any 75 m length	2 in any 75 m length

Notes to table:

a. Category A roads are roads with a legal speed limit greater than 70 kilometers per hour; all other roads are Category B roads;

b. Irregularities greater than 7 mm will also be counted as greater than 4 mm;

c. No irregularity greater than 10 mm will be permitted.

2. No irregularity exceeding 4 mm in a 3 m length in the transverse direction for Category A roads and no irregularity exceeding 7 mm in a 3 m length in the transverse direction for Category B roads will be permitted.

TEXTURE DEPTH AND PERMEABILITY

EXT1.T710.9 TEST LOCATIONS AND METHODOLOGY

Carry out testing to determine the texture depth and permeability. The method of testing will be as follows

1. Unless otherwise agreed by the CM each area of polymer modified friction course to be tested will be divided into approximately equal sub-areas as stated in the following table. Tests for texture depth and permeability will be carried out on each sub-area at positions which in the opinion of the CM are representative of the sub-area of polymer modified friction course as a whole. No measurement will be taken within 300 mm of the longitudinal edge of the carriageway;
2. If agreed by the CM the number of tests for texture depth and permeability may be reduced to the minimum stated in the following table:

Rate of Testing for Texture Depth and Permeability		
Area of bituminous material laid and compacted in one day	No of sub-areas/tests	
	Normal	Minimum
< 5,000 m²	10	4
5,000 - 10,000	15	10
> 10,000 m²	20	20

3. Test will be carried out before the area of polymer modified friction course is used by Constructional Plant or other vehicles;
4. The test method for the determination of the permeability of polymer modified friction course material measures the time taken for 150 ml of water to drain into the material:
   a. Apparatus
      i. A non-porous ring with an internal diameter of 150 mm ± 2 mm, and a minimum height of 20 mm;
      ii. Suitable sealant for sealing one end of the ring onto the friction course surface;
      iii. A measuring cylinder for measuring 150 ml of water to an accuracy of 1 ml;
      iv. Two containers, each suitable for containing and pouring 150 ml of water;
      v. A stop watch.
   b. Procedure
      i. The test location will be carefully inspected and any unusual features recorded;
      ii. One end of the ring will be placed on the friction course at the location to be tested, and the interface sealed with sealant to prevent any leakage of water;
      iii. Two volumes of water of 150 ml each will be prepared using the measuring cylinder and the two containers;
      iv. One 150 ml measure of water will be poured into the ring quickly and steadily without spillage;
      v. As soon as all of the water has drained into the friction course, the second 150 ml of water will be poured into the ring quickly and steadily without spillage, and at the same time the stop watch started;

vi. The time taken for the second 150 ml of water to drain into the friction course surface will be recorded.

c. The following information will be recorded

i. The test location;

ii. The time taken for the second 150 ml of water to drain into the friction course surface, to the nearest one second;

iii. That the test was carried out in accordance with this Specification.

5. The test method for determination of the texture depth of carriageways covers the determination of the texture depth of carriageways by the sand patch test:

a. Material: dry natural sand, with a rounded particle shape, which has been washed and then screened such that it meets the grading stated in the following table:

Grading of Sand	
BS test sieve	Percentage by mass passing
600 microns	100
300 microns	95 - 100
150 microns	0 - 6

b. Apparatus

i. A soft brush;

ii. A robust measuring cylinder having an internal diameter of 20 ± 2 mm and a flat top surface such that its internal volume is 25 ± 0.1 ml;

iii. A flat wooden disc of 65 mm diameter with a 1.5 mm thick hard rubber disc attached to one face and a handle fixed to the other face;

iv. A steel rule calibrated to 1 mm;

v. A suitable wind shield;

vi. A funnel with an outlet tube at least 100 mm long with a bore of between 4 mm and 6 mm, and capable of accepting a volume of at least 200 ml;

vii. A steel straight edge for screeding off the measuring cylinder;

viii. A steel-wire brush.

c. Procedure

i. The test location will be at least 300 mm square. It will be vigorously brushed ten times in two directions at right angles using the steel wire brush, and then dried and swept clean with the soft brush;

ii. Sand will be poured into the measuring cylinder to fill it to overflowing, and any excess sand will be screeded off using the straight edge. All sand on the outside of the cylinder will be removed, taking care not to drop any sand onto the test location. Alternatively, this step in the procedure may be carried out in a laboratory, and the sand transferred to a suitable container ready for pouring;

iii. The measured volume of sand will be poured onto the centre of the test location through the funnel to form a heap. The wind shield will be used to protect the test location if required;

iv. The sand will be spread outwards with a circular motion over the test location, using the rubber-face disc with its face parallel to the surface of the carriageway. This will be continued until the patch of sand is approximately circular and will spread outwards no more;

v. The size of the circular patch of sand will be measured to the nearest 1 mm along three diameters which are aligned at approximately 120 degrees to each other;

vi. If the difference between the maximum and minimum of the three measurements exceeds 20% of the average of the three measurements, then all the measurements will be discarded and the test repeated at an adjacent location;

vii. The test will be repeated for all the ten test locations for each section of carriageway lane.

d. Method of calculation

i. The texture depth (T) for each test will be calculated from the equation

$T = 31000 / D^2$ mm

Where D is the average of the three diameter measurements of the sand patch calculated to the nearest 1 mm;

ii. The average texture depth for the ten tests will be calculated.

e. The following information will be recorded

i. The test location;

ii. The average diameter of the sand patch for each test to the nearest 1 mm;

iii. The texture depth for each test to the nearest 0.1 mm;

iv. The average texture depth to the nearest 0.1 mm;

v. That the test was carried out in accordance with this Specification.

EXT1.T720.9 COMPLIANCE CRITERIA FOR TEXTURE DEPTH

The results of tests for texture depth on an area of polymer modified friction course must comply with the following requirements:

1. The average texture depth not less than 1.5 mm;
2. Not more than one of the tests for texture depth giving a result of less than 1.2 mm will be permitted.

EXT1.T730.9 COMPLIANCE CRITERIA FOR PERMEABILITY

The time for 150 ml of water to drain into the polymer modified friction course in the permeability test as stated in EXT1.T710 must not exceed 30 seconds.

EXT2 CONCRETE CARRIAGEWAYS

MATERIALS

GENERAL

EXT2.M010.9 APPLICATION OF OTHER WORKSECTIONS

Comply with the relevant provisions of the following Sections unless otherwise specified in this Worksection:

1. Concrete: Worksection CON1;
2. Formwork and finishes to concrete:
   a. Worksection FOR for works carried out under site formation / road and drainage works contract; or
   b. Worksection CON2 for all other works not mentioned in sub-clause (2)(a) above.
3. Reinforcement: Worksection CON3;
4. Curing compound: Worksection CON1;
5. Earthworks: Worksection EAR1.

CONCRETE

EXT2.M110.9 CONCRETE FOR CARRIAGEWAY CONSTRUCTION

Complying with the following requirements:

1. Designed mix, grade: 40/20;
2. Containing either PFAC, or a minimum of 265 kg of PC plus a minimum of 85 kg of PFA per m^3 of compacted concrete;
3. At least 30% by mass content of fine aggregate to total aggregate;
4. Workability, in terms of designed slump value: not exceeding 75 mm;
5. Minimum cementitious content: 350 kg/m^3.

ANCILLARY MATERIALS

EXT2.M205.9 GENERAL

Adhesives, adhesive primer, sealant, sealant primer, and caulking material shall be in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compound) Regulation.

EXT2.M210.A REINFORCEMENT

Steel fabric to BS 4483:2005:

1. Manufactured from steel wire to BS 4482:2005;
2. Having a type 2 bond classification.

EXT2.M220.9 DOWEL BARS, TIE BARS, CRADLES AND TIE BARS FOR CRADLES

Plain, round steel bars to CS2:1995 and:

1. Grade 250;
2. With dowel bars straight and with both ends sawn square and burrs removed;
3. With tie bars straight and with one end sawn square and burrs removed.

EXT2.M230.A CEMENT MORTAR

Consisting of:

1. 1 part cement (complying with CON1) to 3 parts of fine aggregate (sand or crushed rock to BS EN 13139 and shall be less than or equal to 4 mm);
2. The minimum amount of water to achieve a consistency suited to the required work.

EXT2.M240.9 FINE AGGREGATE FOR CONCRETE

1. Clean, hard and durable crushed rock in accordance with CON1;
2. Do not use natural sand unless with prior agreement of the CM.

EXT2.M250.9 COARSE AGGREGATE FOR CONCRETE

1. Clean, hard, durable crushed rock complying with BS 882:1992;
2. Ten percent fines values of at least 100 kN;
3. Water absorption not exceeding 0.8%;
4. Flakiness index not exceeding 35%.

EXT2.M260.9 POLYETHYLENE SHEETING

Impermeable and having a nominal thickness of 0.125 mm.

EXT2.M270.9 JOINT FILLER

Approved proprietary type consisting of a firm, compressible, single thickness, non-rotting filler.

EXT2.M280.A JOINT SEALANT

Cold poured, two part polymer based sealant to BS EN 14188: Part 2, Class A, and:

1. Suited to the climatic conditions of Hong Kong, performing effectively over a temperature range of 0°C to 60°C;
2. For use in conjunction with Approved proprietary types of primers and caulking material as recommended by the joint sealant manufacturer.

EXT2.M290.9 BOND BREAKER TAPE

Of an Approved proprietary type recommended by the joint sealant manufacturer and comprising a polyethylene film with adhesive applied to one side and covering the full width of the groove.

EXT2.M300.9 GROOVE FORMING STRIP

Of an Approved proprietary type:

1. Comprising a firm compressible strip of either:
   a. Ethylene vinyl acetate foam with a density of at least 90 kg/m³; or
   b. Synthetic rubber.
2. 25 mm deep and 5 mm thick;
3. Sufficiently rigid to remain in position during concreting without deforming or stretching.

EXT2.M310.9 ADHESIVE FOR GROOVE FORMING STRIP

An Approved proprietary type recommended by the groove forming strip manufacturer.

EXT2.M320.9 SLEEVES FOR DOWEL BARS AND TIE BARS

Manufactured from PVC and:

1. With a wall thickness not exceeding 1.5 mm;
2. Of an internal diameter allowing a tight fit to the bars.

EXT2.M330.9 EPOXY RESIN GROUT

An Approved proprietary type.

SUBMISSIONS

EXT2.M410.9 GENERAL

Submit the particulars and certificates required for Approval under the terms of this sub-section, at least 14 days before the first delivery of the material to the Site. Submit certificates for each batch of the material delivered to the Site.

EXT2.M420.9 JOINT FILLER

Submit manufacturer's literature and a certificate for Approval, showing:

1. The manufacturer's name;
2. The date and place of manufacture;
3. That the joint filler complies with the requirements of this Specification and including results of tests for:
    a. Disintegration and shrinkage;
    b. Recovery value and reduction in mass;
    c. Extrusion.

EXT2.M430.9 JOINT SEALANT

Submit manufacturer's literature for Approval, including:

1. The manufacturer's name;
2. Details of the method and time required for mixing the different components;
3. A certificate showing the date and place of manufacture, that the sealant complies with this Specification and results of tests for:
    a. Application life;
    b. Tack-free time;
    c. Resistance to flow;
    d. Recovery;
    e. Adhesion and cohesion in tension and compression;
    f. Resistance to heat ageing.

EXT2.M440.9 GROOVE FORMING STRIP

Submit manufacturer's literature and a certificate for Approval, showing:

1. The manufacturer's name;
2. The date and place of manufacture;
3. That the groove forming strip complies with this Specification;
4. The results of tests for density.

EXT2.M450.9 JOINT SEALANT PRIMER

Submit particulars of the following for Approval:

1. Caulking material for joint sealant;
2. Adhesive for groove forming strip;
3. Bond breaker tape;
4. Sleeves for dowel bars and tie bars.

EXT2.M460.9 SAMPLES

Submit samples of the following proposed materials for Approval at the same time as the particulars of the material:

1. Polyethylene sheeting;
2. Joint filler;
3. Bond breaker tape;
4. Groove forming strip;
5. Sleeves for dowel bars, including compressible filler, and for tie bars.

WORKMANSHIP

MATERIAL

EXT2.W010.9 SUBMISSION FOR APPROVAL

Submit particulars of proposed methods of construction of concrete carriageways, for Approval at least 7 days before the construction of the trial length.

STORAGE OF MATERIALS

EXT2.W110.9 JOINT SEALANT ETC

1. Store joint sealant, and adhesive for groove forming strip:
   a. In sealed containers, marked to identify the contents;
   b. Protected from exposure to conditions which may adversely affect the material;
   c. In accordance with the manufacturer's recommendations.
2. Do not use materials after their recommended shelf life has been exceeded.

EXT2.W120.9 POLYETHYLENE SHEETING ETC

Store polyethylene sheeting, joint filler, bond breaker tape, groove forming strip and sleeves for dowel bars and tie bars in accordance with the manufacturer's recommendations in a dry, weatherproof store, with a raised floor. Store joint filler in sealed plastic bags and do not expose to moisture or the air.

PRELIMINARY WORK

EXT2.W210.9 INSTALLATION OF UTILITIES

Complete pipes, cables, manholes, chambers, gullies and other utilities below concrete carriageways and:

1. Deposit and compact fill material in trenches before carriageway is constructed;
2. Protect openings to manholes, chambers and gullies by the use of temporary covers or other Approved means.

EXT2.W220.9 BOX-OUT CONSTRUCTION

Form box-outs in concrete carriageways for covers, frames and other hardware for fixing in position after the main slab has been cast and before the infill slab is concreted.

EXT2.W230.9 FORMATION AND SUB-BASE

Start the construction of concrete carriageways as soon as practicable after the formation or sub-base has been completed and protect the following until construction of the carriageway starts:

1. Formation: as EAR1.W2320;
2. Sub-base: as EXT1.W510.

EXT2.W240.9 CONCRETING PERMANENT CARRIAGEWAY

1. Do not place concrete in the permanent carriageway, other than in the trial length, until the results of every test on the trial length complies with the specified requirements for the trial length;

2. Concrete may be placed in the permanent carriageway before the results of compressive tests on the trial mix are available, provided that the result of every other test on the trial mix and the trial length complies with the specified requirements for trial mix concrete and for the trial length.

EXT2.W250.9 CHANGES IN MATERIALS AND METHODS OF CONSTRUCTION

Unless permitted by the CM, do not change the materials, mix design, methods of production and methods of construction used to produce a trial length which complies with the specified requirements.

EXT2.W260.9 LAYING POLYTHENE SHEETING

Lay polythene sheeting flat and without creases below concrete carriageways, making laps at least 300 mm and leaving no gaps at the edges of bays.

FORMWORK

EXT2.W310.9 FORMWORK

1. Unless otherwise Approved, use steel formwork for concrete carriageways.
2. Do not place concrete against excavated surfaces or against kerbs unless permitted by the CM.

EXT2.W320.9 FINISHES

As struck from the formwork, with an even surface, without grout runs and:

1. Transverse and longitudinal joints:
   a. Maximum permitted abrupt irregularities: 3 mm;
   b. Maximum permitted gradual irregularities: 5 mm in 2 m.
2. Other edges of the carriageway:
   a. Maximum permitted abrupt irregularities: 5 mm;
   b. Maximum permitted gradual irregularities: 10 mm in 2 m.

EXT2.W330.9 REMOVAL OF FORMWORK

Do not loosen or remove formwork to excavated surfaces and kerbs until at least 7 hours after concreting has been completed.

PLACING AND COMPACTING CONCRETE

EXT2.W410.9 GENERAL

Unless otherwise Approved, place concrete continuously between the joints in the concrete carriageway.

EXT2.W420.9 UNREINFORCED SLABS

Place and compact concrete to the full thickness of the slab in one operation.

EXT2.W430.9 REINFORCED SLABS

Unless otherwise Approved:

1. Place and compact concrete to the level of the reinforcement as shown on the Drawings;
2. Place the fabric reinforcement in position and place and compact concrete to the remaining thickness of the slab;

3. Ensure that the time between compaction of the first layer and placing of the remaining layer does not exceed 30 minutes unless, in the opinion of the CM, the concrete already placed is sufficiently workable and his permission has been obtained. Where such permission is not given, form a construction joint as CON1.W510 to CON1.W570 and do not place concrete against concrete already laid for at least 24 hours unless permitted by the CM.

EXT2.W440.9 INFILL SLABS

1. Place and compact concrete in infill slabs around covers, frames and other hardware after they have been fixed in position;
2. Do not place and compact concrete in infill slabs at the same time as the concrete in the main slab.

CONSTRUCTION JOINTS

EXT2.W510.9 GENERAL

Form construction joints only where Approved or in cases of emergency, if concreting is interrupted by bad weather, plant breakdown or similar circumstances. Do not form construction joints within 2.5 m of an existing or planned expansion or contraction joint.

EXT2.W520.9 TRANSVERSE CONSTRUCTION JOINTS

Form by either:

1. Using formwork and cast-in tie bars; or
2. Breaking back from an unformed edge and fixing the tie bars and sleeves with epoxy resin grout in drilled holes.

SURFACE FINISH

EXT2.W610.9 STRIKING OFF

Unless combined double beam compactor levellers are being used, strike the concrete off after compaction to slightly above the levels of the formwork and regulate the surface by the use of a regulating machine or a vibrating beam.

EXT2.W620.9 REGULATING MACHINES

Use purpose made regulating machines that are:

1. Spanning the full width of the slab, either transversely or obliquely;
2. Equipped with at least two oscillating-type transverse screeds;
3. Supported on a carriage.

EXT2.W630.9 VIBRATING BEAMS

Must:

1. Have a steel or aluminium surface;
2. Be mounted on a separate carriage;
3. Be driven by a motor to provide a vibration frequency of at least 3500 cycles per minute.

EXT2.W640.9 SCRAPING STRAIGHT-EDGES

After regulation by regulating machine or vibrating beam:

1. Regulate the surface of the carriageway with at least two passes of a scraping straight-edge with a blade length of at least 1.8 m;

2. Where scraping straight-edges operate in conjunction with regulating machines, ensure that they pass across the surface at right angles to the longitudinal axis of the carriageway;
3. If the surface is torn by the straight-edge, regulate again using the regulation machine or vibrating beam and then by the scraping straight-edge.

EXT2.W650.9 REGULATION OF SMALL AREAS

1. Use wooden floats to tamp and regulate small areas of the carriageway, as Approved;
2. Do not use steel trowels or floats.

SURFACE TEXTURING

EXT2.W710.9 GENERAL

After the surface of the concrete carriageway has been regulated and before the application of curing compound, texture the surface by brushing with a wire broom, except for surface channels and the edges of slabs which do not require to be textured.

EXT2.W720.9 WIRE BROOMS FOR SURFACE TEXTURING

1. Use wire brooms which:
   a. Are at least 450 mm wide;
   b. Have two rows of tufts 20 mm apart with the tufts in each row in line with the gaps in the other and at 10 mm centres;
   c. Have tufts containing an average of 14 wires, each of 32 gauge and initially 100 mm long.
2. Replace the broom if any of the tufts wears down to 90 mm.

EXT2.W730.9 PROCEDURE

Produce the surface texture by brushing evenly across the slab, in one direction, at right angles to the longitudinal axis of the carriageway. Carry out brushing after the moisture film has disappeared from the concrete surface and before the initial set is complete.

CURING CONCRETE

EXT2.W810.9 CURING METHODS

Protect the surfaces and edges of concrete carriageways by one of the methods stated in CON1.W1410 to CON1.W1490. Apply curing compound, if used, to the surface immediately after texturing and to the edges immediately after the formwork has been removed.

FORMING MOVEMENT JOINTS

EXT2.W910.9 GENERAL

1. Use materials for joints in concrete carriageways in accordance with the manufacturer's recommendations or as otherwise specified herein;
2. Form joints perpendicular to the top surface of the slab.

EXT2.W920.9 FIXING DOWEL BARS

Securely fix dowel bars, tie bars and their sleeves in position through holes in the formwork before concreting and ensure:

1. Bars are parallel to the top surface of the slab and to each other;

2. Bars at transverse joints are parallel to the adjacent longitudinal joint or to the longitudinal axis of the carriageway if there is no longitudinal joint, or to other lines as Instructed.

EXT2.W930.9 FIXING JOINT FILLER

Cut joint filler to size before fixing and:

1. Securely fix in position to the existing concrete surface before concreting;
2. Ensure that there are no gaps between the joint filler and the formation;
3. Cut holes in the filler for dowel bars to form a sliding fit to the sleeved bar.

EXT2.W940.9 TRANSVERSE JOINTS GENERALLY

Ensure that transverse joints are straight and perpendicular to the longitudinal axis of the carriageway, unless otherwise permitted by the CM.

EXT2.W950.9 FORMING TRANSVERSE JOINTS

Form transverse expansion and contraction joints at the locations marked on the Drawings and ensure that:

1. The joints are continued across the longitudinal joints and are in line and of the same type on both sides of the longitudinal joint;
2. The joints are continued through kerbs, edgings and quadrants, their foundation and backing where they must be of the same dimensions and materials as the transverse joints, with the omission of the dowel bars;
3. Additional contraction joints are formed at intervals not exceeding 4 m;
4. The joint filler and groove sealant in expansion joints provides complete separation of adjacent slabs.

EXT2.W960.9 LONGITUDINAL JOINTS

Form longitudinal joints only where shown on the Drawings.

EXT2.W970.9 ISOLATION JOINTS

Form isolation joints at manholes and chambers.

EXT2.W980.9 FORMING GROOVES GENERALLY

Ensure that the grooves for joint sealant:

1. Are straight;
2. Have parallel sides perpendicular to the top surface of the slab;
3. Have a flat bottom surface, parallel to the top surface of the slab.

EXT2.W990.9 TRANSVERSE EXPANSION AND ISOLATION JOINT GROOVES

Form by sawing the groove to the width and depth shown on the Drawings not less than 7 days after concreting. Ensure that the grooves are located directly above the joint filler such that its upper surface is entirely contained within the groove.

EXT2.W1000.9 TRANSVERSE CONTRACTION JOINT GROOVES

Form using one of the following methods:

1. Method 1:
    a. Saw an initial groove as soon as practicable after concreting without spalling the edges;
    b. Ensure that the width of the initial groove is less than that required for the final groove and its depth is between ¼ and ⅓ of the thickness of the slab;
    c. Saw the final groove to the width and depth shown on the Drawings not less than 7 days after concreting;

d. Ensure that the centre lines of the initial and the final grooves coincide.

2. Method 2: saw the final groove to the width and depth shown on the Drawings as soon as practicable after concreting, without spalling the edges.

EXT2.W1010.9 GROOVES AT TRANSVERSE CONSTRUCTION JOINTS

Form by fixing groove forming strip, with adhesive, to concrete already placed before concreting the adjacent slab.

EXT2.W1020.9 PROTECTION OF GROOVES

Before permanent sealing, protect grooves from contamination by temporary sealing strip or by other Approved methods.

EXT2.W1030.9 GROOVE CONDITION PRIOR TO SEALING

Ensure that the groove is clean and dry at the time of applying the primer and the joint sealant.

EXT2.W1040.9 SEALING JOINTS

Unless otherwise Approved, carry out the permanent sealing of joints at least 7 days after concreting and:

1. Immediately before permanent sealing, remove groove forming strips, temporary seals, dirt and loose material from the groove and the sides and clean and roughen the groove with water jetting, sand blasting or other Approved methods;
2. Where the joint sealant is not required to extend to the bottom of the groove, firmly pack caulking material into the bottom of the groove;
3. Fix bond breaker tape continuously and evenly along the bottom of the groove for its full width and length;
4. Apply primer to the sides of the groove in accordance with the manufacturer's recommendations;
5. Apply joint sealant between the minimum and maximum drying times of the primer recommended by the manufacturer and:
   a. Mix the components of the sealer thoroughly in accordance with the manufacturer's recommendations, using a power operated paddle mixer for sufficient time to produce a homogeneous mass without entrapped air;
   b. Dispense the sealant into the groove as soon as practicable after mixing and within the time recommended by the manufacturer.

EXT2.W1050.9 FINISHING JOINTS

Remove excess joint sealant, using a purpose made finishing tool, so that the finished surface of the sealant is between 4 mm and 6 mm below the surface of the slab.

PROTECTION

EXT2.W1110.9 PEDESTRIAN LOADS

Immediately after the application of the concrete curing system:

1. Fence the carriageway off from pedestrian traffic; and
2. Cover the carriageway with protective sheeting, lapped and held securely in position in such a manner as to prevent damage to the carriageway, for at least 24 hours.

EXT2.W1120.9 LOADS FROM PLANT AND MATERIALS

Do not apply loads from materials not forming part of the permanent works or from construction plant and other vehicles until:

1. At least 7 days after concreting;

2. All joints have been permanently or temporarily sealed or protected.

TOLERANCES

EXT2.W1210.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

WORKS OUTSIDE SITE BOUNDARY

EXT2.W1310.9 APPROVED CONTRACTOR FOR PUBLIC WORKS

Concrete carriageway works required to be carried out by a contractor or sub-contractor who is on the current List of Approved Contractors for Public Works for Roads and Drains are specified in Project Specific Specification.

EXT2.W1320.A SPECIFICATION

Carry out the works specified under EXT2.W1310 in accordance with Sections 6, 10, 14, 15 and 16 of the Hong Kong Government General Specification for Civil Engineering Works (2020 Edition) and its amendments published 42 days prior to the date for the return of tenders unless otherwise specified.

EXT2.W1330.9 HANDING OVER INSPECTION

Notify the CM to arrange with Highways Department for a joint handing over inspection. Allow the CM to give at least 2 working days advance notice for this inspection.

EXT2.W1340.9 RECORD DRAWINGS AND TEST REPORTS

Provide as-built record drawings and all test reports to the CM for submitting to Highways Department.

TESTING

TRIAL MIX CONCRETE

EXT2.T010.9 WORKABILITY

Ensure that trial mix concrete complies with the following requirements:

1. Each of the six slump values: not exceeding 85 mm;
2. Average of the six slump values: not exceeding 80 mm.

TRIAL LENGTH OF CARRIAGEWAY

EXT2.T110.9 GENERAL

1. Construct a trial length of carriageway to demonstrate that the proposed materials, mix design, methods of production and methods of construction will produce a carriageway complying with the Drawings and this Specification;
2. For construction of the trial length, use all the materials, mix design, methods of production and methods of construction submitted for Approval;
3. Construct the trial length over a width of two bays and include at least one expansion joint, one contraction joint and the longitudinal joint between the bays.

EXT2.T120.9 LOCATION

Unless shown otherwise on the Drawings, construct the trial length as the first 30 m of the permanent carriageway, or such other length as Approved.

EXT2.T130.9 NOTIFICATION

Inform the CM at least 48 hours, or whatever shorter period is agreed with him, before commencing the construction of the trial length.

EXT2.T140.9 COMPLETION

Complete the trial length in sufficient time before the permanent carriageway is constructed to allow the CM a period of at least 7 days to determine if the specified requirements have been complied with in the trial length.

EXT2.T150.9 PROTECTION

1. Protect the trial length from damage and retain it in position unless otherwise Instructed;
2. Do not remove a trial length which forms part of the permanent carriageway and which complies with the specified requirements.

TESTS ON THE TRIAL LENGTH

EXT2.T210.9 ALIGNMENT, LEVEL, SURFACE REGULARITY AND TEXTURE DEPTH

1. Survey the trial length to determine the accuracy of the alignment and level;
2. Test the surface regularity as EXT2.T810 to EXT2.T850;
3. Test the texture depth as EXT2.T910 to EXT2.T1010.

EXT2.T220.9 CONCRETE CORES

1. Take concrete cores from the trial length to determine:
   a. The thickness of the slab;

b. The positions of the reinforcement and the joint components;
c. The amount of segregation of the constituents;
d. The amount of voids.

2. Take, prepare, inspect and test the cores as EXT2.T310 to EXT2.T340.

EXT2.T230.9 COMPLIANCE CRITERIA

The results of tests on trial lengths must comply with the following:

1. Alignment, levels and slab thickness: as EXT2.W1210;
2. Surface regularity: as EXT2.T850;
3. Texture depth: as EXT2.T1010;
4. Positions of reinforcement and joint components: refer to Appendix H "Schedule of Tolerances" to this Specification;
5. Amount of segregation of constituents and presence of voids: as EXT2.T340.

EXT2.T240.9 NON-COMPLIANCE

If the result of any test on the trial length does not comply with the specified requirements:

1. Submit particulars of proposed changes to the materials, mix design, methods of production or methods of construction to the CM;
2. Construct further trial lengths until the result of every test on the trial length complies with the specified requirements;
3. Make further trial mixes unless, in the opinion of the CM, non-compliance was not due to the trial mix.

EXT2.T250.9 FAILED TRIAL LENGTHS

Unless otherwise permitted by the CM, remove trial lengths, or parts of trial lengths, which do not comply with the specified requirements.

TESTING CORES FROM TRIAL LENGTHS

EXT2.T310.9 TAKING CORES

Take cores in accordance with CS1:2010 as follows:

1. Take cores as soon as the concrete has hardened sufficiently for them to be taken;
2. Provide two cores from each bay and one core from each joint from positions as Instructed;
3. Take 150 mm diameter cores unless otherwise Approved to the full depth of the slab.

EXT2.T320.9 REINSTATEMENT

1. Reinstate core holes using the Approved concrete mix;
2. Repair joints as Instructed.

EXT2.T330.9 INSPECTION

Prepare and inspect cores in accordance with CS1:2010 to determine:

1. The thickness of the slab and the positions of the reinforcement and joint components;
2. Evidence of segregation of the constituents and the presence of voids.

EXT2.T340.9 COMPLIANCE CRITERIA

Cores must not exhibit honeycombing which means interconnected voids arising from, for example, inadequate compaction or lack of mortar.

CONCRETE

EXT2.T410.9 GENERAL

Test to determine the workability and compressive strength in accordance with CON1.T510 to CON1.T670 except in respect of the provisions of the following clauses in this sub-section.

EXT2.T420.9 COMPLIANCE CRITERIA - WORKABILITY

The average slump value of the two specimens taken from one sample of concrete must not exceed that Approved by more than 10 mm.

EXT2.T430.9 SAMPLING FOR COMPRESSIVE STRENGTH TESTING

Provide one sample of concrete from each 25 m³ or 25 batches of concrete, or from the amount of concrete produced each day, whichever is the less.

MATERIALS FOR JOINTS

EXT2.T510.9 DEFINITION OF "BATCH"

A batch of joint filler or joint sealant is defined as any quantity of the material of the same type, manufactured by the same manufacturer, covered by the same certificates and delivered to the Site at any one time.

EXT2.T520.9 SAMPLING

1. Provide one sample of each type of joint filler and sealant at the same time as particulars of the material are submitted to the CM;
2. Unless otherwise permitted by the CM, provide one sample of each material from each batch delivered to the Site;
3. Unless otherwise permitted by the CM, provide one sample of mixed joint sealant on each day that joints are sealed;
4. Size of sample of joint filler: sufficient to permit testing in accordance with this Specification;
5. Take samples of unmixed joint sealant and associated primers from sealed containers delivered to the Site. Take samples of mixed joint sealant immediately before the sealant is applied to the joint. Sample in accordance with BS 2499:Part 3:1993, taking samples of the following sizes:
   a. Unmixed joint sealant: 1 kg;
   b. Mixed joint sealant: 1.5 kg;
   c. Primer for joint sealant: 1 litre.

TESTING JOINT FILLER

EXT2.T610.9 TESTING LABORATORY

Employ a laboratory accredited by HOKLAS to carry out the relevant tests.

EXT2.T620.9 SCOPE OF TESTS

Test samples of joint filler, in accordance with the following clauses in this sub-section, to determine the recovery value, the reduction in mass and the extrusion.

EXT2.T630.9 APPARATUS

Use the following apparatus to carry out the tests:

1. Equipment for measuring the plan dimensions of the joint filler, accurate to 0.5 mm;

2. Equipment for measuring the thickness of the joint filler, accurate to 0.1 mm;
3. A balance, accurate to 0.1% of the specimen mass;
4. A compression test machine complying with BS 1610:Part 1:1992, with auxiliary platens, 100 mm × 100 mm and a minimum thickness of 13 mm;
5. An extrusion mould, open on one side only and rigidly fixed to a base plate and:
   a. 100 mm × 100 mm (+0.5 mm, -0.0 mm) internal dimensions;
   b. Sufficiently deep to test the specimen;
   c. Provided with a close fitting pressure plate which fits, without binding;
   d. Provided with a horizontal measuring dial gauge or device, readable and accurate to 0.1 mm.

EXT2.T640.9 COMPRESSION AND RECOVERY TEST

Carry out the test as follows:

1. Prepare four specimens from the sample, each 100 mm × 100 mm (±2.5 mm);
2. Measure the thickness (t_1) of the four specimens to the nearest 0.1 mm and weigh two specimens to within 0.1% of their mass (m_1);
3. Subject each specimen to three applications of load in the compression test machine at 24 hour intervals. During each application of the load, compress the specimen to 50% of its original thickness at a strain rate of 1.3 mm per minute. Ensure that the load required to achieve the compression is at least 0.07 N/mm² and does not exceed 10 N/mm². Release the load as soon as the specified compression is achieved;
4. After the third application of the load, allow a recovery period of 30 minutes and then measure the thickness (t_2) of each specimen to the nearest 0.1 mm;
5. Reweigh the two previously weighed specimens to within 0.1% of their mass (m_2).

EXT2.T650.9 EXTRUSION TEST

Carry out the test as follows:

1. Prepare one specimen, 100 mm × 100 mm (±0.5 mm);
2. Measure the thickness of the specimen to the nearest 0.1 mm;
3. Place the specimen in the extrusion mould and subject it to one application of the load as EXT2.T640 (3). Measure the extrusion at the open side of the mould to the nearest 0.1 mm, with the gauge or device, when the specimen is compressed to 50% of the original thickness and before the load is released.

EXT2.T660.9 CALCULATION

1. Calculate the recovery value (R) for each specimen from the following equation:

   $R = t_2/t_1 \times 100\ \%$

   Where:

   t_1 is the original thickness of the specimen (mm);

   t_2 is the thickness of the specimen after the third application of load (mm);
2. Calculate the reduction in mass (M) of each specimen from the following equation:

   $M = (m_1 - m_2)/m_1 \times 100\ \%$

   Where:

   m_1 is the original mass of the specimen (g);

   m_2 is the mass of the specimen after the third application of load (g).

EXT2.T670.9 TEST RESULTS

Report the following to the CM:

1. Type and source of filler;
2. The recovery values to the nearest 0.5%;

3. The reductions in mass to the nearest 0.1%;
4. The extrusion to the nearest 0.1 mm;
5. That the test methods used were in accordance with this Specification.

EXT2.T680.9 COMPLIANCE CRITERIA

The results of tests on joint filler must comply with the following requirements:

1. Each of the four specimens in the in the compression and recovery test must have a recovery value of at least 70% and the reduction in mass of the two new specimens must not exceed 1%;
2. The extrusion of the free edge of the specimen must not exceed 6 mm as determined by the extrusion test.

TESTING SEALANTS

EXT2.T710.A TEST METHOD

1. Test sealants in accordance with BS 5212: Part 3:1990, for:
   a. Application life;
   b. Tack-free time;
   c. Resistance to flow;
   d. Recovery;
   e. Adhesion and cohesion in compression and tension;
   f. Resistance to heat ageing.
2. Upon request by the CM, each sample of joint sealant shall be tested in accordance with BS EN 14188: Part 2. Otherwise, manufacturer's literature and certificates for the tests in accordance with BS EN 14188: Part 2 shall be provided.

SURFACE REGULARITY

EXT2.T810.9 GENERAL

Carry out testing to determine the surface regularity.

EXT2.T820.9 SCOPE OF THE TEST

1. The surface regularity of the carriageway will be determined by measuring the number of irregularities in the surface;
2. An irregularity is defined as a gap between the surface of the carriageway and a 3 m straight edge placed on the carriageway exceeding the specified amount;
3. Irregularities are measured in millimetres, perpendicular to the straight edge.

EXT2.T830.9 TEST METHODS

1. The longitudinal surface regularity of carriageways with a total length of 75 m or more may be measured using a rolling straight-edge of the type designed by the UK Transport and Road Research Laboratory;
2. The longitudinal surface regularity of carriageways with a total length not exceeding 75 m and the transverse regularity of all carriageways will be measured using a 3 m straight-edge.

EXT2.T840.9 PROCEDURE

1. The longitudinal surface regularity will be measured along lines parallel to the longitudinal axis of the carriageway and approximately 1 m from the near side edge of each carriageway lane;

2. The transverse surface regularity will be measured along lines at right angles to the longitudinal axis of the carriageway at 10 m intervals along the length of the carriageway.

EXT2.T850.9 COMPLIANCE CRITERIA

1. The maximum number of irregularities in the longitudinal direction must not exceed those stated in the following table:

Permitted Irregularities in the Longitudinal Direction			
Total Length of Carriageway	Size of Irregularity	Permitted N° of Irregularities (Category A Road)	Permitted N° of Irregularities (Category B Road)
<75 m	>4 mm	(9 × total length)/75	(18 × total length)/75
	>7 mm	1	2
75 m – 300 m	>4 mm	9 in any 75 m length	18 in any 75 m length
	>7 mm	1 in any 75 m length	2 in any 75 m length
>300 mm	>4 mm	20 in any 300 m length	40 in any 300 m length
		9 in any 75 m length	18 in any 75 m length
	>7 mm	2 in any 300 m length	4 in any 300 m length
		1 in any 75 m length	2 in any 75 m length

Notes:

a. Category A roads are those with a legal speed limit greater than 70 kilometres/hour, all other roads being Category B;

b. Irregularities greater than 7 mm will also be counted as being greater than 4 mm;

c. No irregularity is to exceed 10 mm;

2. There must be no irregularity exceeding 4 mm in a 3 m length in the transverse direction for Category A roads and no irregularity exceeding 7 mm in a 3 m length in a transverse direction for Category B roads.

TEXTURE DEPTH

EXT2.T910.9 GENERAL

Carry out testing to determine the texture depth.

EXT2.T920.9 SCOPE OF THE TEST

The texture depth of concrete carriageways will be determined by the sand patch test.

EXT2.T930.9 TIMING OF THE TEST

Testing will be carried out at least 2 days after the surface texturing has been carried out and before the area is used by construction plant or other vehicles.

EXT2.T940.9 TEST LOCATIONS

Each carriageway lane will be divided into sections of equal length not exceeding 150 m and testing will be carried out at 10 locations on each section at approximately equal spacing. No measurement will be taken within 300 mm of the longitudinal edges of the sections.

EXT2.T950.9 PROVISION OF TEST APPARATUS AND MATERIALS

Provide all apparatus and materials for the test to be carried out as EXT2.T960 and EXT2.T970.

EXT2.T960.9 SAND FOR THE TEST

Provide dry, natural sand, with a rounded shape, which has been washed and then screened so that it meets the grading stated in the following table:

Grading of Sand	
Test Sieve to BS 410:1986	Percentage by Mass Passing
600 microns	100
300 microns	95 - 100
150 microns	0 - 6

EXT2.T970.9 APPARATUS

The test will be carried out using the following:

1. A soft brush;
2. A robust measuring cylinder having an internal diameter of 20 mm ± 2 mm and a flat top surface, such that its internal volume is 25 ml ± 0.1 ml;
3. A flat wooden disc of 65 ± 2 mm diameter with a 1.5 mm minimum thickness hard rubber disc attached to one face and a handle fixed to the other face;
4. A steel rule calibrated to 1 mm;
5. A suitable wind shield;
6. A funnel with an outlet tube at least 100 mm long with a bore of between 4 mm and 6 mm and capable of accepting a volume of at least 200 ml;
7. A steel straight-edge for screeding off the measuring cylinder;
8. A steel-wire brush.

EXT2.T980.9 PROCEDURE

The test will be carried out as follows:

1. The test location which will be at least 300 mm square will be vigorously brushed at least 10 times in two directions at right angles, using the steel-wire brush, then dried and swept clean with the soft brush;
2. Sand will be poured into the measuring cylinder to fill it to overflowing and any excess screeded off using the straight-edge. All sand on the outside of the cylinder will be removed without dropping any onto the test location. This step of the procedure may, alternatively, be carried out in the laboratory and the sand transferred to a suitable container, ready for pouring;
3. The measured volume of sand will be poured onto the centre of the test location, through the funnel to form a heap, using the wind shield to protect the test location, if necessary;
4. The sand will be spread outwards with a circular motion over the test location, using the rubber faced disc with its face parallel to the carriageway. This will be continued until the patch of sand is approximately circular and will spread outwards no more;
5. The size of the sand patch will be measured to the nearest 1 mm along three diameters which are aligned at approximately 120° to each other;
6. If the difference between the maximum and minimum of the three measurements exceeds 20% of the average of the three measurements, then all the measurements will be discarded and the test repeated in an adjacent location;
7. The test will be repeated for all the 10 test locations for each section of carriageway lane.

EXT2.T990.9 CALCULATION

1. The texture depth (T) for each test will be calculated from the equation:

$T = 31000/D^2$ mm

Where:

D is the average of the three diameter measurements of the sand patch calculated to the nearest mm;

2. The average texture depth for the 10 tests will be calculated.

EXT2.T1000.9 TEST REPORT

The test report will comprise the following:

1. Test location;
2. The average diameter of the sand patch for each test to the nearest 1 mm;
3. The texture depth for each test to the nearest 0.1 mm;
4. The average texture depth to the nearest 0.1 mm;
5. Confirmation that the test was carried out in accordance with this Specification.

EXT2.T1010.9 COMPLIANCE CRITERIA

The results for each section of carriageway lane must comply with the following requirements:

1. Average texture depth: not less than 0.7 mm; and
2. Not more than one of the 10 measured texture depths less than 0.6 mm.

EXT3 PATHS AND PAVED AREAS

MATERIALS

GENERAL

EXT3.M010.9 APPLICATION OF OTHER SECTIONS

Where applicable comply with the relevant provisions of the following Worksections unless otherwise specified in this Worksection:

1. Earthworks: Worksection EAR1;
2. Sub-bases and bituminous materials: Worksection EXT1;
3. Concrete pavings (including formwork, reinforcement, concreting, jointing and finishing): Worksection EXT2.

EXT3.M020.9 DEFINITION

1. The term "paving unit" is used in this Specification to describe a precast concrete paving slab or interlocking block;
2. Paving units are classified as either Grade A or Grade B in accordance with the following:
   a. Grade A paving units shall comply with all clauses of EXT3;
   b. Grade B paving units shall comply with all clauses of EXT3 except for those requirements specified for Grade A paving units only.
3. Grade A paving units shall be used unless otherwise stated on drawings.

EXT3.M030.B DETAILS OF UNITS

Submit the following particulars for Approval at least 14 days before commencement of laying:

1. Name and address of manufacturer;
2. Original certification or a certified true copy of the certification to ISO 9001 for the manufacturing plant. If a copy of the ISO certificate is submitted, it shall be certified true by the certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS;
3. A certificate from the manufacturer showing the manufacturer's name and the date and place of manufacture and including results of tests for:
   a. Compressive strength of concrete cubes at 28 days;
   b. Compressive strength of interlocking blocks;
   c. Bending strength of paving slabs to BS EN 1339.
4. A certificate from the manufacturer showing the source and the particle size distribution of the recycled aggregates;
5. Drawings showing the layout of the units within the paved area;
6. A certificate from the manufacturer showing the results of the following tests for Grade A paving units:
   a. Dimensional deviations of paving slabs to BS EN 1339;
   b. Dimensional deviations of paving blocks to BS EN 1338;
   c. Slip / skid resistance value of paving slabs to BS EN 1344;

d. Slip / skid resistance value of paving blocks to BS EN 1344 or unpolished slip / skid resistance value of paving block to BS EN 1338;
e. 24-hour cold water absorption value of paving slabs and blocks to AS/NZS 4456.14;
f. Abrasion resistance of paving slabs and blocks to BS EN 1338.

7. For interlocking concrete blocks, a statement of compliance from the manufacturer showing that the manufacturer has put in place a system to assure that the paving units contain 20% to 25% of recycled glass cullet by weight of the total aggregates. The statement of compliance shall be issued by an independent assessment body with recognized status (e.g. Hong Kong Productivity Council, Hong Kong Quality Assurance Agency, etc.) and it will only be valid within 6 months from the date of statement issue date. The independent assessment body shall be approved by the CM;
8. Where percentage of recycled aggregates as specified in EXT3.M130 cannot be fully complied with due to shortage in supply of recycled aggregates in the market, the Contractor shall submit the following additional particulars to the CM:
   a. A written confirmation from the manufacturer confirming the shortage in supply of recycled aggregates in the market;
   b. Proposed quantities of paving units for which recycled aggregates as specified in EXT3.M130 cannot be fully complied with.

EXT3.M040.B SAMPLES

1. Submit samples of each type of paving units showing the actual size, colour, variation in colour, finish / texture as specified, and general characteristics of the appearance for Approval of the source and type of the units at the same time as the particulars of the units are submitted;
2. The submitted samples of Grade A paving units shall be subject to a visual inspection by the CM and in compliance with the following requirements:
   a. The samples shall not have significant visible differences in colour and texture between samples when examined in accordance with BS EN 1338;
   b. The samples shall not exhibit defects such as cracking, flaking or dislodging of aggregates when examined in accordance with BS EN 1338;
   c. Fine materials shall not be easily dislodged from the surfaces of any samples during gentle manual handling;
   d. The samples shall have sharp and straight edges without any defect.

PAVING MATERIAL

EXT3.M110.9 CONCRETE

As specified in Worksection EXT2: designed mix grade: 30/20.

EXT3.M120.9 BITUMINOUS MATERIALS

As specified in Worksection EXT1.

EXT3.M130.A INTERLOCKING CONCRETE BLOCKS

1. Concrete grade:
   a. Blocks used in footways and cycle tracks: Grade 30/10;
   b. Blocks used in areas subject to vehicular access: Grade 45/10.
2. Aggregates:
   a. The aggregates shall contain not less than 70% by weight of recycled aggregates;

b. The recycled fine aggregates shall constitute not less than 40% by weight of the total recycled aggregates. The recycled glass cullet shall be included as recycled fine aggregates and shall constitute 20% to 25% by weight of the total aggregates;

c. The recycled glass cullet shall all pass a 3.35 mm BS test sieve and shall be integrated with other constituents in such a manner that there is no sharp edge nor burr exposed to put the pedestrian at risk when the paving unit surface is eroded;

d. Coarse recycled aggregates shall be retained on a 5 mm BS test sieve;

e. Fine recycled aggregates shall all pass a 5 mm BS test sieve;

f. The recycled aggregates shall contain not more than 0.5% of wood and other materials less dense than water by using the manual sorting test method in accordance with BRE Digest 433;

g. The recycled aggregates shall contain not more than 1% of other foreign materials (e.g. metals, plastics, clay lumps, asphalt and tar etc.) by using the manual sorting test method in accordance with BRE Digest 433;

h. The recycled aggregates, except recycled glass cullet, shall be recycled from inert construction and demolition materials sourced from the public fill banks managed by the Civil Engineering and Development Department or other sources approved by the CM;

i. The recycled glass cullet shall be produced from glass waste generated from local sources approved by the CM;

j. The nominal maximum aggregate size for concrete in precast units shall be 10 mm.

3. Dimensions:
   a. Size: as shown on Drawings;
   b. Chamfers: not to exceed 5 mm unless otherwise approved by the CM.
4. Shape: rectangular;
5. Vertical nibs:
   a. Provide at least one nib on one of the stretcher faces and one nib on one of the header faces;
   b. Depth of nib to be less than the width of the joint;
   c. Do not include nibs into working dimensions.
6. Colour:
   a. As shown on Drawings and consistent over the paved area, stable and fade resistant under any outdoor climate situations;
   b. Colour pigments for Grade A paving units shall comply with the following requirements unless otherwise approved by the CM:
      i. To BS EN 12878:2005;
      ii. Be UV-stable;
      iii. Be composed of iron oxides, chrome oxide, titanium oxide or cobalt aluminium oxide.
7. Abrasion resistance for Grade A paving units: not more than 23 mm to BS EN 1338:2003;
8. Each precast unit shall bear an inscribed mark for the identification purpose that the unit contains recycled glass cullet of 20% to 25% by weight of the total aggregates;
9. Notwithstanding sub-clause (2) above,
   a. The Contractor may propose for the CM's approval the use of recycled fine aggregates without recycled glass cullet in the concrete where there is shortage of supply of recycled glass cullet; and / or

b. The Contractor may propose for the CM's approval the use of virgin aggregates in lieu of recycled aggregates in the concrete when there is a shortage of supply of recycled aggregates.

10. Notwithstanding sub-clause (2) above, subject to the CM's agreement, the Contractor may use recycled fine aggregates without recycled glass cullet in the concrete for the minor repair works to existing concrete pavers;
11. Meeting the test requirements specified;
12. For tactile blocks, slip resistance value shall be determined by Wet Pendulum Test using slider 55 in accordance with AS 4586-2013 and achieve the minimum requirements tabulated below:

Gradient of footways	Minimum slip resistance value measured by Wet Pendulum Test
≤ 3%	45
>3% and ≤ 7%	50
>7% and ≤ 12%	55
> 12%	60

EXT3.M140.A PRECAST CONCRETE PAVING SLABS

1. Concrete grade: 30/10;
2. Aggregates:
   a. The aggregates shall contain not less than 70% by weight of recycled aggregates;
   b. The recycled fine aggregates shall constitute not less than 40% by weight of the total recycled aggregates;
   c. Coarse recycled aggregates shall be retained on a 5 mm BS test sieve;
   d. Fine recycled aggregates shall all pass a 5 mm BS test sieve;
   e. The recycled aggregates shall contain not more than 0.5% of wood and other materials less dense than water by using the manual sorting test method in accordance with BRE Digest 433;
   f. The recycled aggregates shall contain not more than 1% of other foreign materials (e.g. metals, plastics, clay lumps, asphalt and tar, glass etc.) by using the manual sorting test method in accordance with BRE Digest 433;
   g. The recycled aggregates shall be recycled from inert construction and demolition materials sourced from public fill banks managed by the Civil Engineering and Development Department or other sources approved by the CM.
3. Dimensions:
   a. Size: as shown on Drawings;
   b. Chamfers: not exceeding 5 mm unless otherwise approved by the CM.
4. Shape: as shown on Drawings;
5. Vertical nibs:
   a. Provide at least one nib on one of the stretcher faces and one nib on one of the header faces;
   b. Depth of nib to be less than the width of the joint;
   c. Do not include nibs into working dimensions.
6. Colour:
   a. As shown on Drawings and consistent over the paved area, stable and fade resistant under any outdoor climate situations;
   b. Colour pigments for Grade A paving units shall comply with the following requirements unless otherwise approved by the CM:

i. To BS EN 12878:2005;
ii. Be UV-stable;
iii. Be composed of iron oxides, chrome oxide, titanium oxide or cobalt aluminium oxide.

7. Abrasion resistance for Grade A paving units: not more than 23 mm to BS EN 1338:2003;
8. Notwithstanding sub-clause (2) above, the Contractor may propose for the CM's approval the use of 100% virgin aggregates, or a mix of any proportions of virgin aggregates and recycled aggregates, in the concrete when there is a shortage of supply of recycled aggregates;
9. Meeting the test requirements specified;
10. For tactile paving slab, slip resistance value shall be determined by Wet Pendulum Test using slider 55 in accordance with AS 4586-2013 and achieve the minimum requirements tabulated below:

Gradient of footways	Minimum slip resistance value measured by Wet Pendulum Test
≤ 3%	45
>3% and ≤ 7%	50
>7% and ≤ 12%	55
> 12%	60

EXT3.M150.A CLAY BRICK PAVERS

1. To consist essentially of clay or other argillaceous material, and be dried and fired at a high temperature with exposed faces of an extruded, wire cut or pressed finish to the required shape;
2. Dimensions:
   a. Size: as shown on Drawings;
   b. Chamfers: not exceeding 7 mm.
3. Shape: as shown on Drawings;
4. Vertical nibs:
   a. Provide at least one nib on one of the stretcher faces and one nib on one of the header faces;
   b. Depth of nib to be less than the width of the joint;
   c. Do not include nibs into working dimensions.
5. Colour: as shown on Drawings and consistent over the paved area;
6. Type: to BS EN 1344:2013 and as shown on Drawings.

BEDDING, POINTING AND SEALING MATERIALS

EXT3.M210.9 BEDDING SAND

Sand with:

1. Moisture content exceeding 4% but not more than 8% at time of laying;
2. Particle size distribution as stated in the following table:

Particle size distribution of sand for bedding precast units	
BS test sieve size	Percentage by mass passing
10 mm	100
5 mm	85 - 100
2.36 mm	65 - 100
1.18 mm	40 - 98
600 microns	25 - 72
300 microns	10 - 35
150 microns	0 - 15
75 microns	0 - 10

EXT3.M220.9 JOINT FILLING SAND

Sand with:

1. A moisture content less than 0.5% at time of filling joints;
2. A particle size distribution as stated in the following table:

Particle size distribution of sand for filling joints between precast units	
BS test sieve size	Percentage by mass passing
2.36 mm	100
1.18 mm	90 - 100
600 microns	60 - 90
300 microns	30 - 60
150 microns	15 - 30
75 microns	5 - 10

EXT3.M230.A CEMENT MORTAR SEALING

Consisting of:

1. One part of cement to three parts of fine aggregate by volume together with the minimum amount of water necessary to achieve a consistency suitable for the required work;
2. Fine aggregate of sand or crushed rock to BS EN 13139 and shall be less than or equal to 4 mm;
3. Colouring pigment as Approved.

EXT3.M240.9 POLYTHENE SHEETING

Impermeable and having a nominal thickness of 0.125 mm.

ACCURACY AND TOLERANCES

EXT3.M310.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

WORKMANSHIP

HANDLING AND STORAGE

EXT3.W010.9 PRECAST UNITS

1. Handle and store units on pallets to avoid damage to corners and chamfered edges;
2. Store pallets on a levelled, well-drained and maintained hard-standing ground and in a manner which will not result in damage or contamination of the units;
3. Protect the units from damage and do not use damaged units unless permitted by the CM.

EXT3.W020.9 SAND

Store sand for filling joints between units in waterproof bags and keep under cover until used.

LAYING IN-SITU CONCRETE PAVING

EXT3.W110.9 LAYING

Lay insitu concrete paved areas in bays not exceeding 20 m².

EXT3.W120.9 FINISH

Finish concrete surfaces as follows:

1. Method of producing finish: levelling the surface of the compacted concrete with a screed board, wood floating or power floating the surface and brushing the surface with a stiff brush;
2. Abrupt irregularities permitted: brush marks < 3 mm
3. Gradual irregularities permitted: < 10 mm in 2 m
4. Specific requirement: Rough Texture.

LAYING BITUMINOUS PAVING

EXT3.W210.A LAYING

1. Lay and compact bituminous materials for footways, cycle tracks and paved areas with steel-wheeled and pneumatic-tyred rollers. Compaction shall start before the temperature of the newly laid material falls below 100°C and shall continue until all roller marks have been removed. For locations where rollers cannot operate effectively, compact the bituminous material by hand-operated mechanical compaction plant approved by the CM;
2. Take cores in accordance with EXT1.T510 for the checking of air void content and compacted layer thickness of the bituminous material for works with area of not less than 200 m². For works with area smaller than 200 m² but greater than 50 m², at least 2 cores shall be taken from each layer of bituminous material laid. For works with area less than 50 m², no coring is required unless otherwise instructed by the CM;

3. Test the cores taken in accordance with sub-clause (2) to determine the air void content. The average air void content of the cores shall be not less than 3% nor greater than 9%. If the test result does not comply with the specified requirement, 2 additional cores shall be taken at locations agreed by the CM and the average air void content determined from these 2 cores shall replace the original value for compliance checking. Notwithstanding this, no cores shall have an air void content of less than 2.5% nor greater than 10%;
4. Measure each core taken from the final surfacing layer to determine the compacted layer thickness that shall not deviate by more than 5 mm from the specified thickness. If the measured thickness does not comply with the requirement, 2 additional cores shall be taken at locations agreed by the CM and the average thickness determined from these 2 cores shall replace the original measured value for compliance checking;
5. If no bulk sample is taken for determination of the Rice's specific gravity, the corresponding value obtained from the mix design shall be used in determining the air void content of the core unless other value is suggested by the Contractor and agreed by the Contract Manager;
6. If either the air void content or the compacted thickness of the core is outside the specified limits, the sub-area from which the cores were taken shall be considered as not complying with the requirements specified in this clause.

LAYING CLAY BRICK PAVERS

EXT3.W310.9 LAYING

1. Do not lay clay brick pavers until the layout has been Approved;
2. Commence laying clay brick pavers in the permanent area after the layout and the method of construction have been Approved, and the trial area is constructed to the satisfaction of the CM pursuant to the specified requirements;
3. Lay clay brick pavers in herringbone pattern with a header course at 90 degrees to all edge restraints, except where adjacent to flush concrete restraining beams and public utility access covers;
4. Unless otherwise approved by the CM, comply with EXT3.W420, EXT3.W430, EXT3.W440, EXT3.W460, EXT3.W470, EXT3.W490, EXT3.W500 and EXT3.W510;
5. Lay all full units first and ensure the best laying face is chosen;
6. For clay brick pavers laying over concrete aprons surrounding public utility access covers, lay on a bed of fresh mortar of one part cement to three parts sand, where a minimum bedding sand thickness as specified in EXT3.W470 cannot be achieved.

LAYING PRECAST CONCRETE UNITS

EXT3.W410.9 LAYOUT

1. Submit particulars of proposed method of construction for Approval and arrange a trial area to be constructed on site;
2. Commence laying paving slabs or interlocking blocks in the permanent area after the layout and the method of construction have been Approved, and the trial area is constructed to the satisfaction of the CM pursuant to the specified requirements.

EXT3.W420.9 KERBS AND EDGINGS

1. Complete bedding of kerbs and edgings prior to laying paving units;
2. Ensure concrete used for insitu concrete kerbs and edgings reaches the compressive strength of at least 20 MPa before units are laid.

EXT3.W430.9 PRECAUTIONARY MEASURES FOR DRAINAGE

Ensure measures are taken to prevent drainage across or through the area of paving during laying, bedding and compaction of the units.

EXT3.W440.9 FORMATION LEVEL

1. Lay units as soon as practicable after completion of formation layers(s);
2. Protect formation until laying of units commences as Worksection EAR1.

EXT3.W450.9 INTERLOCKING BLOCK PATTERN

Lay interlocking blocks for carriageways and paved areas where vehicles will have access to a herring-bone pattern unless otherwise stated in the Contract.

EXT3.W460.9 CUTTING UNITS

Where cutting of units is required use a mechanical cutting device. Ensure quality of any cut edge is as that for uncut edge with a true line and free from chips and cracks.

EXT3.W470.9 BEDDING LAYER

Lay bedding layer as follows:

1. Lay a layer of sand, screeded and tamped to a uniform depth, over the complete width of the area to be paved. The quantity of sand must be sufficient to permit screeding to waste and to achieve a tamped thickness which exceeds 20 mm and does not exceed 30 mm;
2. Do not disturb the sand layer by additional compaction, foot-marks or other damage after the layer has been screeded and tamped to the required level and before the units are laid;
3. Do not screed and tamp sand more than 1 m in advance of the units which have been laid.

EXT3.W480.9 BEDDING PAVING SLABS

Lay paving slabs as follows:

1. Lay on the prepared sand layer immediately after screeding and tamping in such a manner that the sand is not disturbed;
2. Adjust slabs to form uniform joints between 2 mm and 3 mm wide and bed into the final position using a wooden mallet or a plate vibrator fitted with a rubber base-pad;
3. Do not bed paving slabs closer than 1 m behind the laying edge other than on completion of the paved area against a kerb or edging;
4. Carry out final levelling of the slabs as soon as practicable after bedding and before changes in the moisture content of the prepared sand layer occur;
5. Remove and replace damage paving slabs immediately.

EXT3.W490.9 BEDDING INTERLOCKING BLOCKS

Lay interlocking blocks as follows:

1. Lay on the prepared sand layer immediately after screeding and tamping in such a manner that the sand is not disturbed. Lay interlocking blocks individually on the prepared sand layer by manual methods or in clusters by mechanical methods;
2. Lay in such a manner that the blocks are not in direct contact with each other and that uniform joints of between 2 mm and 3 mm wide are formed. Bed interlocking blocks flush by at least two passes of a heavy-duty plate compactor fitted with a rubber-pad;
3. Do not bed blocks closer than 1 m behind the laying edge other than on completion of the paved area, against a kerb or edging;
4. Carry out final levelling of the blocks as soon as practicable after bedding and before changes in the moisture content of the prepared sand layer occur;

5. Remove and replace damaged interlocking blocks immediately.

EXT3.W500.9 JOINT FILLING AND COMPACTION OF UNITS

1. After the units have been bedded, spread sand for filling the joints over the surface of the units and brush into the joints in such a manner that all joints are completely filled;
2. Fill joints as soon as practicable after bedding and on the day the units are laid and bedded;
3. Further compact paved areas by at least two passes of a plate compactor fitted with a rubber base-pad after filling the joints to ensure that the joints are completely filled. Add sand as required and compact into the joints;
4. Compact carriageways and paved areas to which vehicles will have access by either one of the following way and add sand as required and brush and compact into the joints:
    a. At least ten evenly-spaced passes of a pneumatic tyred roller having a gross weight of between 10 tonnes and 12 tonnes;
    b. A plate compactor which shall have the following capacity:
        i. Minimum plate area of 0.25 m^2;
        ii. Minimum effective force per unit area of plate of 75 kN/m^2;
        iii. Frequency of 65 – 100 Hz; and
        iv. Minimum mass of 200 kg.
5. Remove excess sand after completion of compaction;
6. Remove and replace damage units immediately.

EXT3.W510.9 SEALING AT ABUTMENTS

Place pigmented mortar or concrete matching colour of paving units, unless otherwise Instructed, to the full depth of units to form a seal between units and adjacent kerbs, edgings, quadrants, covers, frames etc.

EXT3.W520.9 REINSTATEMENT

Where excavation is to be carried out in paved areas constructed of paving slabs or interlocking blocks, extract the units as follows:

1. Use manual methods for a distance of at least 300 mm beyond the limit of the excavation;
2. Thoroughly clean unbroken units to remove all sand and deleterious material. Stack the units on pallets for re-use;
3. Re-lay units to be re-used in accordance with the relevant requirements of this Worksection.

PROTECTION

EXT3.W610.9 PAVED AREA SURFACES

Do not permit the use of footways, cycle tracks and other paved areas by constructional plant or vehicles other than those which, in the opinion of the CM, are essential in the construction of subsequent work. In any case do not use such plant and vehicles that will damage or overload the surface.

ACCURACY AND TOLERANCES

EXT3.W710.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

WORKS OUTSIDE SITE BOUNDARY

EXT3.W810.9 APPROVED CONTRACTOR FOR PUBLIC WORKS

Path and paving works required to be carried out by a contractor or sub-contractor who is on the current List of Approved Contractors for Public Works for Roads and Drains are specified in Project Specific Specification.

EXT3.W820.A SPECIFICATION

Carry out the works specified under EXT3.W810 in accordance with Sections 6, 9 10, 11, 14, 15, 16 and 18 of the Hong Kong Government General Specification for Civil Engineering Works (2020 Edition) and its amendments published 42 days prior to the date for the return of tenders unless otherwise specified.

EXT3.W830.9 HANDING OVER INSPECTION

Notify the CM to arrange with Highways Department for a joint handing over inspection. Allow the CM to give at least 2 working days advance notice for this inspection.

EXT3.W840.9 RECORD DRAWINGS AND TEST REPORTS

Provide as-built record drawings and all test reports to the CM for submitting to Highways Department.

TESTING

GENERAL

EXT3.T010.9 QUALITY ASSURANCE SCHEMES

Tests stated in this Worksection may be reduced in number as agreed by the CM if such materials or articles delivered to Site satisfy the following conditions:

1. To bear the stamps of the registered certification trade mark of the BA Institution, known as the BS Kitemark; or
2. To be covered by a manufacturer's quality assurance scheme stated in the Contract or approved by the CM.

CHARACTERISTIC COMPRESSIVE STRENGTH OF INTERLOCKING BLOCKS

EXT3.T110.9 DEFINITION OF 'BATCH'

a. A batch of interlocking blocks is any quantity of interlocking blocks of the same type, size and finish, of the same concrete grade, manufactured in the same place, covered by the same certificates stipulated under EXT3.M030 (2) delivered to the Site;

b. Interlocking blocks of different colours can be grouped together to form a batch provided that they are manufactured with the same type of materials and production methods.

EXT3.T120.9 SAMPLES FOR TESTING

1. Provide one sample of interlocking blocks from every 1000 m² of interlocking blocks, or part thereof, in a batch;
2. Number of interlocking blocks in each sample: 8;
3. Carry out sampling at random so that the sample comprises interlocking blocks that are distributed throughout the batch.

EXT3.T130.9 TEST PROCEDURE

Test each sample to determine the characteristic compressive strength at 28 days by means of a load test as follows:

1. Apparatus:
    a. A compression test machine complying with CS1:2010. Bearing faces of the platens on the test machine must be at least as large as the interlocking blocks and with a flatness tolerance of 0.05 mm;
    b. If a test machine with platens smaller than the interlocking blocks is used, auxiliary plates of adequate size must be placed centrally between the platens and the interlocking block to be tested. The flatness tolerance of the bearing faces of the auxiliary platens measured in accordance with CS1:2010 must not be more than 0.05 mm and the thickness of the plates at least 25 mm;
    c. Two pieces of packing, each with a thickness of between 5 mm and 6 mm and dimensions exceeding the interlocking block by between 15 mm and 25 mm. Use plywood, chipboard or medium density hardboard packing.
2. Adopt the following procedure:
    a. Cap the interlocking block on the running surface and underside with a suitable capping material in accordance with Clause 15.5.2 of CS1:2010 and immerse in water for at least 24 hours before compression;

b. Place the interlocking block symmetrically on the lower platen of the test machine, between the two pieces of packing with the running surface facing upwards;
c. Apply the load without shock and steadily increase at a constant rate within a stress range of between 150 kPa/s and 700 kPa/s;
d. Record the load at which the interlocking block fractures as the breaking load;
e. Repeat the test for the other blocks.

EXT3.T140.9 CALCULATIONS

Make calculations in accordance with the following:

1. Calculate the compressive strength (C) of each interlocking block from the equation:

$$C = \frac{W}{A} \times \frac{2.5}{1.5 + \frac{L}{H}} MPa$$

Where:

- W is the breaking load (N)
- A is the nominal gross plan area based on the manufacturing dimensions of the interlocking blocks or the area of the tested portion if the interlocking block size is reduced for testing (mm²)
- L is the lesser of the two plan dimensions (mm)
- H is the thickness of the block (mm)

2. Calculate the unbiased standard deviation (s) from the following equation:

$$s = \sqrt{\frac{\Sigma C^2 - n(Cm)^2}{n-1}} MPa$$

Where:

- n is the number of interlocking blocks in each sample
- ΣC^2 is the sum of the square of the compressive strengths of the n interlocking blocks (MPa)
- Cm is the average of the compressive strengths of the n interlocking blocks

3. Calculate the characteristic strength (Cc) of the batch from the following equation:

Cc = Cm - 1.65s MPa

Where:

- Cm is the average of the compressive strengths of the n interlocking blocks and stated in (2) above
- s is the unbiased standard deviation as stated in (2) above.

EXT3.T150.9 REPORTING

Report on the following:

1. Source, name of manufacturer and type of blocks;
2. Identification marks of blocks;
3. Date of manufacture of blocks;
4. Nominal gross plan area of each block to the nearest 100 mm²;
5. Nominal height of each block to the nearest mm;
6. Breaking load of each block to the nearest kN;
7. Compressive strength of each block to the nearest MPa;
8. Average of the eight compressive strengths to the nearest MPa;
9. Unbiased standard deviation to the nearest MPa;

10. Characteristic compressive strength to the nearest MPa;
11. That the test method used was in accordance with this Specification.

EXT3.T160.9 COMPLIANCE CRITERIA

The characteristic compressive strength of the interlocking blocks sample must be:

1. 30 MPa for blocks in footways and cycle tracks; and
2. 45 MPa for blocks in carriageways and paved areas to which vehicles will have access.

TRANSVERSE BREAKING LOAD OF CLAY BRICK PAVERS

EXT3.T210.9 DEFINITION OF "BATCH"

A batch of clay brick pavers is any quantity of pavers of the same type and size, of the same strength, manufactured in the same place, covered by the same certificates and delivered to the Site at any one time.

EXT3.T220.A SAMPLES FOR TESTING

1. No bulk sample shall represent more than 10,000 pavers from the same batch;
2. The sample size of each bulk sample of each type of clay brick pavers for each test shall be as stated in BS EN 1344:2013. The number of specimens in each sample shall be 10.

EXT3.T230.A TEST PROCEDURE

Test clay brick pavers in accordance with the procedures laid down in BS EN 1344: 2013.

EXT3.T240.9 CALCULATIONS

Divide the load by the measured width of each paver, and round the result to the nearest N/mm. Calculate the arithmetic mean of the results from the specimens comprising the test sample to the nearest N/mm.

EXT3.T250.9 REPORTING

Report on the following:

1. Source, name of manufacturer and type of pavers;
2. Identification marks of pavers;
3. Date of manufacture of pavers;
4. Nominal length, width and height of each paver to the nearest mm;
5. Transverse breaking load of each paver to the nearest N/mm;
6. Mean transverse breaking load of the pavers to the nearest N/mm;
7. That the test method used was in accordance with this Specification.

EXT3.T260.9 COMPLIANCE CRITERIA

The mean transverse breaking load of a sample of clay pavers shall not be less than:

1. 30 N/mm with no individual result less than 24 N/mm for Class T2 clay pavers in footways and cycle tracks;
2. 80 N/mm with no individual result less than 50 N/mm for Class T3 clay pavers in carriageways, run-ins and other paved areas to which vehicles will have access, footways and cycle tracks where vehicular loads due to frequent illegal parking or other reasons are anticipated.

BENDING STRENGTH OF PRECAST CONCRETE PAVING SLABS

EXT3.T310.9 DEFINITION OF "BATCH"

a. A batch of precast concrete paving slabs is any quantity of paving slabs of the same type, size and finish, of the same concrete grade, manufactured in the same place covered by the same certificates stipulated under EXT3.M030 (2) delivered to the Site;

b. Paving slabs of different colours can be grouped together to form a batch provided that they are manufactured with the same type of materials and production methods.

EXT3.T320.9 SAMPLES FOR TESTING

1. Provide one sample of paving slabs from every 1000 m² of paving slabs, or part thereof, in a batch;
2. Number of paving slabs in each sample: 8;
3. Carry out sampling at random so that the sample comprises paving slabs that are distributed throughout the batch.

EXT3.T330.B TEST PROCEDURE

Test precast concrete paving slabs in accordance with the procedures laid down in BS EN 1339.

EXT3.T340.9 CALCULATIONS

Calculate the mean strength of the sample to the nearest 0.1 MPa.

EXT3.T350.9 REPORTING

Report on the following:

1. Source, name of manufacturer and type of paving slabs;
2. Identification marks of paving slabs;
3. Date of manufacture of paving slabs;
4. Nominal length, width and height of each paving slab to the nearest mm;
5. Failure load of each paving slab to the nearest 0.1 kN;
6. Strength of each paving slab to the nearest 0.1 MPa;
7. Mean strength of the three paving slabs tested to the nearest 0.1 MPa;
8. That the test method used was in accordance with this Specification.

EXT3.T360.A COMPLIANCE CRITERIA

1. The mean bending strength of a sample of paving slabs shall not be less than 4.0 MPa;
2. Bending strengths of individual slabs shall not be less than 3.2 MPa.

ADDITIONAL TESTS FOR GRADE A PAVING UNITS

EXT3.T410.9 DEFINITION OF "BATCH"

a. A batch of paving units is any quantity of paving units of the same type, size and finish, of the same concrete grade, manufactured in the same place covered by the same certificates and delivered to the Site at any one time;

b. Paving units of different colours can be grouped together to form their respective batches provided that they are manufactured with the same type of materials and production methods.

EXT3.T420.9 SAMPLES FOR TESTING

1. Provide one sample of Grade A paving units from every 1000 m² of the paving units, or part thereof, in a batch, each for the following tests:

Test	Number of paving units in each sample
a. Dimensional deviation	8
b. Slip/Skid resistance	5
c. Water absorption value	10

2. Carry out sampling at random so that the sample comprises paving units that are distributed throughout the batch;
3. The sample can be used for other tests.

EXT3.T430.B DIMENSIONAL DEVIATION

1. Carry out the test as follows:
   a. Measure the overall dimensions and thickness of each sample of paving blocks to BS EN 1338;
   b. Measure the overall dimensions and thickness of each sample of paving slabs to BS EN 1339.
2. Compliance criteria:

   Tolerances for the dimensions of each individual paving unit shall be within ±2 mm for length and width, and ±3 mm for thickness.

EXT3.T440.A SLIP / SKID RESISTANCE

1. Test the slip / skid resistance of each sample of paving units to BS EN 1344:2013;
2. Compliance criteria:

   The mean slip / skid resistance of a sample is specified in Project Specific Specification.

EXT3.T450.A WATER ABSORPTION VALUE

1. Carry out the test as follows:
   a. Test the 24-hour cold water absorption value of each sample of paving units to AS/NZS 4456.14:2003;
   b. Calculate the characteristic water absorption value (Wc) from the following equation:

      Wc = Wm + 1.65 Xs %

      Where:

      Wm is the average water absorption rate of the sample;

      Xs is the unbiased standard deviation as stated in AS/NZS 4456.2:2003.
2. Compliance criteria:

   The sample shall have a characteristic water absorption value not more than 6% by 24-hour cold immersion method to AS/NZS 4456.14:2003.

SURVEILLANCE TESTS FOR TACTILE BLOCKS AND PAVING SLABS

EXT3.T510.A SURVEILLANCE TEST FOR TACTILE INTERLOCKING CONCRETE BLOCKS

1. Test Arrangements:

a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
b. Comply with the following pertaining to surveillance tests:
i. Provide attendance on the Site;
ii. Provide, deliver and collect samples etc. as specified or as directed by the CM.

2. Testing Samples:
a. Provide one set of test sample for each type of tactile blocks from the batch of material delivered to Site under one delivery note or as instructed by the CM;
b. One set of test sample shall consist of three tactile interlocking concrete blocks.
3. Testing methods:
As per EXT3.M130 (12);
4. Non-compliance:
a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
i. Remove the representative batch off Site; or
ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.
b. When the representative batch of tactile interlocking concrete blocks is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);
c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

EXT3.T520.A SURVEILLANCE TEST FOR TACTILE PRECAST CONCRETE PAVING SLABS

1. Test Arrangements:
a. When Instructed, surveillance tests shall be carried out by the CM or a Direct Contractor;
b. Comply with the following pertaining to surveillance tests:
i. Provide attendance on the Site;
ii. Provide, deliver and collect samples etc. as specified or as directed by CM.
2. Testing Samples:
a. Provide one set of test sample for each type of tactile paving slabs from the batch of material delivered to Site under one delivery note or as instructed by CM;
b. One set of test sample shall consist of three tactile precast concrete paving slabs.
3. Testing methods:
As per EXT3.M140 (10);
4. Non-compliance:
a. In the event that the testing samples fail to meet the testing requirements, follow either one of the following actions:
i. Remove the representative batch off Site; or

ii. Carry out re-test for the representative batch in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 on three separate sets of samples selected by the CM from the representative batch. In case of any one sample fails the re-test, remove the representative batch off Site.

b. When the representative batch of tactile precast concrete paving slabs is removed off Site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clause (3) in a laboratory that complies with the requirements stated in PRE.B9.570 for one sample selected by the CM from the replacing batch. In case of such test fails, follow action stated in sub-clause (4)(a);

c. Bear all associated costs for the test and re-test required in sub-clauses (4)(a) and (4)(b). No extension of time will be allowed.

EXT4 ROUTE INDICATORS

MATERIALS

GENERAL

EXT4.M010.9 STATUTORY REQUIREMENTS

Comply with the following:

1. Road Traffic Ordinance, Cap 374;
2. Road Tunnels (Government) Ordinance, Cap 368; and
3. All their subsidiary legislation.

EXT4.M020.9 DESIGN

Design traffic signs, including letters, characters, numbers, symbols and borders in accordance with the conditions and restrictions imposed by the Commissioner for Transport.

EXT4.M030.9 COMPATIBILITY OF MATERIALS

Ensure all materials used in traffic sign construction are mutually compatible with each other.

SUBMISSIONS

EXT4.M110.9 TRAFFIC SIGNS

Submit to the CM the following details at least 14 days prior to fabrication:

1. Manufacturer's name;
2. Details of materials and finishes to be used in the manufacture of the signs.

EXT4.M120.9 ILLUMINATION OF SIGNS

As scheduled or shown on Drawings.

MATERIALS FOR TRAFFIC SIGNS

EXT4.M210.A STANDARDS

Comply with BS EN 12899:Part 1:2007 except that the requirements for marking signs shall not be applied.

EXT4.M220.9 GENERAL

1. Use only galvanized bolts, nuts, screws and rivets with traffic signs secured to galvanized pedestrian guard railing;
2. Insulate aluminium fixings from ferrous materials with an Approved type non-conductive insulator at least 2 mm thick.

EXT4.M230.A HOT FINISHED SEAMLESS TUBES

To BS EN 10297: Part 1.

EXT4.M240.B HOT ROLLED SECTIONS

To BS EN 10365.

EXT4.M250.A HOT ROLLED STRUCTURAL STEEL SECTIONS

To BS EN 10056.

EXT4.M260.A WELDABLE STRUCTURAL STEELS

To BS EN 10025.

EXT4.M270.A STAINLESS STEEL

To BS EN 10088: Part 2, Grade 1.4401.

EXT4.M280.A STAINLESS STEEL TUBES

To BS 6362:1990, suitable for threading in accordance with BS EN 10226.

EXT4.M290.A ALUMINIUM ALLOY

Free from defects and surface blemishes and in accordance with the following:

1. Grade: EN AW-6082 in the T6, T651 or T62 tempers;
2. Anodized to grade AA25 to BS EN ISO 7599.

EXT4.M300.A WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS SUITABLE FOR GENERAL ENGINEERING PURPOSES

1. Plate, sheet and strip: to BS EN 485:Part 1:2016, BS EN 485:Part 2:2016+A1:2018, BS EN 485:Part 3:2003 and BS EN 485:Part 4:1994;
2. Drawn tube: to BS EN 754:Part 1:2016, BS EN 754:Part 2:2016, BS EN 754:Part 3:2008, BS EN 754:Part 4:2008, BS EN 754:Part 5:2008, BS EN 754:Part 6:2008, BS EN 754:Part 7:2016 and BS EN 754:Part 8:2016;
3. Bars, extruded round tubes and sections: to BS EN 755:Part 1:2016, BS EN 755:Part 2:2016, BS EN 755:Part 3:2008, BS EN 755:Part 4:2008, BS EN 755:Part 5:2008, BS EN 755:Part 6:2008, BS EN 755:Part 7:2016, BS EN 755:Part 8:2016 and BS EN 755:Part 9:2016.

EXT4.M310.A FACES FOR TRAFFIC SIGNS

1. Faces for traffic signs shall be formed using retroreflective or non-retroreflective plastic sheeting. Unless otherwise permitted by the CM, a single piece of sheeting shall be used. If more than one sheet is used, the number of sheets shall be kept to a minimum. Sheeting shall be fixed in accordance with the manufacturer's recommendations;
2. The colours for the materials for faces of traffic signs, including the background, letters, characters, numerals, symbols and borders, shall be matched for colour in accordance with the sheeting manufacturer's recommendations at the time of fabrication to provide a uniform appearance by day and by night;
3. Letters, characters, numerals, symbols and borders shall be clear cut and sharp-edged and shall have no cracks;
4. Sheeting material, including letters, characters, numerals, symbols and borders shall be fully fixed using adhesive. There shall be no air bubbles, creases, cracks or other blemishes;
5.
    a. The back of traffic sign shall be marked with the manufacturer's name and manufacturing date in month / year as shown in the following manner:
        i. Manufacturer's name;
        ii. Month / year.

b. The marking shall either be printed on non-retroreflective self-adhesive material in accordance with BS EN 12899: Part 1 or stamped by a punch without damaging the front face of traffic sign or other method approved by the CM. The letter size shall not be smaller than 12 mm (h) x 8 mm (w).

6. For each colour of externally illuminated and transilluminated signs, the uniformity of luminance, determined by the ratio of the lowest to the highest level measured at any part of the sign, shall be as shown in the following table and in accordance with BS EN 12899: Part 1, Table 21.

Illuminated face area	Uniformity of luminance
$\leq 1.5\ m^2$	U2
$> 1.5\ m^2$	U1

7. Background letters, characters, numerals, symbols and borders to:
   a. Be clear cut, sharp edged and free from cracks;
   b. Be matched for colour;
   c. Provide a uniform appearance by day and by night.

EXT4.M320.9 BACKING PLATES AND SPILL SCREENS

1. Material: aluminium;
2. Thickness: 3 mm.

EXT4.M330.B RETROREFLECTIVE SHEETING

Prismatic retroreflective sheeting shall be Type IX material complying with ASTM D 4956-16b. The use of Class RA2 glass bead retroreflective sheeting complying with BS EN 12899: Part 1, Table 4 shall be subject to the approval of the CM.

EXT4.M340.A NON-RETROREFLECTIVE SHEETING

To BS EN 12899:Part 1:2007.

EXT4.M350.9 PLASTIC SHEETING

An Approved proprietary type.

FIXINGS FOR TRAFFIC SIGNS

EXT4.M410.9 GENERAL

Ensure fixing materials are compatible to the materials that they are to be fixed.

EXT4.M420.A ISO METRIC BLACK HEXAGON BOLTS, SCREWS AND NUTS

To BS 4190:2014.

EXT4.M430.A ISO METRIC BLACK CUP AND COUNTERSUNK HEAD BOLTS AND SCREWS WITH HEXAGON NUTS

To BS 4933:2010.

EXT4.M440.9 METAL WASHERS

To BS 4320:1968.

EXT4.M450.A RIVETS

To BS ISO 1051.

EXT4.M460.9 BANDING

Stainless steel.

EXT4.M470.9 WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS

Rivet, bolt and screw stock to BS 1473:1972.

EXT4.M480.B CARBON, CARBON MANGANESE AND STAINLESS STEELS

Specific requirements, general inspection and testing procedures to BS EN ISO 3506: Part 1 for bolts, screws and studs, and to BS EN ISO 3506: Part 2 for nuts.

EXT4.M490.9 BOLT LENGTH

The thread position of bolt to project through the nut by a minimum of one thread and a maximum of four threads.

EXT4.M500.9 RAG AND INDENTED BOLTS

To BS 1494:Part 2:1967.

EXT4.M510.9 EXPANSION AND RESIN BONDED BOLTS

An Approved proprietary type capable of withstanding the design loading.

PAINT TO TRAFFIC SIGN FACES

EXT4.M610.B GENERAL

To BS EN 12899: Part 1, Tables 16 and 1.

1. Faces of traffic signs to which a painted or stoved finish is to be applied shall be thoroughly cleaned and pre-treated before painting and stoving;
2. Pre-treatment shall be by anodising or by using an etching primer or by a process approved by the CM;
3. At least one undercoat and at least one finishing coat of paint shall be applied and stoved to a thickness of between 0.0315 mm and 0.0375 mm of enamel over a minimum thickness of 0.025 mm of primer. If light colours are to be applied over dark colours, at least two coats of the light colour shall be applied. The final surface shall have a uniform thickness and an egg-shell flat finish and shall be smooth and free of defects;
4. The colour of the finished coating shall be uniform. The colours, including white, shall comply with the chromaticity and luminance factors of BS EN 12899: Part 1, Tables 16 and 1 and, for comparative purposes, shall comply with the following gloss paint colours in accordance with BS 381C:
   a. Red: No. 537 – signal red;
   b. Orange: No. 557 – light orange;
   c. Yellow: No. 355 – lemon yellow;
   d. Blue: No. 109 – middle blue;
   e. Green: No. 225 – light brunswick green.
5. Parts of faces coloured black shall be non-retroreflective and shall have a luminance factor not exceeding 0.03 as specified in accordance with BS EN 12899: Part 1;
6. The Volatile Organic Compound (VOC) content of all paint applied on surfaces of traffic signs shall comply with the VOC limits stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation.

EXT4.M620.A PAINTED FINISH

For the following areas on the sign face:

1. Colour: homogeneous and uniform, to BS 381C:1996 and referenced as follows:

Colour	Reference Number	Colour Reference
Red	537	Signal Red
Orange	557	Light Orange
Yellow	355	Lemon Yellow
Blue	109	Middle Blue
Green	225	Light Brunswick Green

2. Black:
   a. Type: non-reflective;
   b. Luminance factor: maximum 0.03, measured in accordance with BS EN 12899:Part 1:2007.

MATERIALS FOR ROAD STUDS

EXT4.M710.A ROAD STUDS

1. To Road Traffic Ordinance, Cap 374 and its subsidiary legislation;
2. Except for thermoplastic road studs, road studs shall be an Approved proprietary type;
3. Reflecting road studs shall comply with BS EN 1463: Part 1 and BS EN 1463: Part 2;
4. Permanent reflecting road studs to be used as lane line markers on dual carriageway trunk roads and primary distributor roads must be a type to which traffic cylinders of an Approved type can be attached. The method of attachment must be such that the traffic cylinder can be easily detached from the road stud;
5. Thermoplastic road studs of white colour shall be applied for indicating the limits of a zebra crossing or a light signal crossing, unless otherwise agreed or instructed by the CM;
6. Temporary reflecting road studs to be used as markers for temporary traffic routes must be fluorescent yellow.

EXT4.M720.9 BITUMEN GROUT FOR ROAD STUDS

1. Comprising:
   a. Bitumen:
      i. Bitumen content: 25 to 30% of the total mass;
      ii. Bitumen grade: tropical grade filled bitumen, oxidised grade R 85/25.
   b. Hydrated lime filler:
      i. Percentage by mass of hydrated lime passing a 75 micron BS test sieve: minimum of 85%.
2. Properties:
   a. Penetration at 25°C: 12±4;
   b. Softening point: 105°C ± 5°C;
   c. Specific gravity: not to exceed 1.8.

WORKMANSHIP

DELIVERY AND STORAGE OF MATERIALS

EXT4.W010.9 TRAFFIC SIGNS

Store sheets in a dry, weatherproof store in a manner which will not result in damage or deformation. Separate traffic signs which are stored together by the use of slip sheets.

FABRICATION OF TRAFFIC SIGNS

EXT4.W110.9 POSTS

1. Colour:
   a. Beacons at zebra crossings: paint with alternate black and white stripes;
   b. Other posts:
      i. Paint grey in accordance with BS 5252F:1976, Code 18B19; or
      ii. Galvanize to BS EN ISO 1461:2009 and comply with EXT7.W020. Treat galvanized areas affected by cutting and drilling using an Approved method;
2. Length:
   a. Posts supporting external luminaries: length protruding above top of signs to be as short as practicable;
   b. Other posts: must not protrude above the top of signs.

EXT4.W120.A BACKING PLATES

1. For signs not exceeding 1200 mm high x 2400 mm wide fabricate from a single sheet;
2. For signs exceeding 1200 mm high x 2400 mm long use a minimum number of sheets, rectangular in shape and approximately the same size;
3. Drill holes in the backing plate prior to painting or the application of retroreflective or non-reflective sheeting.

EXT4.W130.9 SPILL SCREENS

1. Extend spill screens to the entire width of the backing plate;
2. Cut corners to the same radius as the corners of the backing plate;
3. Consider spill screens to be part of the backing plate and design stiffeners and mountings to accommodate the combined size.

EXT4.W140.9 FACES FOR TRAFFIC SIGNS

1. Fabricate from a single sheet of retroreflective or non-retroreflective plastic sheeting unless otherwise Instructed;
2. If more than one sheet is required, keep the number of sheets used to a minimum;
3. Fix sheeting material, including letters, characters, numerals, symbols and borders using adhesive. Ensure there are no bubbles, creases, cracks or other blemishes;
4. Fix in accordance with the manufacturer's instructions.

EXT4.W150.9 LACQUER COATINGS

1. Apply to the face of traffic signs at the time of manufacture.
2. Ensure coatings are uniform and continuous.

EXT4.W160.9 PAINT TO TRAFFIC SIGN FACES

1. Thoroughly clean and pre-treat, by anodising, using and etching primer or another Approved process, the traffic sign face prior to painting or stoveing;
2. Apply a minimum of one undercoat and one finishing coat of paint and stove to a thickness of 0.0315 mm - 0.0375 mm of enamel over a minimum thickness of 0.025 mm of primer. Where light colours are applied over dark colours, apply a minimum of two coats. Ensure the final surface has a uniform thickness, an egg-shell flat finish and is smooth and free from defects.

ASSEMBLY OF TRAFFIC SIGNS

EXT4.W210.9 JOINTS

Weld or join using brackets, nuts, bolts and washers where joints for framework and stiffeners are not an integral part of the backing plate.

EXT4.W220.A FIXINGS

1. Spacing of rivets and other fixings to be uniform and not to exceed 150 mm around the outside edge of the sheet and 300 mm on cross braces;
2. Use an additional neoprene, nylon or other Approved material washer to protect face of sign from metal nuts, bolts, washers and screws;
3. Protection to sign edges shall be Class E1 in compliance with BS EN 12899: Part 1, Table 14.

EXT4.W230.9 COVER PLATES FOR FIXINGS

Use a material of the same colour as the part of the face in which it is in contact.

EXT4.W240.9 CONNECTIONS TO ROAD LIGHTING COLUMNS

When fixing traffic signs to columns do not drill columns.

EXT4.W250.A BACKING PLATES

1. Connect to posts by an Approved method;
2. Drill holes if ferrous components before finishes are applied;
3. When backing plates are stiffened with additional reinforcing members, these members shall be fixed to the backing plates in compliance with Class P2 in Table 13 of BS EN 12899: Part 1.

EXT4.W260.9 LACQUER COATINGS

Apply to the edges of holes drilled in plates with plastic sheeting immediately before fixings are inserted.

COVERING OF TRAFFIC SIGNS

EXT4.W310.9 GENERAL

1. Ensure coverings are sufficiently opaque to prevent reflection from the covered sign. Do not remove coverings until Instructed;
2. Unless otherwise Instructed, blank out the faces of traffic signs which have been erected but do not relate either wholly or in part to the traffic situation in operation.

EXT4.W320.9 METHOD OF COVERING

Where required blank out traffic signs using the following methods:

1. A 1.5 mm thick sheet compatible with the sign material;

2 A self-adhesive plastic film if the sign is to be covered for a period of more than 12 months;

3. An Approved loose cover sheet.

EXT4.W330.9 FIXING COVER SHEETS

1. Fix using 5 mm diameter stainless steel bolts, washers and nuts or non-ferrous rivets at maximum 600 mm spacing;
2. Pass bolts through 5 x 12 mm diameter plastic distance piece between the face of the sign and the cover plate;
3. Fill holes remaining on the finished face of the sign using blocked rivets;
4. Colour rivet face by an Approved method.

EXT4.W340.9 PLASTIC FILM

Fix and remove in accordance with the manufacturer's recommendations. Ensure that the self-adhesive plastic film is compatible with the material it is to be adhered to.

EXT4.W350.9 LOOSE COVERS

Fasten securely to the back of the sign. Do not apply tape or adhesive material to the face of the sign.

INSTALLATION OF ROAD STUDS

EXT4.W410.9 ROAD STUDS

1. Install in accordance with the manufacturer's recommendations;
2. Do not install road studs until concrete work has reached the specified grade strength;
3. Ensure surfaces to which bonded road studs are to be fixed are clean, and free from dust, grease and other deleterious matter prior to installation of the road studs.

EXT4.W420.9 DEPRESSIBLE ROAD STUDS

Fix in place with bitumen grout.

EXT4.W430.N LAYING OF THERMOPLASTIC ROAD STUDS

1. Road surfaces shall be prepared in accordance with EXT8.W010 to EXT8.W050 prior to laying of thermoplastic road studs. The hot-applied thermoplastic material for thermoplastic road studs shall be prepared and laid in accordance with EXT8.W120 to EXT8.W140;
2. The thermoplastic road studs for indicating the limits of a pedestrian crossing shall be square in plan, the sides of a square stud shall not be less than 95 mm nor more than 110 mm in length;
3. The thickness of thermoplastic road studs, not including surface applied solid glass beads, shall not be less than 2 mm nor more than 5 mm. The thickness shall be measured in accordance with BS 3262: Part 3, Appendix B.

EXT4.W440.N TEST CERTIFICATE

When required by the CM, the Contractor shall submit the test certificate prepared and signed by a local or overseas independent laboratory to the CM before commencing the relevant works in order to certify that the reflecting road studs to be used in the Contract comply with BS EN 1463: Part 1 and BS EN 1463: Part 2.

TESTING

TESTING TRAFFIC SIGNS

EXT4.T010.A TESTING

In accordance with BS 8442 and:

1. The number of signs tested to be as Instructed or indicated on the Drawings;
2. The number and type of tests to be carried out on the traffic signs to be as Instructed;
3. Carry out testing in such a manner that will not cause damage to the traffic signs;
4. Carry out testing at an Approved laboratory.

EXT4.T020.A COMPLIANCE CRITERIA

The results of tests of traffic signs must comply with BS 8442.

EXT5 KERBS, EDGINGS AND QUADRANTS

MATERIALS

KERBS, EDGINGS AND QUADRANTS

EXT5.M010.9 INSITU CONCRETE

1. Kerbs, edgings and quadrants: concrete grade 30/20;
2. Foundations and backings to kerbs, edgings and quadrants: concrete grade 20/20.

EXT5.M020.A PRECAST CONCRETE

Hydraulically pressed and complying with BS EN 1339:2003, excluding the testing of weathering resistance, abrasion resistance, slip / skid resistance and:

1. Nominal length of kerbs: 1000 mm;
2. Nominal length of edgings: 750 mm.

EXT5.M030.9 GRANITE

Kerbs, edgings and quadrants:

1. Worked straight or circular;
2. Corners: square;
3. Top front and back edges: parallel;
4. Ends: chisel-dress square to form a close butt-joint with adjacent kerbs and:
   a. Depth on the front face: 140 mm minimum;
   b. Depth on the back face and full width of the top face: 75 mm minimum.
5. Length: 600 mm minimum.

WORKMANSHIP

PRECAST CONCRETE AND GRANITE KERBS, EDGINGS AND QUADRANTS

EXT5.W010.9 LAYING

1. Lay on a regulating layer of cement mortar;
2. Thickness: 10 mm minimum and not exceeding 40 mm.

EXT5.W020.9 JOINTS

1. Generally:
   a. Not exceeding 10 mm in width;
   b. Filled and flush pointed with cement mortar.
2. Expansion joints on bridge decks: as shown on the Drawings;
3. Transverse expansion and contraction joints laid on or adjacent to concrete carriageways: in accordance with Worksection EXT2.

EXT5.W030.9 RADIUS KERBS

Use for kerbs less than 10 m external radius.

INSITU KERBS, EDGINGS AND QUADRANTS

EXT5.W110.9 LAYING

Construct in accordance with BS 5931:1980 and lay using an Approved type of automatic extrusion machine or by other Approved alternative method.

EXT5.W120.9 FINISHING

1. Kerbs, quadrants and edgings must have regular sides, edges, arrises and chamfers;
2. Finish concrete surfaces as follows:
   a. Method of producing finish: levelling the surface of the compacted concrete with a screed board and steel trowelling the surface under firm pressure or power floating the surface;
   b. Abrupt irregularities permitted: Nil;
   c. Gradual irregularities permitted: <5 mm in 2 m;
   d. Specific requirement: Uniform, dense and smooth surface, free from trowel marks. No staining or discolouration.
3. Do not finish or dress kerbs, edges and quadrants with cement mortar.

EXT5.W130.9 JOINTS

1. Generally: flush pointed with cement mortar;
2. Contraction joints: form at intervals not greater than 4 m;
3. Transverse expansion and contraction joints laid on or adjacent to concrete carriageways: in accordance with Worksection EXT2.

ACCURACY AND TOLERANCES

EXT5.W210.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

WORKS OUTSIDE SITE BOUNDARY

EXT5.W310.9 APPROVED CONTRACTOR FOR PUBLIC WORKS

Kerbs, edging and quadrant works required to be carried out by a contractor or sub-contractor who is on the current List of Approved Contractors for Public Works for Roads and Drains are specified in Project Specific Specification.

EXT5.W320.A SPECIFICATION

Carry out the works specified under EXT5.W310 in accordance with Sections 6, 9, 10, 11, 14, 15, 16 and 18 of the Hong Kong Government General Specification for Civil Engineering Works (2020 Edition) and its amendments published 42 days prior to the date for the return of tenders unless otherwise specified.

EXT5.W330.9 HANDING OVER INSPECTION

Notify the CM to arrange with Highways Department for a joint handing over inspection. Allow the CM to give at least 2 working days advance notice for this inspection.

EXT5.W340.9 RECORD DRAWINGS AND TEST REPORTS

Provide as-built record drawings and all test reports to the CM for submitting to Highways Department.

EXT6 CONCRETE PROFILE BARRIERS

MATERIALS

EXT6.M010.9 CONCRETE MIX

Grade 30/20 as Worksection CON1.

EXT6.M020.9 FORMWORK

Use steel formwork unless otherwise permitted by the CM. Do not loosen or remove formwork until at least 7 hours after completion of concreting.

EXT6.M030.9 CONCRETE FINISH

Finish concrete surfaces as follows:

1. Unformed concrete surfaces, Class U5, as follows:
   a. Method of producing finish: Level the surface of the compacted concrete with a screed board, wood float or power float the surface and steel trowel the surface under firm pressure or power float the surface;
   b. Abrupt irregularities permitted: nil;
   c. Gradual irregularities permitted: < 5 mm in 2 m;
   d. Specific requirements: uniform, dense and smooth surface, free from trowel marks, no staining or discolouration.
2. Concrete surfaces for transverse joints, use Class F3 as follows:
   a. Type of formwork normally used: plywood;

      Note: formwork of this type will normally produce a concrete surface which complies with the characteristics of finish stated but other types of formwork may be used to produce the specified finish.

   b Formwork pattern: pattern of formwork joints and tie holes as stated in sub-clauses (4) and (5) below;
   c Abrupt irregularities permitted: < 3 mm;
   d. Gradual irregularities permitted: < 5 mm in 2 m;
   e. Specific requirements: even surface, no grout runs.
3. Exposed concrete surfaces, use Class F5 as follows:
   a. Type of formwork normally used: sealed plywood Note: formwork of this type will normally produce a concrete surface which complies with the characteristics of finish stated but other types of formwork may be used to produce the specified finish;
   b. Formwork pattern: pattern of formwork joints and tie holes as stated in sub-clauses (4) and (5) below;
   c. Abrupt irregularities permitted: < 2 mm;
   d. Gradual irregularities permitted: < 3 mm in 2 m;
   e. Specific requirements: even surface, uniform, dense and smooth surface, no grout runs, no grain pattern, no crazing, no blemishes, no staining or discolouration.

4. Panel joints: formwork panels for the finishes in sub-clauses (2) and (3) above shall be the same size and shall form a regular pattern approved by the CM. The lines of joints between panels shall be straight and continuous, horizontal and vertical, or inclined to suit the pattern of profiled formwork, and shall be coincident with construction joints and other joints and with recesses in the concrete surface. The number of make-up pieces shall be kept to a minimum;
5. Tie holes: holes left by formwork ties and components in concrete surfaces with the finishes in sub-clauses (2) and (3) above shall be in line horizontally and vertically and shall form a regular pattern approved by the CM. Unless otherwise permitted by the CM, holes in profiled formwork shall be located in such a manner that the holes are completely within recesses in the concrete surface.

EXT6.M040.9 JOINTS IN CONCRETE PROFILE BARRIERS

Form joints:

1. At locations which coincide with expansion or construction joints in the adjoining structure or carriageway; or
2. At intervals not exceeding 12 m, whichever is less; and
3. In accordance with the appropriate provisions of Worksection CON6.

EXT6.M050.9 PROTECTIVE POLYTHENE SHEETING

Impermeable polythene sheeting with a nominal thickness of 0.125 mm.

EXT6.M060.9 CEMENT MORTAR

Cement mortar consisting of one part of cement to three parts of fine aggregate by volume together with the minimum amount of water necessary to achieve a consistency suitable for the required work. Fine aggregates to be sand or crushed rock to BS 1200:1976 passing a 5 mm BS Test Sieve.

WORKMANSHIP

CONSTRUCTION OF PROFILE BARRIERS

EXT6.W010.9 SLIP-FORMED CONCRETE PROFILE BARRIERS

Construct by slip-form machine between sliding forms to BS 5931:1980. Slip-form machines to comply with BS 5931:1980, Appendix A.

EXT6.W020.9 PRECAST CONCRETE PROFILE BARRIERS

Lay on a cement mortar regulating layer, 10 – 40 mm thick.

SUBMISSIONS

EXT6.W110.9 PARTICULARS OF CONCRETE PROFILE BARRIERS

Submit the following particulars to the CM of the proposed methods of construction of the concrete profile barriers at least 14 days before construction of the concrete profile barriers starts:

1. Particulars of formwork for insitu construction using fixed forms as stated in:
   a. Worksection FOR for works carried out under site formation / road and drainage works contracts; or
   b. Worksection CON2 for all other works not mentioned in sub-clause (1)(a) above.
2. Details of slip-form machine for insitu construction between sliding forms; and
3. Methods of manufacture, handling, transport, storing and fixing in position of precast units.

PROTECTION OF WORKS

EXT6.W210.9 PROTECTION

1. Immediately after the formwork has been removed or the curing compound applied, protect concrete profile barriers with polythene sheeting for at least 24 hours from exposure to conditions which may adversely affect the concrete;
2. Ensure the sheeting is lapped and held securely in position in a manner that will not damage the concrete surface.

TOLERANCES

EXT6.W310.9 GENERAL

1. Refer to Appendix H 'Schedule of Tolerances' to this Specification;
2. Form a smooth alignment of the barriers.

TESTING

TRIALS

EXT6.T010.9 TRIAL LENGTHS

1. Construct trial lengths to demonstrate that the proposed materials, mixes, methods of production and methods of construction will produce concrete profile barriers complying with this Specification;
2. Construct trial length:
   a. In a location separate from the permanent concrete profile barrier; or
   b. Over the first 25 m of the permanent concrete profile barrier; as Instructed;
3. Allow the CM sufficient time, at least 7 days, to determine whether the specified requirements have been produced in the trial area before further material of the same type is used to construct the concrete profile barrier;
4. Construct trial lengths using the same materials, mixes, method of production and methods of construction as the details submitted to the CM;
5. Inform the CM at least 24 hours before constructing trial lengths, or at another interval agreed by the CM;
6. Unless otherwise Instructed to remove, protect trial lengths from damage and leave in position. Do not remove trial lengths which form part of the permanent barrier and which comply with this Specification.

EXT6.T020.9 SAMPLING AND TEST METHODS FOR TRIAL LENGTHS

1. Test the trial length to determine the accuracy of the alignment, the level and the finish of the concrete surface;
2. Cut cores from the trial length to determine the amount of segregation of the constituents and the presence of voids. Take cores as EXT6.T070.

EXT6.T030.9 COMPLIANCE CRITERIA

1. Alignment and levels of barrier: as EXT6.W310;
2. Finish of concrete surface: as the appropriate provisions of EXT6.M030;
3. Amount of segregation of constituent materials and the presence of voids: as the appropriate provisions of Worksection EXT2.

EXT6.T040.9 NON-COMPLIANCE

1. In the event of non-compliance of any trial length with the specified requirements, submit details of proposed changes to the materials, mixes, methods of production or construction, required to meet the compliance criteria. Construct further trial areas as necessary until the result of every test on trial lengths complies with the specified requirements;
2. Unless otherwise Instructed remove trial lengths, or parts of the trial lengths, which do not comply with the specified requirements for the trial length.

EXT6.T050.9 USE IN THE PERMANENT WORKS

1. Notwithstanding the requirements of sub-clause (2) do not place concrete in the permanent barriers until the result of all the tests on the trial length confirm the specified requirements for the trial length;

2. Concrete may be placed in the permanent barriers before the results of tests for compressive strength of the trial mix are available, provided that the result of every other test or the trial mix and trial length complies with the specified requirements for trial mix concrete and for the trial length.

EXT6.T060.9 SPECIFICATION CHANGES

Unless otherwise permitted by the CM do not change the materials, mixes, methods of production and construction required to meet the compliance criteria. Construct further trial lengths to demonstrate compliance of any proposed changes, unless otherwise Instructed.

EXT6.T070.9 CONCRETE CORES FROM TRIAL LENGTHS

1. Provide two concrete cores from each trial length of concrete profile barriers, taken from positions as Instructed;
2. Samples, testing and compliance criteria for concrete cores from trial lengths: as Worksection EXT2.

EXT7 UNTENSIONED BEAM BARRIERS

MATERIALS

SUBMISSIONS

EXT7.M010.A DETAILS

Submit details of the following, for Approval, at least 14 days prior to installation of beams:

1. A certificate for each batch of beams delivered to Site from the manufacturer in the format of BS EN 10025 stating the manufacturer's name, the date and place of manufacture and showing that the beams comply with the requirements of this Specification, including the carbon equivalent values;
2. Proposed method of installation.

EXT7.M020.9 SAMPLES

Submit samples of the following beam barrier materials for Approval of the source and type.

1. Beams;
2. Posts, cleats and struts;
3. Bolts, nuts and washers.

MATERIALS

EXT7.M110.A UNTENSIONED BEAM BARRIERS

1. Where applicable, steelworks to Worksection STW for works to be handed over to other Government departments upon completion as stated in the Contract unless otherwise stated;
2. Steel plates to BS 1449: Part 1.1, Type BHR, and BS EN 10149: Part 3, Grade S315NC capable of withstanding a tensile force of at least 300 kN which will not deflect by more than 40 mm when loaded centrally with a point load of 1 ton over a simply supported span of 3 m;
3. Hop dip galvanized to BS EN ISO 1461 with a minimum coating thickness of 85 µm.

EXT7.M120.9 BOLT SLOTS IN BEAMS FOR CONNECTION POSTS

1. Prepare in the workshop by cold saw-cutting;
2. Spacing: 2 m or 4 m as shown on the Drawings;
3. Hot dip galvanized with a minimum coating thickness of 70 µm.

EXT7.M140.9 WELDS FOR END BEAM SECTIONS

Full-penetration butt welds.

EXT7.M150.9 CONCRETE FOR FOOTINGS

As Worksection CON1 and:

1. Concrete mix: Grade 20/20;
2. Finish: Class U5 as EXT7.M170.

EXT7.M160.9 CONCRETE FOR ANCHOR BLOCKS

Grade 20/20 as Worksection CON1.

EXT7.M170.9 FINISH TO CONCRETE SURFACES OF ANCHOR BLOCKS

Finish concrete surfaces as follows:

1. Formed finishes:
   Class F5: as specified in EXT6.M030.
2. Unformed concrete surfaces, class U5, as specified in EXT6.M030.

POSTS

EXT7.M210.B POSTS FOR UNTENSIONED BEAM BARRIERS

1. Grade 275JR steel to BS EN 10025: Part 2;
2. Hop dip galvanized in accordance with BS EN ISO 1461 with a minimum coating thickness of 85 µm.

EXT7.M230.9 POSTS FABRICATED FROM HOLLOW SECTIONS

1. Seal by welding mild steel sealing plates over the open ends;
2. Plate thickness: 3 mm.

FIXINGS

EXT7.M310.B CLEATS AND STRUTS

1. Fabricated from angle sections to BS EN 10056;
2. Material: weldable structural steel to BS EN 10025: Part 2, Grade 275JR;
3. Hot dip galvanized in accordance with BS EN ISO 1461 with a minimum coating thickness of 85 µm.

EXT7.M320.B BOLTS

To BS 4190, and:

1. Size: M 16;
2. Strength: Grade 4.6;
3. Bolts for beam splicing, connecting beams to posts and for connecting beams to cleats: round or button-headed with oval shoulders;
4. Other bolt types: ISO metric black hexagon type;
5. Hot dip galvanized in accordance with BS EN ISO 1461 with a minimum coating thickness of 55 µm;
6. Bolt length: such that the threaded portion of each bolt projects through the nut by not more than four threads;
7. Rag, indented and expansion bolts and resin bonded bolts: Approved proprietary type and capable of withstanding the design loading.

EXT7.M330.B NUTS

To BS 4190, and:

1. Strength: Grade 4 or 5;
2. Hot dip galvanized in accordance with BS EN ISO 1461 with a minimum coating thickness of 55 µm;
3. Tapped 0.4 mm oversized to accommodate galvanized coating.

EXT7.M340.A WASHERS

Black, mild steel to BS 4320, Form E, F or G and manufactured from steel to BS 1449: Part 1.1 and BS EN 10149: Part 3, Grade S315NC.

EXT7.M350.A PLAIN WASHERS

1. Of dimensions suitable for use with M 16 bolts and nuts;
2. Thickness: 2 mm;
3. Hot-dip galvanized in accordance with BS EN ISO 1461 with a minimum coating thickness of 55 μm.

EXT7.M360.A SHAPED WASHERS

To BS EN 13835 and shaped to fit the curvature of circular hollow sections used as posts:

1. Material: cast iron;
2. Thickness: 5 mm minimum.

WORKMANSHIP

GENERAL

EXT7.W010.A STORAGE AND PROTECTION

1. Store beams and posts off a levelled, well drained and maintained hard-standing ground on level supports in a manner which will not damage, deform or contaminate the materials;
2. Protect beams and posts from damage and ensure that damaged materials are not used in permanent work unless permitted by the CM. Measures to protect the materials from the effects of weather shall be submitted to the CM for approval.

EXT7.W020.A HOT DIP GALVANIZING

1. Unless otherwise specified, galvanized coatings to be applied by hot-dip galvanizing to be in accordance with BS EN ISO 1461 with minimum mean coating thickness of 45 microns to 85 microns depending on thickness of article as stipulated in Table 3 of BS EN ISO 1461, unless otherwise specified. The coating thickness to comply with the following Table:

Article Thickness	Minimum Mean Coating Thickness
> 6 mm	85 µm
> 3 mm to ≤ 6 mm	70 µm
≥ 1.5 mm to ≤ 3 mm	55 µm
< 1.5 mm	45 µm

2. Unless Approved, all components are to be galvanized after welding, drilling and cutting operations are complete;
3. All hot dip galvanizing is to be carried out by galvanizers with ISO 9001 certification. Submit the name of galvanizer for Approval;
4. Submit original invoice/delivery note and galvanizing certification for each delivery. These documents shall include the following information:
   a. Project title/number;
   b. Name of galvanizer;
   c. Types and dimensions of articles;
   d. Quantities.
5. Attach a durable identification tape to each batch of galvanized articles indicating the project title, galvanizing certification number and name of galvanizer.

FORMING FOOTINGS

EXT7.W110.9 COMPACTED EARTH FOOTINGS

1. Deposit and compact the following to obtain a relative compaction of at least 95% throughout:
   a. Sub-base material: to the bottom 250 mm of the foundation pit;
   b. Fine fill material: to the remainder of the pit;
2. Posts: securely fix in position during deposition and compaction of the fill material.

EXT7.W120.9 CONCRETE FOOTINGS

1. Ensure the top surface of the footings is finished level with the adjoining ground;

2. Posts:
   a. Surround posts with polyethylene sheeting prior to placing of concrete;
   b. Ensure posts are securely fixed in position during concreting.

CONSTRUCTION OF BEAM BARRIERS

EXT7.W210.9 GENERAL

Untensioned beam barriers when delivered to site must be ready for assembly. Beams and posts shall be free from blisters, flux, uncoated spots and other defects.

EXT7.W220.9 INSTALLATION AND FIXING

1. Install beam barriers to a smooth alignment and within 10 mm of the position and height as shown on the Drawings. Ensure transition sections provide a smooth and uniform transition;
2. Curve in the workshop those beams to be installed to a radius less than 45 m;
3. Use rag, indented, expansion or resin bonded bolts for fixing to concrete. Fit bolts into pockets and fill with cement mortar or resin grout;
4. Bolt beam barriers to metalwork.

TOLERANCES

EXT7.W310.9 GENERAL

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

EXT8 ROAD MARKING

MATERIALS

GENERAL

EXT8.M010.9 ROAD MARKING

Road markings are white or yellow continuous or intermittent lines, letters, characters, figures, arrows or symbols marked on the carriageway to guide road users and pedestrian.

EXT8.M020.A SKID RESISTANCE

The minimum skid resistance of road marking materials when measured in accordance with the method contained in Annex D of BS EN 1436 shall be Class S1.

EXT8.M030.A FUNCTIONAL LIFE

The functional life of the road-marking material shall be at least 1 year after laying is carried out as defined in BS EN 1436.

THERMOPLASTIC MATERIALS

EXT8.M110.B HOT APPLIED THERMOPLASTIC MATERIAL

1. Unless otherwise specified in Drawings, use either one of the following materials:
   a. Type 'A' - Standard hot applied thermoplastic material;
   b. Type 'B' - Alkyd resin hot applied thermoplastic material.
2. Complying with BS EN 1871, with particular attention to the following material properties:
   a. Softening point: Class SP2 when tested in accordance with Annex F of BS EN 1871;
   b. Luminance factor: Class LF4 for white material and Class LF2 for yellow material when tested in accordance with Annex E of BS EN 1871.
3. Solvent-free marking substance supplied in block, granular or powder forms, which can be heated to a molten state and then applied with an appropriate hand or mechanical applicator, and form a cohesive film by cooling;
4. With solid glass beads to BS EN 1423 of refractive index conforming to Class A when determined in accordance with Annex A of BS EN 1423 so that not less than 25% of the volume of material comprises glass beads;
5. Colour: as shown on Drawings.

EXT8.M120.9 CERTIFICATION

When required by the CM, submit, 14 days before the commencement of the Works, a test certificate prepared and signed by an independent laboratory, showing the manufacturer's name, the place and date of manufacture and certifying that samples taken from the road marking materials to be used in the Contract have been tested and are in compliance with the specified standards.

PREFORMED MATERIALS

EXT8.M210.B COLD APPLIED ROAD MARKINGS

1. An Approved proprietary type with glass beads to BS EN 1423 of refractive index conforming to Class A when determined in accordance with Annex A of BS EN 1423, applied during manufacture;
2. Colour: as shown on Drawings.

EXT8.M250.A COLD PLASTIC ROAD MARKINGS

To BS EN 1871. The luminance factor shall be Class LF4 for white material and Class LF2 for yellow material when applied at the manufacturer's state thickness and tested in accordance with Annex A of BS EN 1871.

PAINT

EXT8.M310.A ROAD MARKING PAINT

1. To BS EN 1871, in particular the following:
   a. Luminance factor: Class LF6 for white material and Class LF2 for yellow material when tested in accordance with Annex A of BS EN 1871;
   b. Difference in luminance factor after UV ageing: Class UV1;
   c. Difference in luminance factor after bleed resistance test: Class BR1.
2. Colour: as shown on Drawings.

ANCILLARY MATERIALS

EXT8.M410.9 TACK COAT

Compatible with the road marking material.

EXT8.M420.A REFLECTIVE GLASS BEADS FOR SURFACE APPLICATION

Complying with BS EN 1423:2012 of refractive index conforming to Class A when determined in accordance with Annex A of BS EN 1423:2012.

WORKMANSHIP

PREPARATION FOR ROAD MARKING

EXT8.W010.9 ROAD CONDITION

Ensure that the road surface is clean, dry and free from any loose detritus, mud, old and/or flaking road marking materials or similar extraneous matters.

EXT8.W020.9 CLEANING

When directed, remove oil and grease by high pressure water jetting, shot blasting, grinding or other Approved methods.

EXT8.W030.9 BITUMINOUS SURFACES

No surface preparation is required to bituminous road surfaces which have not been opened to traffic.

EXT8.W040.9 CONCRETE SURFACES

1. If the road has not previously been opened to traffic, remove all curing compound and laitance from the road surface by wire brushing or other Approved method;
2. Apply a tack coat to the road surface in accordance with the manufacturer's recommendations.

EXT8.W050.9 EXISTING ROAD MARKINGS

1. Where road markings are to be replaced by material of a different type, remove the existing material by high pressure water jetting, shot blasting, grinding or other Approved methods; do not mask the existing markings using black paint or similar method;
2. Where road markings are to be replaced by material of a similar type, roughen the existing marking by an Approved method until the thickness of the existing material is reduced by approximately 50%;
3. Carry out the removal or roughening of existing road markings adjacent to any longitudinal or transverse joint by an Approved method which will not damage the joint.

LAYING THERMOPLASTIC MATERIALS

EXT8.W110.A SUPPLY, DELIVERY AND STORAGE

Ensure that road marking materials are supplied, delivered and stored in accordance with the following:

1. Thermoplastic materials: each container shall be clearly and indelibly marked with the following information:
   a. The name, trade mark or other means of identification of the manufacturer;
   b. Batch number;
   c. Date of manufacturer;
   d. The number and date of the Standard, i.e. BS EN 1871;
   e. Whether reflectorized;
   f. Colour (white, yellow or black);
   g. Chemical description and type of resin;
   h. Maximum application temperature and maximum safe heating temperature;

i. Relative density;
j. The class of its content if applicable;
k. A warning about the use of lead pigment if applicable.

2. Road marking paint material: shall be discarded after expiry of the shelf life;
3. Preformed material: in accordance with the manufacturer's recommendations.

EXT8.W120.9 CODE OF PRACTICE

Prepare thermoplastic road marking materials on site and lay in accordance with clauses 4 and 5 of BS 3262: Part 3:1989.

EXT8.W130.9 AMBIENT CONDITIONS

Do not lay road markings when:

1. The road surface is wet; or
2. When the ambient air temperature in the shade is below 10ºC.

EXT8.W140.9 LAYING PLANT

Ensure that the apparatus employed for the laying of road markings is capable of producing markings to a uniform thickness and width. The marking must have clean edges and be free from streaks, lumps and blisters.

EXT8.W150.9 THICKNESS

Thickness of road markings laid and measured in accordance with Appendices B of BS 3262:Part 3:1989:

1. Screed markings: 4 mm;
2. Sprayed markings
   (other than yellow edge lines): ≥1.5 mm;
3. Sprayed yellow edge lines: ≥0.8 mm.

LAYING PREFORMED MATERIAL

EXT8.W210.9 LAYING COLD APPLIED ROAD MARKINGS

Lay:

1. In accordance with the manufacturer's recommendations;
2. When the surface of the carriageway is dry;
3. To a thickness of at least 1.5 mm.

APPLYING ROAD-MARKING PAINT

EXT8.W240.9 APPLICATION OF ROAD-MARKING PAINT

1. Use road-marking plant only where the use of other road marking material, such as thermoplastic, will affect the functional performance of the road markings and with the written approval of the CM;
2. Apply in accordance with the manufacturer's recommendation;
3. Do not apply road-marking paint for temporary road markings and covering up existing road markings.

PERFORMANCE REQUIREMENTS

EXT8.W270.A ROAD MARKING PERFORMANCE FOR ROAD USERS

Comply with BS EN 1436, in particular the following:

1. Minimum luminance coefficient under diffuse illumination: Class Q2 and Q3 on asphaltic surface and concrete surface respectively for white markings, and Class Q1 for yellow markings when measured in accordance with Annex A of BS EN 1436;
2. Minimum coefficient of retroreflected luminance for dry road markings: Class R2 and R1 for permanent white and yellow markings respectively, and Class R3 for temporary markings when measured in accordance with Annex B of BS EN 1436;
3. Minimum luminance factor for dry road markings: Class B3 for white markings and B2 for yellow markings when measured in accordance with Annex C of BS EN 1436.

TEMPORARY ROAD MARKINGS

EXT8.W310.9 GENERAL

1. Use cold-applied performed material for temporary road markings;
2. Use proprietary black tape approved by the CM for covering up existing road markings temporarily during the course of road works;
3. Remove temporary road markings.

EXT8.W320.9 DISPOSAL

Dispose of temporary markings after removal and:

1. Remove all traces of tape from the surface of the carriageway;
2. Make good any existing, permanent road markings to Approval and so that it is safe for traffic to use the road.

REMOVAL OF EXISTING ROAD MARKINGS

EXT8.W360.9 REMOVAL OF EXISTING ROAD MARKINGS BY SHOT-BLASTING

Where directed by the CM to remove the existing road marking by steel shot-blasting, use Approved self-propelled shot-blasting machine with a minimum cleaning path of 350 mm.

TOLERANCES

EXT8.W410.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

EXT9 FENCING, GATES AND GUARDRAILS

MATERIALS

GENERAL

EXT9.M010.9 ALTERNATIVE DESIGN

The Contractor may offer an alternative design for the pedestrian guard railing or that which is to be erected as temporary works and shown on the Drawings or detailed in this Specification. Such design must be in accordance with BS 7818, Table 1, Class C.

EXT9.M020.9 SUBMISSIONS

Submit the following details to the CM at least 28 days prior to fabrication:

1. A certificate from the manufacturer stating their name, date and place of manufacture and a statement confirming that the materials comply with the requirements of this Specification; and
2. Details of alternative design proposals as EXT9.M010 where applicable.

EXT9.M030.9 SAMPLES

Submit with the other details required by EXT9.M020 samples of the following for Approval of source and type:

1. Each type of pedestrian guard railing to be used;
2. Mesh infill;
3. Each type of bolt, nut and washer to be used in the fabrication.

FENCING

EXT9.M120.9 GALVANIZED STEEL WIRE FOR FENCING

To BS 4102:1990.

EXT9.M130.9 GALVANIZED WIRE NETTING FENCING

To BS 1485:1983 or of Approved local manufacture.

CONCRETE POSTS

EXT9.M210.9 PRECAST CONCRETE FENCING POSTS

Reinforced concrete to dimensions shown on the Drawings and the following:

1. Concrete: Grade 25/10 as Worksection CON1;
2. Reinforcement: as Worksection CON3;
3. Finish: fair faced as Worksection CON2.

STEEL AND ALUMINIUM FOR GATES, POSTS AND GUARD RAILS

EXT9.M310.9 HOT FINISHED SEAMLESS STEEL TUBES

To BS 6323:Part 31982.

EXT9.M320.9 STEEL TUBES AND TUBULARS SUITABLE FOR SCREWING TO BS 21 PIPE THREADS

To BS 1387:1985.

EXT9.M330.9 HOT ROLLED STEEL SECTIONS

To BS 4:Part 1:1980.

EXT9.M340.9 HOT ROLLED STRUCTURAL STEEL SECTIONS (EQUAL AND UNEQUAL ANGLES)

To BS 4848:Part 4:1972 (1986).

EXT9.M350.9 WELDABLE STRUCTURAL STEELS

To BS 4360:1986.

EXT9.M360.9 STAINLESS STEEL

To BS EN 10088-2:2005, Grade 1.4401.

EXT9.M370.9 STAINLESS STEEL TUBES

To BS 6362:1990 Grade 316 S 31, and a type suitable for threading in accordance with BS 21:1985.

EXT9.M380.9 ALUMINIUM

1. Grade: H30TF;
2. Anodized to grade AA25 in accordance with BS 1615:1987.

EXT9.M390.9 WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS SUITABLE FOR GENERAL ENGINEERING PURPOSES

1. Plate, sheet and strip: to BS 1470:1987;
2. Drawn tube: to BS 1471:1972;
3. Bars, extruded round tubes and sections: to BS 1474:1987.

FIXINGS

EXT9.M410.9 TYPE

1. Use only galvanized bolts, nuts, screws and rivets with galvanized pedestrian guard railing;
2. Insulate aluminium fixings from ferrous materials with an Approved type non-conductive insulator at least 2 mm thick.

EXT9.M420.9 ISO METRIC BLACK HEXAGON BOLTS, SCREWS AND NUTS

To BS 4190:1967.

EXT9.M430.9 ISO METRIC BLACK CUP AND COUNTERSUNK HEAD BOLTS AND SCREWS WITH HEXAGONAL NUTS

To BS 4933:1973.

EXT9.M440.9 METAL WASHERS

To BS 4320:1968.

EXT9.M450.9 RIVETS

To BS 4620:1970 (1988).

EXT9.M460.9 RIVET, BOLT AND SCREW STOCK

Wrought aluminium and aluminium alloys to BS 1473:1972.

EXT9.M470.9 BOLT LENGTH

The thread position of bolt to project through the nut by a minimum of one thread and a maximum of four threads.

EXT9.M480.9 RAG, INDENTED, EXPANSION AND RESIN BONDED BOLTS

An Approved proprietary type capable of withstanding the design loading.

INFILL PANELS FOR GUARD RAILINGS

EXT9.M510.9 MESH INFILL PANELS

To BS 4483:1985 and free from surface defects, surface irregularities and mesh misalignment.

WORKMANSHIP

ERECTING FENCING

EXT9.W010.9 LOCATION

Erect fencing to lines and levels as shown on the Drawings.

EXT9.W020.9 ERECTION

Comply with BS 1722:Part 1:1986:Section 3 in respect of:

1. Level of top of fence (sub-section 3.1);
2. Fixing posts and struts (sub-section 3.2);
3. Fixing fencing infill (sub-section 3.3);
4. Fixing gates within fencing (sub-section 3.4);
5. Renovation of damaged coatings (sub-section 3.5).

EXT9.W030.9 FIXING

1. Fix selvage wires at top, bottom and mid points of fencing and strain tight to each straining post by means of eye bolts or other suitable straining device;
2. Strain fence between straining posts and secure to straining and intermediate posts using galvanized mild steel flats fixed with galvanized mild steel bolts, nuts and washers.

FABRICATION, PROTECTION AND INSTALLATION OF PEDESTRIAN GUARD RAILING

EXT9.W110.9 STORAGE AND PROTECTION

1. Store and protect guard railing off the ground on level supports in a manner that will not result in damage, deformation or contamination;
2. Do not use any damaged guard railing in the permanent works unless permitted by CM.

EXT9.W120.9 WELDING

1. Unless otherwise permitted by the CM, do not make welded joints after galvanizing. Where permitted, ensure welded areas are free from scale and slag and treated with an alternative zinc-coating system;
2. Type of weld: fillet;
3. Ensure welded surfaces are clean and flush, prior to application of the protective coating.

EXT9.W130.9 HOT DIP GALVANIZING

Hot dip galvanize all steel components forming pedestrian guard railing to BS EN ISO 1461:2009 with minimum mean coating thickness of 45 microns to 85 microns depending on thickness of article as stipulated in Table 3 of BS EN ISO 1461:2009, unless otherwise specified. Galvanize components after welding, drilling and cutting operations are complete. The coating thickness to comply with the following Table:

Article Thickness	Minimum Mean Coating Thickness
> 6 mm	85 µm
> 3 mm to ≤ 6 mm	70 µm
≥ 1.5 mm to ≤ 3 mm	55 µm
< 1.5 mm	45 µm

EXT9.W140.9 INSTALLATION

1. Use guard railing curved in the workshop for radii of less than 45 m. Do not use straight lengths in this application;
2. Fix guard railing to concrete using rag, indented, expansion or resin bonded bolts. Fix bolts into pockets and fill with cement mortar or resin grout;
3. Bolt fix guard railing to metalwork.

ACCURACY AND TOLERANCES

EXT9.W210.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

EXT10 PLAY/FITNESS EQUIPMENT AND PLAY SURFACES

MATERIALS

PLAY/FITNESS EQUIPMENT

EXT10.M010.A PLAY / FITNESS EQUIPMENT

1. Play / fitness equipment in the Specification refers to a proprietary play and / or fitness equipment item, which shall be supplied and installed by an Approved sub-contractor selected by the Contractor from the Housing Authority Play / fitness Equipment Agents Reference List as approved by the HA Play Equipment Review Board (abbreviated as "the List" hereunder), this Approved sub-contractor is hereinafter referred to as the "agent". The List, listing requirements and guiding principles for reviewing the listing of agents are given in Appendix …..;
2. Play equipment item as mentioned in sub-clause (1) of this clause also refers to a fixed integral physical structure installed in a designated play area that is accessible to users for participation in various play activities such as balancing, climbing, crawling, creeping, spinning, rocking, rotating, tilting, sliding, springing, swinging, etc. thereof. Individual component of a play equipment item refers to any portion of the play equipment that provides a specific play activity;
3.
    a. A multi-play equipment item is a play equipment item that shall be able to perform the specified 'core play activities' and shall comply with the requirements on the number(s) of 'non-core play activities' which is / are to be proposed by the Contractor as specified in EXT10.M015 (8)(a)(i);
    b. An individual play equipment item is a play equipment item that shall be able to perform the play activity as specified in EXT10.M015 (8)(a)(ii).
4. Fitness equipment item as mentioned in sub-clause (1) of this clause also refers to a fixed integral physical structure installed in a designated fitness area that is accessible to users for participation in various exercise activities complying with the requirements of 'core exercise activities and 'non-core exercise activities' as specified in EXT10.M015 (8)(b). Individual component of a fitness equipment item refers to any portion of the fitness equipment that provides a specific exercise activity;
5. Type and play activity of a play / fitness equipment item for respective target user age groups (aged 2-5 and / or 5-12, or adults or elderly), safety margin / use zone and critical fall height (or the free height of fall) in the designed play / fitness area shall be designed in accordance with the following international standards of safety, the latest edition of the standards referred to shall apply:
    a. BS EN 1176-1:2017, BS EN 1176-2:2017, BS EN 1176-3:2017, BS EN 1176-4:2017, BS EN 1176-5:2019, BS EN 1176-6:2017, BS EN 1176-7:2008, BS EN 1176-10:2008, BS EN 1176-11:2014; or
    b. ASTM F1487-17.
6. A Play Consultant (PCon) is a company which:
    a. Has more than three years of relevant experience in playground safety inspection;

b. Has at least one certified inspector who possesses the qualification of Certified Playground Safety Inspector (CPSI) – National Recreation and Park Association (NRPA), US;

c. Has at least one certified inspector who possesses the qualification of Certified Annual Outdoor Inspector – Register of Play Inspector International Ltd (RPII), UK.

7. Nomination and engagement of PCon:

a. Nominate a candidate for the CM's approval to be the PCon and submit the candidate's declaration of no conflict of interest in carrying out compliance check, safety audit or other duties specified in the Contract;

b. Upon the CM's approval, the Contractor shall enter into a written contract for service with the PCon and the contract for service shall be made available for the CM's inspection upon request by the CM;

c. In the event that the Contractor fails to comply with any of the requirements in sub-clauses 7(a) and 7(b) above, the Employer shall be entitled to engage a PCon forthwith and deduct all costs, charges and expenses arising from or in connection with the engagement of a PCon in accordance with the Contract and / or recover such costs, charges and expenses as a debt from the Contractor.

8. Nomination and engagement of replacement PCon:

a. In the event that the PCon employed by the Contractor is unable or refuses to carry out such duties as specified in the Contract or is not performing satisfactorily in the opinion of the CM, the CM may withdraw his approval for engagement of the PCon at any time;

b. Within seven (7) days of the CM's notice of withdrawal, nominate a candidate for the CM's approval to be the replacement PCon and submit the candidate's declaration of no conflict of interest in carrying out compliance check, safety audit or other duties specified in the Contract;

c. Upon the CM's approval, the Contractor shall enter into a written contract for service with the replacement PCon and the contract for service shall be made available for the CM's inspection upon request by the CM;

d. In the event that a replacement PCon engaged as per sub-clauses 8(b) and 8(c) above is unable or refuses to carry out such duties as specified in the Contract or is not performing satisfactorily in the opinion of the CM, the CM may withdraw his approval for the replacement PCon at any time;

e. Within seven (7) days of the CM's notice of withdrawal of approval for the replacement PCon, nominate a candidate to be engaged as the further replacement PCon as per sub-clauses 8(b) and 8(c) above;

f. In the event that the Contractor fails to comply with any of the requirements in sub-clauses 8(a) to 8(e) above, the Employer shall be entitled to engage a replacement PCon forthwith and deduct all costs, charges and expenses arising from or in connection with the engagement of a replacement PCon in accordance with the Contract and / or recover such costs, charges and expenses as a debt from the Contractor.

EXT10.M015.9 DESIGN SUBMISSION

1. Before expiry of the …. months from the notified date for commencement of the Works, submit to the CM design proposal provided by the proposed agent(s) selected from the List stated in sub-clause (1) of EXT10.M010 for the designated play / fitness area(s) for the CM's Approval. The Contractor shall obtain the current List from the CM for preparation of design proposal. The design proposal shall:

a. Include suitable equipment items, fixing details and other builder's works requirements in compliance with the Drawings, the requirements stated in EXT10.M010 and this clause;

b. Provide information on the international safety standard complied with, the place of origin, place of manufacture, name of manufacturer, brand name, model number and manufacturer's installation manual;

c. Include play equipment item that complies with international standards of safety. The international standards of safety are namely BS EN 1176:2008 and / or ASTM F1487-11 for all aspects including safety margin / use zone, critical fall height (or the free height of fall), separation of age group etc., the latest edition of the standards referred to shall apply. Document and certifications issued by the testing laboratory with international accreditation to prove the compliance of the equipment item, not individual component of the equipment item, with recognised international standards of safety shall be submitted;

d. Include at least one or one third of the total required numbers of equipment items for the respective play / fitness area, whichever is more, which shall be accessible to the disabled or in compliance with the latest Americans with Disabilities Act Accessibility Guidelines for Building and Facilities (ADAAG) or equivalent. Physical barriers shall be provided as far as practicable to separate equipment for different age groups in those areas;

e. Include the audit report of compliance check / safety audit of the design proposal to demonstrate compliance with the international standards of safety in sub-clause (1)(c) above by the appointment of either:

i. a Play Consultant (PCon) as specified in EXT10.M010 (6); or

ii. a laboratory accredited under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or by an accreditation body with mutual recognition arrangements with HOKLAS who is qualified to carry out safety compliance check.

who shall carry out the compliance check / safety audit on the design proposal in accordance with BS EN 1176:2008 and / or ASTM F1487-11, the latest edition of the standards referred to shall apply, and compile the audit report.

The compliance check / safety audit shall take into account all elements within the designated play / fitness area including signage, furniture, lamp pole, bollard, boundary fence and planter wall etc. as shown on the Drawings;

f. Include drawings showing bilingual signage in Chinese and English for each designated play / fitness area to indicate the designated user groups and the users' guides on the proper use of the equipment items.

2. The Contractor shall be responsible for the identification of proposed agent(s). *There shall be at least two proposed agents included in the proposal and each shall be involved in play equipment items amounting to at least one third of the total sum of play equipment items for the whole Site;

3. There shall be no more than 3 proposed agents supplying and installing the equipment items for the whole Site;

4. Submit revised design proposal, drawings and relevant information upon comment or where considered necessary by the CM;

5. In the situation if the proposed agent(s) providing the equipment items of the design proposal is suspended or removed from the List before the design proposal is approved, the Contractor shall re-submit a new design proposal;

6. Upon notification in writing by the CM of the Approved design proposal, the Contractor shall engage with the agent(s) in providing the equipment items of the Approved design proposal as the Approved sub-contractor(s) for the supply and installation of the Approved equipment items;

7. Within 28 days from the date of the CM's notification of the Approval of the design proposal, submit detailed information comprising shop drawings and fixing details of the equipment items for the CM's approval;

8. The equipment items included in the design proposal in sub-clauses (1), (4) and (5) of this clause shall be suitable equipment items with detailed functional component type and play / exercise activity meeting, but not be limited to, the following requirements:
   a. CPA [ ] as shown on Drawing no. …….., in accordance with the international standards of safety * BS EN 1176:2008 / *ASTM F1487-11, the latest edition of the standards referred to shall apply,, consisting of …… number(s) of multi-play equipment item(s), and …… number(s) of individual play equipment item(s) with critical fall height of ..... mm, detailed as follows:
      i. *Multi-play equipment item [ ] for children with an age range of *2-5 / *5-12 years capable of performing a minimum of ..... number(s) of core play activities which are .....(Insert project specific requirements)..... , and a minimum of ..... number(s) of non-core play activities which play activities are to be proposed by the Contractor in the design proposal submission;
      ii. *Individual play equipment item [ ] for children with an age range of *2-5 / *5-12 years capable of performing at least one play activity per play equipment item;

CPA [ ]	Play Equipment Item [ ]	
Core Play Activity	Component Type	Descriptions
Sliding	……. (type) Slide	Made of ……. (material); (Description of component(s): shape, features and relations with other components) ……
Climbing	…… (type) Climber	Made of ……. (material); (Description of component(s): shape, features and relations with other components) ……
Climbing	……. (type) Staircase / ladder	Made of ……. (material); (Description of component(s): shape, features and relations with other components) ……
Standing	……. (type) Deck	Made of ……. (material); (Description of component(s): shape, features and relations with other components) ……
Cover	……. (type) Roof	Made of ……. (material); (Description of component(s): shape, features and relations with other components) ……
Walking	……. (type) Bridge	Made of ……. (material);

		(Description of component(s): shape, features and relations with other components) ……
Separation / Sensory (touch, hear, sight)	……. (type) Panel	Panel made of ……. (material); (Description of component(s): shape, features and relations with other components) ……
Rocking	……. (type) Spring Rider	(Description of component(s): shape, features and relations with other components) ……
Spinning	……. (type) Spinner	Made of ……. (material); (Description of component(s): shape, features and relations with other components) ……
Swaying	……. (type) Swaying component	Made of ……. (material); (Description of component(s): shape, features and relations with other components) ……

b. Fitness Area [ ] as shown on Drawing no(s). ……..…… consisting of:-

i. *Elderly fitness equipment item(s) capable of performing a minimum of ..... number(s) of core exercise activities which are .....(Insert project specific requirements)..... , and a minimum of ..... number(s) of non-core exercise activities which exercise activities are to be proposed by the Contractor in the design proposal submission *with critical fall height of ..... mm;

ii. *Fitness equipment item(s) capable of performing a minimum of ..... number(s) of core exercise activities which are .....(Insert project specific requirements)..... , and a minimum of ..... number(s) of non-core exercise activities which exercise activities are to be proposed by the Contractor in the design proposal submission *with critical fall height of ..... mm;

The Contractor may in respect of any fitness area propose a quantity of elderly fitness equipment items that does not correspond to the number of core exercise activities as long as the required number of core exercise activities and non-core exercise activities are fulfilled. For fitness equipment item(s), arrangement similar to that for elderly fitness equipment item(s) is also acceptable.

Fitness Area [ ] – Fitness Equipment		
Core Exercise Activity	**Component Type**	**Descriptions**
Lower Body exercises	…. (Type) e.g. bike, stepper, pedalling etc.	Made of ……. (material); (Description of

9.

		component(s): shape, features and relations with other components) …… ……..
Upper Body exercises	…(Type) e.g. Stretcher (push / pull), grab bar, etc.	Made of ……. (material); (Description of component(s): shape, features and relations with other components) …… ……..

Each play / fitness component is counted for one core play / exercise activity only. Play / fitness component once counted as core play / exercise activity shall not be recounted as non-core play / exercise activity.

EXT10.M020.9 WARRANTY

The Contractor and the agent for the design, supply and installation of the play / fitness equipment shall separately warrant the Employer in respect of the play / fitness equipment as detailed in Clause SCC7.6 of the Special Conditions of Contract. In particular, the structural integrity of the play / fitness equipment, and the timber parts and polyethylene components thereof shall be subject to the specified periods of warranty.

PLAY SURFACES - BALL COURT SURFACES

EXT10.M110.9 BALL COURT SURFACES

As scheduled on Drawings.

EXT10.M120.A INDOOR BALL COURT SURFACING

1. An Approved proprietary product to BS EN 14904:2006;
2. Slip resistance to BS EN 14904:2006;
3. Limit of VOC contents:
   a. Architectural paints in compliance with FIN7.M010;
   b. Sealant in compliance with WAT5.M110;
   c. Adhesive in compliance with TIM1.M090.
4. Toxicity to BS EN 71-3:2019;
5. Fire performance: as per Code of Practice for Fire Safety in Buildings 2011.

EXT10.M130.A OUTDOOR BALL COURT SURFACING

1. An Approved proprietary product either of the followings:
   a. Inorganic surface coating system as EXT10.M170; or
   b. EPDM system as EXT10.M180.
2. Slip resistance to EXT10.M170 or EXT10.M180;
3. Limit of VOC contents:
   a. Architectural paints in compliance with FIN7.M010;
   b. Sealant in compliance with WAT5.M110;
   c. Adhesive in compliance with TIM1.M090.
4. Toxicity to BS EN 71-3:2019.

EXT10.M140.X DELETED

EXT10.M150.N DESIGN SUBMISSION

1. Before expiry of the …. months from the notified date for commencement of the Works, submit to the CM a proposal from the agent / supplier for the ball court surface to be laid in the designated area(s) for the CM's Approval. The agent / supplier to be proposed by the Contractor for such purpose shall be directly appointed by the ball court surface system manufacturer as his approved installation agent. The design proposal shall include but not be limited to the following:
   a. Catalogue, brand name, model name or number, manufacturer's instruction, installation manual or procedure and color chart etc.;
   b. Name, address and contact person of the local supplier/ manufacturer/ specialist sub-contractor;
   c. Where applicable, either
      i. The document from the manufacturer showing his supplier as the agent/distributor in Hong Kong; or
      ii. The document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed product.
   d. For inorganic surface coating system and EPDM system:
      i. Original or a certified true copy of the certification to ISO 9001 certificate for the manufacturing plant of inorganic surface coating system and EPDM system. If a copy of the ISO certificate is submitted, it shall be certified true by the certification body or by the QCM. The certification body shall either be accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS;
      ii. Full test certification issued by the accredited testing laboratory under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or by an accreditation body with mutual recognition arrangements with HOKLAS or by other laboratory certified under EN ISO/IEC 17025:2017 for performing the test on ball court surface product to demonstrate the compliance of requirement stipulated in either:
         - EXT10.M170 for inorganic surface coating system; or
         - EXT10.M180 for EPDM system.
   e. At least 3 local job reference accepted by Works Department or any other Government Authority in the past 5 years from the date of submission;
   f. Detailed method statement and shop drawings for the installation of the ball court surface and substrate preparation, showing:
      i. Programme of the installation, from preparation of substrate to acceptance of the substrate by the specialist sub-contractor to installation of ball court surface system;
      ii. Division of substrate and its relationship with the dimension of ball court and adjacent structure;
      iii. Type and location of joints;
      iv. Edge, corner, joint treatment, fall direction, finish floor level, etc..
2. Submit revised proposals, drawings and relevant information upon comment or where considered necessary by the CM;

3. Operation instruction, maintenance manual with details on cleaning schedule, method and agents; and repair recommendation, etc. to be submitted within 1 month from the completion of the installation.

EXT10.M160.N QUALITY REQUIREMENTS FOR SUBSTRATE FOR OUTDOOR BALL COURT SURFACING SYSTEM

1. The substrate to receive ball court surfacing system refers to in-situ concrete on top of structure at podium level or on top of sub-base at ground level complying with requirements of Worksection CON1 and as shown on the Drawings;
2. Concrete size to be 6m by 6m for each bay, or maximum to be 10m by 10m per bay. The Contractor is required to submit layout of joints showing relationship to the dimension of ball court and adjacent structure for the CM's Approval. Details and location of expansion and contraction joints, and method statement for the concreting sequence, programme and technique shall be submitted to the CM's satisfaction;
3. Monolithic levelling concrete with fall of 1:100 and levels as shown on the Drawings;
4. Smooth finish: finish with a steel trowel or power floated to a smooth surface and free of blemishes according to clause 10.7 of BS 8204-2:2003+A2:2011;
5. No additional screed for the purpose of fall levelling or smooth finishes;
6. Ponding shall be less than 3mm thick under a 2m straight edge. Surface regularity to Class SR1 of BS 8204-1:2003+A1:2009 and Table 6 of BS EN 14877:2013;
7. Surface shall be free from any laitance, stain, rusting, protrusions, cracks, holes, rubbish, grease, oil and any other foreign matters;
8. Any cracks or damages shall be patched or repaired prior to the application of surface coating. Repairing method as per EXT10.W215 sub-clause (3);
9. Expansion joint with sealant and contraction joint of 1/4 depth of concrete, if any, should be demonstrated in method statement;
10. The Contractor shall notify his specialist sub-contractor to inspect and accept the concrete substrate prior to application of ball court surface materials.

EXT10.M170.N QUALITY REQUIREMENTS FOR INORGANIC SURFACE COATING SYSTEM

1. Mineral based finish of inorganic nature coating system comprising but not less than:
   a. One proprietary primer coat;
   b. Two proprietary under-coats mixed with fine silica sand;
   c. One proprietary top coat.
2. Quality requirements of the physical properties of inorganic surface coating system are as follows:

Properties	Value to be achieved	Test Method/ Standard
Overall nominal thickness	1.0 mm (±10%)	
Surface colour	Uniform and in standard colour	
Air permeability	≥ 380 g/m^2/24 hours	JIS Z0208
Slip resistance	In compliance with FIN5.G050	
Adhesion	≥ 24.5kgf/cm^2 at standard condition ≥ 22.4kgf/cm^2 when immersed in water	6.10 of JIS A6909
Abrasion Resistance	≤ 0.15 mm	JIS K7204 Taber's test 1000 rotations

Accelerated Weather Resistance	No change	5.8 of JIS A6909 WS type, 2000 hours
Water Resistance	No swelling and no peeling	6.8 of JIS K5668, 2 years
Cleaning Resistance	No breathing, no wear and no tear	6.10 of JIS K5668, 1000 times
Gasoline Resistance	No change	7.7 of JIS K5400
Freeze-thaw Resistance	No change	JIS A6910, 20 cycles
Incombustibility	Pass	JIS A1321 flame proof test & Building Ministry notice no. 1828 for incombustibility
Acid Resistance	No change	Tested with Citric acid (pH4) at 60 °C for 7 days
Alkali Resistance	No change	6.9 of JIS K5668, 1 month
Salt Water Resistance	No change	Tested with 3% salt water at room temperature for 3 months
VOC	Max. 250g/L	Prescribed VOC limit

3. The inorganic surface coating system shall comply with the toxicity requirement of BS EN 71-3:2019. Before installation, the Contractor shall submit to the CM the certificate from the manufacturer and the associated test report(s) certifying compliance with the aforesaid international standards;
4. Installation shall be in accordance with manufacturer's instructions;
5. Efflorescence, uneven colouration, greases/ oil, chemical residue, stain, water spot, and defects will not be accepted. When any of the aforesaid arises, coating should be re-done as per approved repairing method.

EXT10.M180.N QUALITY REQUIREMENTS FOR EPDM SYSTEM

1. EPDM system can be either in cast in-situ, roll form or hybrid type;
2. The total thickness of the system for:
   a. Cast in-situ type-EPDM system in layer(s) shall not be less than 10 mm;
   b. Roll form type-EPDM system in layer(s) shall not be less than 8 mm; or
   c. Hybrid type-EPDM system in layer(s) shall not be less than 8 mm.
3. The system shall comply with EN 14877:2013, or the latest edition;
4. Quality requirements of the physical properties of EPDM system are as follows:

Properties	Value to be achieved	Test Method/ Standard
Friction (Dry)	80 to 110	EN 13036-4:2011
Friction (Wet)	55 to 110	EN 13036-4:2011
Shock Absorption	SA 25 to 34	EN 14808:2005
Vertical Deformation	≤ 6 mm	EN 14809:2005
Vertical Ball Rebound	≥ 85% (≥ 0.89 m)	EN 12235:2013 using a basketball

Resistance to Wear	Mass loss between 500 and 1500 cycles shall be less than 4.0g	EN ISO 5470-1:2016 using H18 abrasive wheels and a (1±0.001) kg load at 60 hz/min
Colour Loss	Colour fastness shall be no less than grey scale 3	EN ISO 20105-A02:1995
Tensile Properties	≥ 0.4 MPa	EN 12230:2003
Absolute Thickness	≥ 7mm	EN 1969:2000 (method A)

5. The EPDM system shall comply with the toxicity requirement of BS EN 71-3:2019. Before installation, the Contractor shall submit to the CM the certificate from the manufacturer and the associated test report(s) certifying compliance with the aforesaid international standards;
6. Installation shall be in accordance with manufacturer's instructions;
7. Upon completion of application the quality and performance requirements are as follows:

Property	Value to be achieved	Test Method/ Standard
Surface Regularity	Target requirement: ≤ 6 mm; Maximum size of any permitted deviations: 8 mm; Maximum number of permitted deviations > 6 mm & < 8 mm: 4	EN 13036-7:2003 3m straight edge
	Requirement: ≤ 2 mm; Maximum size of any permitted deviations: 0; Maximum number of permitted deviations: 0	EN 13036-7:2003 0.3m straight edge

EXT10.M190.N LINE MARKING FOR OUTDOOR BALL COURT SURFACING SYSTEM

1. Line marking to be proprietary non-skid coating system as recommended by the approved ball court surfacing system manufacturer;
2. With a drying time not exceeding 30 minutes;
3. Submission of line marking information shall include but not limited to the followings:
   a. Name and type of coating system;
   b. Supplier/ manufacturer information;
   c. International standard in compliance;
   d. Toxicity information and anti-poison or antidote information;
   e. Storage condition and requirement;
   f. Application method in accordance with the manufacturer’s instruction;
   g. Disposal method.
4. Observe the safety standard on application and storage as Worksection FIN7;
5. Submit VOC data for architectural paints in compliance with FIN7.M010.

ADHESIVE AND FIXINGS FOR BALL COURT SURFACING

EXT10.M210.A ADHESIVES USED IN EPDM SYSTEM

1. As recommended by the ball court surfacing manufacturer;
2. Adhesives and adhesive primer shall be in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compound) Regulation and submit VOC data in accordance with TIM1.M090;
3. Submission of adhesive information shall include but not limited to the followings:
   a. Name and type of adhesive;
   b. Supplier/ manufacturer information;
   c. International standard in compliance;
   d. Toxicity information and anti-poison or antidote information;
   e. Storage condition and requirement;
   f. Application method in accordance with the manufacturer's instruction;
   g. Disposal method.
4. Observe the safety standard on application and storage as Worksection FIN7.

EXT10.M220.X DELETED

PLAY SURFACES - IMPACT ABSORBING SURFACING MATERIALS (IASM)

EXT10.M310.9 GENERAL REQUIREMENTS

1. The extent of IASM is shown on the Drawing(s) and shall include safety margin / use zone, underneath and surrounding of the play / fitness equipment as specified in sub-clause (8) of EXT10.M015;
2. In addition to compliance with other requirements stipulated in the Specification for IASM, IASM shall comply with the manufacturers' recommendations for safety, design and installation requirements of the play / fitness equipment under which the surfacing material is to be installed;
3. The IASM shall be in the form of pre-fabricated modular units. Wet-pour IASM applied in-situ shall not be accepted.

EXT10.M320.A QUALITY REQUIREMENTS

1. The quality requirements of IASM are as follows:
   a. A proprietary pre-fabricated synthetic rubber or Ethylene-Propylene-Diene-Monomer (EPDM) product, details as specified by the manufacturer, to comply in all aspects with BS 7188:1998+A2:2009 and / or BS EN 1177:2018, the latest edition of the standards referred to shall apply, and be tested by a recognized laboratory. The laboratory shall be accredited under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or by an accreditation body with mutual recognition arrangements with HOKLAS for performing the tests on IASM. The laboratory shall issue the test results on all test items in one submission of HOKLAS endorsed test certificates or equivalent. The full scope of accreditation shall be submitted for the CM's Approval and acceptance;
   b. The "critical fall height" (as defined in BS EN 1177:2018) of the IASM on which the play / fitness equipment is placed shall be greater than the "free height of fall" (as defined in BS EN 1177:2018) or the "fall height" (as defined in ASTM F1292-18, ASTM F3313-19 & ASTM F1487-17) of the play / fitness equipment. The latest edition of the standards referred to shall apply;

c. The IASM material used shall comply with the toxicity requirement of BS EN 71-3:2019. Before installation, the Contractor shall submit to the CM the certificate from the manufacturer and the associated test report(s) certifying compliance of the IASM materials with the aforesaid international standards;

d. The IASM material used shall comply with weathering test requirement of ASTM D4214-07(2015), D1729-16, D2616-19, or UV resistance of DIN EN1297:2004-12;

e. Submit manufacturer's written confirmation to declare the following:

i. The IASM material shall not contain any heavy metals or their compounds as listed below:

- Arsenic;
- Cadmium;
- Chromium;
- Copper;
- Lead;
- Mercury;

ii. The IASM material shall have no flame retardant of polybrominated biphenyl (PBB), polybrominated diphenyl ether (PBDE) or short-chain chlorinated paraffin added as formulated components.

2. When instructed by the CM, collect samples from the Site prior to the installation of IASM for laboratory tests in accordance as per EXT10.T005.

EXT10.M330.9 DESIGN SUBMISSION

1. Before expiry of the …. months from the notified date for commencement of the Works, submit to the CM design proposal(s) from supplier(s) for the IASM to be laid in the designated play / fitness area(s) for each of the area(s) as shown on Drawing no(s). …….. for the CM's Approval. The supplier(s) to be proposed by the Contractor for such purpose shall supply and install IASM. The design proposal shall:

a. Include the IASM catering for the critical fall height requirements in individual designated play / fitness area stated in EXT10.M015 (8) (according to Drawing no(s) ……. or the recommended critical fall height of play equipment submitted in the design proposal whichever the higher), fixing details and other builder's works requirements in compliance with the Drawings, the requirements stated in EXT10.M310, EXT10.M320 and this clause;

b. Provide information including but not limited to the country of origin, place of manufacture, and date of manufacture, manufacturer's instruction on installation, maintenance and inspection procedures of the IASM;

c. Indicate design patterns and maximum critical fall height of IASM in each designated play / fitness areas as shown on Drawing nos. ……..

The Contractor shall be responsible for the identification of supplier(s), and there shall be no more than 3 suppliers supplying and installing the IASM for the whole Site;

2. Submit revised proposal, drawings and relevant information upon comment or where considered necessary by the CM;

3. Upon notification in writing by the CM of the Approved design proposal, engage the supplier providing the IASM of the Approved design proposal as the Approved sub-contractor for the supply and installation of the Approved IASM;

4. The supply and installation of the IASM shall comply with international standards of safety. Those international standards of safety are namely BS 7188:1998+A2:2009, BS EN 1177:2008 and / or ASTM F1292-13, ASTM F1487-11 for all aspects including critical fall height etc.,the latest edition of the standards referred to shall apply. Document and certifications issued by the accredited international testing laboratory to prove that the IASM is in compliance with recognised international standards shall be submitted. Submit samples of IASM with test certificates to the CM for approval prior to ordering / purchasing.

EXT10.M340.9 DELIVERY

1. The IASM delivered to the Site shall be labelled in batch with country of origin, place of manufacture, date of manufacture etc. by the manufacturer and in good condition with intact packaging by the manufacturer. Any batch / lot / piece of the IASM that was manufactured earlier than a period of 9 months before delivery to the Site shall not be accepted or installed;
2. Submit written confirmation from the manufacturer of the place of origin and relevant documentary evidence such as Delivery Note with batch numbers and Laboratory Test Certificate.

EXT10.M350.9 WARRANTY

The Contractor and Approved sub-contractor for the design, supply and installation of the IASM shall separately warrant the Employer in respect of the IASM as detailed in Clause SCC7.6 of the Special Conditions of Contract.

EXT10.M360.9 APPLICATION OF REQUIREMENTS OF OTHER WORKSECTIONS

Where applicable, comply with the relevant provisions of the following Worksections unless otherwise specified in this Worksection:

1. Earthworks: Worksection EAR1;
2. Sub-bases and bituminous materials: Worksection EXT1;
3. Concrete pavings (including formwork, reinforcement, concreting, jointing and finishing): Worksection EXT2.

WORKMANSHIP

GENERAL

EXT10.W010.9 HANDLING AND STORAGE

Handle and store equipment and surfacing materials carefully as per the manufacturer's recommendations and in a manner that:

1. Prevents damage to pre-finished surfaces;
2. Retains protective coverings in position;
3. Prevents contact with harmful elements.

EXT10.W020.9 BUILDER'S WORK IN CONNECTION

.....

EXT10.W030.9 FIXING, ASSEMBLING AND LAYING

Carry out any fixing, assembling or laying in accordance with the manufacturer's instructions.

INSTALLATION OF PLAY/FITNESS EQUIPMENT

EXT10.W110.9 GENERAL

1. Install play / fitness equipment in accordance with manufacturer's instructions, which should comply with BS EN 1176: 2008 and / or ASTM F1487-11,the latest edition of the standards referred to shall apply;
2. All materials and workmanship shall be of the respective character, quality or kind required by this Contract and shall be subject to such examinations, measurements or tests as required by this Contract or as ordered by CM. The measurements and tests are to be carried out by the Contractor;
3. The Contractor shall submit to the CM upon the arrival of the play / fitness equipment and signage on Site, the original or certified true copy of manufacturers' certificates and invoices for verification of the origin of the play / fitness equipment and signage delivered to the Site against the Approved design proposal as stated in EXT10.M015.

EXT10.W120.9 INSTALLATION

1. Ensure play / fitness equipment is placed and fixed in the position and in accordance with safety margin / use zone requirement as shown on the Drawings or to manufacturer's recommendation;
2. Before installing any play / fitness equipment, check and ensure that all permanent draw pits, catch pits, manhole covers and surface channels shall be located outside the safety margin / use zone of the designated play / fitness area as shown on the Drawings and / or Approved design proposal as stated in EXT10.M015. If any permanent draw pits, catch pits, manhole covers or surface channels are found within the safety margin / use zone of the play area, revise the Approved design proposal as necessary to avoid them and re-submit to the CM for approval. Allow sufficient time for any associated checking, re-submission and CM's approval;
3. Upon completion of the installation of play / fitness equipment, the agent(s) shall self-certify that all installed play / fitness equipment on the Site are in compliance with the manufacturer's instruction of installation as stated in EXT10.M010 and the Approved design proposal as stated in EXT10.M015;

4. Upon completion of the installation of play / fitness equipment, the Contractor shall also include the audit report of compliance check / safety audit for all installed play / fitness equipment within each play area which has to be in compliance with the international standards of safety in EXT10.M015(1)(c) by the appointment of either:
   a. A Play Consultant (PCon) as specified in EXT10.M010 (6);
   b. A laboratory accredited under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or by an accreditation body with mutual recognition arrangements with HOKLAS who is qualified to carry out safety compliance check.

   who shall carry out the compliance check / safety audit on the completed installation in accordance with BS 7188:1998+A2:2009, BS EN 1177:2008 and / or ASTM F1292-13, ASTM F1487-11, the latest edition of the standards referred to shall apply.

EXT10.W130.9 EXISTING PLAY / FITNESS EQUIPMENT

Dismantle and set aside existing play / fitness equipment(s) that is / are to be retained in a secure enclosure. Re-assemble once the playground surface has been completed.

LAYING OF BALL COURT SURFACES

EXT10.W210.A GENERAL

1. Obtain the specialist sub-contractor's agreement to the suitability of the substrate for laying surfacing materials;
2. Prepare the substrate concrete in accordance with the Specification and Drawings and in accordance with EXT10.M160 for all outdoor ball court;
3. Lay the ball court surfaces in accordance with the manufacturer's instructions and as shown on the Drawings and Approved shop drawings. Set out ball court on site and obtain Approval from the CM.

EXT10.W220.A INSPECTION PRIOR TO LAYING SURFACING MATERIALS

1. Inspect existing surface to ascertain suitability to receive the surfacing materials. Ensure the existing surface is clean, free from defects, projections and deleterious material that would affect the laying of the surfacing materials;
2. Carry out all works necessary to ensure correct installation of the surfacing materials.

EXT10.W230.A SURFACES PREPARATION

Prior to the application of the ball court surfacing materials:

1. Final check surface smoothness prior to the application of ball court surfacing materials;
2. Sweep, clean and prepare base removing all dirt, grease and loose or other extraneous matter;
3. Repair, cut out and fill, using material compatible with the base, all cracks, hollows or other imperfections;
4. Carry out all works necessary to ensure correct installation of the surfacing materials;
5. Ensure that the base substrate concrete is dry prior to surfacing materials being laid.

EXT10.W240.A DRAINAGE

Install subsurface drainage under the IASM and lay base to falls and levels as shown on the Drawings.

EXT10.W250.9 LAYING

1. Recess all fixing bolts and eyelets below the surfacing materials;
2. Ensure no gaps are left between the surfacing materials and the adjoining hard surface;

3. Cut and fit the surfacing materials to form a close and neat joint around edge and all upstands;
4. Ensure the finished surfacing is even and free from irregularities or projections.

EXT10.W251.N APPLICATION OF INORGANIC SURFACING SYSTEM

1. Apply inorganic surface coating system in strict accordance with the manufacturer's instructions;
2. Joint sealant to be covered with one proprietary top coat or line marking;
3. Saw joint to be covered with all coats of the system as per EXT10.M170;
4. Ensure the finished surfacing is even and free from irregularities or projections;
5. Touch up all surfaces, if required, upon completion;
6. Protect and clean ball court surface upon completion of the application.

EXT10.W252.N APPLICATION OF EPDM SYSTEM

1. Apply EPDM system with the approved adhesive and in strict accordance with manufacturer's instructions;
2. Seam for roll form EPDM should be sharp cut, where applicable;
3. Cut and fit the surfacing materials to form a close and neat joint around edge and all upstands;
4. Ensure no pop-up nor peel-off in all direction. Ensure the finished surfacing is even and free from irregularities or projections;
5. Ensure no gaps are left between the surfacing materials and the adjoining hard surface;
6. Touch up all surfaces, if required upon completion of the application;
7. Protect and clean ball court surface upon completion of the application.

EXT10.W260.X DELETED

EXT10.W270.9 ADHESIVES

Ensure all adhesive and jointing materials used are compatible with the ball court surface and the base material.

EXT10.W280.A LINE MARKING FOR BALL COURT SURFACES

Apply line marking in accordance with the manufacturer's instructions when all quality requirements of the ball court surfacing system have been completed.

INSTALLATION OF IMPACT ABSORBING SURFACING MATERIALS (IASM)

EXT10.W310.9 GENERAL INSTALLATION REQUIREMENTS

Install the IASM in strict compliance with manufacturer's instructions and specification.

EXT10.W320.9 SAMPLES AND DATA

1. Submit samples of the IASM as stated in EXT10.M330, adhesives and fixings for CM's approval before installation;
2. Before the installation works, submit material testing results as stated in EXT10.T005 and safety data for the adhesive in connection with the installation / laying of the IASM accompanied with the manufacturer's requirements and recommendation on safety precautionary measures.

EXT10.W330.9 SURFACING MATERIAL AND ITS FOUNDATION

1. Lay the IASM in accordance with manufacturer's instructions and ensure all adhesive and jointing materials used are compatible with the IASM and the base material;
2. Prepare the base and foundation properly to receive the IASM in accordance with the manufacturer's requirements;
3. The surfacing material shall fit the designated play / fitness area as shown on the Drawings with no gap and level difference between adjoining IASM units and between the peripheral IASM units and its surrounding surface, and shall also fit closely around all play / fitness equipment (and its posts / fittings).

EXT10.W340.9 DRAINAGE

*Install surface drainage under the IASM as specified in Project Specification and in accordance with the Drawings.

*Lay base to falls and levels as shown on the Drawings.

TESTING

ON-SITE VERIFICATION TEST - IMPACT ABSORBING SURFACING MATERIALS (IASM)

EXT10.T005.A VERIFICATION TESTING

1. Test Arrangements:
   a. Carry out verification test in a laboratory approved by the CM when:
      i. Upon delivery of IASM material to site under a Delivery Note;
      ii. During the course of construction when directed by the CM.
   b. Comply with the followings pertaining to tests:
      i. Provide attendance on the Site;
      ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.
2. Testing Samples:
   a. Samples shall be selected by the CM and witnessed by representative of the Contractor;
   b. Collect one set of samples (minimum four whole piece samples for each thickness);
   c. Bear all cost for any replacement samples.
3. Testing Methods:
   a. By a laboratory complying with PRE.B9.570 carried out in accordance with BS 7188:1998+A2:2009, BS EN 1177:2008 and / or ASTM F1292-13, ASTM F1487-11, and BS EN 71-3, or DIN18035 Part 6 & 7 in relation to the toxicity requirement, the latest edition of the standards referred to shall apply, but not limited to, the following quality and performance requirements of the IASM:
      i. Critical fall height;
      ii. Resistance to indentation;
      iii. Ease of ignition;
      iv. Slip resistance;
      v. Toxicity requirement.
   b. The laboratory shall issue to the CM with copy to Contractor the test results on HOKLAS or by an accreditation body with mutual recognition arrangements with 'HOKLAS Approved Signatory' test reports, stating the final testing result on all test items with supporting data for each tested item, directly to the CM.
4. Non-compliance:
   a. In the event that any one of the tests fails to meet the test requirements as stated in sub-clause 3(a):
      i. Remove the representative batch off Site, a representative batch means the materials delivered to Site under the same Delivery Note; or
      ii. Apply to the CM for re-test for the representative batch in accordance with sub-clause (1) on three separate samples, each sample with a minimum of four whole pieces and make up of a total of 12 pieces selected by the CM in a laboratory that complies with the requirements as stated in sub-clause (1). In case of any one sample fails the re-test, remove the representative batch off Site.

b. When the representative batch of IASM material is removed off Site, re-deliver and re-test as stated in sub-clause (1);

c. Bear all additional time and costs arising from or in connection with any re-tests.

5. When instructed, further verification tests shall be carried out by the CM or a Direct Contractor during the course of construction as directed by the CM.

a. Comply with the following pertaining to the verification tests:

i. Provide attendance on the Site;

ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.

b. Test Samples as per sub-clause (2);

c. Test Methods as per sub-clause (3);

d. Non-compliance as per sub-clause (4).

EXT10.T010.9 IN-SITU DROP TEST

1. Upon completion of installation of the IASM, carry out the in-situ drop test on critical fall height in accordance with BS EN 1177:2008 and / or ASTM F1292-13, ASTM 1487-11, the latest edition of the standards referred to shall apply, at random sampling of not more than 5% by area or four pieces of mats / tiles, whichever is larger by area, in each designated play / fitness area, to be agreed with the CM, for each thickness category of IASM installed, inclusive of all ingress / egress, landing zone of the play / fitness equipment and submit to CM the in-situ drop test / re-test results on HOKLAS endorsed test certificates with written certification;
2. Exact locations for carrying out the in-situ test shall be verified by the CM;
3. Non-compliance:

a. In the event that any in-situ drop test fails to meet the critical fall height requirements, remove and re-install the IASM that failed the test, and take three separate in-situ drop tests of the same designated play area of IASM supplied and installed by the same Approved sub-contractor in sub-clause (1) at three separate locations within the same designated play / fitness area for re-test;

b. Where any of the re-tests fails to meet the testing requirements as specified in sub-clause (1), all IASM of the same batch supplied and installed by the same Approved sub-contractor represented by the failed mats / tiles shall be removed;

c. When the representative batch of IASM material is removed off Site, re-install the IASM and re-test the rectified areas in accordance to sub-clauses (1) and (2);

d. Bear all additional time and costs arising from or in connection with any re-tests.

4. At a date to be agreed with the CM but not prior to the expiry of 18 months from the date of completion of the respective Section of Works as certified by CM, carry out the in-situ drop test on the critical fall height in accordance with the test version in sub-clauses (1) and (2) above. Re-conduct the in-situ drop test(s) on the IASM in accordance with sub-clause (3) should the in-situ drop test fail. Bear all associated costs and time incurred for the retesting required and replacement of sub-standard IASM;
5. Testing of critical fall height should refer to critical fall height of IASM specified and as shown on Drawings.

EXT11 EXISTING VEGETATION TREATMENT

MATERIALS

GENERAL

EXT11.M010.9 ANTI-DESICCANT SPRAY

Anti-desiccant spray to be approved proprietary water dispersed plastic spray type.

EXT11.M020.9 HESSIAN BINDING

Hessian binding to be natural woven jute, natural brown colour, 150 to 200 mm wide in a continuous roll.

EXT11.M030.9 JUTE STRING

Jute string to be braided jute fibres, total 3 mm diameter, natural brown colour.

WORKMANSHIP

GENERAL

EXT11.W010.9 SCOPE OF EXISTING VEGETATION TREATMENT

The extent of works required, conditions of site, tree felling, vegetation treatment, weed and creeper removal etc. and any individual plants requiring treatment and/or transplanting are given in the Project Specific Specification.

EXT11.W020.9 PRE-TENDER INSPECTION

Prior to tendering inspect the site to confirm the extent of the works and that maintenance works specified can properly be carried out.

EXT11.W030.9 TOOLS AND EQUIPMENT

Ensure tools and equipment used are sharp and appropriate for the works specified.

EXT11.W040.9 EROSION

Carry out all operations taking precautions to prevent erosion and slippage of slopes.

PRESERVATION OF EXISTING TREES AND SHRUBS

EXT11.W052.A PROTECTION OF EXISTING VEGETATION

Option A

1. Protect all existing trees, palms, bamboos and other vegetation within, adjoining or outside the Site boundary as shown on the Drawing no(s). ……. under Appendix B to this Specification, unless specified or instructed to be pruned or felled by the CM;

Option B

1. Protect all existing trees, palms, bamboos and other vegetation within, adjoining or outside the Site boundary which are being or will be affected by the carrying out of the Works, unless specified or instructed to be pruned or felled by the CM. The existing trees, palms, bamboos and other vegetation known to be in the vicinity of the Site are as shown on the drawing no(s). ……. under Appendix U to this Specification for reference only;
2. Protect the branch structure, crown and root zone of all existing trees, palms and bamboos to be retained and any overhanging vegetation, unless specified or Instructed to be pruned;
3. Erect necessary structural support constructed with GMS hollow sections or I- beams as directed by the CM when working around existing trees to ensure their structural stability and proper growth throughout the construction period.

EXT11.W055.9 PROTECTION FOR PRESERVED TREES

Exercise the greatest care to avoid any damage to the preserved trees by complying with the following:

1. Take all necessary precautions to ensure that:
   a. No nails or other fixings shall be driven into the trees, including the exposed tree roots;
   b. No fencing, services, or signs other than the identification labels or markings required under sub-clause (5) of PRE.B8.1116 shall be attached to any part of the trees;

c. No trees shall be used as anchorages for ropes or chains used in guying or pulling or for equipment used for removing stumps, roots or other trees, or for any other purposes;

d. No soil, materials, equipment or machinery shall be stockpiled or stored within the tree protection zones;

e. No site offices, workshops, canteens, containers or similar structures shall be installed within the tree protection zones;

f. Petrol, oil, bitumen, creosote, cement and other materials likely to be injurious to the trees shall be kept away from the tree protection zones, and any accidental spills of these materials shall be cleaned up immediately;

g. Excessive water shall be drained away from the tree protection zones to prevent damage to tree roots by asphyxiation;

h. The surface on slopes shall be shaped so that water will not drain to the tree trunks but bypass them;

i. No passage or parking of vehicles and no operation of equipment or machinery shall take place within the tree protection zones unless otherwise agreed by the CM;

j. No stripping of surface vegetation or top layer of soil, and no paving or earth filling shall be carried out within the tree protection zones unless otherwise agreed by the CM;

k. No fires shall be lit within the tree protection zones or in a position where the flames will likely extend to within 5 m of foliage, branches or trunks of the trees, taking into consideration the size of the fire and the wind direction;

l. No concrete mixing, gas tank filling, paintbrush and tool cleaning, or equipment maintenance shall be carried out within the tree protection zones;

m. Any necessary scarification or cultivation within the tree protection zones shall be carried out carefully by hand so as not to cause damage to the trees, in particular the bark and the roots;

n. Any equipment, in particular delivery vehicles, overhead cranes, excavation machines, drilling rigs and piling rigs, shall be carefully operated so as not to cause striking of the trunks, branches, foliage or root collars of the trees;

o. The trees to be felled that are adjacent to, or that lie within a continuous canopy of, the preserved trees, shall be carefully removed, and if necessary in sections but not using bulldozers in any circumstances, so as not to cause damage to the preserved trees such as scraping bark off trunks or breaking branches of trees;

p. Do not use herbicides that can leach through the soil, such as the products containing sodium chlorate, and any other herbicides that are injurious to the trees when it is necessary to use herbicides to kill any vegetation;

q. Make allowance for the slope of the ground so that damaging materials such as concrete washings, mortar or diesel oil cannot run towards the trees;

r. Do not use alkaline clays or limestones for filling or paving. Mix concrete on a thick plastic tarpaulin or outside the Site and rinse the mixing trucks out on the Site, so as not to cause changes, in particular increases, in soil pH;

s. Haul away all building debris and chemical wastes for proper disposal. In any circumstances, do not burn or bury them on the Site and do not dispose them by pouring them on the soil within the Site.

2. Repair any damage to the trees in accordance with the requirements stipulated in EXT11.W712;

3. Where the passage or parking of vehicles or the operation of equipment or machinery within the tree protection zones as referred to in sub-clause (1)(i) above is considered necessary and is agreed by the CM, carry out the following measures to reduce soil compaction:

a. Minimise the traffic of the vehicles, equipment or machinery;

b. Confine the passage or parking of vehicles or operation of equipment or machinery to the areas laid with temporary protective mulching and also with double, overlapping, thick metal sheet coverings, or other materials of equivalent strength as agreed by the CM, placed on top.

4. Where it is necessary to clear the existing undergrowth within the tree protection zones to allow access and visibility for, and operation of any construction work, comply with the following:

a. Prune shrubs and grass or cut other herbaceous plants to a height of not less than 50 mm above the ground level that they shall not be pulled out by equipment in any circumstances;

b. Obtain CM's agreement prior to commencing the vegetation clearance.

5. Protect the preserved trees, where necessary, from increased exposure to sun and wind due to removal of adjacent trees;

6. Align all routes of the overhead services within the Site and all access routes to the Site or within the Site away from the preserved trees as far as possible and seek the CM's approval to the alignment;

7. Report to the CM of any preserved tree having structural defects or unhealthy or decaying symptoms which may pose danger to the public if the tree falls.

EXT11.W060.9 PHOTOGRAPHIC RECORD OF EXISTING TREES

1. Provide a full set of photographs of each individually numbered tree as shown on Drawings or as Instructed at the commencement of the Works for the CM's agreement on the existing conditions of the trees. Comply with the following requirements for the photographs:

a. All photographs shall be date-stamped to indicate the dates that the photographs are taken and shall be well-annotated; and

b. The photograph of each tree shall show clearly the whole tree as far as possible, the identification number of the tree, and the status of the tree as identified by the labelling or marking system on the Site.

2. Update the photographic record of the non-OVT taken in accordance with sub-clause (5)(e) of PRE.B8.1116 and submit a report on the updated photographic record to the CM at every three months intervals. Comply with the following requirements for the photographic record:

a. Each of the reports shall comprise all preserved non-OVT;

b. Each of the reports shall be in the form of an A4-sized, bound document which shall bear a report cover indicating the Contract number, Contract title, and date of the report;

c. The format of the reports shall be agreed by the CM prior to the submission of the first report;

d. All photographs shall be date-stamped to indicate the dates that the photographs are taken and shall be well-annotated;

e. The photograph of each tree shall show clearly the whole tree as far as possible, the identification number of the tree, and the status of the tree as identified by the labelling or marking system on the Site as required in sub-clause (5) of PRE.B8.1116;

f. Each of the reports shall include details of any damage caused to the trees and any signs of health deterioration of the trees in the reporting period, accompanied with photographic record of the damage and the tree deterioration.

EXT11.W062.A RECORD OF PRESERVED AND TRANSPLANTED TREES INCLUDING OLD AND VALUABLE TREE (OVT)

1. Engage a Qualified Arborist (QAr) as specified in PRE.B8.1230 to prepare and submit the monitoring reports on the preserved and transplanted trees, including OVT in accordance with the following requirements:
   a. The timetable for submission of reports shall be as follows:

Period	Frequency of submission of monitoring reports	Time frames for submission of monitoring reports
From the date of commencement of the employment of the QAr to the completion date certified by the CM.	At monthly intervals	Within the first week of each month
Within the Maintenance Period to until the preserved and transplanted trees, including OVT, are handover to LCSD or a Direct Contractor employed direct by the Authority.	At bimonthly (every two months) intervals	Within the first week of every two months

   b. The reports shall be in the form of an A4-sized, bound document which shall bear a report cover indicating the Contract number, Contract title, and date of the report and shall be signed by the QAr;
   c. The format of the reports shall be agreed by the CM prior to the submission of the first report.
2. Submit method statements for the work, the site activities, and the precautionary or mitigation measures in respect of the preserved and transplanted trees, including OVT, as described in the following items:
   a. Work planned to be carried out to each of the preserved and transplanted trees, including OVT, in the next reporting period, including but not limited to the recommended arboricultural work as part of tree maintenance, repair to damage or health deterioration, or precautionary or mitigation measures against damage by site activities;
   b. Other site activities planned to be carried out within the tree protection zone of each of the preserved and transplanted trees, including OVT, in the next reporting period, including but not limited to the tree preservation and protection work stipulated in PRE.B8 and EXT11;
   c. Potential damage to the preserved and transplanted trees, including OVT, by the site activities planned to be carried in the next reporting period and proposed precautionary or mitigation measures;
   d. Any other details relevant and specific to the purpose of the reports.
3. Obtain the CM's approval prior to the commencement of such works / activities, and ensure that the QAr shall carry out the following:
   a. Provide arboricultural advice in the preparation of the method statements as per sub-clause (2) above and the preparation of any reports on repair of damage of the preserved and transplanted trees, including OVT;
   b. Supervise arboricultural work to the preserved and transplanted trees, including OVT;
   c. Provide on-site advice in relation to site control within the tree protection zones of the preserved and transplanted trees, including OVT and at their adjacent areas.

EXT11.W075.9 WATERING EXISTING VEGETATION

Water existing vegetation with non-toxic water to keep it in a healthy condition; during the dry season, water at least three time per week at the rate of 10 litres per sq. m.

EXT11.W085.A PRUNING OF EXISTING TREES

1. Do not carry out pruning to the preserved trees, including OVT, without the prior approval of the CM unless the pruning work is required under the Contract or is directed by the CM. Notify the CM of any preserved trees, including OVT, the branches of which interfere with the Works and thus require pruning. Carry out the approved pruning work during the site clearance stage unless otherwise instructed or agreed by the CM;
2. Comply with the following when carrying out the pruning work:
    a. Provide all necessary tools and equipment, and physical support, and take all necessary safety precautions to protect the people engaged in the pruning work as well as the people and property in the vicinity;
    b. For all pruning work to the preserved and transplanted trees, including OVT, the extent of pruning shall be agreed between the QAr and the CM on the Site prior to the commencement of the pruning work and the pruning work shall only be carried out under the supervision of the QAr;
    c. Carry out all pruning work in accordance with good horticultural practice and the recommendations of BS 3998;
    d. Do the pruning and removal of branches by using sharp, clean implements to give a single flat, sloping face;
    e. Trim ragged, rough edges of bark or wood cleanly from around wounds with a sharp knife to the minimum extent that is necessary so as to hasten wound closure, and cut twigs less than 15 mm diameter with sharp secateurs;
    f. Carry out pruning with the cut just above and sloping away from an outward-facing healthy bud, and carry out the removal of branch by having the final cut of the last branch segment made just outside the branch collar when it is present or at an angle being the mirror image of the branch bark ridge when there is no branch collar, so that no part of the stem is damaged or torn, and no snags or stumps are left;
    g. Remove large branches in stages beginning with the removal of the main weight of the branch from perimeter of crown in towards the trunk and with the final cut of the last branch segment made in a way as described in sub-clause (2)(f) above, without leaving a stub and damaging the bark;
    h. Make all cuts to avoid splintering or tearing of bark that would catch water and encourage rot, and cut back cracks, cavities or rotten wood with a clean, sharp implement to remove the dead, damaged and decayed tissue without damaging the living tissue;
    i. Do not carry out topping, which is cutting off all of the top branches to the same height, in any circumstances;
    j. Unless otherwise instructed by the CM, leave any cuts or wounds uncovered instead of painting them with wound dressing or coating so as to avoid water retention and disease development;
    k. Remove any material pruned from the trees away from the Site as soon as possible;
    l. Reinstate any adjacent areas affected by the pruning work;

m. If tree surgery and pruning works is required to trees adjoining but outside the Site boundary, and with canopies or branches encroached into or trespassed on the Site, the Contractor shall provide method statement for the tree surgery and pruning works, coordinate, liaise and seek advice and / or approval from the tree owner / maintenance agents and / or relevant Authority / Government Department prior to the commencement of the tree surgery and pruning works.

EXT11.W090.9 CONTROL OF PEST AND DISEASE FOR EXISTING TREES

1. Take all necessary precautionary measures to protect the preserved trees from pest and disease attack, and all necessary control measures to eradicate pest and disease from the infected trees in the execution of the Works;
2. Before commencing the application of the pest and disease control measures, submit the method statements for the control measures to the CM for approval:
   a. The method statements for the pest and disease control measures shall cover, amongst other aspects as required by the CM, the pesticide or fungicide to be used and any other necessary associated arboricultural work to the infected areas.
3. Commence the application of the control measures only after obtaining the CM's approval to the method statements;
4. Comply with the following requirements in applying the pest and disease control measures:
   a. Adopt environmental friendly measures; and
   b. Follow strictly the safety precautions as the manufacturer's instruction in using pesticide or fungicide so as to avoid causing danger or harm to the public and the environment.

SITE CLEARANCE

EXT11.W110.9 GENERAL

1. Clear all existing vegetated areas of all rubbish, waste materials and felled timber, including any generated from the works specified herein;
2. Clear all debris, rubbish, silt etc. from drainage channels, catchpits and grilles thereon;
3. Clear each part of the site at times and to the extent required by this Specification and as Instructed;
4. Remove cleared materials from site to a properly designated tip.

EXT11.W120.9 UNDERGROWTH CUTTING

Carry out a complete undergrowth cut and clear scrub and bushes by hand or by Approved mechanical means.

EXT11.W130.9 CREEPER CLEARANCE

Clear all wild creepers entwining existing trees and shrubs and grub up their entire root systems.

REMOVAL OF EXISTING TREES

EXT11.W210.A GENERAL

Fell diseased, dead trees and trees marked with removal granted as shown on the Drawing no(s) …….. or as Instructed. Subsequent handling of yard waste shall comply with Worksection EXT18.

EXT11.W220.9 TREE REMOVAL

Completely remove the tree including the stump to the extent of the depth of the root system below ground, by hand, machine hacking or grubbing out.

EXT11.W230.9 LARGE TREES IN CONFINED SPACES

Carefully take down in sections any large trees in confined spaces or near other trees which are to be retained.

EXT11.W240.9 PROTECTION MEASURES FOR TREES TO BE FELLED/TRANSPLANTED

The limits of site clearance shall be agreed by the CM on the Site before site clearance commences. Comply with the following requirements in respect of tree removal, either by felling or by transplanting:

1. In respect of tree felling, comply with the following:
   a. Fell only those trees earmarked for such under the Contract and labelled for such on the Site pursuant to sub-clause (5) of PRE.B8.1116 or those as directed or approved by the CM;
   b. Take all necessary precautions to protect the people engaged in the tree felling work as well as the people and property in the vicinity;
   c. Fell the trees by cutting them near the ground, with their stumps ground rather than pulled so that the roots of the nearby plants to be retained are not injured;
   d. Remove the stumps and rootballs of the felled trees carefully to avoid causing damage to the roots of the nearby plants to be retained, where it is necessary to have such removal as directed by the CM;
   e. Remove all debris, wood, and roots where necessary pursuant to sub-clause (1)(d) above, from the trees felled from the Site as soon as possible.
2. In respect of tree transplanting either within or off the Site, comply with the following:
   a. Transplant only those trees earmarked for such under the Contract and labelled for such on the Site pursuant to sub-clause (5) of PRE.B8.1116 or those as directed or approved by the CM;
   b. Commence any work related to tree transplanting on the Site only after having complied with the requirements stipulated to be completed prior to commencing the tree transplanting work.
3. Where it is found necessary for the completion of the Works to remove, either by felling or by transplanting, any trees other than those earmarked for such under the Contract or those directed or approved for such during the progress of the Works by the CM, carry out the following:
   a. Report to the CM the necessity of such tree removal;
   b. Provide all reasonable assistance as required by the CM in the tree survey and the justification for the proposed tree removal with substantiation and the necessary details such as method statement, site formation plan and architectural or engineering drawings, for the CM's preparation of the tree felling or transplanting application for the tree removal.

TRANSPLANTING EXISTING TREES AND PALMS

EXT11.W310.9 GENERAL

1. Make reference to Development Bureau's 'Guidelines on Tree Transplanting' and submit a 'Method Statement' for CM's approval;
2. Carry out tree transplantation in accordance with true horticultural practice and use specialist equipment as required;
3. Wrap trunk and large lower branches with hessian binding, as EXT11.M020, and tie with jute string, as EXT11.M030, at least one day prior to rootball preparation;

4. Sever lateral roots in stages over a period of at least 8 weeks prior to transplantation when instructed;
5. Treat all trees transplanted as new planting with respect to planting methods and defects liability except that any replacements as SLW9.W130 will be limited to the normal maximum size commercially available for that plant species;
6. Protect trees during transportation as SLW1.W210 (1).

EXT11.W320.9 IMMEDIATE TRANSPLANTATION

Transplant existing semi-mature trees, within two hours of uplifting, either:

1. To their final positions; or
2. To Contractor's temporary store as Instructed.

EXT11.W330.9 ROOTBALLS

1. Make reference to Development Bureau's 'Guidelines on Tree Transplanting' for rootball preparation; and
2. Keep rootballs intact with the soil to the appropriate sizes as shown on the Drawings and wrapped in hessian.

EXT11.W340.9 WATERING

1. Fill tree pit with water and allow to drain before planting;
2. Keep the whole tree, including rootball and heissan binding, moist at all times;
3. Water the transplanted trees (thoroughly soaked into the rootball soil) everyday during the first three months after transplant to keep them in healthy condition, irrespective of temperature, except in periods of heavy rainfall as determined by the CM.;
4. Afterwards, water to field capacity the area covered by the spread of transplanted trees three times per week or as Instructed by the CM.

EXT11.W350.9 CROWN THINNING

Carry out limited crown thinning prior to rootball preparation, to those trees scheduled and/or shown on the Drawings, as Worksection SLW8. Retain form and shape of tree.

EXT11.W360.9 ANTI-DESICCANT SPRAY APPLICATION

Prior to rootball preparation spray trees thoroughly when required, covering whole of leaves, branches and trunks:

Apply spray in accordance with manufacturer's instructions.

TRANSPLANTING EXISTING SHRUBS AND BAMBOOS

EXT11.W410.9 GENERAL

Treat all shrubs transplanted as new planting with respect to planting methods and defects liability except that any replacements, as SLW9.W130, will be limited to the normal maximum size commercially available for that plant species.

EXT11.W420.9 TRANSPLANTATION

Transplant existing shrubs and bamboos within two hours of uplifting either:

1. To their final positions as shown on Drawing or as Instructed; or
2. To Contractor's temporary store as Instructed.

EXT11.W430.9 ROOTBALLS

Keep rootballs intact with the soil to a minimum size of 750 mm diameter and 450 mm depth and wrapped with hessian. Transplant in a suitable size basket and keep moist at all times.

EXISTING SHRUBS

EXT11.W510.9 PRUNING

Prune existing shrubs as SLW9.W430 unless otherwise Instructed.

EXISTING GRASSED AREAS

EXT11.W610.9 REINSTATEMENT

Reinstate existing grassed areas including levelling, grass seeding and post planting operations as Worksection SLW7.

EXT11.W620.9 CUTTING

Cut grass, on existing grassed areas, to 25 mm sward and make subsequent cuts as SLW9.W410.

TREATMENT/REPLACEMENT OF DAMAGED TREES AND SHRUBS

EXT11.W710.9 RESPONSIBILITY

Accept responsibility and costs of treatment or replacement of existing trees/shrubs arising from the execution of the works whether on or surrounding the site.

EXT11.W712.9 REPAIR OF DAMAGE TO EXISTING TREES AND OTHER AFFECTED PLANTS

1. Carry out all necessary work of repair of any damage to the preserved trees and any other damaged plants within the Site together with the necessary mitigation landscape works to reinstate the affected land. Bear all costs for all necessary work of repair of damage and reinstatement works if the necessity for such work is, in the opinion of the CM, due to neglect or failure on the part of the Contractor to comply with any obligation expressed or implied on the Contractor's part under the Contract;
2. The work of repair of damage as per sub-clause (1) above shall include the following:
    a. All necessary arboricultural work to the preserved trees and any other damaged plants, which may include:
        i. Tree surgery work to remove dead, damaged, diseased or hazardous parts, to repair wounds, or to provide cables or braces for additional support;
        ii. Watering and / or mulching in case of water deficiency;
        iii. Applying appropriate fertilizers in case of nutrient deficiency;
        iv. Applying appropriate pest and disease control measures in case of pest and disease attack.
    b. The replacement planting pursuant to sub-clause (7) below for the trees and any other plants damaged to an extent as described in sub-clause (6) below and the subsequent Establishment Works for the new plants for 2 years, when instructed by the CM;
    c. Any other reinstatement work necessary to bring the damaged plants to their original condition prior to the occurrence of the damage, as directed by the CM.

3. Notify the CM of any damage to the preserved trees and other affected plants within the same day of the occurrence of damage and submit to the CM within 24 hours of the occurrence of damage, a report comprising the following information in a format agreed by the CM:
    a. The timing of the damage;
    b. The nature and extent of the damage;
    c. Photographic records of the damage;
    d. The proposed work of repair of the damage;
    e. The proposed protection measures to avoid recurrence of similar incident.
4. When directed by the CM, firm up and secure all dislodged trees and any other dislodged plants and treat all wounds of the damaged plants within 3 days of the occurrence of the damage;
5. Save as stated in sub-clause (4) above, do not carry out any work of repair of the damage prior to the CM's acceptance of the report as required in sub-clause (3) above;
6. Provide replacement planting of the damaged trees and any other affected plants under the following circumstances:
    a. In the opinion of the QAr in the case of an OVT, or the CM in the case of a non-OVT, the damaged plants are dead;
    b. In the opinion of the QAr in the case of an OVT, or the CM in the case of a non-OVT, the trees or other affected plants have been substantially damaged and have become moribund, resulting in one or more of the following conditions:
        i. Imminent plant death within the coming growing season is predicted;
        ii. The structural integrity of the damaged trees or other affected plants is permanently compromised and consequently the trees or other affected plants become an irreparable public hazard;
        iii. Any major parts of the damaged trees or other affected plants have been lost and consequently their form, habit and balance have been grossly altered so that their function cannot be reasonably recovered or the trees or other affected plants are causing harm to other preserved trees.
7. When instructed by the CM, carry out the following:
    a. Carry out the removal of the damaged plants for which replacement planting as sub-clause (6) above is required, in accordance with the following requirements:
        i. For the removal of the damaged trees including any damaged OVT, prepare a tree felling application document to the CM's satisfaction and provide any other assistance or information as required by the CM for applying approval from the appropriate Government approving authority to the felling of the damaged trees;
        ii. Fell the damaged trees including any damaged OVT only after obtaining the CM's approval to the tree felling, which shall normally be given only after the tree felling application has been approved by the appropriate Government approving authority;
        iii. Remove the damaged plants including any damaged OVT from the Site as soon as possible.
    b. Carry out the replacement planting of new plants to compensate for the damaged plants including any damaged OVT in accordance with the following requirements:
        i. Complete the replacement planting within 28 days from the CM's instruction or other time duration as agreed by the CM;

ii. For the replacement planting for the damaged plants including any damaged OVT, plant new plants of the same species and of similar size and form as the damaged plants prior to the damage, or provide other alternative replacement planting together with the necessary mitigation landscape works to reinstate the affected land as agreed by the CM.

EXT11.W714.9 AFTERCARE TO OLD AND VALUABLE TREE

1. Provide the Aftercare to the Old and Valuable Tree for the period as stated in the Contract;
2. Perform the following during the period for the Aftercare to the Old and Valuable Tree as per sub-clause (1) above:
   a. Ensure that the QAr shall prepare and submit monitoring reports on the OVT comprising the details and within the time frames as stipulated in EXT11.W062; the requirements of the report format shall be in accordance with sub-clause (6) of PRE.B8.1116;
   b. Ensure that the QAr shall conduct a final survey of the OVT and a final site survey and final soil tests of its tree protection zone, and submit a report on the same comprising the details and within the time frames as stipulated in EXT11.W062; the requirements of the report format shall be in accordance with sub-clause (6) of PRE.B8.1116;
   c. Carry out any tree maintenance work, work of repair to damage or health deterioration, or precautionary or mitigation measures against damage, to the OVT as recommended by the QAr in the monitoring reports as per sub-clause (2)(a) above, or in the report on final tree survey / final site survey / final soil tests as per sub-clause (2)(b) above, or in any other written advice given by the QAr during the period for the Aftercare to the Old and Valuable Tree.

EXT11.W716.9 ESTABLISHMENT OPERATIONS DURING AFTERCARE PERIOD

During the Aftercare Period, carry out the operations as scheduled below applicable to the Old and Valuable Tree, and in accordance with this Specification:

Operation	Anticipated No.	Timing
Watering	180	Min. twice per week during dry seasons, or as Instructed.
Fertilizing	2	Once per year as Instructed.
Soil aeration	2	Immediately after fertilizer application.
Checking and adjusting tree ties	12	Check every two months; adjust/replace as necessary.
Pruning	Min 2	As Instructed.
Pesticide	As required	Check monthly; treat immediately.
Fungicide	As required	Check monthly; treat immediately.
Typhoon damage; assessment and repair	As required	As specified.

EXT11.W720.9 CIRCUMSTANCES FOR TREE/SHRUB REPLACEMENT

Provide replacement trees for those existing trees/shrubs which were to be retained in the following circumstances:

1. Death of the existing tree/shrub;

2. Substantial damage resulting in a condition that tree/shrub-death is confidently predicted within one year or that the tree/shrub's structural integrity is permanently compromised and consequently is a public hazard;
3. Substantial damage resulting in a condition that the form, habit and balance of the tree/shrub has been grossly spoiled.

EXT11.W730.9 REPLACEMENT TREES/SHRUBS

Replacement trees/shrubs as near as is technically possible to the stature and species as that existing at Contract commencement will be specified.

EXT12 EARTHWORKS

MATERIALS

EXISTING SOILS

EXT12.M010.9 GENERAL

1. Prior to tender, inspect the existing subsoil and topsoil to ensure that it is acceptable for the work specified herein;
2. No claims shall subsequently be considered in respect of existing soils which would relieve the Contractor of his responsibilities under Worksection SLW9 of this Specification.

EXT12.M020.9 EXISTING SUBSOIL

Existing subsoil consists mainly of granular DG, generally derived from original deposits.

EXT12.M030.9 DG AS PLANTING MEDIUM

Soil as EXT12.M020 for planting and grassing has in certain areas been roughly spread by others, and forms the basic constituent of fabricated soil, when mixed with other materials, for planting areas at existing ground levels, and areas already made up.

IMPORTED SOILS

EXT12.M110.9 SUBSOIL

Subsoil to be evenly textured, good clean granular DG containing no stones larger than 50 mm in any dimension, nor any deleterious matter. Do not use any subsoil from land which have been used by industries identified as having potential for causing land contamination as stipulated in “Guidance Note for Contaminated Land Assessment and Remediation” issued by Environmental Protection Department.

EXT12.M120.9 DG AS PLANTING MEDIUM

DG as planting medium to be evenly textured, granular soil free from weeds, deleterious matter, and stones larger than 50 mm in any dimension. Do not use any DG from land which have been used by industries identified as having potential for causing land contamination as stipulated in “Guidance Note for Contaminated Land Assessment and Remediation” issued by Environmental Protection Department.

SOIL CONDITIONERS

EXT12.M210.9 MANUFACTURED SOIL CONDITIONER

Manufactured soil conditioner to be properly composted organic material with the following characteristics:

1. Fine, free flowing consistency;
2. Stable composition;
3. Not capable of raising the temperature of the treated soil more than 5°C above the temperature of the untreated soil;
4. Not made with materials that are known to contain pathogens or other toxic materials injurious to plants, humans, or animals;
5. Giving off neither toxic nor obnoxious fumes;

6. With a pH value between 6.5 and 7.75;
7. With a moisture content of less than 80% (moisture weight as a proportion of overall weight);
8. With an organic matter content of not less than 85% (dry matter);
9. With a carbon to nitrogen ratio between 20 and 55;
10. Heavy Metal:
    a. Arsenic ≤ 41 mg/kg dw;
    b. Cadmium ≤ 39 mg/kg dw;
    c. Chromium ≤ 1200 mg/kg dw;
    d. Copper ≤ 1500 mg/kg dw;
    e. Mercury ≤ 17 mg/kg dw;
    f. Nickel ≤ 420 mg/kg dw;
    g. Lead ≤ 300 mg/kg dw;
    h. Selenium ≤ 36 mg/kg dw;
    i. Zinc ≤ 2800 mg/kg dw.
11. Pathogen:
    a. Salmonella sp. ≤ 3 MPN/4g;
    b. E. coli ≤ 1000 MPN/g.

EXT12.M220.9 CERTIFICATION

For every batch of soil conditioner as EXT12.M210 of 300m³ or part thereof delivered to Site, take one sample for testing as directed by the CM. Every batch of soil conditioner set aside for sampling and testing should be properly segregated and labelled, and not to be used until the CM's approval is given. Within 14 calendar days of taking the samples, submit to the CM certificates of analysis from an Approved laboratory stating:

1. pH (H_2O) value;
2. Moisture content (calculated as the loss in weight between the dry weight and the overall weight as a percentage of the overall weight);
3. Organic matter content (dry weight);
4. Organic carbon content (using loss of ignition `Ashing' method of testing);
5. Nitrogen content ('Kjeldahl' Method);
6. Carbon: nitrogen ratio;
7. Heavy metal content; and
8. Pathogen content.

This sampling and certification requirement may be exempted if the supply of soil conditioner is from an Approved source, such as the composting facilities operated by the Environmental Protection Department. In such case, Contractor is required to submit relevant product literature and quality documents to demonstrate conformation of specified properties for the CM's review and consideration to grant exemption. The operator of the Approved source shall deliver the soil conditioner direct to Site.

EXT12.M230.9 SAND

Sand to be clean, graded non-marine sand of size 4 mm or below.

EXT12.M235.9 GRADED SAND FOR SAND BASED LAWN

Sand to be clean, sharp graded quartz or non-marine sand with particle size distribution as stated in the following table. Certificate of analysis shall be submitted to the CM together with a sample of the sand for every 100 m^3 of graded sand to be used in the Works and prior to execution of any works using the sand.

Particle size distribution of sand for grassed area	
BS test sieve size	Percentage by mass passing (%)
1.18 mm	98 – 100
0.6 mm	85 +/- 5
0.212 mm	20 +/- 5
0.15 mm	0 – 5
0.063 mm	0 – 1

EXT12.M236.9 AGGREGATE FOR SAND BASED LAWN

For area specified as "Sand Based Lawn", aggregate to be washed clean stone, 10 to 15mm in size.

EXT12.M240.A COMPOST

Compost as shown on Drawings, to be:

1. Manufactured soil conditioner: as per EXT12.M210, with a Certificate of Analysis as EXT12.M220; and/or
2. Compost: animal manure as per EXT12.M245 or food waste compost produced by O.Park / or other production facilities operated by Environmental Protection Department (EPD).

EXT12.M245.9 ANIMAL MANURE

Animal manure as shown on Drawings, to be:

1. Well rotted, fully mature and without smell;
2. Accompanied by a Certificate of Analysis as EXT12.M220.

EXT12.M250.9 SYNTHETIC SOIL CONDITIONER

Synthetic soil conditioner to be free flowing synthetic acrylamide polymer crystals, 0.15-5mm in diameter when dry:

1. Capable of absorbing water and nutrients in gel form swelling to 100-550 times of original dry weight;
2. Having a minimum effective life of 2 years when used in the soil.

EXT12.M260.9 COCO PEAT

Coco peat to be finely textured fibrous material derived from the husk of the coconut.

EXT12.M270.9 SOIL BINDER

Soil binder to be an Approved proprietary type and consisted of a binding medium applied in aqueous suspension by spraying onto the surface of the soil to stabilise the soil. The binding agent shall not be injurious to plant growth.

EXT12.M280.N BIOCHAR

1. Biochar to be highly porous form of charcoal converted from woody biomass through pyrolysis, a thermal decomposition process under low oxygen;
2. The Contractor to collect from local production facilities including, but not limited to, those produced by EcoPark and / or other production facilities operated by Environmental Protection Department (EPD), or as approved by the CM. The Contractor shall liaise with EPD's direct contractor if they deliver the Biochar to the Site directly.

FABRICATED SOILS

EXT12.M310.9 GENERAL MIX

Fabricated soils as shown on Drawings, to be:

1. Comprise a mixture of:
   a. 3 parts DG, as per EXT12.M030; or EXT12.M120;
   b. 1 part manufactured soil conditioner, as per EXT12.M210; or
   c. 1 part animal manure, as per EXT12.M245.
2. Comprise a soil which sustains healthy plant growth in a variety of landscape situations free from pernicious weeds, roots, clay lumps, non-soil material and chemical contamination;
3. Certification:

   Take one sample for testing prior to planting, and one sample for every 2,000 m^2 of planting area or part thereof prepared on Site. Submit to the CM certificates of analysis from an Approved laboratory within 14 calendar days of taking the samples. Apply mitigation measures as per EXT12.W260, EXT12.W270, EXT12.W280, and EXT12.W290 if the tested samples do not comply with the following characteristics:
   a. pH value between 5.5 and 6.5;
   b. Organic matter more than 4%;
   c. Nitrogen content more than 0.2%.

EXT12.M320.9 LIGHTWEIGHT MIX

Lightweight soil to comprise a mixture of:

1. 2 parts DG, as EXT12.M120;
2. 1 part manufactured soil conditioner, as EXT12.M210;
3. 1 part vermiculite or volcanic pellets, with a particle size of 5-10 mm.

EXT12.M330.9 SOIL FILLING MIX FOR USE IN GRASS PAVING SYSTEM

Soil filling mix as shown on Drawings, for use in reinforced grass surfaces which are to receive either grass seed as SLW7.M270 or turves as SLW7.M110, to comprise of:

1. 4 parts DG, as EXT12.M030 or EXT12.M120;
2. 1 part manufactured soil conditioner, as EXT12.M210;
3. 2 parts sand as EXT12.M230;
4. Quick release fertilizer as SLW1.M130 at a rate of 300 g/m^3.

EXT12.M340.A ROOT ZONE MEDIUM MIX FOR USE IN SAND BASED LAWN

At top 300 mm of root zone medium mix as shown on Drawings, for use in area specified as “Sand Based Lawn”, to comprise a mixture of:

1. 9 parts of graded sand, as per EXT12.M235;
2. 1 part manufactured soil conditioner, as per EXT12.M210.

BOULDERS AND ROCKS

EXT12.M410.9 GRANITE

Granite boulders and rocks to have a natural, weathered appearance, free from blasting and drill marks, obtained from a local source and:

1. Shape: rounded;
2. Size: various, ranging from a minimum of 750 x 600 x 500 mm to a maximum size of 1800 x 1200 x 900 mm;

3. Colour: grey.

EXT12.M420.9 SERPENTINE

Serpentine boulders and rocks to comprise hard, metamorphic rock (normally obtained from Taiwan):

1. Size: various, ranging from a minimum of 500 x 500 x 500 mm to a maximum of 1800 x 1200 x 900 mm;
2. Colour: strongly veined blue and white.

EXT12.M430.9 GREAT LAKE ROCK

Great lake rocks to be from the Great Lake (Tai Hu), near Suzhou, or from other Approved regions of China, and:

1. Each rock being of one piece;
2. Appearance: slender, with folds and a large number of holes on the surface and containing such shapes as "deep hollows", "eye holes", "twists" and "strange grooves" without visual defects;
3. Colour: blackish grey;
4. Size: various, ranging from a minimum 800 x 500 x 300 mm to a maximum of 3000 x 1200 x 900 mm.

EXT12.M440.9 REJECTS

Remove, at own expense, any boulders and rocks rejected by the CM.

WORKMANSHIP

GENERAL

EXT12.W010.9 STOCKPILES

1. Obtain Approval of stockpile areas prior to the commencement of any stockpiling of materials;
2. Stabilise firmly all materials stockpiled against wind blow and erosion by water, at all times.

SUBSOIL PREPARATION

EXT12.W110.9 GRADING

Grade existing subsoil or DG as planting medium to form free flowing contours without water collecting hollows.

For area specified as “Sand Based Lawn”, prepare the sub-base as follows:

1. Grade existing subsoil to minimum 400mm below finished levels;
2. Compact formations to obtain a relative compaction of at least 95% to a depth of 200 mm below the formation;
3. Fill aggregate as per EXT12.M236 to 200mm below finished levels;
4. Protect the finished sub-base with impermeable protective sheeting before laying of graded sand as per EXT12.M235.

EXT12.W120.9 CLEANING

1. Remove rubbish, weeds, metal, deleterious material, and all stones exceeding 50mm in any dimension from existing subsoil or DG as planting medium, to a depth of 400mm;
2. Backfill any voids left by this operation with imported DG as planting medium, as per EXT12.M120.

EXT12.W130.9 RIPPING

Rip subsoil or DG as planting medium prior to spreading topsoil:

1. At 500 mm centres to a depth of 400mm or as shown on Drawings, to improve water and air movement;
2. Removing from site all obstructions to cultivation, or deleterious material brought to the surface;
3. Backfilling any voids left by this operation with imported DG as planting medium, as per EXT12.M120;
4. Do not rip ground at a slope exceeding 15° to the horizontal.

PREPARATION OF PLANTING MEDIA

EXT12.W210.9 CONTAMINATED GROUND

Obtain Approval to confirm the location and volume of all areas contaminated by petrol, or other toxic substances, and:

1. Excavate all such contaminated ground to be planted or sown to 500 mm below the depths specified in EXT12.W410;
2. Remove the contaminated material to a properly designated tip;

3. Backfill all such excavated areas with fabricated soil, as EXT12.M310.

EXT12.W225.9 PREPARATION OF PLANTING MEDIUM

1. Remove contaminated soil as per EXT12.W210;
2. Grade, rip and clean existing subsoil or DG as planting medium as per EXT12.W110, EXT12.W120 and EXT12.W130.

EXT12.W230.A FABRICATED SOIL MIX

1. Where the finished levels comprise existing DG as per EXT12.M030, mix with manufactured soil conditioner as per EXT12.M210, and/or animal manure, as per EXT12.M245 to form Fabricated Soil, as per EXT12.M310, to the depths given in EXT12.W410. Take samples and test the same for every 1,000 m² of planting area or part thereof;
2. After completion of the test, apply Biochar as per EXT12.M280 to planters designated by the CM at the rates 10-20% of soil volume or in accordance with manufacturer's instructions, mix thoroughly into the soil with compost as EXT12.M240 in ratio 1:2 (biochar: compost) to the 300 mm depths. Do not use more than 30% biochar of soil volume.

EXT12.W240.9 POLYMER MIX

Mix thoroughly, fully hydrated synthetic soil conditioner, as EXT12.M250, at a rate of 1.5 kg dry polymer to 1 m³ fabricated soil, as EXT12.M310, and incorporate 600 gms of slow release fertilizer, as SLW1.M110.

EXT12.W250.9 COMPOST MIX

Mix thoroughly 50 mm thick layer of compost, as EXT12.M240, into the top 150 mm of topsoil or fabricated soil.

EXT12.W255.9 ROOTZONE MEDIUM MIX

Mix thoroughly 10 mm thick layer of manufactured soil conditioner as per EXT12.M210, into the top 30 mm of graded sand for area specified as “Sand Based lawn”.

EXT12.W260.9 RAISING NITROGEN CONTENT

Mix slow or controlled release nitrogen fertilizer at the rate calculated using the formula:

$$F = \frac{11{,}400 \times B}{Z}$$

where F = Fertilizer required in gm/sq.m.
B = Nitrogen deficiency in percent.
Z = Nitrogen content of fertilizer in percent.

EXT12.W270.9 RAISING PH LEVEL

Add limestone, as SLW1.M150, at the rate of 100 g/m² per application as required to raise pH of fabricated soil to within the range 5.5 to 6.5.

EXT12.W280.9 LOWERING PH LEVEL

Thoroughly mix in appropriate quantities of either:

1. Sulphate of ammonia (during periods of wet weather only);
2. Natural sphagnum peat moss with pH of 4 to 4.5.

EXT12.W290.9 INCREASING ORGANIC MATTER CONTENT

Add, as a separate operation, either manufactured soil conditioner, as EXT12.M210, or Coco Peat, as EXT12.M260, to the fabricated soil at the rate of 5 mm thickness for each 1% shortfall in organic matter content, spread over the deficient area and thoroughly mix through the full depth of the fabricated soil.

MAKING UP LEVELS

EXT12.W310.9 FABRICATED SOIL

Where the levels are required to be made up to the finished level, import fabricated soil, as EXT12.M310, and spread and grade to the depths given in EXT12.W410.

EXT12.W320.9 POLYMER MIX

Import polymer mix, as EXT12.W240, to make up levels to the depths given in EXT12.W410, in the locations as shown on Drawings.

EXT12.W325.9 ROOTZONE MEDIUM MIX

Where the levels are required to be made up to the finished level, import graded sand, as per EXT12.M235, and spread and grade to the depths given in EXT12.W410 before cultivate with manufactured soil conditioner to form the rootzone medium mix.

EXT12.W330.9 GENERAL SOIL FILLING IN GRASS PAVING SYSTEM

Fill openings of the grass paving system, in the location as shown on Drawings, with:

1. Soil filling mix, as EXT12.M330 to receive turves as SLW7.M110 for turf finish; or
2. Grass seed and soil filling mix as SLW7.M270 for grass seed finish.

DEPTHS OF PLANTING MEDIA

EXT12.W410.9 FABRICATED SOIL

Provide to the depth(s) for the following planting situations:

1. Shrub and ground-cover areas: 600 mm;
2. Grassed Area: 300 mm;
3. Sand Based Lawn: 300 mm with root zone medium mix as per EXT12.M340;
4. Tree pits: as per SLW2.W250 or 1200 mm whichever is greater;
5. Grass paving system: to depths to suit the system in use and / or as shown in the Drawings or indicated in the schedules issued under individual CM's Instruction;
6. Soil volume per tree shall be at a minimum of 12 m^3.

FINAL GRADING

EXT12.W510.9 GENERAL

Grade all areas to free flowing contours and without humps or water collecting hollows.

EXT12.W520.9 PLANT BEDS

Slightly mound plant beds to levels shown on the Drawings ±150 mm at the top of the mound.

EXT12.W530.9 BEHIND RETAINING WALLS

Finish soil levels, immediately behind retaining walls, 75 mm ±25 mm below the top of the wall after settlement.

EXT12.W540.9 ADJACENT PAVED AREAS

1. Finish soil 25 mm ±25 mm below adjacent paving to plant beds at ground level;
2. Finish soil flush +25 mm -0 mm with adjacent paving to grassed areas at ground level.

EXT12.W550.9 GRASS PAVING SYSTEM

The turf finish or grass seed finish of the grass paving system to flush with the surrounding finished levels, or to depths to suit the system in use and/or as shown on Drawings, with allowance of settlement.

EXT12.W555.9 SAND BASED LAWN

The finished grading of rootzone medium mix after compaction by rollers shall be flushed with the surrounding finished levels, kerb or to depths as shown on Drawings, with allowance of settlement.

BACKFILLING RAISED PLANTERS WITH IMPERMEABLE BASES

EXT12.W610.9 PROCEDURE

1. Spread drainage layer in accordance with Worksection EXT13 in the bottom of the container;
2. Place filter layer, as EXT13.M110, over aggregate;
3. Place planting medium in 250 mm ±25 mm thick layers, lightly consolidating each layer before spreading the next;
4. Fill ground level containers to 50 mm ±10 mm below the top with fabricated soil, as EXT12.M310;
5. Fill podium level containers with lightweight soil, as EXT12.M320;
6. Leave the surface smooth and level to receive plants.

BOULDERS AND ROCKS

EXT12.W710.9 PLACING

Place boulders in the required positions during backfilling but prior to planting.

EXT12.W720.9 FIXING GRANITE AND SERPENTINE BOULDERS

Ensure complete stability, with 25% by volume of the boulder below finished ground level to the satisfaction of the CM.

EXT12.W730.9 FIXING GREAT LAKE ROCKS

Place rocks in their required positions, prior to planting, in locations as directed by the CM on site, and:

1. For rocks at least 3000 mm high x 1200 mm long x 900 mm wide, place in a concrete base 1200 mm long x 900 mm wide x 300 mm deep;
2. For rocks at least 3000 mm high x 1200 mm long x 900 mm wide, place and wedge with small rocks to prevent movement, with 25% by volume of the boulder below finished ground level to the satisfaction of the CM.

SURPLUS MATERIAL

EXT12.W810.9 REMOVAL

Remove all surplus soils, arising from the Works to a properly designated tip.

EXT13 DRAINAGE TO PLANTERS

MATERIALS

DRAINAGE LAYER

EXT13.M010.9 AGGREGATE

Aggregate to be clean stone, 25 – 50 mm diameter.

EXT13.M020.9 LIGHTWEIGHT AGGREGATE

Lightweight aggregate to be clean clinker, or other Approved equivalent material.

1. Size: 20 – 50 mm diameter;
2. Density: 500 kg per m^3 maximum weight when compacted.

FILTER LAYER

EXT13.M110.9 FILTER LAYER FOR PLANTERS

Permeable, non-woven, thermally bonded geotextile, type not affected by acids, alkalis, bacteria, humidity, or rotting and shall meet performance requirements set out in the table:

Properties	Test Method	Acceptance Standards
Mechanical Properties		
(i) Wide width strip tensile - Mean peak strength	**BS EN ISO 10319**	Not less than 3.0 kN/m
(ii) CBR puncture resistance - Mean peak strength	**BS EN ISO 12236**	Not less than 525 N
Hydraulic Properties		
(i) Pore size - Mean AOS O_{90}	**BS EN ISO 12956**	Not more than 300 µm
(ii) Permeability - 5cm head	**BS EN ISO 11058**	Not less than 100 $l/m^2/s$

WORKMANSHIP

DRAINAGE LAYER

EXT13.W010.9 CLEANING OUT WEEPHOLES

Prior to placing the drainage layer clean out all weepholes. When drainage layer has been placed by others, prior to any soiling operations, clean out all weepholes taking care not to damage any rodent grilles. Advise CM of any weepholes which cannot be cleared or are missing.

EXT13.W020.9 LEVELS

Place the base of the drainage layer level (+0 mm -25 mm) with the bottom of weepholes.

EXT13.W030.9 PRECAST CONCRETE / PORTABLE PLANT BOXES

Lay drainage layers evenly over the base of precast concrete / portable plant boxes to compacted depths indicated below:

Plant Box		Aggregate	
Height (mm)	Position	Depth (mm)	Type Clause Ref.
750 or less	Ground level	75	EXT13.M010
Above 750	Ground level	100	EXT13.M010
750 or less	Podium level	75	EXT13.M020
Above 750	Podium level	100	EXT13.M020

EXT13.W040.9 IN-SITU CONCRETE PLANTERS WITH IMPERMEABLE BASES

Lay drainage layers evenly over base of in-situ concrete plant boxes with impermeable bases to compacted depths indicated below:

Plant Box		Aggregate	
Height not exceeding (mm)	Position	Depth (mm)	Type Clause Ref.
750 or less	Ground level	75	EXT13.M010
Above 750	Ground level	100	EXT13.M010
750 or less	Podium level	75	EXT13.M020
Above 750	Podium level	100	EXT13.M020

EXT13.W050.9 IN-SITU CONCRETE PLANTERS WITH PERMEABLE BASES

Form drainage strips of aggregate along back of perimeter walls of in-situ concrete planters with permeable bases to dimensions and in positions indicated below:

Plant Box Type	Aggregate (EXT13.M010)	
	Strip Dimensions (mm) (Width x height)	Position
Level	200 x 200 high	Along all walls
Sloping	200 x 200 high	Along lower wall
Level & sloping	200 x 200 high x 500 long	Over each weep hole

FILTER LAYER

EXT13.W110.9 APPLICATION

Cover all drainage aggregate, where exposed to soil, with filter layer, as EXT13.M110. Lap joints between sheets and overlap other materials by 200 mm.

EXT14 HYDROSEEDING

MATERIALS

GENERAL

EXT14.M010.9 SCOPE

The application, by high pressure spraying, of a specified mixture of grass seed, fertilizer, mulch and other additives in aqueous suspension.

EXT14.M020.9 METHOD STATEMENT

Submit to the CM, at least 14 days before starting hydroseeding operations, details of materials to be used and method of application to be employed. Include the following:

1. Species and rate of application of seed;
2. Type and rate of application of fertilizer, mulch, soil binder and soil conditioner;
3. Type and colour of dye;
4. Type of protective fabric material;
5. Details of the company employed to carry out the hydroseeding;
6. Equipment to be used.

SEED MIXES

EXT14.M110.A BASIC MINIMUM SEED MIX FOR USE BETWEEN APRIL AND AUGUST

Minimum 30 g/m² (spreading rate) mix comprising:

Species	Rate
Cynodon dactylon (Bermuda grass)	13 – 15 g/m²
Paspalum notatum (Bahia grass)	8 – 10 g/m²
Chloris gayana (Rhodes grass)	1 – 4 g/m²
Others selected from "other recommended species" listed in EXT14.M120	5 g/m²
Shrub species selected from EXT14.M145, when instructed by the CM	5 g/m²
Fern species leaf fragments full of mature sporangia selected from EXT14.M146, when instructed by the CM	2 g/m²

EXT14.M120.A OTHER RECOMMENDED SPECIES

1. Eragrostis curvula (Weeping love grass) (not more than 2%);
2. Eremochloa ophiuroides (Centipede grass);
3. Cenchrus echinatus (Buffel grass / Bur grass).

EXT14.M130.A BASIC MINIMUM SEED MIX FOR USE BETWEEN SEPTEMBER AND MARCH

Minimum 35 g/m² (spreading rate) mix comprising:

Species	Rate
Cynodon dactylon (Bermuda grass)	15 g/m²
Paspalum notatum (Bahia grass)	10 g/m²
Lolium perenne (Perennial Ryegrass)	5 g/m²
Others selected from "other recommended species" listed in EXT14.M120	5 g/m²
Shrub species selected from EXT14.M145, when instructed by the CM	5 g/m²
Fern species leaf fragments full of mature sporangia selected from EXT14.M146, when instructed by the CM	1 g/m²

EXT14.M145.9 SHRUB SPECIES

Any of the three listed below:

1. Raphiolepis indica;
2. Melastoma sanguineum;
3. Lespedeza spp.;
4. Desmodium spp.;
5. Crotalaria pallida;
6. Crotalaria retusa;
7. Others accepted by the CM.

EXT14.M146.A FERN SPECIES

Any one of the following:

1. Cibotium barometz;
2. Dicranopteris pedata;
3. Nephrolepis auriculata;
4. Woodwardia japonica;
5. Others accepted by the CM.

EXT14.M150.9 GERMINATION

Germination capacity of each variety to be at least 80%.

EXT14.M160.9 PURITY

1. Purity of each variety to be greater than 90%;
2. Total weed seed content not more than 0.5%;
3. Other crop seed not more than 1%.

EXT14.M170.9 CERTIFICATION

Provide a certificate of testing, no less than 14 days before hydroseeding starts, stating:

1. Date of tests (within 6 months of hydroseeding);
2. Species variety;
3. Percentage germination (with date of assessment);
4. Percentage composition by weight (with statement of impurities).

ANCILLARY MATERIALS

EXT14.M210.9 FERTILIZER INCLUDED IN THE HYDROSEEDING MIX

A soluble compound fertilizer in the ratio 15:15:15 NPK, or similar Approved compound applied at a rate of at least 100 g/m² in the hydroseeding mix.

EXT14.M220.9 DYE AND SOIL BINDER

The application rate of dye and soil binders shall strictly refer to manufacturer recommendation.

1. Dye, to be: an Approved type, suitable for hydroseeding purposes and non-injurious to plant growth;
2. Soil binder, as EXT12.M270.

EXT14.M230.9 MULCH FOR HYDROSEEDING

A proprietary type manufactured from cellulose or paper based materials for application at a minimum rate of 170 g/m².

EXT14.M240.9 PROTECTIVE FABRIC MATERIAL FOR HYDROSEEDING

An Approved proprietary type of degradable fabric that does not degrade within 100 days after application or until the specified grass cover has been established.

EXT14.M250.9 HYDROSEEDING POST-PLANTING FERTILIZER

Consisting of 15:15:15 (nitrogen/phosphorus/potassium) mix or an Approved equivalent.

WORKMANSHIP

GENERAL

EXT14.W010.9 PROGRAMME

1. Carry out hydroseeding between 1st March and 31st August. Hydroseeding outside this period may be Approved on condition that any additional maintenance requirements specified by the CM are carried out at the Contractor's expense;
2. Carry out hydroseeding during damp overcast conditions, but not during rain or periods of strong winds.

EXT14.W020.9 STORING GRASS SEED

Store grass seed in bags off the ground in a clean, dry, well ventilated location free from vermin. Carry out prolonged storage under controlled conditions of temperature and humidity.

EXT14.W030.9 STORING FERTILIZER

Store fertilizer off the ground in sealed waterproof bags and protect from exposure to conditions which may adversely affect the fertilizer.

EXT14.W040.9 HYDROSEEDING EQUIPMENT

Use hydroseeding plant for application of mix.

PREPARATION

EXT14.W110.9 SURFACE FINISH

1. Clear away rubbish and vegetation from areas to be hydroseeded and form site to the levels indicated;
2. Lightly scarify to leave a coarse, open textured surface, level with (+25 mm -0 mm) adjoining hard surfaces;
3. Carry out finishing work by machines across the direction of slope;
4. Do not leave vehicle track marks or bucket teeth marks parallel to the line of maximum gradient of the slope.

EXT14.W120.9 CULTIVATION

1. Cultivate areas less steep than 1:2 to a depth of 125 mm and bring to a 25 mm deep fine tilth by Approved mechanical means or by hand raking;
2. Remove all stones larger than 30 mm in any dimension;
3. If necessary, carry out regrading of the surface to conform to the prescribed finished levels and create free flowing contours free from humps and water collecting hollows;
4. Finish final level (+25 mm -0 mm) with any adjacent hard surfaces.

EXT14.W130.9 CULTIVATION ON EMBANKMENTS

Do not cultivate the existing soil on embankments with slopes of 1:2 or steeper, to ensure that the slope remains stable and to prevent erosion.

EXT14.W140.9 WATERING

When Instructed thoroughly moisten the previously prepared soil prior to hydroseeding, and use a fine spray hose attachment to avoid soil erosion and run off.

EXT14.W150.9 PREPARING TREE SEEDS

1. Soak all tree seeds to be included in the hydroseeding mix (except Acacia Species) in water at room temperature, for 4 to 8 hours immediately before mixing with other ingredients of the hydroseeding mix;
2. Immerse seeds of Acacia confusa in water, bring water to boil, remove seeds immediately and mix seeds with other ingredients of the hydroseeding mix.

APPLICATION

EXT14.W210.9 MIXING

1. Thoroughly mix materials for hydroseeding on site in the hydroseeding equipment immediately before spraying, ensuring that seed is not damaged;
2. Blend in water at the rate of 5 litres/m² to form an aqueous gel solution, unless otherwise instructed.

EXT14.W220.9 APPLYING SOIL BINDERS

1. Apply soil binders as EXT12.M270 at the rate recommended by the manufacturer, modified as necessary to suit conditions in Hong Kong;
2. Use dye to demonstrate that adequate cover has been achieved unless otherwise instructed due to the fact that run off or water courses are coloured to an unacceptable level.

EXT14.W230.9 SPRAYING HYDROSEEDING SOLUTION

Spray the solution by high pressure pump to evenly cover the area and:

1. Constantly agitate the hydroseeding mixture during spraying to keep it homogeneous and avoid blockage to pipes;
2. Ensure that material is not lost during application due to run off.

POST APPLICATION OPERATIONS

EXT14.W310.9 PATCHING UP

1. Where hydroseeded areas do not show 90% cover over any 10 m² area, 28 days after hydroseeding:
   a. Respray areas where, in the opinion of the CM germination has been unsuccessful;
   b. Respray areas affected by repairs to washout and gullies and other erosion on slopes.
2. Patch up areas which, in the opinion of the CM, are not accessible or are too small for the use of a hydroseeder, by broadcasting seeding as follows:
   a. Lightly scarify the area with a rake or similar implement;
   b. Broadcast the seed and fertilizer over the area at a rate of not less than 75 g/m² (±5%);
   c. Cover the seed by lightly working into the surface or by spreading sufficient soil to just cover the seed;
   d. Carry out broadcast seeding using Bermuda grass (Cynodon dactylon), perennial ryegrass (Lolium perenne) or carpet grass (Axonopus compressus).

EXT14.W320.9 PROTECTION OF HYDROSEEDING

1. Following hydroseeding, including patching up, cover the area with bio-degradable erosion resistant fabric, as EXT14.M240 and fix securely with 100 mm long staples at 1000 mm staggered centres, with a minimum of 150 mm overlap between adjacent sheets of fabric sufficient to avoid local erosion;

2. On sloping ground lay fabric along the greatest slope and fully adhere to the hydroseeded surface by sprinkling with water with an Approved spray;
3. Do not permit walking on areas that have been hydroseeded unless for fixing protective material and for patching up.

EXT14.W330.9 WATERING DURING DRY WEATHER

During dry weather water hydroseeded slopes to encourage germination and growth of the grass as follows:

1. During periods of dry weather determine watering requirements with the CM twice weekly;
2. Thoroughly water areas as necessary or as Instructed and complete watering within 24 hours of receiving such instruction;
3. Use fresh water only for the works;
4. When required obtain an analysis of the water to be used for Approval;
5. Apply water using an Approved hose or sprinkler so as not to erode the slope;
6. Make good any erosion of hydroseeding that may occur.

EXT14.W340.9 APPLYING POST-PLANTING FERTILIZER

Apply post-planting fertilizer at a rate of 50 g/m² (±5%) between two months and nine months after application of hydroseeding and, unless otherwise permitted by the CM, during the period 1st March and 31st August.

EXT14.W350.9 CUTTING

1. Reduce by cutting to a height of 100 mm when the grass sward is 300 mm high;
2. Rake off and dispose of all cuttings within 24 hours of cut.

TESTING GRASS COVER

EXT14.W410.9 TESTING

1. Attend with CM when carrying out tests to determine grass cover 100 days after grassing and at the end of the Establishment Period;
2. The number of tests will be determined by the CM in locations which, in his opinion, are representative of the grassed area as a whole;
3. Mark out an approximately square area of 10 m² at each test location and cut grass to a height of 300 mm if necessary;
4. Measure the percentage of bare ground, other than rock and other hard material, in each 10 m² test area.

EXT14.W420.9 ACCEPTANCE CRITERIA

1. Hydroseeding to achieve a cover by grass species of at least 90% of the surface area of each 10 m² of the area to be hydroseeded within 100 days after the area has been hydroseeded;
2. Grass cover to be healthy, vigorous and free from perennial and other weeds.

EXT14.W430.9 NON-COMPLIANCE

If the result of any test for grass cover does not comply with the specified requirements for grass cover, re-hydroseed or reseed the area as EXT14.W310 (1) or (2), as Instructed depending upon the size of the defective area.

EXT15 MISCELLANEOUS EXTERNAL WORKS

DESIGN

GENERAL

EXT15.D010.9 EXTERNAL FURNITURE

External furniture in this Specification refers to a series of proprietary external furniture comprising, but not be limited to, seating bench, litter bin, chess table set, table tennis table, bollard and bicycle rack, in accordance with the performance requirements and design intent as specified.

EXT15.D020.9 DESIGN SUBMISSION

1. Unless the CM instructs otherwise, submit to the CM at the time as specified in the Project Specific Specification at least 3 design proposals from different agents/suppliers for the external furniture specified in EXT15.M010 to EXT15.M060 meeting with the requirements as specified in the Specification and shown on the design intent Drawing(s) for CM's selection and approval. Each design proposal shall include plans, elevations, sections and details, and the following information:
   a. The place of origin of the external furniture, name of manufacturer, brand name, model number, manufacturer's instruction on installation procedures;
   b. Product details and descriptions etc. with detailed layout drawing indicating the relationship of the furniture to the surrounding external works;
   c. Materials, colours, sizes, dimensions, assemblage and fixing of various components of the external furniture and other items as instructed by the CM and/or as shown on the design intent Drawing(s);
   d. Minimum design loading for seating bench, chess chair, chess table and table tennis table;
   e. Copy of structural calculation by RSE verifying the proposed minimum design loading for the external furniture. The copy of the structural calculation shall be certified true by the QCM;
   f. Builder's works requirements and method statement on fixing the external furniture to the substrate, wall or pavement surface;
   g. Test certificates for the specified tests in clauses EXT15.M110 and EXT15.M120, where appropriate.

   Each design proposal shall also be accompanied with a quotation from the respective agents/suppliers. The Contractor shall be responsible for the identification of agents/suppliers, preparation of invitation documents and invitation of quotations. Sufficient time shall be allowed for agents/suppliers to prepare and return their quotations. The quotation closing date and time, and location of the quotation box of the Contractor for deposition of quotations shall be specified in the invitation of quotations. Make invitation to the CM at least 14 days before the quotation closing date for his arrangement of representation to witness the opening of quotations at the Contractor's office. Quotations received shall be opened promptly after the specified closing date and time. Opening of the quotations shall be witnessed by at least two representatives of the Contractor and two representatives of the CM;
2. Re-submit revised design proposals, quotations, drawings and relevant information where commented or considered necessary by the CM;

3. Upon notification in writing by the CM of his selected and approved design proposal among the submitted design proposals (a copy of the Contractor's submitted quotation in respect of the Approved design proposal may be attached with CM's notification for the sake of reference), engage the respective agents/suppliers for the supply and installation of the external furniture of the Approved design proposal provided that the actual cost of procuring each of the Approved external furniture shall not exceed the amount shown on the quotation submitted to the CM for the Approved design proposal;
4. If, prior to entering into sub-contract with the agents/suppliers providing the Approved external furniture, it becomes apparent to the Contractor that the actual cost of any of the Approved external furniture exceeds the amount shown on the quotation submitted to the CM for the Approved design proposal for whatever reasons, give immediate notice to the CM for further instruction. Any claim for additional costs due to higher actual costs than the quotation submitted to the CM for the Approved design proposal arising from or after entering into sub-contract with the agent/supplier providing the Approved external furniture shall not be considered. Submit certified true copy of the sub-contract(s) to substantiate the actual costs of the procurement of the Approved external furniture;
5. In addition to sub-clause (1) above, the CM may at his own discretion before or after the Contractor's submissions in sub-clause (1), obtain design proposals and quotations directly from agents/suppliers of external furniture and instruct the Contractor as appropriate;
6. Within 28 days from the date of CM's notification of selection and approval of the design proposal, submit detailed information comprising shop drawings and fixing details of the external furniture for CM's approval;
7. Allow at least 6 months for the process of ordering, material delivery and installation.

EXT15.D030.9 SAMPLE SUBMISSION

After being notified in writing by the CM of his selected and approved design proposal and before ordering of the products, submit samples of the components of the external furniture showing their physical properties such as material, colour, texture and fixing details etc. for the CM's approval.

EXT15.D040.9 DELIVERY

Submit original or certified true copies of Certificate of Origin for the external furniture delivered to the Site.

MATERIAL

EXTERNAL FURNITURE

EXT15.M010.9 SEATING BENCH

1. Seating bench: as specified in Project Specific Specification;
2. The design of the seating bench shall fit for purpose. The product shall be rigid, well supported and not prone to deformation. The components shall have no sharp edge, corner and projections etc.;
3. Material used shall be able to withstand cigarette burns and discolouring from exposure to ultraviolet radiation from the sun. There shall be no toxic emission upon combustion of any components and parts;
4. Allow a range of colours on materials used for CM's selection.

EXT15.M020.9 LITTER BIN

1. Litter bin: as specified in Project Specific Specification;
2. Provide litter bin with ash tray at designated smoking areas only as specified by CM and/or shown on the landscape layout plan;
3. The design of the litter bin shall fit for purpose. The product shall be rigid, well supported and not prone to deformation. The components shall have no sharp edge, corner and projections etc.;
4. Materials used must be able to withstand cigarette burns and discolouring from exposure to ultraviolet radiation from the sun. There shall be no toxic emission upon combustion of any components and parts;
5. Allow a range of colours on materials used for CM's selection.

EXT15.M030.9 CHESS TABLE SET

1. Chess table set: as specified in Project Specific Specification;
2. Allow at least one seating place for wheelchair user to access the chess table;
3. The design of the chess table set shall fit for purpose. The product shall be rigid, well supported and not prone to deformation. The components shall have no sharp edge, corner and projections etc.;
4. Materials used shall be able to withstand cigarette burns and discolouring from exposure to ultraviolet radiation from the sun. There shall be no toxic emission upon combustion of any components and parts;
5. Allow a range of colours on materials used for CM's selection.

EXT15.M040.9 BOLLARD

1. Bollard: as specified in Project Specific Specification;
2. The design of the bollard shall fit for purpose. The product shall be rigid, well supported and not prone to deformation. The components shall have no sharp edge, corner and projections etc.;
3. Materials used shall be able to withstand cigarette burns and discolouring from exposure to ultraviolet radiation from the sun. There shall be no toxic emission upon combustion of any components and parts;
4. Allow a range of colours on materials used for CM's selection;
5. Avoid protruding projections and loose-fixed component parts that are easy to be stolen.

EXT15.M050.9 TABLE TENNIS TABLE

1. Table tennis table: as specified in Project Specific Specification;
2. The design of the table tennis table shall fit for purpose. The product shall be rigid, well supported and not prone to deformation. The components shall have no sharp edge, corner and projections etc.;
3. Materials used must be able to withstand cigarette burns and discolouring from exposure to ultraviolet radiation from the sun. There shall be no toxic emission upon combustion of any components and parts;
4. Allow a range of colours on materials used for CM's selection.

EXT15.M060.9 BICYCLE RACK

1. Bicycle rack: as specified in Project Specific Specification;
2. The design of the bicycle rack shall fit for purpose. The product shall be rigid, well supported and not prone to deformation. The components shall have no sharp edge, corner and projections etc.;
3. Materials used shall be able to withstand cigarette burns and discolouring from exposure to ultraviolet radiation from the sun. There shall be no toxic emission upon combustion of any components and parts;
4. Allow a range of colours on materials used for CM's selection.

EXT15.M070.N MOVABLE SEATING

1. All movable seating as shown on drawing nos. specified in Project Specific Specification, shall be composed of:
   a. Base: Glass-fibre reinforced composites as specified in EXT15.M080 / Concrete, as approved by the CM;
   b. Finish: Wood Plastic Composite as specified in EXT15.M090;
   c. Armrest: powder coated GMS tube; colour samples shall be provided for the CM’s approval.
2. All fixing shall be concealed. Shop drawings shall be submitted for the CM’s approval.

EXT15.M080.N FIBREGLASS PLANTER BOX

1. Glass-fibre reinforced composites, with either cement or resin binders:
   a. Cement: As FIN1.M010;
   b. Sand: As FIN1.M410;
   c. Pigment: As FIN1.M820;
   d. Glass fibres: To be alkali resistant, in the form of chopped strand mat or woven fabric;
   e. Architectural paint used in product shall be in compliance with FIN7.M010.
2. Construction: Moulded, using hand-layup or spray-layup method;
3. Colour: Tinted or painted to colour as instructed by the CM;
4. Accessories:
   a. Pre-drilled holes for drainage if used at exterior; or
   b. Undrilled and fully watertight for interior use;
5. Strength: Vertical wall panel deformation to be ≤ L/200 when fully filled with soil;
6. Waterproofing: Liquid applied elastomeric waterproofing material, tested on field by flooding with water for 30 minutes without water leakage.

EXT15.M090.N WOOD PLASTIC COMPOSITE (WPC)

1. Submission Requirements:

a. At sample submission and approval stage, submit a sample of the proposed WPC and accessories for the CM's approval together with all the following substantiation for the CM's information:
   i. Job reference(s) of the proposed WPC;
   ii. Name, address and contact person of the local supplier;
   iii. Name, address and contact person of the manufacturer;
   iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent or distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed WPC;
   v. Original or a certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of test reports showing full compliance with the requirements of sub-clauses (2)(b), (2)(c) and (2)(d) below for the CM's information of the proposed WPC:
      - The test reports shall be submitted at sample submission and approval stage, or at a time not later than the delivery of the materials;
      - In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all the delivered materials off Site. Bear all associated costs and the extra time required.

b. After approval of the submitted sample of the proposed WPC, submit shop drawings for the CM's approval showing the materials, fixing, joints, hatch opening details, loading requirements, supporting frames and drainage for the application of the proposed WPC in the outdoor landscape furniture;

c. For decking and cladding components using the proposed WPC (with loading agreed by the CM), submit detailed structural calculations of the supporting frames endorsed by RSE and the shop drawings and associated information as specified in sub-clause (1)(b) above. There shall not be any gap which jeopardize the safety of pedestrians at any junctions between WPC decking components specified in the shop drawings.

2. Quality Requirements:
   a. A proprietary product made of plastic and wood fibre;
   b. Surface spread of flame shall comply with Class 2 of BS 476 Part 7:1997, or Class C of BS EN 13501-1:2007 when used in landscape furniture, decking and artworks;
   c. Composition of the submitted WPC shall contain a minimum of 35% wood fibre;
   d. Coefficient of friction shall comply with Grade "Good" of Appendix C of the Design Manual: Barrier Free Access 2008.

COMPONENTS OF EXTERNAL FURNITURE

EXT15.M115.9 WOOD PLASTIC COMPOSITE (WPC)

1. Submission Requirements:
   a. At sample submission and approval stage, submit a sample of the proposed WPC and accessories for the CM's approval together with all the following substantiation for the CM's information:
      i. Job reference of the proposed WPC;
      ii. Name, address and contact person of the local supplier;
      iii. Name, address and contact person of the manufacturer;

iv. Where applicable, either the document from the manufacturer showing his authorization for the supplier as the agent or distributor in Hong Kong or document from the supplier showing the appointment of the manufacturer and manufacturer's agreement for the production of the proposed WPC;

v. Original or a certified true copy (issued or certified by the laboratory that complies with PRE.B9.570) of test reports showing full compliance with the requirements of sub-clause 2(b), 2(c) and 2(d) below for the CM's information of the proposed WPC:

- The test reports shall be submitted at sample submission and approval stage, or at a time not later than the delivery of the materials;
- In the event that no test report has been submitted for the CM's information when the materials are delivered to Site, remove all the delivered materials off Site. Bear all associated costs so incurred and no extension of time will be allowed.

b. After approval of the submitted sample of the proposed WPC, submit shop drawings for the CM's approval showing the materials, fixing, joints, hatch opening details, loading requirements, supporting frames and drainage for the application of the proposed WPC in the outdoor landscape furniture;

c. For decking and cladding components using the proposed WPC, submit detailed structural calculations of the supporting frames endorsed by RSE and the shop drawings and associated information as specified in sub-clause (1)(b) above. Any junctions between WPC decking components specified in the shop drawings shall not produce any gaps jeopardizing pedestrians.

2. Quality Requirements:

a. A proprietary product made of plastic and wood fibre;

b. Surface spread of flame shall comply with Class 2 of BS 476 Part 7:1997, or Class C of BS EN 13501-1:2007 when used in indoor site furniture, cladding or decking;

c. Composition of the submitted WPC shall contain a minimum of 35% wood fibre;

d. Coefficient of friction shall comply with Grade "Good" of Appendix C of the Design Manual: Barrier Free Access 2008.

EXT15.M116.9 MAINTENANCE MANUAL FOR WPC

Submit to the CM five sets of maintenance manuals for the completed works within three months after the certified date of completion of the Works. This should be developed in parallel with the design and should include, but not be limited to, the following information:

1. Name, address and telephone number of each supplier and / or sub-contractor involved in the supply of materials, components, assemblies and finishes;
2. Recommendations in English and Chinese for maintenance procedures and routine maintenance activities;
3. A full set of as-built drawings including the structural calculations;
4. Submit one set electronic copy of the as-built drawings in AutoCAD file format or other editable format as approved by the CM.

EXT15.M120.9 FINSIHES TO GALVANIZED MILD STEEL

Show no sign of rusting when tested to ASTM B117-97:2009 for 1000 hours.

WORKMANSHIP

GENERAL

EXT15.W010.9 HANDLING AND STORAGE

Handle and store all external furniture carefully and in a manner that:

1. Prevent damage to pre-finished surfaces;
2. Retain protective coverings in position for as long as possible;
3. Prevent contact with harmful elements.

EXT15.W020.9 FIXING, ASSEMBLING AND LAYING

1. Carry out any fixing, assembling or installation in accordance with the manufacturer's instructions;
2. Ensure all external furniture is/are placed and fixed in the position as set out in the Drawings, and in accordance with manufacturer's recommendation;
3. Avoid exposing the base plate which may cause potential hazard in hurting the feet of pedestrians.

INSTALLATION OF EXTERNAL FURNITURE

EXT15.W110.9 SEATING BENCH

Install seating bench in accordance with manufacturer's specifications and instructions.

EXT15.W120.9 LITTER BIN

Install litter bin in accordance with manufacturer's specifications and instructions.

EXT15.W130.9 CHESS TABLE SET

Install chess table set in accordance with manufacturer's specifications and instructions.

EXT15.W140.9 TABLE TENNIS TABLE

1. Assemble table tennis table in accordance with manufacturer's specifications and instructions;
2. Location of the table tennis table to be advised by CM;
3. The table tennis table shall be firmly fixed to the ground or be secured against displacement either by its own weight or by anchoring. The table tennis table installed in accordance with the manufacturer's instructions shall withstand without any displacement or toppling over a horizontal force of 1.5 kN per meter length of the table structure, applied in the middle of the highest part of the structure (excluding the net), in both the length and the width of the table.

EXT15.W150.9 BOLLARD

1. Install bollard onto the pavement surface in accordance with manufacturer's specifications and instructions;
2. Should the installed bollard become off-plumbed due to ground settlement and/or soil displacement etc., the Contractor shall rectify the situation where applies to ensure the bollard is firmly upright.

EXT15.W160.9 BICYCLE RACK

1. Assemble bicycle rack in accordance with manufacturer's specifications and instructions;
2. Install bicycle rack with the adjacent pavement surface in accordance with manufacturer's specifications and instructions.

EXT16 ZERO IRRIGATION SYSTEM (ZIS)

MATERIALS

GENERAL

EXT16.M010.9 DEFINITION FOR ZIS- MODULAR TYPE

Zero Irrigation System (ZIS) - Modular type is an at-grade sub-irrigation system which utilises capillary action to deliver storm water stored in precast concrete water retention module with water retention boxes, joined via inter-connecting pipes, to top soil.

EXT16.M015.9 DEFNITION FOR ZIS- INSITU TYPE

Zero Irrigation System (ZIS) - Insitu type is an at-grade sub-irrigation system which utilises capillary action to deliver storm water stored in water retention boxes to top soil.

EXT16.M020.9 COMPOSITION FOR ZIS- MODULAR TYPE

The ZIS- Modular type shall comprise the following major components:

1. A network precast concrete water retention module with water retention boxes with inter-connected pipes to allow distribution/ extraction of water to/ from all water retention boxes within the modular set using the siphon principle via the primary inspection chamber;
2. Waterproofing membrane as EXT16.M115;
3. Filter layer, as EXT16.M120;
4. Geotextile filter layer for ZIS, as EXT16.M125;
5. Precast concrete water retention module as EXT16.M131;
6. Medium for capillary action as EXT16.M140;
7. Decomposed Granite (DG) as EXT12.M120;
8. Primary inspection chamber as EXT16.M146;
9. Secondary inspection chamber as EXT16.M147;
10. Mechanical water level indicator as EXT16.M160;
11. Interconnecting pipes as EXT16.M165;
12. Water retention box as EXT16.M130;
13. Fitting/ fitment for pipe installations as FWP3.1.3.070;
14. Subsoil drainage pipes as EXT16.M155;
15. Precast concrete water retention module refer to drawing no. LA/STD/L/ZR-01 and LA/STD/L/ZR-02 at Appendix C of the Specification;
16. Fixing device for tree anchorage.

EXT16.M025.A COMPOSITION FOR ZIS - INSITU TYPE

The ZIS - Insitu type shall comprise the following major components:

1. In-situ reinforced concrete planter wall;
2. Waterproofing membrane - Sodium bentonite layer, as EXT16.M110;
3. Filter layer, as EXT16.M120;
4. Water retention box as EXT16.M130;
5. Drainage cell as EXT16.M135;
6. Medium for capillary action as EXT16.M140;

7. Decomposed Granite (DG) as EXT12.M120;
8. Ground water recharge device as EXT16.M145 and overflow pipe as EXT16.M150;
9. Mechanical water level indicator as EXT16.M160;
10. Fixing device for tree anchorage;
11. Inspection Chamber.

EXT16.M030.9 APPLICATION OF OTHER WORKSECTIONS

Where applicable, comply with the relevant provisions of the following Worksections unless otherwise specified in this Worksection:

1. Concrete Works: Worksection CON;
2. Earthworks: Worksection EXT12;
3. Drainage to Planter: Worksection EXT13;
4. Pipes and fitting: Worksection DRA;
5. Soft Landscape Works (Planting): Worksection SLW;
6. Waterproofing : Worksection WAT.

EXT16.M040.9 ACCESSORIES

ZIS- Insitu type shall comprise the following accessories in the installation:

1. Sodium bentonite powder;
2. Sodium bentonite strip.

EXT16.M050.9 SHOP DRAWINGS AND MATERIAL SUBMISSIONS FOR ZIS- MODULAR TYPE

1. Submit shop drawings and material submission with all critical information to the CM for Approval within 6 months of the notified date for commencement of the Works;
2. Re-submit shop drawings and material submission to the CM for Approval within 14 days upon receipt of the CM's comments which require amendments to be made;
3. The shop drawings shall include but not limited to the following:
    a. The overall layout and configuration of each type of ZIS, detailed dimensions and setting out for each type of water retention boxes, number of each type of water retention boxes, zonal arrangement, placement etc.;
    b. Water-proofing membrane for the precast concrete water retention module;
    c. The details of built-in connector in the precast concrete water retention module to facilitate easy connection of inter-connecting pipes;
    d. The mounting details of inter-connecting pipes with critical information such as inverted level, gradient/fall to demonstrate the use of siphon principle to distribute/ extract water via the primary inspection chamber to all water retention boxes are feasible;
    e. The location, access and details of primary and secondary inspection chambers within mechanical water level indicator;
    f. Overflow pipe connection to drainage provision and connection to other sets of modular ZIS;
    g. Total estimated volume of recycled glass cullet with calculation and tentative date for collection;
    h. Other builder's work requirements;
    i. The interfacing details with structure in the vicinity.
4. The material submission above shall include but not limited to the following:
    a. Particulars of all materials for the construction of ZIS;

b. Manufacturer's literature and certificates of material compliance with the requirements of this Specification.

EXT16.M055.9 SHOP DRAWINGS AND MATERIAL SUBMISSION FOR ZIS- INSITU TYPE

1. Submit shop drawings and material submission with all critical information to the CM for Approval within 6 months of the notified date for commencement of the Works;
2. Re-submit shop drawings and material submission to the CM for Approval within 14 days upon receipt of the CM's comments which require amendments to be made;
3. The shop drawings shall include but not limited to the following:
   a. The overall layout and configuration of each type of ZIS, detailed dimensions and setting out for each type of water retention boxes, number of each type of water retention boxes, zonal arrangement, placement etc.;
   b. Water-proofing membrane for the precast water retention boxes;
   c. The details of built-in connector in the water retention boxes to facilitate easy connection of inter-connecting pipes;
   d. The mounting details of water pipes;
   e. The location, access and details of inspection chambers within mechanical water level indicator;
   f. The configuration of ground water recharge devise and overflow pipe connection to drainage provision;
   g. Other builder's work requirements;
   h. The interfacing details with structure in the vicinity.
4. The material submission above shall include but not limited to the following:
   a. Particulars of all materials for the construction of ZIS;
   b. Manufacturer's literature and certificates of material compliance with the requirements of this Specification.

EXT16.M060.9 METHOD STATEMENT

Submit to the CM, within 6 months of the notified date for commencement of the Works, and resubmit if amendments are necessary, the method statement comprising but not limited to the following:

1. Details and particulars of materials to be used;
2. Method of application of the materials to be deployed in relation to ZIS;
3. Description of the complete procedures for construction of all components of ZIS, including precast water retention boxes;
4. Programme of the construction works including verification testing and/ or mock up as EXT16.M075.

EXT16.M070.9 SAMPLES FOR ZIS- MODULAR TYPE

Submit samples of components of the ZIS-Modular type including but not limited to the following for the CM's approval at least six months prior to construction of ZIS:

1. Waterproofing membrane;
2. Filter layer;
3. Geotextile filter layer;
4. Precast concrete water retention module;
5. Water retention box;
6. Drainage cell;
7. Medium for capillary action;
8. Primary and secondary inspection chamber with lockable cover;

9. Pipes and fittings in relation to overflow pipe connection to drainage provision and connection to other sets of modular ZIS;
10. Mechanical water level indicator;
11. Inter-connecting pipes & associated fittings.

EXT16.M071.9 SAMPLES FOR ZIS- INSITU TYPE

Submit samples of components of the ZIS- Insitu type including but not limited to the following for the CM's approval at least six months prior to construction of ZIS:

1. Sodium bentonite waterproofing layer;
2. Filter layer;
3. Water retention box;
4. Drainage cell;
5. Medium for capillary action;
6. Lockable inspection chamber with cover;
7. Pipes &fittings for ground water recharge and overflow pipe;
8. Mechanical water level indicator.

EXT16.M075.9 MOCKUP FOR ZIS PLANTER

1. At a time as requested by the CM, prepare & maintain a mock up with planting (planting species to be agreed with the CM) on site, for duration of not less than 6 months or as instructed by the CM, with all major components of modular ZIS with not less than 3 nos. of water retention boxes, connected by inter-connecting pipes which allow the distribution / extraction of water to/from the all water retention boxes in the set using siphon principle via the primary inspection chamber;
2. Take record in weekly basis for the water level at primary and secondary inspection chamber. Submit monthly report with regular water level record and photo records regarding establishment of plantings. No actual construction on site is permitted prior to the satisfaction of mock up and approval is given by the CM.

EXT16.M080.9 AS-BUILT RECORD FOR PLANTERS WITH ZIS

Submit full particulars of the as-built ZIS for the CM's review and record. The record shall include all relevant information such as number and types of water retention boxes, its placement, piping connection with levels and other information as required by the CM.

MAJOR COMPONENTS

EXT16.M110.9 SODIUM BENTONITE WATERPROOFING LAYER FOR ZIS- INSITU TYPE

The sodium bentonite waterproofing layer shall be a geo-synthetic clay liner coated with polyethylene layer to the entire surface of the woven side, with the following characteristics:

1. An even and continuous bentonite layer made mainly of sodium bentonite powder;
2. Mass per unit area: minimum 4,300 g/m^2;
3. Thickness: minimum 6mm;
4. Maximum tensile strength in accordance with EN ISO 10319: machine direction not less than 12.0 kN/m; or ASTM D6768: machine direction not less than 12.0 kN/m;
5. Peel strength in accordance with ASTM D6496: not less than 60N/10cm;
6. Static puncture strength in accordance with EN ISO 12236 or ASTM D6241 not less than 2,000N;
7. Hydraulic Conductivity in accordance with EN 14150 or ASTM D5084-90: not more than 2 x 10^{-11} 4 m/s;

8. Index Flux (q10) in accordance ASTM D 5887: minimum 2.7 x 10^{-9} (m^3/m^2)/s;
9. Geotextile layer: polypropylene non-woven material.

EXT16.M115.9 WATERPROOFING MEMBRANE

Appropriate water proofing should be applied to all precast concrete water retention module in ZIS- Modula type or applied inside ZIS- Insitu type planters when necessary to ensure water-tightness. Refer to WAT6.M220.

EXT16.M120.9 FILTER LAYER

Refer to EXT13.M110.

EXT16.M125.9 GEOTEXTILE FILTER LAYER FOR ZIS- MODULAR TYPE

Permeable, non-woven, thermally bonded geotextile, type not affected by acids, alkalis, bacteria, humidity, or rotting and shall meet performance requirements set out in the table:

Properties	Test Method	Acceptance Standards
Mechanical Properties		
(i) Wide width strip tensile - Mean peak strength	**BS EN ISO 10319**	Not less than 3.0 kN/m
(ii) CBR puncture resistance - Mean peak strength	**BS EN ISO 12236**	Not less than 525 N
Hydraulic Properties		
(i) Pore size - Mean AOS O_{90}	**BS EN ISO 12956**	Not more than 150 µm
(ii) Permeability - 5cm head	**BS EN ISO 11058**	Not less than 100 l/m^2/s

EXT16.M130.9 WATER RETENTION BOX

The water retention box shall be a modular polyethylene or polypropylene tank resistant to bacteria, moulds and algae, soil-borne chemicals. The water retention box shall possess the following characteristics and refer to drawing no. LA/STD/L/ZR-01 and LA/STD/L/ZR-02 (for modular type), LA/STD/L/AS-01 (for insitu type) at Appendix C to the Specification:

1. Type: prefabricated modular tank intended for underground application;
2. Compressive strength in accordance with ASTM D1621: not less than 210 kPa or equivalent;
3. Approximate size: (Length) 400-800mm, (Width) 375- 600mm, (Height) 360-500mm, or as approved by the CM.

EXT16.M131.9 PRECAST CONCRETE WATER RETENTION MODULE FOR ZIS-MODULAR TYPE

The precast concrete water retention module for water retention medium and box shall of concrete and possess the following characteristics:

1. Materials : Concrete with appropriate reinforcement. Refer to Worksection CON
2. Sufficient compressive strength designed for underground use/ placement of not less than 1.2m below ground;
3. Approximate size: refer to drawing no. LA/STD/L/ZR-01 and LA/STD/L/ZR-02 at Appendix C to the Specification;

4. With built in connector to allow/ facilitate connection of pipes while maintaining effectively water-tightness;
5. With GMS lifting ring or similar to facilitate transportation;
6. With appropriate anchorage as underground guying for treesl;
7. Each precast concrete water retention module is to be water tight without leakage including fittings at connection pipes.

EXT16.M135.9 DRAINAGE CELL FOR ZIS- INSITU TYPE

A minimum 30mm thick polyethylene moulded drainage layer shall have the following functions and properties. Delivery and installation shall be in accordance with the manufacturer's instructions.

1. To allow water to be distributed evenly across each water-retention box;
2. High crush strength to support the loading of vegetation and soil to be provided;
3. Biological and chemical resistance: unaffected by moulds and algae, soil-borne chemicals, bacteria and bitumen;
4. Flow rate in accordance with ASTM D4716: not less than 1.4 litres/ m/ second at 1% gradient;
5. Compressive strength in accordance with ASTM D1621: not less than 980 kPa or equivalent.

EXT16.M140.9 MEDIUM FOR CAPILLARY ACTION– RECYCLED GLASS CULLET/ RIVER SAND

1. Provide recycled glass cullets in all ZIS planters as shown on Drawings as a medium for capillary action to transport collected rainwater to subsoil for plant absorption. Recycled glass cullet of size below 3.5mm is a good medium for capillary action and is considered an environmental conscious alternative to river sand;
2. The Environmental Protection Department (EPD) has maintained some recycled glass cullet storage locations in Hong Kong and the recycled glass cullet stored therein are made available for collection by contractors of the construction industry. The Contractor may contact EPD for collection of recycled glass cullet for the Works. The above information is given in good faith for reference only and no guarantee can be given nor responsibility be taken by the Employer or the CM for the availability and supply of recycled glass cullet;
3. The Contractor shall be responsible for liaison and collection of recycled glass cullet, if available, from EPD and submit relevant part of the chit when requested by the CM;
4 Should there be genuine difficulty in using recycled glass cullet, e.g. supply shortage within 2 months of intended application, submit justification and detail particulars and seek the CM's approval before commencement of the works of ZIS planters on Site. Upon the CM's approval, clean river sand as per EXT12.M230 shall be used as the medium for capillary action. Bear all additional cost incurred and no extension of time will be granted.

EXT16.M145.9 GROUND WATER RECHARGE DEVICE FOR ZIS- INSITU TYPE

1. Once the designated water discharge level is reached, the ground water recharge device shall allow discharge of excess water from in-situ reinforced concrete planter wall to adjoining packets of aggregates;
2. Materials: UPVC pipes and fittings refer to DRA2.M190.

EXT16.M146.9 PRIMARY INSPECTION CHAMBER FOR ZIS- MODULAR TYPE

1. Provide a minimum number of 1 primary inspection chamber for each modular set of ZIS to connect a network of water retention boxes with inter-connected pipes to allow distribution/ extraction of water to/ from all precast concrete water retention modules and water retention boxes within the modular set using the siphon principle via the primary inspection chamber;
2. Each primary inspection chamber shall connect to maximum 2 sets of water retention boxes network with optimum not more than 10 numbers of water retention boxes. The number of water retention boxes in each network connected to the same primary inspection chamber shall be as balance as possible for proper exercise of siphon principle;
3. Location and Placement: refer to drawing no. LA/STD/L/ZR-02 at Appendix C to the Specification;
4. Size: approximately 200 - 300mm in internal diameter;
5. Materials: UPVC refer to DRA2.M190 or PE complying with BS EN 12201;
6. Accessories: Mechanical water level indicator, lockable covers, end cap and other fittings at the bottom of primary inspection chamber;
7. All pipe connections shall be water tight to prevent water leakage at each joint.

EXT16.M147.9 SECONDARY INSPECTION CHAMBER FOR ZIS- MODULAR TYPE

1. A minimum number of 2 secondary inspection chambers for each modular set of ZIS should be installed to gauge the water level in selected precast concrete water retention module;
2. Location and Placement: refer to drawing no. LA/STD/L/ZR-02 at Appendix C to the Specification;
3. Size: approximately 200 - 300mm in internal diameter;
4. Material: UPVC refer to DRA2.M190 or PE complying with BS EN 12201;
5. Accessories: Mechanical water level indicator, lockable covers and end cap at the bottom of secondary inspection chamber;
6. All pipe connections shall be water tight to prevent water leakage at each joint.

EXT16.M150.A OVERFLOW PIPES FOR ZIS- INSITU TYPE

1. Once the designated water discharge level is reached, the overflow pipe shall allow direct discharge of excess water from in-situ reinforced concrete planter. All pipe connections shall be water tight to prevent water leakage at each joint;
2. Material: UPVC pipes and fittings refer to DRA2.M190.

EXT16.M155.9 SUB-SOIL DRAINAGE PIPES FOR ZIS- MODULAR TYPE

1. Sub-soil drainage pipes shall be installed at the level just below the geotextile filter layer. Once the designated water discharge level is reached, the sub-soil drain pipes shall allow discharge of excess water from per-cast concrete containers. All pipe connections shall be water tight to prevent water leakage at each joint;
2. Material: UPVC pipes and fittings refer to DRA2.M180.

EXT16.M160.A MECHANICAL WATER LEVEL INDICATOR AND LOCK

1. The mechanical water level indicator shall be installed inside the lockable inspection chamber at the appropriate locations of the system to reflect the level of retained water. The dial should be conveniently readable from outside the lockable inspection chamber upon removal of cap;
2. The water level indicator should possess the following properties:
   a. Mechanically operable without the need of batteries or electric wiring;
   b. Dial face with empty and full indicator.

3. Each lockable inspection chamber shall be provided with a pad lock or a password lock as approved by the CM. Should there be more than one inspection chamber, the Contractor shall provide pad locks with the same keys or password locks with the same password as approved by the CM.

EXT16.M165.9 INTERCONNECTING PIPES FOR ZIS- MODULAR TYPE

1. Interconnecting pipes should be installed to connect all precast concrete water retention modules and water retention boxes within each modular set and the primary inspection chamber to allow distribution/ extraction of water to/ from all water retention boxes within the modular set using the siphon principle via the primary inspection chamber. All pipe connections shall be providing with easy fitting ends to prevent water leakage at each joint;
2. Material: Polyethylene or polypropylene;
3. Refer to drawing no. LA/STD/L/ZR-01 and LA/STD/L/ZR-02 at Appendix C of the Specification.

ACCESSORIES

EXT16.M200.9 SODIUM BENTONITE POWDER FOR ZIS- INSITU TYPE

Sodium bentonite in powder form.

EXT16.M210.9 SODIUM BENTONITE STRIP FOR ZIS- INSITU TYPE

Flexible hydrophilic strip made of but not limited to natural sodium bentonite clay and synthetic rubber as per manufacturer’s recommendations.

WORKMANSHIP

GENERAL

EXT16.W010.9 HANDLING AND STORAGE

Handle and store the materials carefully as per the manufacturer's recommendations and in a manner that:

1. Prevents damage to surface coating;
2. Prevents contact with harmful elements.

EXT16.W020.9 BUILDER'S WORK IN CONNECTION

The Contractor shall responsible for all builders works in association with the construction of the modular and/or insitu ZIS system.

EXT16.W030.9 FIXING, ASSEMBLING AND LAYING

Carry out any fixing, assembling or laying in accordance with the manufacturer's instructions.

INSTALLATION OF MAJOR COMPONENTS

EXT16.W110.9 INSTALLATION FOR ZIS- MODULAR TYPE

1. Compact the soil within the confines of planters to prepare for the base of ZIS as EXT3.W120;
2. Cast concrete binding layer to the bottom of planter for each individual concrete container;
3. Lay the water retention boxes wrapped with filter layer in accordance with the manufacturer's instructions to each concrete container;
4. Connect the secondary inspection chamber to the individual water retention boxes with mechanical water level indicator;
5. Connect primary inspection chamber with mechanical water level indicator to the piping system connecting each concrete containers and water retention boxes;
6. Fill the spaces inside concrete containers with medium for capillary action up to top level of the concrete containers;
7. Lay the concrete container to the planter, ensure all piping levels are the same to each concrete containers;
8. Ensure all connection pipe fittings are water tight;
9. Carry out water flood test as EXT16.T110;
10. Install sub-soil drainage system right below the geotextile filter layer, i.e. below the top of concrete container;
11. Back fill DG between all concrete containers to the top level of the concrete containers;
12. Lay the geotextile filter layer on top of DG and all concrete containers as per above item 10 except tree pit location;
13. Set indicator at each tree planting location for future identification on tree location;
14. Back fill DG as EXT12.M120 above geotextile filter layer as per item 11 above to specified soil level.

EXT16.W115.9 INSTALLATION FOR ZIS- INSITU TYPE

1. Compact the soil within the confines of planters to prepare for the base of ZIS as EXT3.W120;
2. Laying sodium bentonite layer up to 200mm lap down of the reinforced concrete planter wall with minimum 150mm overlapping or as per manufacturers' recommendations between each sodium bentonite layer. Fix and apply the sodium bentonite layer in accordance with the manufacturer's instructions;
3. Lay drainage cell flat at the base of reinforced concrete planter in accordance with manufacturer's instructions;
4. Lay filter fabric on top of the drainage cell;
5. Connect the ground water recharge device from ZIS to adjacent subsoil area;
6. Verify level of pipe opening against nearby silt trap or sub-soil drainage system before connecting to the overflow pipe from the ZIS;
7. Seal pipe opening of the reinforced concrete planter wall by the sodium bentonite grout (bentonite powder or bentonite strip) in accordance with the manufacturer's instructions;
8. Laying the water retention boxes wrapped with filter layer in accordance with the manufacturer's instructions;
9. Filling the spaces between water retention boxes with river sand up to 50mm above the boxes;
10. Install lockable inspection chamber and mechanical water level indicator;
11. Lay the filter layer on top of river sand;
12. Carry out water flood test as EXT16.T110;
13. Backfill DG as EXT12.M120 for planter.

TESTING

ON-SITE VERIFICATION TEST

EXT16.T110.9 WATER FLOOD TEST TO ZIS FOR ZIS- MODULAR TYPE

1. Test Arrangements:
   a. Carry out water flood test to verify the water-tightness of each precast concrete water retention module with water retention boxes and river sand or glass cullet as appropriate prior to backfilling of DG; test to be carried out in the presence of the CM or his representatives;
   b. The difference of water level recorded from the beginning of water flood test and after 48 hours shall not be more than 10mm; No disruption/ abnormalities observed during the filling / extraction of the water through the primary inspection chamber via the connecting pipes;
   c. The test report and water level records shall be submitted to the CM within 7 days after the test.
2. Test Samples:
   a. All and entire ZIS planters unless instructed otherwise.
3. Test Method:
   a. Distribute water through the primary inspection chamber via the connecting pipes to all water retention boxes to a level agreed with the CM and maintain for 48 hours;
   b. Mark the top water level at clearly visible locations and regularly inspect for any drop of water level;
   c. Extract water through the primary inspection chamber via the connecting pipes from precast water retention boxes by siphon effect to a level agreed with the CM.
4. Non-compliance:
   a. In the event of test failing to meet the requirement stated in sub-clause 1(b) above:
      i. Submit to the CM detailed proposals for remedial measures;
      ii. Carry out subsequent repairs and necessary action to fulfill the original design intent; and
      iii. Bear all associated time and costs of any subsequent flood testing.

EXT16.T115.9 WATER FLOOD TEST TO ZIS FOR ZIS- INSITU TYPE

1. Test Arrangements:
   a. Carry out water flood test to verify the water-tightness of each insitu ZIS planter with water retention boxes and river sand or glass cullet as appropriate prior to backfilling of DG; test to be carried out in the presence of the CM or his representatives;
   b. The difference of water level recorded from the beginning of water flood test and after 48 hours shall not be more than 10mm; No disruption/ abnormalities observed during the filling / extraction of the water through the primary inspection chamber via the connecting pipes;
   c. The test report and water level records shall be submitted to the CM within 7 days after the test.
2. Test Samples:
   a. All and entire ZIS planters unless instructed otherwise.
3. Test Method:

a. Carefully flood the ZIS planter to a level agreed with the CM and maintain for 48 hours;
b. Mark the top water level at clearly visible locations and regularly inspect for any drop of water level.

4. Non-compliance:
   a. In the event of test failing to meet the requirement stated in sub-clause 1(b) above:
      i. Submit to the CM detailed proposals for remedial measures;
      ii. Carry out subsequent repairs and necessary action to fulfill the original design intent; and
      iii. Bear all associated time and costs of any subsequent flood testing.

EXT16.T120.9 SUBMISSION

Produce 3 bound copies of the maintenance manual upon completion of the whole of the Works. This should be developed in parallel with the shop drawing submission and shall include, but not limit to, the following information –

1. Name, address and telephone number of each firm and/or sub-contractor involved in the supply of materials, components, assemblies and finishes;
2. Copies of material, component and finishes certification and test reports as required by this Specification;
3. A trouble shooting including but not limited to the procedures for regular checking of water level inside primary/ secondary inspection chamber, recommend action for planter drought/ suspected water leakage of the system, provision of backup irrigation method in case of malfunction of the system;
4. A procedural guide to fill-in water if the planter is in drought;
5. A procedural guide to drain out water if necessary;
6. Recommendations for routine maintenance works including:
   a. Monthly horticultural maintenance or as necessary;
   b. Frequency checking of water level at primary and secondary inspection chamber.
7. A full set of construction progress photo records showing each critical steps of system installation, including but not limited to construction of blinding layer, placement of module precast concrete water retention module, connection of pipe fittings. backfill of glass cullet or river sand as appropriate, before and after backfill of clean DG;
8. A full set of as built drawings, updated to include any changes made up to the time of completion of the proposed systems.

EXT17 AUTOMATIC DRIP IRRIGATION SYSTEM

DESIGN

GENERAL

EXT17.D010.9 DEFINITION

1. Automatic Drip Irrigation System (ADIS) is a surface drip irrigation system which delivers water to the planting areas at low water pressure through a network of driplines fitted with emitters. A typical ADIS shall comprise a Control Zone and Watering Zone(s);
2. The demarcation of the Control Zone is measured from a water supply point teed-off from the main water supply pipes, up to the boundary of the Watering Zone(s) where water is distributed through a network of driplines. This zone comprises all the regulating devices such as controller unit, valves, filter and pressure regulator for controlling the proper operation of the system, and to ensure that a specified amount of water is delivered to all the planting areas within the specified period;
3. A Watering Zone is demarcated by a set of driplines arranged in continuous loop served by one single solenoid valve. Isolation valves shall be provided to enable proper isolation of different zones for maintenance. The operation of one or more Watering Zones in an ADIS is controlled by the regulating devices in the Control Zone.

EXT17.D020.9 GENERAL REQUIREMENTS

1. The ADIS shall be designed, supplied and installed by a sub-contractor Approved by the CM;
2. Subject to the CM's Approval, the sub-contractor shall be a company which has:
   a. More than three years of relevant experience in ADIS design, installation and maintenance; and
   b. At least one Technical Manager who has more than three years of design experience and he / she shall be responsible for all technical issues including design submission, certification and checking after installation.
3. ADIS shall be installed for the areas indicated in Drawing Nos. …… and ……., and comply with the following requirements:
   a. The ADIS shall be designed to effectively water all planting areas and to allow operational flexibility to cater for different watering requirements in different planting areas (Watering Zones) separately due to variation in plant type / species and soil condition;
   b. All plantings shall receive specific amount of water within the day for proper and healthy growth and sufficient soaking into the soil for encouragement of vigorous root growth;
   c. All above ground services, e.g. intermediate junction boxes, shall be arranged in concealed but accessible locations, and demarcated for easy identification;
   d. Coordinate the design and installation works to avoid abortive works. Coordination at early design stage is required when installation of underground connection pipe across planters is necessary.

EXT17.D030.9 GENERAL SCOPE OF WORKS

1. Technical design of the ADIS shall meet the design criteria and parameters specified in EXT17.D040. The design and installation of the plumbing works of the ADIS shall comply in all aspects with the requirements of the Water Authority;
2. The ADIS shall be installed in accordance with the Approved design proposal including installation of teed-off fittings to the main water supply point;
3. Check and test of every system component. The completed installation shall be subject to satisfactory testing as EXT17.T020;
4. Provide training to the management and maintenance staff during the Maintenance Period;
5. Inspection of the ADIS on a monthly basis during the Maintenance Period as EXT17.T040 to ensure proper performance of the system.

EXT17.D040.9 DESIGN PARAMETERS

1. Dripline design shall meet the following requirements:
   a. Dripline emitter spacing to be 300mm +/- 10%;
   b. Dripline to dripline placing to be 300mm +/- 10% apart;
   c. Driplines to be installed in “Ring” or “Grid” connection;
   d. The lateral run length of dripline at a given water pressure shall not exceed the maximum lateral run length as recommended by the manufacturer.
2. Watering Zone
   a. The aggregate flow rate for each Watering Zone shall not exceed 0.7 litre/second;
   b. The number of Watering Zones should be minimised as far as practicable;
   c. The area of each Watering Zone shall not exceed the effective area in relation to the maximum lateral length of the dripline in design calculation or 100 m², whichever is less;
   d. One Watering Zone may serve more than one individual planter. The driplines in each planter may be linked up using distribution tubing as EXT17.M130 for connecting the driplines system between planters within each Watering Zone. Distribution tubing shall pass through the pipe sleeve pre-installed in planter walls; or underground PVC conduit for kerb planters;
   e. The water velocity in headers shall be designed to no more than 1.5 metre/second and no more than 3.5 bar to reduce friction loss, long-term wear and hydraulic water hammer.
3. Component Security
   a. All system components requiring subsurface protection during installation or for maintenance shall be accommodated in irrigation valve boxes as EXT17.M100. The irrigation valve boxes shall be arranged in concealed but accessible locations and clearly demarcated with irrigation valve box labels as EXT17.M110 for easy identification for future maintenance;
   b. Alternatively, the controller unit in the Control Zone may be mounted on wall or a post in upright position. In this situation, the controller unit shall be stored inside a proprietary IP66 stainless steel enclosure fitted with a stainless steel lock.
4. Rain sensor

   Mount the rain sensor on the top of a stainless steel post at min. 1500 mm above ground level. For best performance, the sensor shall be positioned in an open area where the rain sensor head receive direct rainfall without physical obstruction and within lightning protection zone which provide protection against lightning strike.

EXT17.D050.9 WATER CONSUMPTION RATE

Option 1

The irrigation patterns and programmes shall be optimized to suit the plant growth with minimum water consumption. The average annual water consumption shall be ……. litre/day/m².

Option 2

The reduction in 25% or more of outdoor water use for irrigation may be achieved through the use of water efficient irrigation devices and automatic controls. The calculation shall be based on the following equation as stated in credit WU 2 in BEAM Plus New Buildings (Version 2.0) manual:

$$ID = \sum_{January}^{December} \frac{ET \times K_L \times A \times CE}{IE}$$

ID : Annual irrigation demand satisfied by using potable water (L)
ET : Monthly reference evapotranspiration (mm)
K_L : Landscape coefficient of the landscape type
A : Area of the landscape type (m^2)
CE : Efficiency of controller serving the landscape type
IE : Efficiency of irrigation method serving the landscape type

EXT17.D060.9 TECHNICAL DESIGN PROPOSAL SUBMISSION

1. At least six months before the programmed commencement of the installation work on Site, submit for CM's approval the technical design proposal, including shop drawings, installation details, calculations, manuals, method statement, installation programme, testing proposal and training proposal as EXT17.T020. The submission shall detail the installation procedures and other relevant technical information to substantiate the system design;
2. Shop drawings shall include but not be limited to the following:
   a. Schematic design layout and configuration of ADIS showing the location of controller / timer and other components;
   b. Number, setting out and the covering area of each Watering Zone. Each zone shall be controlled by means of a solenoid valve to fulfill the system performance;
   c. Design calculation to demonstrate compliance with the design criteria and parameters, adequacy of the supply pressure, flow rate and pipe sizes for effective operation of the system;
   d. Other builder's work requirements; and
   e. Interfacing details with structure services and works in the vicinity.
3. Resubmit for Approval within 14 days upon receipt of CM's comments. Allow the times for submission / resubmission for obtaining the CM's Approval. Bear all associated costs and no extension of time will be granted.

EXT17.D070.9 MATERIAL SUBMISSION

1. Within 14 days upon acceptance of the technical design proposal by the CM, submit samples of material to the CM for approval;
2. The list of samples of the proposed materials shall include but not be limited to the following:
   a. Battery powered controller unit with external rain sensor input port;
   b. *Rain sensor;
   c. Solenoid valve;
   d. Stainless Steel Screen Filter;
   e. Ball Valve;
   f. Non-return Valve;
   g. Pressure Regulator;

h. Irrigation Valve Box;
i. Dripline;
j. Air Relief Valve;
k. Flush Valve;
l. Dripline Operation Indicator; and
m. Others accessories - uPVC pipes and fittings.

3. All pipes and fittings for plumbing works under sub-clause (2) shall comply with the requirement of the Water Authority for the intended application;
4. Submission Requirements:

   Full particular of all materials including:

   a. Catalogue, brand name / model name and job reference;
   b. Name, address and contact person of the local supplier;
   c. Name, address and contact person of the manufacturer;
   d. Approval by the Water Authority with a valid approval document if applicable;
   e. Manufacturer's literature and certificates of components showing compliance with the requirements of this Specification;
   f. Other specified submission requirements for the materials.

5. Sample Board:
   a. Provide sample board(s) to display samples of components, pipes, fittings and jointing materials and accessories to be used in the ADIS installation and listed in sub-clause (2) above;
   b. The sample board is to be kept by the CM on Site together with associated relevant certificates / test reports / catalogues / supporting documents upon submission;
   c. Each sample, with clear numbering and labelling, shall be firmly fixed onto a rigid wooden or metal board. A list shall also be affixed on the sample board to show the item description, make and brand, country of origin and locations of installation.

MATERIAL

GENERAL

EXT17.M010.9 GENERAL REQUIREMENTS

All materials of the ADIS shall comply with the relevant clauses in other Worksections of the Specification unless otherwise stated in this Worksection EXT17. Alternative materials may be used only with prior Approval before ordering / installation.

EXT17.M020.9 COMPOSITION

The ADIS shall comprise a Control Zone and Watering Zone(s):

1. Control Zone
   a. Battery powered controller unit with external rain sensor input port, as EXT17.M030;
   b. *Rain sensor as EXT17.M040;
   c. Solenoid valve as EXT17.M050;
   d. Screen Filter as EXT17.M060;
   e. Other accessories including but not limited to
      i. Ball Valve as EXT17.M070;
      ii. Non-return Valve as EXT17.M080;
      iii. Pressure Regulator as EXT17.M090;
      iv. Irrigation Valve Box as EXT17.M100.
2. Watering Zone
   a. Dripline with built-in check valve, as EXT17.M120;
   b. Other accessories including but not limited to
      i. Air Relief Valve as EXT17.M140;
      ii. Flush Valve as EXT17.M150;
      iii. Dripline Operation Indicator as EXT17.M160;
      iv. uPVC pipes and fittings as EXT17.M170.

MAJOR COMPONENTS

EXT17.M030.9 BATTERY POWERED CONTROLLER UNIT

The controller unit shall possess the following characteristics:

1. Power Source: non-built-in battery powered using AA or 9V alkaline battery;
2. With external rain sensor input port;
3. With output terminals to independent solenoid valves using DC pulse (controller unit with built-in solenoid valve as one single unit not acceptable);
4. Water adjustment ranging from at least 0 to 150% to accommodate changing weather condition;
5. Non-volatile memory holding all programmes without batteries;
6. Low battery indicator;
7. Water resistance rating:

   IP24 rating or above for above ground installation and IP68 rating for below ground installation;
8. Underwriters Laboratories (UL) or Conformité Européenne (CE) Approved;

9. For Control Zone serving more than one Watering Zone, the controller unit provided shall be a multi-stations model with multiple programming options;
10. Manual irrigation mode available.

EXT17.M040.9 RAIN SENSOR (OPTIONAL)

The rain sensor shall have the following characteristics:

1. Compatible with controller unit as EXT17.M030;
2. Multiple rainfall setting;
3. Adjustable device to control drying time;
4. With latching hinge and bracket to maintain alignment;
5. Switch electrical rating: 24 V, 3A or above;
6. UL or CE Approved.

EXT17.M050.9 SOLENOID VALVE

The solenoid valve shall possess the following characteristics:

1. One-piece solenoid design with captured plunger and springs;
2. Operate with DC latching solenoid;
3. Compatible with system controller unit as EXT17.M030;
4. With flow control device for precise zone adjustment and manual shutoff;
5. Internal bleed with manual override;
6. Minimum Operating pressure range: 1.5 to 10 bars;
7. Water Temperature rating: up to 40 °C;
8. Operating range: 9VDC.

EXT17.M060.9 SCREEN FILTER

The filter shall possess the following characteristics:

1. The filter case is made up of UV-resistant, durable corrosive-resistant plastic material;
2. With replaceable 150-200 mm mesh stainless steel screen;
3. With flush cap or flush valve for easy flushing of particles;
4. Operating pressure up to 8 bars;
5. Operating ceiling flow rate not less than 60 litre/minute.

EXT17.M070.9 BALL VALVE

Refer to PLU1.M610 and PLU1.M660.

EXT17.M080.9 NON-RETURN VALVE

Refer to PLU1.M640.

EXT17.M090.9 PRESSURE REGULATOR

Refer to PLU1.M910 and PLU1.M920.

EXT17.M100.9 IRRIGATION VALVE BOX

The irrigation valve box shall possess the following characteristics:

1. Made up of UV-resistant materials;
2. Reinforced cover with bevelled edges;
3. Lid shall be securely fastened to body with stainless steel bolts, washers and clips;
4. Skid-resistant lid texture;
5. Pre-moulded pipe slots;
6. Sidewall with reinforced ribs with wide flange bases.

EXT17.M110.9 IRRIGATION VALVE BOX LABEL

Irrigation Valve box labels to be 250 mm x 140 mm x 2 mm thick, white acrylic or aluminium with:

1. Typical wording includes "Control Zone / Watering Zone" as heading and "Automatic Controller / Gate valve / non-returning valve / filter / pressure regulator / solenoid valve etc." as contents;
2. If there is more than one Watering Zone, the heading shall be subdivided into zone 1, zone 2, zone 3, etc.;
3. The wording shall be heat - indented in black characters;
4. The size of the capital letter to be not less than 16 mm and the lower case to be not less than 9 mm;
5. The size of Chinese character to be not less than 20 mm;
6. Fix the label to the top cover of the irrigation valve box with silicon adhesive sealant.

EXT17.M120.9 DRIPLINE WITH BUILT-IN CHECK VALVE

The dripline shall possess the following characteristics:

1. 17mm diameter;
2. Constructed with pressure compensation, integral emitters with an internal check valve;
3. Protection to minimize dirt intrusion;
4. UV resistant tubing;
5. Flow rates: 2.2-2.3 litre/hour;
6. Minimum Operating Pressure: $\leq$ 1.4 bars;
7. Emitter spacing 300mm +/- 10%.

EXT17.M130.9 DISTRIBUTION TUBING

The distribution tubing shall possess the following characteristics:

1. 17mm diameter;
2. UV resistant tubing;
3. Maximum Operating Pressure: $\geq$ 4.1 bars.

EXT17.M140.9 AIR RELIEF VALVE

1. Operating pressure range: up to 4.13 bars;
2. Material: UV-resistant plastic.

EXT17.M150.9 FLUSH VALVE

1. Operating pressure range: up to 3.0 bars;
2. Parts removable for maintenance;
3. Material: UV-resistant plastic.

EXT17.M160.9 DRIPLINE OPERATION INDICATOR

The indicator provides visual confirmation that the ADIS is in operation and shall possess the following characteristics:

1. Minimum operating pressure should be compatible with the minimum operating pressure of the dripline system;
2. Indicator stem shall extend to a height of at least 12 cm for vertical pop-up stem type, or the color flag shall be at upright position (90°) for flag type operation indicator;
3. Material: UV-resistant plastic.

EXT17.M170.9 UNPLASTICIZED PVC (UPVC) PIPES AND FITTINGS

Refer to PLU1.M200.

EXT17.M180.9 PIPE SLEEVES

1. Refer to PLU1.M430;
2. Diameter of pipe sleeves shall be at least one size larger than the PVC conduit that passes through the wall partition.

EXT17.M190.9 SILICON SEALANT

Refer to WAT5.M170.

WORKMANSHIP

GENERAL

EXT17.W010.9 SITE ASSEMBLY AND INSTALLATION

1. Prior to installing the ADIS, ensure the main water supply system is functioning properly, and is suitable for the proposed ADIS;
2. Install ADIS strictly in accordance with the manufacturer's recommendations and the Approved installation details;
3. Coordinate the planter wall / kerb construction and makes necessary allowance for connection fittings to link up with driplines in adjacent planters to form one Watering Zone. The provision and installation of PVC conduits and pipe sleeve fittings on planter walls / kerb should comply with the Specification and Drawings.

EXT17.W020.9 HANDLING AND STORAGE

Handle and store the materials carefully as per the manufacturer's recommendations.

EXT17.W030.9 BUILDER'S WORK IN CONNECTION

*1. In-situ reinforced concrete planter wall as CON1;

*2. Masonry walls as MAS1;

3. ……

EXT17.W040.9 FIXING, ASSEMBLING AND LAYING

1. Ensure adequate protection to the existing waterproofing layer during the installation process;
2. Provide adequate temporary protection to the installed irrigation system in the field during construction and liaise closely with the Approved sub-contractor on the protection required during construction;
3. Carry out any fixing, assembling or laying in accordance with the manufacturer's recommendations.

INSTALLATION OF MAJOR COMPONENTS

EXT17.W050.9 SEQUENCE AND GENERAL PROCEDURES

1. Preparatory Works
   a. Check and confirm the water pressure and flow rate of the water supply point, to which the ADIS is to be connected, are in order;
   b. Do not remove the non-return and air vacuum valves from the water supply point;
   c. Check and confirm the installation locations of the controller unit of the Control Zone;
   d. Remove any stones or sharp-edged objects or construction debris from the soil to avoid damage to the drip tubing;
   e. Keep all pipes and fittings clear of dirt and debris, protect exposed ends by plugging while the installation of other components is in progress.
2. Control Zone Installation
   a. Place irrigation valve box at appropriate location and connect pipe fitting to the water supply point through pre-molded pipe slots of the irrigation valve box. Accommodate all controller unit, gate valves and non-return valves into irrigation valve box(es);

b. For upright installation of the controller unit, mount the stainless steel controller box to wall or a stainless steel post with conduit clamp at 1,100-1,500 mm above ground level;

c. Mount the rain sensor (if provided) on the top of a stainless steel post at 1,500-2,000 mm above ground level;

d. Fix a copy of laminated schematic design layout plan of the ADIS referred to at EXT17.D060 (2)(a) inside the enclosure where the controller unit is located;

e. Connect and accommodate solenoid valve, screen filter and pressure regulator into irrigation valve box(es);

f. Fix the irrigation valve box labels as EXT17.M110 on the top of the irrigation valve boxes;

g. Determine the number of Watering Zones.

3. Watering Zone Installation

a. Identify the zone boundaries of each Watering Zone;

b. Determine the maximum lateral run length for a given water pressure;

c. Determine the dripline layout based on the configuration of the planter and identify the locations of supply header and flush header. The location of all headers shall be 150mm from the planter wall;

d. Establish the overall grid pattern by connecting the supply header and the flush header with driplines using manufacturer's fittings as appropriate. The spacing between driplines is 300mm +/- 10 % apart and 150mm from planter edge;

e. For Watering Zone serving more than one planter, connect the driplines system in each planter by distribution tubing which may pass through the pipe sleeves pre-installed in planters wall or underground PVC conduits for kerb planters;

f. Perform a pressure loss calculation from the water supply point to the farthest end of the header to confirm that the water pressure at all driplines is adequate;

g. The lateral run length of a Watering Zone is measured from the supply header to the flush header, which should not exceed the maximum lateral run length as recommended by the manufacturer;

h. Use Approved dripline stakes to hold driplines in place;

i. Install the air relief valve at the highest point of the Watering Zone;

j. Install the flush valve at the lowest point of the flush header or at the end of the dripline;

k. Install the operation indicator at the appropriate location;

l. Flush the dripline systems thoroughly prior to installing the last connections on each header;

m. Repeat the process as described in sub-clauses (3)(a) to (3)(l) above for each Watering Zone.

4. Final Check

a. Check all valves, tubing and connections for leaks;

b. Verify the location of each air relief valve in field, ensuring one is installed at each localized high point;

c. Check and record water pressure at the supply header and flush header to ensure the system runs below the maximum operating pressure.

EXT17.W060.9 JOINTING UNPLASTICIZED PVC (UPVC) PIPES

Refer to PLU1.W291.

TESTING

GENERAL

EXT17.T010.9 GENERAL REQUIREMENTS

1. Carry out complete performance tests for all components and systems installed, make all necessary adjustments and commission the installations in accordance with the Specification, manufacturers' recommendations and the completed installation satisfies the functional requirements specified;
2. Prior to any tests, submit detailed procedures and a programme for testing for CM's approval;
3. Submit the followings for CM's approval:
   a. Test reports;
   b. Operation and Maintenance manuals;
   c. As-built record drawings.
4. Provide training on management and maintenance of the ADIS to estate management and maintenance staff.

EXT17.T020.9 TESTING AND TRAINING

1. At least two (2) weeks before scheduled testing, submit testing schedule to the CM for approval. The testing shall demonstrate the ADIS is designed and installed in accordance with the Specification and manufacturers' recommendation;
2. The tests shall include but not limited to the following items:
   a. Test the proper functioning of the controller units, including manual activation of each control valve in sequence, and automatically by using the program setting function of controller unit;
   b. Test the proper functioning of the rain sensor (if provided);
   c. Test the proper functioning of all valves, screen filters and pressure regulators;
   d. Carry out water tightness test in accordance with PLU1.T050;
   e. Carry out water pressure test in each Watering Zone to ensure that the pressure variation within the Watering Zone falls within 10 percent range;
   f. Carry out water consumption rate test to ensure that the water consumption rate falls within +/- 5 percent of the range specified in EXT17.D050;
   g. Test the uniformity of the wetting pattern formed around emitters of the driplines by visual observation during operation to demonstrate uniform water delivery;
   h. Test the proper functioning of the locking devices in the irrigation valve boxes, operation indicator and other provisions.
3. In the event of any test failures, investigate the cause(s) of the failure, modify the installation works and replace all defective components as required. Carry out re-test for compliance as required under sub-clauses (1) and (2). Should any preceding test result may have been impacted by a particular fault, repeat such test after the fault has been rectified. Bear all associated costs for investigation / modification / replacement works etc. and the test / re-test required. No extension of time will be granted;
4. Upon completion of all tests, submit test records to the CM for final review;
5. Provide appropriate training to the estate management and maintenance staff on the proper operation and maintenance of the system including but not limited to briefing session, on-site familiarization visit and technical demonstration.

EXT17.T030.9 OPERATION AND MAINTENANCE MANUALS

1. Within one month after completion of the whole ADIS system, submit an Operation and Maintenance Manuals in both English and Chinese, to the CM for approval. Provide to the CM one (1) digital copy and three (3) sets of binded hard copy of the Operation & Maintenance Manuals;
2. The manuals shall include but not limited to the following information:
   a. A full set of as-built drawings, updated to include any changes made up to the time of completion of the ADIS system;
   b. A simplified user manual and troubleshooting guide covering the major components of the ADIS for frontline estate management and maintenance staff, in both English and Chinese, highlighting the key operation and maintenance procedures;
   c. Recommendations for routine maintenance works including:
      i. Irrigation schedule (daily watering quantity and intervals);
      ii. Operating schedule (adjustment of timer under different seasons);
      iii. Timing and method for cleaning, checking and replacement of any components;
      iv. A method statement covering the procedures for replacement of damaged or otherwise defective materials or components.
   d. Training video with audio clips on the following topics:
      i. Setting up of controller units, rain sensor, solenoid valve and pressure regulator;
      ii. Maintenance issues such as cleansing of filter and flushing of driplines;
      iii. Trouble-shooting and checking procedures in case the system breakdowns;
      iv. Replacement of defective components such as controller units and driplines.
   e. Technical specification, schedules, catalogues and user manuals of major components including contacts (i.e. designated contact persons, e-mail addresses, postal addresses and telephone numbers) of each agent and / or manufacturers involved in the supply of materials, components and accessories;
   f. Provide two sets of laminated schematic design layout plans showing the location of controller units, irrigation valve boxes and other components of the ADIS;
   g. The terms and conditions of any guarantees / warranties relating to the installed system.

EXT17.T040.9 REGULAR INSPECTION REPORT DURING MAINTENANCE PERIOD

During the Maintenance Period, the Contractor shall deploy competent technicians or such other suitable personnel to carry out any necessary inspection, testing and repair work on a monthly basis. The Contractor shall submit to the CM contact information of the personnel including their mobile telephone numbers.

EXT17.T050.9 FINAL INSPECTION

1. At one month before the end of the Maintenance Period, the Contractor shall carry out final inspection of the whole ADIS;
2. The Contractor shall carry out any adjustment, rectification, replacement, or alteration, as may be required to correct any faulty works prior to the expiry of the Maintenance Period;
3. Update the Operation and Maintenance Manuals as stipulated in EXT17.T030 and submit the final version of the Operation and Maintenance Manuals to the CM for approval within one month upon completion of the Maintenance Period if any alterations or adjustments are conducted during the Maintenance Period;

4. Provide final on-site familiarization visit and technical demonstration to the estate management and maintenance staff.

EXT18 YARD WASTE TREATMENT AND MANAGEMENT

GENERAL

EXT18.G010.N DEFINITIONS

In this Worksection the following words and expressions shall have the meaning hereby assigned to them except when the context otherwise requires:

1. "Yard waste" means any waste generated from removal of any types of vegetation within, adjoining or outside the Site boundary under the Contract and is usually biodegradable. Typical yard waste includes but not limited to tree trunks, stumps, branches, twigs, leaves, weeds, cut flowers, grass clippings, bushes and shrubs etc.;
2. "Yard waste treatment and management" means the recycle and / or reuse of yard waste with methods accepted by the CM.

EXT18.G020.N SCOPE OF YARD WASTE TREATMENT AND MANAGEMENT

1. Yard waste treatment and management plan is for minimizing yard waste disposal as municipal solid waste in landfills;
2. Yard waste are recyclable materials for the purpose of direct reuse or recycling as far as practicable. Yard waste suitable for recycling shall not be disposed of in landfills, unless with the prior agreement by the CM;
3. Prepare and submit the plan referred to in sub-clause (1) above and related method statement in accordance with requirements stipulated in this Worksection within specified timeframe;
4. Setup, supervise and manage the entire workflow of the approved yard waste treatment plan and management process throughout the progress of the Works, in collaboration with the QAr, as specified in PRE.B8.1110, PRE.B8.1116, PRE.B8.1230 and PRE.B8.1260 including logistic in delivering the yard waste to the designated location as stipulated in this Worksection;
5. Any parts of plant carrying diseases or pests, that are not suitable for recycling, shall be bagged and sealed in strong bags and properly disposed of at designated sites, or handled in accordance with the prevailing guidelines issued by Greening, Landscape and Tree Management Section of Development Bureau, HKSAR Government as directed by the CM.

EXT18.G030.N SUBMISSION OF YARD WASTE TREATMENT AND MANAGEMENT PLAN AND METHOD STATEMENT

1. Within 28 days after the notified date for commencement of the Works submit a yard waste treatment and management plan to the CM for approval including the following particulars:
   a. Organization chart of personnel, including the QAr, responsible for supervising the implementation of the yard waste management;
   b. Layout plans showing the proposed locations for yard waste treatment and management, supplement with relevant details and particulars such as locations of machinery, equipment, ancillary facilities, temporary works areas, storage areas and etc.;
   c. Logistic and arrangement on separation and sorting of yard waste and proposed routing to storage areas;
   d. Routine management and monitoring measures to ensure effectiveness of yard waste treatment process;

e. Safety measures to be adopted to reduce risk of fire hazards or injury to operating personnel;

f. Logistic in delivering the suitable yard waste to the designated location stipulated in this Worksection or as directed by the CM;

g. Program of the Works;

h. Reference should be made to prevailing guidelines issued by Greening, Landscape and Tree Management Section of Development Bureau, HKSAR Government and other relevant Government Departments;

i. Any other relevant details as required by the CM.

WORKMANSHIP

GENERAL

EXT18.W010.N HANDLING AND STORAGE

1. The Contractor shall allow and maintain a safe and hygienic environment for the operation and storage in relation to yard waste treatment and management.
2. Any contaminants, chemical residuals, or diseased parts of plants in the yard waste shall be sorted out for disposal before carrying out any subsequent treatment works.

EXT18.W020.N HANDLING AND DELIVERING TO SHREDDING

1. Under normal circumstance, the Contractor shall deliver suitable yard waste, after proper sorting and necessary cutting into appropriate sizes in accordance with this Worksection, to Environmental Protection Department (EPD)'s shredding facility in the Y • PARK located at Tsang Tsui, Tuen Mun or other suitable facilities as designated by EPD for processing into various useful materials such as wood chips, sawdust, wood boards, wood beams, etc. for reuse, recycling and upcycling. Allow for adoption of other shredding facility that may be subsequently designated by EPD. Bear all associated costs and any extra time required due to switching to the alternative designated shredding facility;
2. The Contractor shall deliver all collected fallen trees not contaminated by rocks or other unsuitable materials to the Y • PARK or other shredding facility designated by EPD for recycling;
3. Yard waste which are suitable for processing at EPD's shredding facility are essentially tree trunks and branches, and unless otherwise agreed by EPD, shall be:
    a. Preferably not more than 6000 mm in length and not more than 600 mm in diameter;
    b. Free from less woody content except twigs and leaves attached to the tree trunks and branches;
    c. Free from foreign objects such as soil, stone, bricks, chain-link fences, iron bars, cloths, waste plastics, all construction and demolition waste and etc.;
    d. Free from wood decay;
    e. Not be infected by pest or disease.
4. The Contractor should note that EPD will review the above requirements and the types of yard waste to be accepted by its shredding facility from time to time. The Contractor shall be obliged to follow the revised or new requirements, from time to time, promulgated by EPD. In the event of doubt, the Contractor may liaise direct with EPD on the tree waste acceptance criteria with respect to the yard waste produced by the Contractor;
5. The acceptance criteria of yard waste by EPD and logistic arrangement on delivering the yard waste to the Y • PARK are provided in Appendix U to the Specification for reference;
6. The Contractor is recommended to complete a one-off registration to become member of the Y • PARK by contacting EPD directly via its website: https://www.ypark.hk/zh-hant/

EXT18.W030.N PLANTS WITH PESTS AND DISEASES

The Contractor shall screen and identify diseased plants. All parts of plants carrying diseases or pests shall be collected and sealed in storage bags and properly disposed at designated sites, such as designated landfill sites or handled in accordance with the guidelines issued by Greening, Landscape and Tree Management Section of Development Bureau, HKSAR Government including "Guidelines on Brown Root Rot Disease" and "Guidelines on Yard Waste Reduction and Treatment", and subject to the approval by the CM to avoid further contamination and spread of diseases.

EXT18.W040.N QUALITY CONTROL

1. Keep a daily record of the weight of yard waste generated and delivered to the Y • PARK or other shredding facility of EPD;
2. Submit the record weekly signed by QAr to the CM and upon completion of the yard waste treatment and management exercise;
3. Comply with the following requirement on quality control:
    a. Divide the Site into different zones based on specific condition of the Site before carrying out of tree felling;
    b. Carry out visual inspection by QAr before tree felling to identify diseased trees, exclude them from recycle treatment and dispose the felled diseased trees stipulated in EXT18.W030;
    c. Tree logs from trees felled in each zone shall be placed together with proper zone identification;
    d. Carry out further visual inspection of the tree logs by QAr before recycle treatment and delivering to the designated location in accordance with this Worksection, to identify any diseased tree logs, exclude them from recycle treatment and dispose them as stipulated in EXT18.W030.

EXT19 ARTWORKS

MATERIALS

GENERAL

EXT19.M010.N GENERAL

All artworks shall be durable and impact resistant. In outdoor and semi-outdoor, they shall be able to withstand typhoon and heavy rain in Hong Kong. They shall also be water resistant with minimal maintenance requirement, robust, not easy damaged, not easy to climb, safely fixed, not easy to fall and shall not cause damage or injury to users or visitors. All the structural elements, including but not limited to details and related calculations, shall be submitted by the Contractor to relevant authority for approval.

EXT19.M020.N WOOD SCULPTURE (FREE STANDING OR WALL MURAL)

1. The sculpture or a group of sculptures must be finished in the dimension and fixed on the location stably as shown on Drawings;
2. The sculpture or a group of sculptures must be finished with the treatment or coating including pest control, flame retardant (supported with certificate) and preservation. Other protection such as anti-UV and water resistance is required;
3. For any colour, durable paint suitable for exterior use, such as multi-layer acrylic paint is recommended; alternative paint could be proposed with job reference(s) on public housing project of the Hong Kong Housing Authority or public works projects of other Government departments in Hong Kong for the CM's approval;
4. For public safety, sharp edge, corner, tiny components, gaps, holes or other potential risk should be avoided;
5. The form or any content of the sculpture should not cause offense to the public.

EXT19.M030.N TILE MOSAIC MURAL

1. The installation surface should be a smooth uniform and levelled plane. The installation surface should be concrete with plastering; wooden backing is not allowed;
2. For outdoor or semi-outdoor area, thickness of mosaic tile should not be less than 3 mm. And outdoor mosaic glue / adhesive is required;
3. In order to achieve weather proofness and waterproofness for the mosaic wall, the sealant shall follow the manufacturer's instructions and recommendations;
4. Subject to the CM's decision, a mosaic tile sub-contractor, with previous mosaic mural installation job reference(s), should be proposed for the CM's approval;
5. The form or any content of the artwork should not cause offense to the public.

EXT19.M040.N ALUMINIUM CURVED ARTWORK WALL MURAL

1. 2D art form (e.g. sticker, printing, print making, engraving etc.) or relief on aluminium is acceptable;
2. For any additional materials apart from aluminium, flame retardant (supported with certificate) and other specific prevention coating or treatment is required;
3. For public safety, sharp edge, corner tiny components, gaps, holes or other risk should be avoided;
4. The form or any content of the artwork should not cause offense to the public.

EXT19.M050.N STANDING SCULPTURE

1. The sculpture or a group of sculptures must be finished in the dimension and fixed on the location stably as shown on Drawings;
2. The individual sculpture and associated supporting structure or plinth shall provide adequate fittings for future temporary relocation to cater for the maintenance of underground utilities;
3. The sculpture or a group of sculptures must be finished with the treatment or coating including pest control, flame retardant (supported with certificate) and preservation. Other protection such as anti-UV and water resistance is required;
4. For public safety, sharp edge, corner, tiny components, gaps, holes or other potential risk should be avoided;
5. The form or any content of the sculpture should not cause offense to the public.

EXT19.M060.N WOOD SCULPTURE WITH RESIN

1. The sculpture must be finished in the dimension and fixed on the location stably as shown on Drawings;
2. The sculpture and associated supporting structure or plinth shall provide adequate fittings for future temporary relocation to cater the maintenance access;
3. The sculpture must be finished with the treatment or coating including pest control, flame retardant (supported with certificate) and preservation. Other protections such as anti-UV and water resistance are required;
4. For any colour, durable paint suitable for exterior use such as multi-layer acrylic paint is recommended; alternative paint could be proposed with job reference(s) on public housing project of the Hong Kong Housing Authority or public works projects of other Government departments in Hong Kong for the CM's approval;
5. For public safety, sharp edge, corner, tiny components, gaps, holes or other potential risk should be avoided;
6. The form or any content of the sculpture should not cause offense to the public.

EXT19.M070.N WALL SURFACE RESERVED FOR ART WORKS IMPLEMENTATION

1. Subject to the CM's decision, wall surface reserved for art works implementation shall be a smooth, uniform and levelled surface applying with plastering and a multi-layer acrylic paint before painting / erection of wall mural;
2. Paints colour shall be submitted to the CM for his approval.

EXT19.M080.N INSTALLATION AND DESCRIPTION PLATE FOR ART WORKS IMPLEMENTATION

A plate made of durable material shall be designed, provided and installed on / next to the artworks to briefly introduce the materials / concepts of the artworks etc. The artwork installation shall be included but not limited to all necessary builder's works, lighting installations and structural support, e.g. plinth, anchor and fixing of artworks.

HONG KONG HOUSING AUTHORITY

SPECIFICATION LIBRARY 2022 (BATCH 4) EDITION

Structural EngineeringWorks Specification

CON CONCRETE WORKS

CON1 INSITU CONCRETE 29

MATERIALS 29

GENERAL 29

CON1.M010.9 STANDARD 29
CON1.M020.9 STATUS OF THE SPECIFICATION 29
CON1.M025.9 STATUS OF THE WORKSECTION 29
CON1.M030.9 GRADES OF CONCRETE 29
CON1.M040.9 CEMENTITIOUS CONTENT 30
CON1.M050.9 FREE WATER/CEMENT RATIO 30

CEMENTS 30

CON1.M110.9 SUBMISSIONS 30
CON1.M120.9 PORTLAND CEMENT (PC) 30
CON1.M130.9 SULPHATE RESISTING PORTLAND CEMENT (SRPC) 30
CON1.M140.9 HIGH ALUMINA CEMENT (HAC) 30
CON1.M150.9 PULVERISED FUEL ASH (PFA) 31
CON1.M160.9 PORTLAND FLY ASH CEMENT (PFAC) 31
CON1.M170.A USE OF PULVERISED FUEL ASH 31
CON1.M180.9 GROUND GRANULATED BLASTFURNACE SLAG (GGBS) 32
CON1.M190.B USE OF GGBS IN PRECAST CONCRETE, STRUCTURAL CONCRETE FOR FOUNDATION WORKS AND OTHER STRUCTURAL CONCRETE 32

AGGREGATES 33

CON1.M210.9 SUBMISSIONS 33
CON1.M215.9 RECYCLED COARSE AGGREGATES 33
CON1.M220.9 SOURCES OF AGGREGATES 33
CON1.M230.9 COARSE AGGREGATE 34
CON1.M240.9 FINE AGGREGATE 34
CON1.M250.9 ALL-IN AGGREGATE 34
CON1.M260.9 LIGHTWEIGHT AGGREGATE 34
CON1.M270.9 AGGREGATES FOR AQUEOUS LIQUID RETAINING STRUCTURES 34
CON1.M280.9 GRADING OF COMBINED AGGREGATES 34

WATER 34

CON1.M310.9 WATER 34
CON1.M320.9 RECYCLED WATER 35

ADMIXTURES 35

CON1.M410.9 ADMIXTURES GENERALLY 35
CON1.M420.A SUBMISSIONS 35
CON1.M430.9 PIGMENTS FOR PORTLAND CEMENT AND PORTLAND CEMENT PRODUCTS 35
CON1.M440.9 ADMIXTURES AND SUPERPLASTICISERS 35

CURING COMPOUNDS 35

CON1.M510.9 GENERAL 35
CON1.M520.9 SUBMISSIONS 35
CON1.M530.9 PROPERTIES 36
CON1.M540.9 CONCRETE CARRIAGEWAY CONSTRUCTION 36
CON1.M550.9 STRUCTURES TO CONTAIN POTABLE WATER 36

ANCILLARY MATERIALS 36

CON1.M610.9 UNDERLAYS TO CONCRETE PAVINGS AND SLABS ON HARDCORE 36
CON1.M620.9 POLYETHYLENE SHEETING FOR CURING 36
CON1.M630.9 WATERPROOF ADHESIVE TAPE 36

CON1.M640.9 BITUMASTIC PAINT 36
CON1.M650.9 REPAIR MORTAR 36
CON1.M660.9 LOW VISCOSITY POLYMER RESIN 37
CON1.M670.9 EPOXY RESIN FOR INJECTION 37
CON1.M680.9 CAST IN STEEL INSERT CHANNELS 37

SOURCES OF SUPPLY OF CONCRETE 37
CON1.M710.9 READY MIXED CONCRETE 37
CON1.M720.9 SUBMISSION FOR APPROVAL 37
CON1.M730.9 SUPPLIER'S CERTIFICATE 38
CON1.M740.9 WITHDRAWAL OF CERTIFICATION 39
CON1.M750.9 SITE BATCHING 39
CON1.M760.A SITE BATCHING PLANT 39

CONCRETE MIXES GENERALLY 39
CON1.M810.9 CHLORIDE CONTENT 39
CON1.M820.9 DESIGNED CONCRETE MIXES 40
CON1.M830.9 USE OF SULPHATE RESISTING PORTLAND CEMENT 40
CON1.M840.9 USE OF PFA AND PFAC 40
CON1.M850.9 CONTROL OF ALKALI-AGGREGATE REACTIONS 40

NO FINES CONCRETE 41
CON1.M910.9 COMPOSITION 41
CON1.M920.9 AGGREGATE/CEMENT CONTENT RATIO 41
CON1.M930.9 CEMENT CONTENT 41

STANDARDISED DESIGNED CONCRETE MIX PROPORTIONS 41
CON1.M1010.9 CEMENT 41
CON1.M1020.9 MIX PROPORTIONS 41
CON1.M1030.9 CONTRACTOR'S RESPONSIBILITY 42
CON1.M1040.9 USE OF ADMIXTURES 42

DESIGNED CONCRETE MIXES 43
CON1.M1110.9 SUBMISSIONS 43
CON1.M1120.9 MAXIMUM CEMENTITIOUS CONTENT 43
CON1.M1130.9 MINIMUM CEMENTITIOUS CONTENT 43
CON1.M1150.9 AQUEOUS LIQUID RETAINING STRUCTURES 44
CON1.M1160.9 INCREASING CEMENTITIOUS CONTENT 44
CON1.M1170.9 MAXIMUM FREE WATER / CEMENT RATIO 44
CON1.M1180.9 MINIMUM SLUMP VALUE 44
CON1.M1190.B CEMENT CONTENT IN CONCRETE WITH PFA OR GGBS 44
CON1.M1200.9 ADJUSTMENT OF FINE AND COARSE AGGREGATES IN DESIGNED CONCRETE MIXES 45

MATERIALS FOR REMEDIAL WORK 45
CON1.M1210.9 GENERAL 45

WORKMANSHIP 46

HANDLING AND STORAGE OF MATERIALS 46
CON1.W010.9 BAGGED CEMENT 46
CON1.W020.9 BULK CEMENT, PFA AND GGBS 46
CON1.W030.9 AGGREGATES 46
CON1.W040.9 ADMIXTURES AND CURING COMPOUNDS 46

BATCHING AND MIXING CONCRETE 47
CON1.W110.9 BATCHING PLANT 47
CON1.W120.9 ALLOWANCE FOR WATER CONTENT OF AGGREGATES 47
CON1.W130.9 QUANTITY OF WATER 47
CON1.W140.9 CONCRETE MIXING PLANT 47
CON1.W150.9 MIXING CONCRETE 47

CON1.W160.9 CEMENT FROM DIFFERING SOURCES 47
CON1.W165.9 PRE-REQUISITES ON MIXING TWO CONCRETE MIXES WITH CEMENT FROM TWO DIFFERING SOURCES 47
CON1.W170.9 REMIXING 48
CON1.W180.9 TRUCK MIXED CONCRETE 48
CON1.W190.9 CLEANLINESS OF MIXER 48
CON1.W200.9 LIGHT-WEIGHT CONCRETE 48
CON1.W210.9 WATERPROOF CONCRETE 48

PROGRAMME AND SITE RECORDS FOR CONCRETING 48
CON1.W305.9 PROGRAMME FOR CONCRETING 48
CON1.W310.A REQUIREMENTS ON SITE RECORDS FOR CONCRETING 49

TRANSPORTING AND PLACING CONCRETE 50
CON1.W410.9 GENERAL 50
CON1.W420.9 CONCRETE BATCHED OFF-SITE 50
CON1.W430.9 CLEANLINESS 50
CON1.W440.9 APPROVAL BEFORE PLACING CONCRETE 50
CON1.W450.9 PROCEDURE 50
CON1.W460.9 USE OF TRUNKING AND CHUTES 50
CON1.W465.9 TEMPERATURE CONTROL IN FRESH CONCRETE 51
CON1.W470.9 TEMPERATURE CONTROL IN MASSIVE STRUCTURAL ELEMENTS 51

TRANSPORTING AND PLACING CONCRETE 51
CON1.W480.9 CONCRETING PLAN 51

FORMING CONSTRUCTION JOINTS 51
CON1.W510.9 LOCATION OF JOINTS 51
CON1.W520.9 AQUEOUS LIQUID RETAINING STRUCTURES 51
CON1.W530.9 WALLS AND COLUMNS 52
CON1.W540.9 EXPOSING AGGREGATE 52
CON1.W550.9 FOOTINGS AND PILE CAPS PREPARED BY OTHERS 52
CON1.W560.9 PLACING ADJACENT CONCRETE 52
CON1.W570.9 INTERRUPTED POURS 52
CON1.W580.9 CONSTRUCTION JOINTS FOR CONCRETE CARRIAGEWAY AND PAVED AREA 52

COMPACTION 52
CON1.W610.9 GENERAL 52
CON1.W620.9 VIBRATING EQUIPMENT 53
CON1.W630.9 USING VIBRATORS 53
CON1.W640.9 NEW CONCRETE 53
CON1.W650.9 COMPACTING NO-FINES CONCRETE 53

PUMPING CONCRETE 53
CON1.W710.9 CM'S APPROVAL 53
CON1.W720.9 PUMPING EQUIPMENT 53
CON1.W730.9 PIPELINES 53
CON1.W740.9 LUBRICATING PIPELINES 53

PLACING CONCRETE UNDER WATER 53
CON1.W810.9 GENERAL 53
CON1.W820.9 STANDARD 54
CON1.W830.9 TREMIES 54
CON1.W840.9 PROCEDURE 54
CON1.W850.9 DEALING WITH BLOCKAGES 54
CON1.W860.9 SURCHARGE AND CONTAMINATED CONCRETE 54

LAYING HOLLOW BLOCK FOR SLABS 54
CON1.W910.9 GENERAL 54

WATERTIGHT BASEMENT CONSTRUCTION 54
CON1.W1010.9 GENERAL 54
CON1.W1020.9 BLINDING LAYER 54
CON1.W1030.9 WATER/VAPOUR PROOF MEMBRANE 54
CON1.W1040.9 FORMWORK TIES 54
CON1.W1050.9 CONCRETE SUPPLY 54
CON1.W1060.9 CONSTRUCTION JOINTS 55
CON1.W1070.9 GROUND WATER 55
CON1.W1080.9 REMEDIAL WORK TO LEAKS ETC. 55
MASS CONCRETE RETAINING WALLS 55
CON1.W1110.9 CONCRETE GRADE 55
CON1.W1120.9 ADDED STONES AND BOULDERS 55
CON1.W1130.9 WEEP HOLES 55
CON1.W1140.9 TEMPERATURE CONTROL 55
GROUND SLABS 55
CON1.W1210.9 LAYING UNDERLAYS TO SLABS LAID ON HARDCORE 55
CON1.W1220.9 BLINDING LAYER 55
KICKERS 55
CON1.W1310.9 WALLS AND COLUMNS 55
CURING 56
CON1.W1410.9 METHODS OF CURING - GENERAL 56
CON1.W1420.9 CURING - METHOD A 56
CON1.W1430.9 CURING - METHOD B 56
CON1.W1440.9 CURING - METHOD C 56
CON1.W1450.9 CURING - METHOD D 57
CON1.W1460.9 CURING - METHOD E 57
CON1.W1470.9 CURING - METHOD F 57
CON1.W1480.9 PROTECTION OF NEW CONCRETE FROM THE WEATHER 57
CON1.W1490.9 MINIMUM PERIODS OF PROTECTION FOR CONCRETE 57
CON1.W1500.9 TEMPORARY REMOVAL OF PROTECTION 58
CON1.W1510.9 ENHANCED CURING CONTROL IN ROOF SLAB 58
LOADING NEW CONCRETE STRUCTURES 58
CON1.W1610.9 LIMITATIONS 58
WORKED FINISHES TO CONCRETE 58
CON1.W1710.9 TYPES OF FINISH 58
CON1.W1720.9 ADDED CEMENT OR WATER 58
CON1.W1730.9 PROTECTION OF LIVING ROOM FLOORS 58
APPLIED SURFACE FINISHES 59
CON1.W1810.9 HARDENING 59
CON1.W1820.9 SURFACE HARDENING 59
CON1.W1830.9 METALLIC OR MINERAL TREATMENTS 59
CRACK REPAIR 59
CON1.W1910.9 GENERAL 59
CON1.W1920.9 INVESTIGATION 59
CON1.W1930.9 METHOD STATEMENT 59
CON1.W1940.9 CONTRACTOR'S RESPONSIBILITY 59
CON1.W1950.9 PROCEDURE FOR CLASSIFICATION - TYPE OF MEMBER 59
CON1.W1960.9 PROCEDURE FOR CLASSIFICATION - WIDTH OF CRACK 60
CON1.W1970.9 PROCEDURE FOR CLASSIFICATION - DEPTH OF CRACK 60
CON1.W1980.9 METHODS OF REMEDIAL REPAIR 60
CON1.W1990.9 REPAIR ACCORDING TO CLASSIFICATION 60
CON1.W2000.N ASSESSMENT OF CUBE AND CORE TESTS RESULTS FOR PROPOSED HIGHER GRADE STRENGTH OF CONCRETE 61

TOLERANCES **61**
CON1.W2010.9 GENERAL 61

TESTING **63**

TRIALS OF DESIGNED CONCRETE MIXES **63**
CON1.T010.9 REQUIREMENT FOR TRIAL MIXES 63
CON1.T020.9 TIMING OF TRIALS 63
CON1.T030.9 PLANT AND LABORATORY TRIALS 63
CON1.T040.B PROCEDURE OF PLANT TRIALS FOR CONCRETE FROM SINGLE BATCHING PLANT 63
CON1.T045.9 PROCEDURE OF PLANT TRIALS FOR MIXING CONCRETES FROM TWO BATCHING PLANTS WITH DIFFERENT CEMENT SOURCES 64
CON1.T050.9 PROCEDURE OF LABORATORY MIX TRIALS 64
CON1.T070.9 STANDARD FOR APPROVAL OF PLANT TRIALS FOR CONCRETE FROM SINGLE BATCHING PLANT 64
CON1.T075.9 STANDARD FOR APPROVAL OF PLANT TRIALS FOR MIXING CONCRETE FROM TWO BATCHING PLANTS WITH DIFFERENT CEMENT SOURCES 65
CON1.T080.9 STANDARD FOR APPROVAL OF LABORATORY MIX TRIALS 65
CON1.T085.9 PROVISIONAL APPROVAL OF PLANT AND LABORATORY MIX TRIALS 66
CON1.T090.9 NON-COMPLIANCE 66
CON1.T100.9 VARIATIONS TO APPROVED MIXES 66
CON1.T110.9 PRACTICAL TESTS FOR SUITABILITY OF THE MIX 66
CON1.T120.9 CERTIFIED EVIDENCE OF MIX SUITABILITY 67

SAMPLING AND TESTING GENERALLY **67**
CON1.T205.9 GENERAL 67
CON1.T210.9 DEFINITION OF "BATCH" 67
CON1.T220.9 SAMPLES FOR TESTING BY DIRECT TESTING CONTRACTOR (DTC) 67
CON1.T230.9 TESTING PROGRAMME 67
CON1.T240.9 SAMPLE SIZES 67

SAMPLING **68**
CON1.T320.9 COARSE AND FINE AGGREGATES 68
CON1.T330.9 WATER FOR MAKING CONCRETE 68
CON1.T340.9 FRESH CONCRETE 69
CON1.T350.9 FACILITIES FOR SAMPLING FRESH CONCRETE 70

TESTS ON AGGREGATES **70**
CON1.T410.9 STANDARD 70
CON1.T420.9 FURTHER ANALYSIS 71

TESTS FOR WORKABILITY **71**
CON1.T510.9 STANDARD 71
CON1.T520.9 ACCEPTANCE VALUES FOR APPROVED MIXES 71

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CUBES **72**
CON1.T610.9 STANDARD FOR CUBE TESTS 72
CON1.T620.9 SAMPLES FOR DESIGNED CONCRETE MIXES 72
CON1.T630.A RESULTS FOR DESIGNED CONCRETE MIXES 73
CON1.T640.A COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES 73
CON1.T650.A TABLE OF COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES 74
CON1.T660.A NON-COMPLIANCE OF DESIGNED CONCRETE MIXES 74
CON1.T670.9 FURTHER TESTS ON DESIGNED CONCRETE MIXES 74

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES 75
CON1.T710.9 GENERAL 75
CON1.T720.9 STANDARD 75
CON1.T730.9 SIZE AND NUMBER OF ROUTINE CORE TEST SAMPLES 75
CON1.T740.9 AGE OF CORE SAMPLES 76
CON1.T750.9 REQUIREMENT FOR FURTHER CONCRETE CORE SAMPLES 76
CON1.T760.9 ASSESSING COMPRESSIVE STRENGTH OF CONCRETE CORES 76
CON1.T770.9 MAKING GOOD CORE HOLES 77
ADDITIONAL TESTS 77
CON1.T810.9 GENERAL 77
CON1.T820.9 CEMENT CONTENT TEST 77
CON1.T830.9 NON-COMPLIANCE OF CEMENT CONTENT TEST 77
CON1.T840.9 AQUEOUS LIQUID RETAINING STRUCTURES 77
CON1.T850.A SCHMIDT HAMMER TEST OF IN-SITU CONCRETE AT EARLY AGE 77
FAILURE TO MEET REQUIRED CRITERIA 78
CON1.T910.9 AQUEOUS LIQUID RETAINING STRUCTURES 78
TESTS FOR REPAIR MORTAR 78
CON1.T1010.9 SAMPLES FROM REPAIR MORTAR 78
TESTS ON GGBS 78
CON1.T1110.B PURCHASER TESTS 78
INVESTIGATION BY EXTENSIVE CORE TESTING 78
CON1.T1210.9 GENERAL 78
CON1.T1220.9 INVESTIGATION AND REPORTS 79
CON1.T1230.9 INVESTIGATION PLAN SUBMISSION 79
CON1.T1240.9 ASSESSMENT CRITERIA 79
CON1.T1250.9 INVESTIGATION REPORT SUBMISSION 79
CON1.T1260.9 RE-EXECUTION OF WORKS REPORT SUBMISSION 80
APPENDICES 81
CON1.APPEND1.9 FORM A 81
CON2 FORMWORK 82
DESIGN 82
FORMWORK DESIGN GENERALLY 82
CON2.D010.A LOADINGS 82
CON2.D020.9 STANDARD 82
CON2.D030.9 INCLINED SURFACES 82
CON2.D040.9 DISMANTLING AND REMOVAL 82
CON2.D050.A BRIDGE AND TRANSFER STRUCTURE CONSTRUCTION 82
CON2.D060.9 FORMWORK FOR STRUCTURAL WALLS IN DOMESTIC BLOCKS 82
FALSEWORK SPANNING PUBLIC HIGHWAYS 83
CON2.D110.A DESIGN RESPONSIBILITY 83
CON2.D120.9 FALSEWORK SPANNING A PUBLIC HIGHWAY 83
CON2.D130.9 APPROVALS 83
SUBMISSIONS 83
CON2.D210.9 TIMING 83
CON2.D220.9 FALSEWORK SPANNING A PUBLIC HIGHWAY 83
CON2.D230.9 PLYWOOD SHEATHING 83
CON2.D240.A LARGE PANEL FORMWORK AND SMALL PANEL METAL FORMWORK FOR DOMESTIC BLOCK 84
CON2.D250.A BRIDGE AND TRANSFER STRUCTURE CONSTRUCTION 84
CON2.D260.9 INSPECTION RECORDS 84

DESIGN OF LARGE PANEL FORMWORK FOR DOMESTIC BLOCK..... 84
CON2.D310.9 GENERAL DEFINITION 84
CON2.D320.9 WALLS NOT EXCEEDING 7.5 M LONG 85
CON2.D330.9 WALLS EXCEEDING 7.5 M LONG WITHOUT OPENINGS 85
CON2.D340.9 WALLS EXCEEDING 7.5 M LONG WITH OPENINGS..... 85
CON2.D350.9 JUNCTIONS..... 85
CON2.D360.9 USE OF OTHER TYPES OF FORMWORK 85
CON2.D370.9 JOINTS IN SHEATHING 85
CON2.D380.9 BACKING STRUCTURE 85
CON2.D390.9 SEALING BASE OF WALLFORMS 85
CON2.D400.9 TOP BRACING..... 85
CON2.D410.9 SLAB EDGES 85
CON2.D420.9 ACCESS WALKWAY 85
CON2.D430.9 OTHER TYPES OF FORMWORK - ACCESS WALKWAY 86
CON2.D440.A PATENT WALLFORM SYSTEMS..... 86
CON2.D450.9 ALTERNATIVE GROUT SEALING SYSTEMS 86
DESIGN OF SMALL PANEL METAL FORMWORK FOR DOMESTIC BLOCK 86
CON2.D510.9 GENERAL DEFINITION 86
CON2.D520.9 JUNCTIONS..... 86
CON2.D530.9 JOINTS IN SHEATHING 86
CON2.D540.9 BACKING STRUCTURE 86
CON2.D550.9 SEALING BASE OF WALLFORMS 86
CON2.D560.9 TOP BRACING..... 87
CON2.D570.9 SLAB EDGES 87
CON2.D580.9 ACCESS WALKWAY 87
CON2.D590.9 PATENT WALLFORM SYSTEMS..... 87
CON2.D600.9 ALTERNATIVE GROUT SEALING SYSTEMS 87
MATERIALS 88
DEFINITIONS 88
CON2.M010.9 FORMWORK OR FORM 88
CON2.M020.9 FALSEWORK 88
CON2.M030.9 TRADITIONAL FORMWORK 88
CON2.M040.9 PERMANENT OR LEFT IN FORMWORK..... 88
CON2.M050.9 LARGE PANEL FORMWORK 88
CON2.M060.9 SMALL PANEL METAL FORMWORK 88
CON2.M080.9 TIMBER FOR FORMWORK 88
SHEATHING..... 88
CON2.M110.9 SUITABLE MATERIALS 88
ANCILLARY MATERIALS 88
CON2.M210.9 RELEASE AGENT 88
CON2.M220.9 SURFACE RETARDERS 88
CON2.M230.9 HOLLOW CONCRETE BLOCKS FOR SLABS..... 88
CON2.M240.9 PRECAST KICKER BLOCKS..... 89
MATERIAL FOR SEALING FORMWORK TIE HOLES..... 89
CON2.M250.9 MORTAR 89
CON2.M260.9 POLYURETHANE FOAM 89
WORKMANSHIP 90
HANDLING AND STORAGE..... 90
CON2.W010.9 FORMWORK..... 90
CON2.W020.9 ANCILLARY MATERIALS..... 90
SAFETY AND PROTECTION..... 90
CON2.W110.9 PERIMETER WALKWAY 90

ERECTING FORMWORK 90
CON2.W210.9 CHECKING AND INSPECTION 90
CON2.W220.9 KICKERS 90
CON2.W230.9 JOINTS 90
CON2.W240.9 TEMPORARY ACCESS 91
CON2.W250.9 PIPE SLEEVES ETC 91
CON2.W260.9 FORMWORK FIXINGS GENERALLY 91
CON2.W270.9 FORMWORK TIES 91
CON2.W280.9 TIES IN STRUCTURAL ELEMENTS WITH WATERTIGHT FUNCTION 91
CON2.W290.9 FORMING CONSTRUCTION JOINTS 91
CON2.W300.9 LAYING HOLLOW BLOCKS FOR SLABS 91
CON2.W310.9 JOINTS IN LARGE PANEL FORMWORK 91
CON2.W315.9 JOINTS IN SMALL PANEL METAL FORMWORK 91
CON2.W320.9 ARRISES 92
KICKERS FOR LARGE PANEL FORMWORK AND SMALL PANEL METAL FORMWORK 92
CON2.W410.9 DEFINITIONS 92
CON2.W420.9 PROVISION OF KICKERS 92
CON2.W430.9 KICKERS FOR EXTERNAL WALLS 92
CON2.W440.9 KICKERS FOR INTERNAL WALLS 92
WORK BELOW GROUND 92
CON2.W510.9 FORMING AGAINST EXCAVATION FACES 92
STRIKING FORMWORK 93
CON2.W610.9 GENERAL 93
CON2.W620.9 CONTRACTOR'S RESPONSIBILITY 93
CON2.W630.9 MINIMUM PERIODS BEFORE STRIKING 93
CON2.W640.9 STRIKING AT LOW TEMPERATURE 93
CON2.W650.9 STRIKING LARGE PANEL FORMWORK AND SMALL PANEL METAL FORMWORK 93
CON2.W660.9 BACK PROPPING SOFFITS 94
CON2.W670.9 LOADING THE STRUCTURE 94
TRIAL PANELS 94
CON2.W710.9 SAMPLES 94
CON2.W720.9 CONSTRUCTION OF TRIAL PANEL 94
CON2.W730.9 SUB-STANDARD TRIALS 94
STANDARD PANEL 94
CON2.W810.9 INSITU STANDARD PANEL 94
FORMED FINISHES FOR CONCRETE 94
CON2.W910.9 TYPE A : ROUGH BOARD FINISH 94
CON2.W920.9 TYPE B : FAIR-FACED FINISH 95
MAINTENANCE OF FORMWORK 95
CON2.W1010.9 PREPARATION FOR RE-USE 95
CON2.W1020.9 DAMAGED AND DETERIORATED FORMWORK 95
CON2.W1030.9 RUBBER SEALS 95
CON2.W1040.9 RE-USE OF TIMBER FORMWORK 95
SEALING FORMWORK TIE HOLES 95
CON2.W1110.9 GENERAL 95
CON2.W1120.9 SEALING THE TIE HOLES 95
TOLERANCES 96
CON2.W1210.9 GENERAL 96
TESTING 97

TESTING OF MORTAR FOR SEALING FORMWORK TIE HOLES 97
CON2.T110.9 LABORATORY TESTING 97
CON2.T120.9 TESTING FOR CHARACTERISTICS OF MORTAR 97
CON2.T130.9 REQUIREMENT FOR FURTHER TEST 97
CON2.T140.9 WATERTIGHTNESS TEST ON SITE 97
CON2.T150.9 FAILURE OF WATERTIGHTNESS TEST 98
CON2.T160.9 ADDITIONAL TESTS UPON FAILURE OF WATERTIGHTNESS TEST 98
CON2.T170.9 MAKE GOOD FORMWORK TIE HOLES 98
CON2.T180.9 BLOWHOLES 98

CON3 REINFORCEMENT 99

MATERIALS 99

REINFORCEMENT GENERALLY 99
CON3.M010.9 STOCKIST'S OR SUPPLIER'S CERTIFICATION 99
CON3.M020.9 VERIFICATION OF SOURCE 99
CON3.M030.9 QUALITY ASSURANCE SCHEME FOR FABRIC REINFORCEMENT 99
CON3.M035.9 PRODUCT CONFORMITY CERTIFICATION SCHEME FOR FABRIC REINFORCEMENT 99
CON3.M040.9 COLOUR CODE SYSTEM OF REINFORCEMENT 100

REINFORCEMENT 100
CON3.M110.9 BAR REINFORCEMENT 100
CON3.M130.9 FABRIC REINFORCEMENT 100
CON3.M140.9 REPLACING FABRIC REINFORCEMENT TO BAR REINFORCEMENT 100

ANCILLARY MATERIALS 100
CON3.M210.9 COVER SPACERS 100
CON3.M220.9 CHAIRS AND SUPPORTS 101
CON3.M230.9 REINFORCEMENT TYING WIRE 101

EPOXY COATED REINFORCEMENT 101
CON3.M250.9 MANUFACTURER'S DOCUMENT AND TEST RESULTS 101
CON3.M260.9 EPOXY COATING TO REINFORCEMENT 101
CON3.M270.9 CHAIRS, SUPPORTS AND SPACERS 102
CON3.M280.9 TYING WIRE 102

MECHANICAL COUPLER 102
CON3.M310.9 TYPE OF MECHANICAL COUPLER 102
CON3.M320.9 SUBMISSION 102
CON3.M330.9 QUALITY ASSURANCE SCHEME FOR MECHANICAL COUPLER 102

WORKMANSHIP 103

GENERAL 103
CON3.W010.9 STORAGE OF REINFORCEMENT 103
CON3.W015.9 STORAGE OF FABRIC REINFORCEMENT IN FACTORY/STOCKYARD 103
CON3.W020.9 SURFACE CONDITION OF REINFORCING STEEL 103
CON3.W030.9 CONTAMINATED OR HEAVILY RUSTED REINFORCEMENT 103
CON3.W040.9 PROTECTION OF EXPOSED REINFORCEMENT 103
CON3.W050.9 COLOUR MARKINGS OF REINFORCEMENT BY STOCKISTS OR SUPPLIERS PRIOR TO DELIVERY 103

FIXING REINFORCEMENT 104
CON3.W110.9 CUTTING AND BENDING REINFORCEMENT 104
CON3.W120.9 COLD BENDING 104
CON3.W130.9 SECURING REINFORCEMENT 104

CON3.W140.9 LOCATING REINFORCEMENT 104
CON3.W150.9 WELDING 104
CON3.W160.9 CONCRETE COVER 104
CON3.W170.9 COMPLIANCE WITH DRAWINGS 104
CON3.W180.9 CM'S INSPECTION 105
TOLERANCES 105
CON3.W210.9 GENERAL 105
EPOXY COATED REINFORCEMENT 105
CON3.W220.9 HANDLING OF REINFORCEMENT 105
CON3.W230.9 STORAGE OF REINFORCEMENT 105
CON3.W240.9 CUTTING AND BENDING REINFORCEMENT 105
CON3.W250.9 REPAIRS TO EPOXY COATING ON SITE 105
MECHANICAL COUPLER 106
CON3.W310.9 QUALIFIED SUPERVISION 106
CON3.W320.9 INSPECTION LOG BOOK 106
TESTING 107
DEFINITIONS 107
CON3.T010.9 BATCH OF BAR REINFORCEMENT 107
CON3.T020.9 BATCH AND LOT OF FABRIC REINFORCEMENT 107
CON3.T025.9 BATCH OF MECHANICAL COUPLER 107
CON3.T030.9 TESTING BY DIRECT TESTING CONTRACTOR (DTC) AND HOUSING DEPARTMENT'S MATERIALS TESTING LABORATORY (HDMTL) 107
CON3.T040.9 TESTING PROGRAMME 107
PURCHASERS TESTING 107
CON3.T110.9 RATE OF SAMPLING 107
CON3.T120.9 PROCEDURE 108
CON3.T130.9 TESTING BY HDMTL 108
CON3.T140.9 ADDITIONAL SAMPLES OF FABRIC REINFORCEMENT DELIVERED TO SITE 108
TESTING BY DTC 108
CON3.T210.9 SCOPE AND NUMBER OF TESTS 108
CON3.T220.9 METHODS OF TESTING 109
COMPLIANCE 109
CON3.T310.9 COMPLIANCE CRITERIA - BAR REINFORCEMENT 109
CON3.T320.A COMPLIANCE CRITERIA - FABRIC REINFORCEMENT 109
RE-TESTS 110
CON3.T410.9 REQUIREMENTS FOR BAR REINFORCEMENT 110
CON3.T420.9 REQUIREMENTS FOR FABRIC REINFORCEMENT 110
CON3.T430.9 STANDARD FOR REJECTION 110
EPOXY COATED REINFORCEMENT 110
CON3.T440.9 ADDITIONAL TEST SPECIMENS FOR EPOXY COATING TEST FOR EACH BATCH 110
CON3.T450.9 TESTING OF THE EPOXY COATING 111
CON3.T460.9 COMPLIANCE CRITERIA FOR EPOXY COATINGS TO REINFORCEMENT 111
CON3.T470.9 NON-COMPLIANCE FOR THICKNESS, ADHESION AND CONTINUITY TESTS 111
CON3.T480.9 TIME REQUIRED FOR TESTING OF THE EPOXY COATED REINFORCEMENT 111
MECHANICAL COUPLER 112
CON3.T510.A RATE OF SAMPLING 112

CON3.T520.9 METHOD OF TESTING 112
CON3.T530.9 COMPLIANCE CRITERIA 112
CON3.T540.9 TIME REQUIRED FOR TESTING 113

CON4 PRECAST CONCRETE 114

DESIGN 114

DESIGN PARAMETERS 114
CON4.D010.9 PRECAST CONCRETE 114
CON4.D020.9 STRUCTURAL JOINT DESIGN 114
CON4.D030.A STEEL LIFTING FRAMES 114
CON4.D040.9 LIFTING POINTS 114

DRAWINGS AND CALCULATIONS 114
CON4.D110.9 GENERAL 114

DESIGN SUBMISSIONS 114
CON4.D210.9 GENERAL 114
CON4.D220.9 PROGRAMME FOR SUBMISSIONS 114
CON4.D230.9 SHOP DRAWINGS 114

JOINTS 115
CON4.D310.9 JOINTS 115
CON4.D320.9 GASKETS 115
CON4.D330.9 MORTAR STOPS 115

WEATHERPROOF JOINTS 115
CON4.D410.9 JOINT DESIGN 115
CON4.D420.9 TYPES OF JOINT 115
CON4.D430.9 DESIGN WIDTH OF JOINTS 115
CON4.D440.9 CONTRACTOR'S RESPONSIBILITY 115

MODIFICATIONS TO THE BUILDING STRUCTURE 115
CON4.D510.9 CONTRACTOR'S RESPONSIBILITY 115
CON4.D520.9 COMPLIANCE WITH GUIDELINES AND REGULATIONS 115
CON4.D530.9 REINFORCEMENT CHANGES 115

MATERIALS 116

GENERAL 116
CON4.M010.9 SUBSTITUTION OF NON-STRUCTURAL CONCRETE 116
CON4.M020.9 PRECAST CONCRETE 116
CON4.M030.9 PRECAST CONCRETE COMPONENTS 116
CON4.M040.9 OFF-SITE MANUFACTURE 116

SUBMISSIONS 116
CON4.M110.9 GENERAL 116
CON4.M120.9 REINFORCEMENT CHANGES 116

CONCRETE GRADE 116
CON4.M210.9 CONCRETE FOR LINTELS 116
CON4.M220.9 CONCRETE FOR STAIRS 116
CON4.M222.9 CONCRETE FOR REFUSE CHUTE 117

NON-SHRINK GROUT FOR PRECAST STAIRS 117
CON4.M230.9 APPROVED MIX 117
CON4.M240.9 CONSTITUENT MATERIALS OF NON-SHRINK GROUT 117
CON4.M250.9 WATER/POWDER RATIO OR WATER CONTENT 117
CON4.M260.9 NON-SHRINK GROUT 117
CON4.M270.9 CONCRETE WITH NON-SHRINK ADDITIVES 117

WEATHER PROOF JOINTS 117
CON4.M310.9 GENERAL 117

CON4.M320.9 SEALANTS 117
CON4.M330.9 MORTAR STOP BACKING RODS 118
CON4.M340.9 DETAILS OF WEATHERPROOFING 118

WORKMANSHIP 119

CASTING PRECAST UNITS 119
CON4.W005.9 QUALITY SYSTEMS AND QUALIFIED SUPERVISION 119
CON4.W010.9 PLACING CONCRETE 119

CASTING LINTELS 119
CON4.W110.9 GENERAL 119
CON4.W120.9 COVER TO REINFORCEMENT 119
CON4.W130.9 BEARING ALLOWANCE 119

CASTING STAIRS 119
CON4.W210.9 CONSTRUCTION 119
CON4.W220.9 FORMWORK 119

CURING 119
CON4.W310.9 GENERAL 119
CON4.W320.9 OTHER CURING METHODS 120

STORAGE, TRANSPORTATION AND LIFTING OF UNITS 120
CON4.W410.9 STRENGTH OF UNITS 120
CON4.W420.9 STORING UNITS 120
CON4.W430.9 DAMAGED UNITS 120
CON4.W440.N TRANSPORTATION 120

ERECTING PRECAST UNITS 120
CON4.W510.9 STANDARD AND SEQUENCE 120
CON4.W520.9 TEMPORARY BRACING 120
CON4.W530.9 DOWEL FIXINGS FOR PRECAST STAIRS 120
CON4.W540.9 BEDDING AND JOINTING PRECAST STAIRS 120

ACCURACY AND TOLERANCES 120
CON4.W610.9 GENERAL 120

IDENTIFICATION FOR PRECAST UNITS 121
CON4.W710.9 IDENTIFICATIONS AND RECORDS 121

DEFECTS 121
CON4.W810.9 MINOR CHIPPING 121
CON4.W820.9 OTHER REPAIRS 121

TESTING 122

SAMPLING AND TESTING 122
CON4.T010.9 FULL SCALE MOCK UP 122
CON4.T020.9 WATERTIGHTNESS TEST 122
CON4.T030.9 SAMPLING FOR WATERTIGHTNESS TEST 122
CON4.T040.9 AGREED TEST PROCEDURES 122
CON4.T050.9 CRITERIA FOR FAILURE 122
CON4.T060.9 REMEDIAL ACTION 122
CON4.T070.9 TESTING OF NON-SHRINK GROUT 122
CON4.T080.A COMPRESSIVE STRENGTH TEST FOR NON-SHRINK GROUT 122

TESTING FIXINGS 123
CON4.T110.9 TENSILE TESTING 123
CON4.T120.9 SHEAR TESTING 123

CON5 PRECAST FACADE UNITS (CONTRACTOR'S DESIGN) 124

DESIGN 124

GENERAL **124**
CON5.D010.9 RELEVANCE OF OTHER SPECIFICATION WORKSECTIONS 124
CON5.D020.9 STANDARD 124
SCOPE OF THE WORK **124**
CON5.D110.9 GENERAL 124
CON5.D120.9 INSITU CONCRETE ELEMENTS INCLUDED 125
CON5.D130.9 SCOPE OF THE DESIGN 125
DESIGN PARAMETERS **125**
CON5.D210.9 GENERAL 125
CON5.D220.9 MINIMUM THICKNESSES 125
CON5.D230.9 OVERHANG AT BASE OF UNITS 125
CON5.D240.9 WINDOW OPENINGS 125
CON5.D250.A LOADINGS 125
CON5.D260.9 MINIMUM CONCRETE GRADE 126
CON5.D270.9 CONCRETE COVER TO REINFORCEMENT 126
CON5.D280.9 LIFTING AND LOCATING DEVICES 126
CON5.D290.9 LOCATION POINTS 126
CON5.D300.9 PERMANENT CONNECTIONS 126
CON5.D310.9 ERECTION RESTRAINTS 126
CON5.D320.9 ADJUSTMENT DEVICES 126
CON5.D330.9 STRUCTURAL SUPPORT 127
INSITU CONNECTION DESIGN **127**
CON5.D410.9 GENERAL 127
CON5.D420.9 REINFORCEMENT, SHEAR CONNECTORS ETC 127
CON5.D430.9 VERTICAL CONNECTIONS 127
CON5.D440.9 HORIZONTAL CONNECTIONS 127
MECHANICAL CONNECTIONS **127**
CON5.D510.9 GENERAL 127
CON5.D520.9 LOAD BEARING FIXINGS 127
CON5.D530.9 TYING BACK FIXINGS 127
CON5.D540.9 LOCATION FIXINGS 128
CON5.D550.9 TYPES OF ATTACHMENT TO STRUCTURE 128
CON5.D560.9 LINKS BETWEEN ANCHORAGES 128
CON5.D570.9 CONCEALMENT OF FIXINGS 128
CON5.D580.9 RESISTANCE TO CORROSION 128
WEATHERPROOF JOINTS **128**
CON5.D610.9 GENERAL 128
CON5.D620.9 TYPES OF JOINT 128
CON5.D630.9 DESIGN WIDTH OF JOINTS 128
CON5.D640.9 COMBINATIONS OF JOINT TYPE AND STRUCTURAL CONNECTIONS 128
CON5.D650.9 CONTRACTOR'S RESPONSIBILITY 129
MODIFICATIONS TO THE BUILDING STRUCTURE **129**
CON5.D710.9 CONTRACTOR'S RESPONSIBILITY 129
CON5.D720.9 TYPES OF MODIFICATION 129
CON5.D730.9 COMPLIANCE WITH GUIDELINES AND REGULATIONS 129
CON5.D740.9 WIND LOADINGS 129
SUBMISSIONS **129**
CON5.D810.9 TENDER DESIGN PROPOSAL 129
CON5.D820.9 REGISTERED STRUCTURAL ENGINEER 129
CON5.D830.9 PROGRAMME FOR SUBMISSIONS 129
CON5.D850.9 SHOP DRAWINGS 130
CON5.D860.9 DRAWINGS AND METHOD STATEMENT 130

CON5.D870.9 METHOD OF FIXING WINDOWS 130
CON5.D880.9 DETAILS OF WEATHERPROOFING 130
CON5.D890.9 QUALITY ASSURANCE SCHEME 130
CON5.D900.9 QUALITY CONTROL PROCEDURES 130
CON5.D910.9 PROGRAMMES 130
CON5.D920.9 LOADING OF INSITU STRUCTURAL MEMBERS 131

SUBMISSIONS FOR PRECASTING 131
CON5.D1010.9 PRELIMINARY DESIGN 131
CON5.D1020.9 METHOD STATEMENTS 131
CON5.D1030.9 CASTING FACILITIES 131
CON5.D1040.9 PRELIMINARY PROGRAMME 131

MATERIALS 132

NON-SHRINK GROUT AND CONCRETE 132
CON5.M010.9 APPROVED MIX 132
CON5.M020.9 CONSTITUENT MATERIALS OF NON-SHRINK GROUT 132
CON5.M030.9 WATER/POWDER RATIO OR WATER CONTENT 132
CON5.M040.9 NON-SHRINK GROUT 132
CON5.M050.9 CONCRETE WITH NON-SHRINK ADDITIVES 132

WEATHERPROOFING 132
CON5.M110.9 GENERAL 132
CON5.M120.9 SEALANTS 132
CON5.M130.9 MORTAR STOP BACKING RODS 133

CONDUIT SYSTEM 133
CON5.M210.9 STANDARDS 133
CON5.M220.9 COLOUR 133
CON5.M230.9 FLAME RESISTANCE 133
CON5.M240.9 TEMPERATURE CLASSIFICATION 133

RIGID PLAIN PVC CONDUITS 133
CON5.M310.9 CONSTRUCTION AND SIZE 133
CON5.M320.9 MECHANICAL PROPERTIES 133
CON5.M330.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUITS 133

PVC CONDUIT FITTINGS 134
CON5.M410.9 CONSTRUCTION 134
CON5.M420.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUIT FITTINGS 134

PVC CIRCULAR CONDUIT BOXES, PVC BOXES FOR ELECTRICAL ACCESSORIES AND PVC ADAPTABLE BOXES 134
CON5.M510.9 CONSTRUCTION AND DIMENSIONS 134
CON5.M520.9 MECHANICAL PROPERTIES 134
CON5.M530.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUIT BOXES 135

WORKMANSHIP 136

GENERAL 136
CON5.W010.9 CASTING YARD 136
CON5.W015.A MANAGEMENT SCHEMES FOR OFF-SITE CASTING 136
CON5.W020.9 QUALITY ASSURANCE SCHEME FOR OFF-SITE CASTING 137
CON5.W025.9 QUALITY ASSURANCE FOR ON-SITE CASTING 137
CON5.W030.9 QUALITY ASSURANCE SCHEME 137
CON5.W035.9 PRECAST CONCRETE CONSTRUCTION AUDITING CONSULTANT 137
CON5.W040.9 QUALIFIED SUPERVISION 138
CON5.W050.9 RECTIFICATION TO QUALITY NON-COMPLIANCE 138
CON5.W055.9 INSPECTION LOG BOOK 138
CON5.W060.9 EQUIPMENT 138
CON5.W070.9 USE OF CASTING YARD 138

CON5.W080.9 SUBMISSION AND PILOT PRODUCTION RUN BEFORE APPROVAL 138
CON5.W090.9 FIRST JOINT INSPECTION AT MANUFACTURER'S FACTORY 139
PRODUCING PRECAST UNITS 140
CON5.W110.9 MOULDS 140
CON5.W120.9 DEFECTIVE MOULDS 140
CON5.W130.9 HORIZONTAL CASTING 140
CON5.W140.9 USE OF RELEASE AGENTS 140
CON5.W150.9 CONCRETING, COMPACTION AND CURING GENERALLY 140
CON5.W160.9 EXTERNAL VIBRATORS 140
CON5.W170.9 CURING BY APPLICATION OF HEAT 140
CON5.W180.9 DEMOULDING GENERALLY 140
CON5.W190.9 CONCRETE STRENGTH BEFORE DEMOULDING 141
CON5.W200.9 IDENTIFICATION AND RECORDS 141
CON5.W210.9 HANDLING INSTRUCTIONS 141
CON5.W220.9 REQUIREMENTS OF OTHER TRADES AND COMPONENTS 141
CON5.W230.9 WINDOWS FIXING TO FACADE UNITS 141
SURFACE FINISHES 141
CON5.W310.9 EXTERNAL FACE 141
CON5.W320.9 EDGES AND OVERHANG SOFFIT 142
CON5.W330.9 INTERNAL FACE - LIVING / DINING / BEDROOMS 142
CON5.W340.9 INTERNAL FACE - BATHROOM 142
CON5.W345.9 INTERNAL FACE - KITCHEN 142
CON5.W350.9 INTERNAL FACE - UTILITY AREA 142
ACCURACY AND TOLERANCES 142
CON5.W410.9 MANUFACTURING AND ERECTION TOLERANCES 142
CON5.W420.9 CHECKING TOLERANCES 142
CON5.W430.9 DEFECTIVE UNITS 142
HANDLING, TRANSPORTATION AND STORAGE 142
CON5.W510.A LIFTING FRAME 142
CON5.W520.9 LIFTING INSERTS AND SUPPORTS 143
CON5.W522.9 TEMPORARY SUPPORTS FOR TRANSPORTATION AND STORAGE 143
CON5.W530.9 INSPECTION 143
CON5.W540.9 LIFTING 143
CON5.W550.9 LIFTING PLANT AND EQUIPMENT 143
CON5.W560.9 STORING UNITS 143
CON5.W570.A TRANSPORTING FROM CASTING YARD 143
CON5.W580.9 LOADING AND OFF-LOADING 143
CON5.W590.9 TRANSPORT VEHICLES 144
ERECTING UNITS 144
CON5.W610.9 PROGRAMME 144
CON5.W620.9 SITE RECORDS 144
CON5.W630.9 CM'S INSPECTION 144
CON5.W640.9 QUALITY CONTROL PROCEDURES 144
CON5.W650.9 LIFTING UNITS INTO POSITION 144
CON5.W660.A TEMPORARY SUPPORT 145
CON5.W670.9 UNITS DAMAGED ON TRANSPORTATION, LIFTING OR ERECTION 145
CON5.W680.9 APPROVAL FOR PERMANENT FIXING 145
CON5.W690.9 PREPARING AND PLACING GROUTING MATERIALS 145
DEFECTS 145
CON5.W710.9 MINOR CHIPPING 145
CON5.W720.9 OTHER REPAIRS 145

CON5.W730.9 REJECTED PANELS 145

JOINTS 145

CON5.W810.9 GENERAL 145
CON5.W820.9 GASKETS 146
CON5.W830.9 MORTAR STOPS 146
CON5.W840.9 JOINT WIDTH 146

CONDUIT SYSTEM 146

CON5.W910.9 APPLICATION 146
CON5.W920.9 SHOP DRAWINGS PREPARATION 146
CON5.W930.9 SUBMISSION AND APPROVAL 146
CON5.W940.9 COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION 146

CONDUIT AND WIRING INSTALLATION 146

CON5.W1010.9 CONDUIT BENDS 146
CON5.W1020.9 BENDING, JOINTING AND TERMINATING OF CONDUITS 147

TESTING 148

SAMPLING AND TESTING GENERALLY 148

CON5.T010.9 RECORDS 148
CON5.T020.9 WITNESSING SAMPLING AND TESTING BY THE CM 148
CON5.T030.9 TESTS AT MANUFACTURER'S FACTORY 148
CON5.T040.9 INSTALLATION OF RFID TAG IN CONCRETE CUBE FOR CUBE COMPRESSION TEST TO BE CARRIED OUT BY DTC OR HDMTL 148

TRIAL UNITS 149

CON5.T110.9 GENERAL 149
CON5.T120.9 ADDITIONAL TRIAL UNITS 149
CON5.T130.9 PROTECTION AND DISPOSAL 149

TESTS ON WORKABILITY 149

CON5.T131.9 STANDARD 149
CON5.T132.9 ACCEPTANCE VALUES FOR APPROVED CONCRETE MIXES 149

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CUBES 149

CON5.T210.9 STANDARD 149
CON5.T211.9 SAMPLES FOR DESIGNED CONCRETE MIXES 149
CON5.T212.9 RESULTS FOR DESIGNED CONCRETE MIXES 150
CON5.T213.9 COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES 150
CON5.T214.9 TABLES OF COMPLIANCE REQUIREMENT FOR DESIGNED CONCRETE MIXES 150
CON5.T215.9 NON-COMPLIANCE OF DESIGNED CONCRETE MIXES 150
CON5.T216.9 FURTHER TESTS ON DESIGNED CONCRETE MIXES 150

TESTS ON COMPRESSIVE STRENGTH OF EARLY CORES FOR PRECAST FACADES 150

CON5.T221.9 GENERAL 150
CON5.T222.9 STANDARD 150
CON5.T223.9 SIZE AND NUMBER OF EARLY CORE SAMPLES 150
CON5.T224.9 AGE OF EARLY CORE SAMPLES 151
CON5.T225.9 ASSESSING COMPRESSIVE STRENGTH OF EARLY CORES 151
CON5.T226.9 NON-COMPLIANCE AND FURTHER TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES FOR PRECAST FACADES 151
CON5.T227.9 MAKING GOOD CORE HOLES 151

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES 151

CON5.T230.9 GENERAL 151
CON5.T231.9 STANDARD 151
CON5.T232.9 SIZE AND NUMBER OF CORE SAMPLES 152

CON5.T233.9 AGE OF CORE SAMPLES 152
CON5.T234.9 REQUIREMENT FOR FURTHER CONCRETE CORE SAMPLES 152
CON5.T235.9 ASSESSING COMPRESSIVE STRENGTH OF CONCRETE CORES 152
CON5.T240.9 NON-COMPLIANCE AND FURTHER TESTING 152
CON5.T245.9 MAKE GOOD CORE HOLES 152
CON5.T250.9 TESTING ON NON-SHRINK GROUT 152
CON5.T260.9 TESTS ON COMPRESSIVE STRENGTH OF GROUT CUBES 152
CON5.T280.9 COUTINHO RING TEST 152

SCHMIDT HAMMER TESTS 153
CON5.T290.9 TESTING FREQUENCY 153

LABORATORY WATERTIGHTNESS TEST 153
CON5.T310.9 NATURE AND PURPOSE OF TEST 153
CON5.T320.9 EXEMPTION FROM TEST 153
CON5.T330.9 TEST PROCEDURE 153
CON5.T340.9 JOINT PERFORMANCE 153

SITE WATERTIGHTNESS TESTS 153
CON5.T410.9 TESTING TRIAL UNIT 153
CON5.T420.A TESTING INSTALLED JOINTS 154
CON5.T430.9 TEST PROCEDURE 154
CON5.T440.9 WITNESSES TO TEST 154
CON5.T450.9 FAILURE OF UNITS 154
CON5.T460.9 REMEDIAL WORK TO UNITS FOR RE-TEST AND ADDITIONAL TESTING 154

TESTING FIXINGS 155
CON5.T510.9 TENSILE TESTING 155
CON5.T520.9 SHEAR TESTING 155

SURVEILLANCE INSPECTION 155
CON5.T710.9 JOINT INSPECTION AT MANUFACTURER'S FACTORY AND BREAKING UP INSPECTION 155

LIFTING ANCHOR 156
CON5.T810.9 DEFINITION OF BATCH 156
CON5.T820.9 TYPE AND LOAD CAPACITY 156
CON5.T830.9 RATE OF SAMPLING 156
CON5.T840.9 COMPLIANCE CRITERION 156
CON5.T850.9 SUBMISSION 156

CON6 MOVEMENT JOINTS 157

MATERIALS 157

JOINT FILLERS 157
CON6.M010.9 COMPRESSIBLE JOINT FILLER 157
CON6.M020.9 INORGANIC COMPRESSIBLE JOINT FILLERS, BOND BREAKERS AND BACKUP MATERIALS 157

SEALANTS 157
CON6.M110.9 GENERAL 157

WATER STOPS 157
CON6.M210.9 WATER STOPS 157

PROPRIETARY EXPANSION JOINTS 157
CON6.M310.9 MECHANICAL EXPANSION JOINTS 157

ANCILLARY MATERIALS 157
CON6.M410.9 ADHESIVE FOR JOINT FILLER 157

WORKMANSHIP 158

GENERAL **158**
CON6.W010.9 JOINT CONSTRUCTION 158
CON6.W020.9 APPLYING SEALANTS 158
MOVEMENT JOINTS **158**
CON6.W110.9 FIXING JOINT FILLER 158
CON6.W120.9 PLACING CONCRETE 158
WATER STOPS **158**
CON6.W210.9 INSTALLATION 158
CON6.W220.9 JOINTING 158
CON6.W230.9 CONCRETING 158

CON7 PRECAST CONCRETE COMPONENTS (ENGINEER'S DESIGN) 159

DESIGN **159**
GENERAL **159**
CON7.D010.9 SCOPE OF THE WORK 159
SUBMISSIONS **159**
CON7.D110.9 LOADING OF INSITU STRUCTURAL MEMBERS 159
PRECAST FAÇADE / PRECAST BALCONY - DESIGN PARAMETERS **159**
CON7.D210.9 ERECTION RESTRAINTS 159
CON7.D220.9 ADJUSTMENT DEVICES 159

MATERIALS **161**
GENERAL **161**
CON7.M010.9 RELEVANCE OF OTHER SPECIFICATION WORKSECTIONS 161
PRECAST FACADE, PRECAST BALCONY, SEMI-PRECAST SLAB, PRECAST STRUCTURAL WALL AND PRECAST PARTITION WALL - CONDUIT SYSTEM **161**
CON7.M110.9 STANDARDS 161
CON7.M120.9 COLOUR 161
CON7.M130.9 FLAME RESISTANCE 161
CON7.M140.9 TEMPERATURE CLASSIFICATION 161
PRECAST FACADE, PRECAST BALCONY, SEMI-PRECAST SLAB, PRECAST STRUCTURAL WALL AND PRECAST PARTITION WALL - RIGID PLAIN PVC CONDUITS **162**
CON7.M210.9 CONSTRUCTION AND SIZE 162
CON7.M220.9 MECHANICAL PROPERTIES 162
CON7.M230.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUITS 162
PRECAST FACADE, PRECAST BALCONY, SEMI-PRECAST SLAB, PRECAST STRUCTURAL WALL AND PRECAST PARTITION WALL - PVC CONDUIT FITTINGS **162**
CON7.M310.9 CONSTRUCTION 162
CON7.M320.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUIT FITTINGS 162
PRECAST FACADE, PRECAST BALCONY, SEMI-PRECAST SLAB, PRECAST STRUCTURAL WALL AND PRECAST PARTITION WALL - PVC CIRCULAR CONDUIT BOXES, PVC BOXES FOR ELECTRICAL ACCESSORIES AND PVC ADAPTABLE BOXES **163**
CON7.M410.9 CONSTRUCTION AND DIMENSIONS 163
CON7.M420.9 MECHANICAL PROPERTIES 163
CON7.M430.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUIT BOXES 163

WORKMANSHIP **165**
GENERAL **165**
CON7.W010.9 CASTING YARD 165

CON7.W015.A MANAGEMENT SCHEMES FOR OFF-SITE CASTING....165
CON7.W020.9 QUALITY ASSURANCE FOR ON-SITE CASTING....166
CON7.W030.9 QUALITY ASSURANCE FOR OFF-SITE CASTING....166
CON7.W040.9 QUALITY ASSURANCE SCHEME....166
CON7.W045.9 PRECAST CONCRETE CONSTRUCTION AUDITING CONSULTANT....166
CON7.W050.9 QUALIFIED SUPERVISION....167
CON7.W055.9 INSPECTION LOG BOOK....167
CON7.W060.9 RECTIFICATION TO QUALITY NON-COMPLIANCE....167
CON7.W070.9 DRAWINGS AND METHOD STATEMENT FOR ON-SITE CASTING....167
CON7.W080.9 PROGRAMME....168
CON7.W090.9 EQUIPMENT....168
CON7.W100.9 USE OF CASTING YARD....168
CON7.W110.9 SUBMISSION AND PILOT PRODUCTION RUN BEFORE APPROVAL....168
CON7.W120.9 FIRST JOINT INSPECTION AT MANUFACTURER'S FACTORY....169

PRODUCING PRECAST UNITS....169
CON7.W210.9 MOULDS....169
CON7.W220.9 DEFECTIVE MOULDS....169
CON7.W230.9 USE OF RELEASE AGENTS....169
CON7.W240.9 CONCRETING, COMPACTION AND CURING GENERALLY....169
CON7.W250.9 EXTERNAL VIBRATORS....169
CON7.W260.9 CURING BY APPLICATION OF HEAT....169
CON7.W270.9 DEMOULDING GENERALLY....170
CON7.W280.9 CONCRETE STRENGTH BEFORE DEMOULDING....170
CON7.W290.9 IDENTIFICATION AND RECORDS....170
CON7.W300.9 REQUIREMENTS OF OTHER TRADES AND COMPONENTS....170

ACCURACY AND TOLERANCES....170
CON7.W410.9 MANUFACTURING AND ERECTION TOLERANCES....170
CON7.W420.9 CHECKING TOLERANCES....171
CON7.W430.9 DEFECTIVE UNITS....171

HANDLING, TRANSPORTATION AND STORAGE....171
CON7.W510.A LIFTING FRAME....171
CON7.W520.9 INSPECTION....171
CON7.W530.9 LIFTING....171
CON7.W540.9 LIFTING PLANT AND EQUIPMENT....171
CON7.W550.9 LOADING AND OFF-LOADING....171
CON7.W560.A TRANSPORT VEHICLES....171

ERECTING UNITS....172
CON7.W610.9 PROGRAMME....172
CON7.W620.9 SITE RECORDS....172
CON7.W630.9 CM'S INSPECTION....172
CON7.W640.9 QUALITY CONTROL PROCEDURES....172
CON7.W650.9 LIFTING UNITS INTO POSITION....172
CON7.W660.9 UNITS DAMAGED ON TRANSPORTATION, LIFTING OR ERECTION....173

TRIAL UNIT....173
CON7.W710.9 GENERAL....173

PRODUCING PRECAST FAÇADE / PRECAST BALCONY UNITS....173
CON7.W810.9 SCOPE OF WORK....173
CON7.W820.9 MOULDS....173
CON7.W830.9 HORIZONTAL CASTING....173
CON7.W840.9 WINDOWS FIXING TO PRECAST FAÇADE / PRECAST BALCONY UNITS....174

CON7.W850.9 SURFACE FINISHES TO EXTERNAL FACE....174
CON7.W860.9 SURFACE FINISHES TO EDGES AND OVERHANG SOFFIT....174
CON7.W870.9 SURFACE FINISHES TO LIVING / DINING / BEDROOMS....174
CON7.W880.9 SURFACE FINISHES TO BATHROOM....174
CON7.W890.9 SURFACE FINISHES TO KITCHEN....174
CON7.W900.9 SURFACE FINISHES TO UTILITY AREA....174
CON7.W910.9 STORING UNITS....174
CON7.W920.9 TRANSPORTING FROM CASTING YARD....174
CON7.W930.9 PROTECTIVE MEASURE FOR ERECTING UNITS....175
CON7.W940.A TEMPORARY SUPPORT....175
CON7.W950.9 APPROVAL FOR PERMANENT FIXING....175
CON7.W960.9 CONDUIT INSTALLATION....175
CON7.W970.9 SHOP DRAWINGS OF CONDUITS....175
CON7.W980.9 SUBMISSION AND APPROVAL OF CONDUITS....175
CON7.W990.9 CONDUIT BENDS....175
CON7.W1000.9 BENDING, JOINTING AND TERMINATING OF CONDUITS....175
CON7.W1010.9 COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION....175

PRODUCING AND ERECTING SEMI-PRECAST SLAB....176
CON7.W1105.9 ERECTION OF SEMI-PRECAST SLAB....176

PRODUCING AND ERECTING SEMI-PRECAST SLAB....176
CON7.W1110.9 STORING AND TRANSPORTING....176
CON7.W1120.9 CLEANSING AND CRACK INSPECTION BEFORE INSITU CONCRETE TOPPING....176
CON7.W1130.9 CONDUIT INSTALLATION....176
CON7.W1140.9 SHOP DRAWINGS OF CONDUITS....177
CON7.W1150.9 SUBMISSION AND APPROVAL OF CONDUITS....177
CON7.W1160.9 CONDUIT BENDS....177
CON7.W1170.9 BENDING, JOINTING AND TERMINATING OF CONDUITS....177
CON7.W1180.9 COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION....177

ERECTING PRECAST STAIRS....177
CON7.W1210.9 DOWEL FIXING....177
CON7.W1220.9 BEDDING AND JOINTING....177

PRODUCING AND ERECTING PRECAST STRUCTURAL WALL / PRECAST PARTITION WALL....177
CON7.W1310.9 STORING AND TRANSPORTING....177
CON7.W1320.9 CLEANSING AND INSPECTION OF JOINTS BEFORE POURING SLAB CONCRETE....178
CON7.W1330.A TEMPORARY SUPPORT....178
CON7.W1340.9 PROTECTIVE MEASURE FOR ERECTING UNITS....178
CON7.W1350.9 BEDDING AND JOINTING....178
CON7.W1360.9 APPROVAL FOR PERMANENT FIXING....178
CON7.W1370.9 CONDUIT INSTALLATION....178
CON7.W1380.9 SHOP DRAWINGS OF CONDUITS....178
CON7.W1390.9 SUBMISSION AND APPROVAL OF CONDUITS....178
CON7.W1400.9 CONDUIT BENDS....178
CON7.W1410.9 BENDING, JOINTING AND TERMINATING OF CONDUITS....179
CON7.W1420.9 COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION....179

TESTING....180

SAMPLING AND TESTING GENERALLY....180
CON7.T010.9 RECORDS....180

CON7.T020.9 WITNESSING SAMPLING AND TESTING BY THE CM 180
CON7.T030.9 TESTS AT MANUFACTURER'S FACTORY 180
CON7.T040.9 INSTALLATION OF RFID TAG IN CONCRETE CUBE FOR CUBE COMPRESSION TEST TO BE CARRIED OUT BY DTC OR HDMTL 180

TESTS ON WORKABILITY 181
CON7.T050.9 STANDARD 181
CON7.T051.9 ACCEPTANCE VALUES FOR APPROVED CONCRETE MIXES 181

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CUBES 181
CON7.T052.9 STANDARD 181
CON7.T053.9 SAMPLES FOR DESIGNED CONCRETE MIXES 181
CON7.T054.9 RESULTS FOR DESIGNED CONCRETE MIXES 181
CON7.T055.9 COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES 181
CON7.T056.9 TABLES OF COMPLIANCE REQUIREMENT FOR DESIGNED CONCRETE MIXES 181
CON7.T057.9 NON-COMPLIANCE OF DESIGNED CONCRETE MIXES 181
CON7.T058.9 FURTHER TESTS ON DESIGNED CONCRETE MIXES 181

COMPRESSIVE TEST ON CONCRETE CUBES 181
CON7.T110.9 GENERAL 181

TESTS ON COMPRESSIVE STRENGTH OF EARLY CORES FOR PRECAST CONCRETE COMPONENTS EXCEPT SEMI-PRECAST SLAB AND PRECAST PARTITION WALL 182
CON7.T121.9 GENERAL 182
CON7.T122.9 STANDARD 182
CON7.T123.9 SIZE AND NUMBER OF EARLY CORE SAMPLES 182
CON7.T124.9 AGE OF EARLY CORE SAMPLES 183
CON7.T125.9 ASSESSING COMPRESSIVE STRENGTH OF EARLY CORES 183
CON7.T126.9 NON-COMPLIANCE AND FURTHER TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES FOR PRECAST CONCRETE COMPONENTS 183
CON7.T127.9 MAKING GOOD CORE HOLES 183

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES EXCEPT PRECAST PARTITION WALL 183
CON7.T128.9 GENERAL 183
CON7.T129.9 STANDARD 184
CON7.T130.9 SIZE AND NUMBER OF CORE SAMPLES 184
CON7.T135.9 AGE OF CORE SAMPLES 184
CON7.T136.9 NON-COMPLIANCE AND FURTHER TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES FOR SEMI-PRECAST SLAB 184
CON7.T140.9 CORE TESTING FOR SEMI-PRECAST SLAB 184
CON7.T150.9 REQUIREMENT FOR FURTHER CORE SAMPLES 184
CON7.T160.9 ASSESSING COMPRESSIVE STRENGTH OF CONCRETE CORES 185
CON7.T180.9 MAKE GOOD OF CORE HOLES 185
CON7.T190.9 TESTING OF NON-SHRINK GROUT 185
CON7.T200.9 TESTS ON COMPRESSIVE STRENGTH OF GROUT CUBES 185

SCHMIDT HAMMER TESTS 185
CON7.T205.9 TESTING FREQUENCY 185

SITE WATERTIGHTNESS TESTS TO PRECAST FAÇADE / PRECAST BALCONY 185
CON7.T210.9 TESTING TRIAL UNIT 185
CON7.T220.A TESTING INSTALLED JOINTS 185
CON7.T230.9 TEST PROCEDURE 185
CON7.T240.9 WITNESSES TO TEST 186
CON7.T250.9 FAILURE OF UNITS 186

CON7.T260.9 REMEDIAL WORK TO UNITS FOR RE-TEST AND ADDITIONAL TESTING 186
CORE TEST AND CRACK INSPECTION FOR SEMI-PRECAST SLAB 186
CON7.T410.9 CORE TEST IN SAMPLE FLAT UNIT 186
SURVEILLANCE INSPECTION 187
CON7.T510.9 JOINT INSPECTION AT MANUFACTURER'S FACTORY AND BREAKING UP INSPECTION 187
LIFTING ANCHOR 187
CON7.T610.9 DEFINITION OF BATCH 187
CON7.T620.9 TYPE AND LOAD CAPACITY 187
CON7.T630.9 RATE OF SAMPLING 188
CON7.T640.9 COMPLIANCE CRITERION 188
CON7.T650.9 SUBMISSION 188

CON8 VOLUMETRIC PRECAST CONCRETE COMPONENTS FOR DOMESTIC BLOCKS 189
DESIGN 189
GENERAL 189
CON8.D010.9 DEFINITION OF VOLUMETRIC PRECAST CONCRETE CONSTRUCTION 189
CON8.D020.9 USE OF VOLUMETRIC PRECAST CONCRETE COMPONENTS 189
CON8.D030.9 RELEVANCE OF OTHER SPECIFICATION WORKSECTIONS 189
CON8.D040.9 DESIGN STANDARDS 190
SCOPE OF WORK 190
CON8.D110.9 GENERAL (ENGINEER'S DESIGN) 190
CON8.D120.9 SCOPE OF THE DESIGN (CONTRACTOR'S DESIGN) 190
DESIGN PARAMETERS (CONTRACTOR'S DESIGN) 191
CON8.D210.9 STABILITY 191
CON8.D220.9 RESISTANCE TO PROGRESSIVE COLLAPSE 191
CON8.D230.9 DEFORMATIONS 191
CON8.D240.9 INTERFACE WITH OTHER STRUCTURAL COMPONENTS 191
CON8.D250.9 EXTERNAL FACES 191
CON8.D260.9 LOADING 191
CON8.D270.9 MINIMUM CONCRETE GRADE 192
CON8.D280.9 CONCRETE COVER TO REINFORCEMENT 192
CON8.D290.9 CONCRETE COVER TO PVC CONDUIT 192
CON8.D300.9 CONCEALMENT OF FIXINGS 192
JOINTS 192
CON8.D410.9 JOINTS 192
CON8.D420.9 GASKETS 192
CON8.D430.9 MORTAR STOPS 192
WEATHERPROOF JOINTS (CONTRACTOR'S DESIGN) 192
CON8.D510.9 JOINT DESIGN 192
CON8.D520.9 TYPES OF JOINT 192
CON8.D530.9 DESIGN WIDTH OF JOINTS 192
PERMANENT STRUCTURAL CONNECTIONS 193
CON8.D610.9 GENERAL (CONTRACTOR'S DESIGN) 193
CON8.D620.9 REINFORCEMENT, SHEAR CONNECTORS ETC 193
CON8.D630.9 VERTICAL PERMANENT STRUCTURAL CONNECTIONS 193
CON8.D640.9 HORIZONTAL PERMANENT STRUCTURAL CONNECTIONS 193
DESIGN TOLERANCES 193
CON8.D710.9 OVERALL TOLERANCES (CONTRACTOR'S DESIGN) 193

CON8.D720.9 VOLUMETRIC PRECAST CONCRETE COMPONENTS MANUFACTURE TOLERANCE (CONTRACTOR'S DESIGN) 193
CON8.D730.9 VOLUMETRIC PRECAST CONCRETE COMPONENTS ERECTION TOLERANCE 193

LIFTING OF VOLUMETRIC PRECAST CONCRETE COMPONENTS 194
CON8.D810.9 LIFTING DESIGN 194
CON8.D820.A STEEL LIFTING FRAMES 194
CON8.D830.9 LIFTING METHOD 194

SUBMISSIONS 194
CON8.D910.9 TENDER DESIGN PROPOSAL 194
CON8.D920.9 REGISTERED STRUCTURAL ENGINEER 194
CON8.D930.9 PROGRAMME FOR SUBMISSIONS 194
CON8.D940.9 DRAWINGS AND METHOD STATEMENT (CONTRACTOR'S DESIGN) 195
CON8.D950.9 DRAWINGS AND METHOD STATEMENT (ENGINEER'S DESIGN) 195

STRUCTURAL MODIFICATIONS TO THE BUILDING STRUCTURE (ENGINEER'S DESIGN) 196
CON8.D1010.9 CONTRACTOR'S RESPONSIBILITY (ENGINEER'S DESIGN) 196
CON8.D1020.9 COMPLIANCE WITH GUIDELINES AND REGULATIONS (ENGINEER'S DESIGN) 196
CON8.D1030.9 REINFORCEMENT CHANGES (ENGINEER'S DESIGN) 196

STUDY MOCK-UP 196
CON8.D1110.9 GENERAL 196
CON8.D1120.9 LOCATION OF CASTING YARD 196
CON8.D1130.9 SIZE OF STUDY MOCK-UP 197
CON8.D1140.9 EXTENT OF COVERAGE OF STUDY MOCK-UP 197
CON8.D1150.9 RESPONSIBILITIES OF THE CONTRACTOR 197
CON8.D1160.9 SHOP DRAWINGS 198
CON8.D1170.9 CM'S COMMENT AND INSPECTION OF STUDY MOCK-UP 198
CON8.D1180.9 AS-BUILT DRAWINGS FOR APPROVAL 198
CON8.D1190.9 MAINTENANCE MANUAL 198
CON8.D1200.9 CM'S APPROVAL TO PROCEED 199
CON8.D1210.9 VALIDATION OF DESIGN ON STUDY MOCK-UP 199
CON8.D1310.9 CORE TEST TO STUDY MOCK-UP 199

MATERIALS 200

GENERAL 200
CON8.M010.9 RELEVANCE OF OTHER SPECIFICATION WORKSECTIONS 200

SUBMISSIONS 200
CON8.M110.9 CONCRETE MIX 200
CON8.M120.9 DETAILS OF WEATHERPROOFING 200
CON8.M130.9 CONDUIT SYSTEM 200

CONCRETE 200
CON8.M210.9 CONCRETE MIX 200
CON8.M220.9 CONCRETE STRENGTH 201
CON8.M230.9 DURABILITY 201
CON8.M240.9 NON-SHRINK GROUT AND CONCRETE WITH NON-SHRINK ADDITIVES 201

JOINTS 201
CON8.M310.9 WEATHERPROOF JOINTS 201

PERMANENT STRUCUTURAL CONNECTIONS 201
CON8.M410.9 RESISTANCE TO CORROSION 201

CONDUIT SYSTEMS 201
CON8.M510.9 GENERAL 201
DIMENSIONS AND TOLERANCES 201
CON8.M610.9 DIMENSIONAL CHECK 201
ON SITE DELIVERY VERIFICATION 201
CON8.M710.9 INSPECTION 201
CON8.M720.9 BREAKING-UP INSPECTION 203
WORKMANSHIP 206
GENERAL 206
CON8.W010.9 OFF SITE CASTING YARD 206
CON8.W020.9 ARCHITECTURAL WORKS 206
CON8.W030.9 BUILDING SERVICES INSTALLATION 206
CON8.W040.9 QUALIFIED SUPERVISION FOR VOLUMETRIC PRECAST CONCRETE COMPONENTS 206
SUBMISSIONS 206
CON8.W110.9 MOULDS 206
CON8.W120.9 METHOD STATEMENT 206
CON8.W130.9 CONDUIT SYSTEM SHOP DRAWINGS 207
CON8.W140.9 PROGRAMMES 207
CON8.W150.9 QUALITY ASSURANCE SCHEME FOR MANUFACTURE OF VOLUMETRIC PRECAST CONCRETE COMPONENTS 207
CON8.W160.9 QUALITY CONTROL PROCEDURES FOR ERECTING VOLUMETRIC PRECAST CONCRETE COMPONENTS 207
MOULD ASSEMBLY 207
CON8.W210.9 TOLERANCE 207
CON8.W220.9 GROUT SEALS 208
CON8.W230.9 GAUGES 208
CON8.W240.9 FITTINGS 208
CON8.W250.9 EXTERNAL FACES 208
CON8.W260.9 DEFECTIVE MOULDS 208
CON8.W270.9 USE OF RELEASE AGENTS 208
MANUFACTURING OF VOLUMETRIC PRECAST CONCRETE COMPONENTS 208
CON8.W310.9 GENERAL 208
CON8.W320.9 CONCRETE MIX 208
CON8.W330.9 CONCRETING, COMPACTION AND CURING GENERALLY 208
CON8.W340.9 CONSTRUCTION JOINTS 208
CON8.W350.9 EXTERNAL VIBRATORS 208
CON8.W360.9 CURING BY APPLICATION OF HEAT 209
CON8.W370.9 DEMOULDING AND STRIPPING MOULDS 209
CON8.W380.9 CONCRETE STRENGTH BEFORE DEMOULDING 209
CON8.W390.9 IDENTIFICATION AND RECORDS 209
CON8.W400.9 REQUIREMENTS OF OTHER TRADES AND COMPONENTS 209
CON8.W410.9 SCOPE OF MINOR REPAIR 209
CON8.W420.9 DEFECTIVE COMPONENTS 210
CON8.W430.9 CLEANING 210
CON8.W440.9 PROTECTION 210
CON8.W450.9 LIFTING 210
CON8.W460.9 SIZE AND WEIGHT OF VOLUMETRIC PRECAST CONCRETE COMPONENTS FOR TRANSPORTATION AND CRANEAGE 210
CON8.W470.9 TEMPORARY STORAGE SUPPORT 211
CON8.W480.A TRANSPORTATION 211

ERECTING VOLUMETRIC PRECAST CONCRETE COMPONENTS 211
CON8.W510.9 SITE RECORDS 211
CON8.W520.9 CM'S INSPECTION 211
CON8.W530.A LIFTING UNITS INTO POSITION 211
CON8.W540.9 UNITS DAMAGED ON TRANSPORTATION, LIFTING OR ERECTION 212
JOINTS AND PERMANENT STRUCTURAL CONNECTIONS 212
CON8.W610.9 GENERAL 212
CON8.W620.9 GROUTING OF PERMANENT STRUCTURAL CONNECTION 212
CON8.W630.9 JOINT WIDTH 212
CONDUIT SYSTEM 212
CON8.W710.9 APPLICATION 212
CON8.W720.9 COMPLETION CERTIFICATION 212
CONDUIT AND WIRING INSTALLATION 212
CON8.W810.9 CONDUIT BENDS 212
CON8.W820.9 BENDING, JOINTING AND TERMINATING OF CONDUITS 212
PROTOTYPE MOCK-UP 212
CON8.W910.9 PROTOTYPE MOCK-UP 212
CON8.W920.9 REMOVAL OF PROTOTYPE MOCK-UP 213
CON8.W930.9 VERIFICATION OF PROTOTYPE MOCK-UP 213
TESTING 214
SAMPLING AND TESTING 214
CON8.T010.9 RECORDS 214
CON8.T020.9 WITNESSING SAMPLING AND TESTING BY THE CM 214
CON8.T030.9 TESTS AT MANUFACTURER'S FACTORY 214
CON8.T035.9 INSTALLATION OF RFID TAG IN CONCRETE CUBE FOR CUBE COMPRESSION TEST TO BE CARRIED OUT BY DTC OR HDMTL 214
CON8.T040.9 FULL SCALE MOCK UP FOR VPB AND VPK 215
TESTS ON WORKABILITY 215
CON8.T045.9 STANDARD 215
CON8.T050.9 ACCEPTANCE VALUES FOR APPROVED CONCRETE MIXES 215
TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CUBES 215
CON8.T060.9 STANDARD 215
CON8.T061.9 SAMPLES FOR DESIGNED CONCRETE MIXES 215
CON8.T062.9 RESULTS FOR DESIGNED CONCRETE MIXES 215
CON8.T063.9 COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES 215
CON8.T064.9 TABLES OF COMPLIANCE REQUIREMENT FOR DESIGNED CONCRETE MIXES 215
CON8.T065.9 NON-COMPLIANCE OF DESIGNED CONCRETE MIXES 215
CON8.T066.9 FURTHER TESTS ON DESIGNED CONCRETE MIXES 215
MIX TESTS 216
CON8.T110.9 GENERAL 216
SCHMIDT HAMMER TESTS 216
CON8.T120.9 TESTING FREQUENCY 216
TESTS ON COMPRESSIVE STRENGTH ON EARLY CORES FOR VPB, VPK, VOLUMETRIC PRECAST LIFT SHAFT AND VOLUMETRIC PRECAST LIFT MACHINE ROOM COMPONENTS 216
CON8.T130.9 GENERAL 216
CON8.T140.9 STANDARD 216
CON8.T150.9 SIZE AND NUMBER OF EARLY CORE SAMPLES 216
CON8.T160.9 AGE OF EARLY CORE SAMPLES 217
CON8.T170.9 ASSESSING COMPRESSIVE STRENGTH ON EARLY CORES 217

CON8.T180.9 NON-COMPLIANCE AND FURTHER TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES FOR VPB, VPK, VOLUMETRIC PRECAST LIFT SHAFT AND VOLUMETRIC PRECAST LIFT MACHINE ROOM COMPONENTS 217
CON8.T190.9 MAKING GOOD CORE HOLES 218
CON8.T195.9 TESTING ON NON-SHRINK GROUT 218
CON8.T200.9 TESTS ON COMPRESSIVE STRENGTH OF GROUT CUBES 218

TESTING FIXINGS 218
CON8.T210.9 TENSILE AND SHEAR TESTING 218

SITE WATERTIGHTNESS TESTS TO EXTERNAL FACES ELEMENT OF VOLUMETRIC PRECAST CONCRETE COMPONENTS 218
CON8.T310.9 TESTING INSTALLED JOINTS 218
CON8.T320.9 TEST PROCEDURE 218
CON8.T330.9 WITNESSES TO TEST 219
CON8.T340.9 FAILURE OF UNITS 219
CON8.T350.9 REMEDIAL WORK TO VOLUMETRIC PRECAST CONCRETE COMPONENTS FOR RE-TEST 219

SITE TESTING OF JOINTS AND PERMANENT STRUCTURAL CONNECTIONS 219
CON8.T410.9 SITE TESTING OF JOINTS AND PERMANENT STRUCTURAL CONNECTIONS 219

LIFTING ANCHOR 220
CON8.T510.9 DEFINITION OF BATCH 220
CON8.T520.9 TYPE AND LOAD CAPACITY 220
CON8.T530.9 RATE OF SAMPLING 220
CON8.T540.9 COMPLIANCE CRITERION 220
CON8.T550.9 SUBMISSION 220

FACTORY VERIFICATION TESTS 220
CON8.T610.9 WATER FLOOD TEST TO INTERNAL INSTALLATIONS 220

CON9 OFF-SITE STEEL REINFORCING BAR PREFABRICATION YARD 222

GENERAL 222

SCOPE AND TYPES 222
CON9.G005.9 APPLICATION 222
CON9.G010.9 SCOPE OF OFF-SITE STEEL REINFORCING BAR PREFABRICATION YARD 222
CON9.G020.A TYPES OF OFF-SITE STEEL REINFORCING BAR PREFABRICATION YARD 222

SUBMISSION 223
CON9.G110.9 GENERAL 223
CON9.G120.9 QUALITY MANAGEMENT SYSTEM 224

TYPE 1 YARD 224
CON9.G210.9 SURVEILLANCE AUDIT / INSPECTION 224
CON9.G220.9 TRACEABILITY 224
CON9.G230.9 PREFABRICATED STEEL REINFORCING BAR PRODUCTS SUMMARY REPORT 224
CON9.G240.9 OFF-SITE STEEL REINFORCING BAR PREFABRICATION YARD REMOVED FROM THE LIST 225

TYPE 2 AND TYPE 3 YARDS 225
CON9.G310.9 REQUIREMENTS ON SECURITY PROCEDURE 225
CON9.G320.9 REQUIREMENTS ON TRACEABILITY PROCEDURE 226

CON9.G330.9 PREFABRICATED STEEL REINFORCING BAR PRODUCTS SUMMARY REPORT 227

MATERIALS 228

REINFORCEMENT GENERALLY 228

CON9.M010.9 STOCKIST'S OR SUPPLIER'S CERTIFICATION 228
CON9.M020.9 VERIFICATION OF SOURCE 228
CON9.M030.9 COLOUR CODE SYSTEM OF REINFORCEMENT 228

REINFORCEMENT 228

CON9.M110.9 BAR / COIL REINFORCEMENT 228

ANCILLARY MATERIALS 229

CON9.M210.9 COVER SPACERS 229
CON9.M220.9 CHAIRS AND SUPPORTS 229
CON9.M230.9 REINFORCEMENT TYING WIRE 229

WORKMANSHIP 230

GENERAL 230

CON9.W010.9 STORAGE OF STEEL REINFORCING BAR DELIVERED TO OSRPY BEFORE PREFABRICATION 230
CON9.W020.9 SURFACE CONDITION OF STEEL REINFORCING BAR 230
CON9.W030.9 CONTAMINATED OR HEAVILY RUSTED REINFORCEMENT 230
CON9.W040.9 COLOUR MARKINGS OF STEEL REINFORCING BAR BY STOCKISTS OR SUPPLIERS PRIOR TO DELIVERY TO THE OSRPY 230

FIXING REINFORCEMENT 230

CON9.W110.9 CUTTING AND BENDING STEEL REINFORCING BAR 230
CON9.W120.9 COLD BENDING 230
CON9.W130.9 SECURING REINFORCEMENT 231
CON9.W140.9 LOCATING REINFORCEMENT 231
CON9.W150.9 WELDING 231
CON9.W160.9 CONCRETE COVER 231
CON9.W170.9 COMPLIANCE WITH DRAWINGS 231
CON9.W180.9 CM'S INSPECTION 231

FIXING REINFORCEMENT 231

CON9.W190.9 QUALIFIED SUPERVISION 231
CON9.W200.9 INSPECTION LOG BOOK 231

TOLERANCES 231

CON9.W210.9 GENERAL 231

TESTING 232

GENERAL 232

CON9.T010.9 TESTING ARRANGEMENT 232

DEFINITIONS 232

CON9.T110.9 BATCH OF STEEL REINFORCING BAR 232
CON9.T120.9 TESTING BY DIRECT TESTING CONTRACTOR (DTC) AND HOUSING DEPARTMENT'S MATERIALS TESTING LABORATORY (HDMTL) 232
CON9.T130.9 TESTING PROGRAMME 232

PURCHASERS TESTING 232

CON9.T210.9 RATE OF SAMPLING 232
CON9.T220.9 PROCEDURE 233
CON9.T230.9 TESTING BY HDMTL 234

TESTING BY DTC 234

CON9.T310.9 SCOPE AND NUMBER OF TESTS 234
CON9.T320.9 METHODS OF TESTING 234

COMPLIANCE 234
CON9.T410.9 COMPLIANCE CRITERIA – STEEL REINFORCING BAR 234
RE-TESTS 234
CON9.T510.9 REQUIREMENTS FOR STEEL REINFORCING BAR 234
CON9.T520.9 STANDARD FOR REJECTION 235

CON1 INSITU CONCRETE

MATERIALS

GENERAL

CON1.M010.9 STANDARD

Unless otherwise specified, comply with 'Code of Practice for Structural Use of Concrete 2013' issued by the Buildings Department, BS8007:1987 and BS5400:Part 4:1990 as appropriate.

CON1.M020.9 STATUS OF THE SPECIFICATION

Where any clauses in this Specification vary from the Regulations of the HKQAA "Quality Scheme for the Production and Supply of Concrete", the clauses in this Specification shall take precedence.

CON1.M025.9 STATUS OF THE WORKSECTION

Worksection EXT2 takes precedence over this Worksection for the construction of the concrete carriageways and bus terminus as indicated on the Drawings specified in the Project Specific Specification.

CON1.M030.9 GRADES OF CONCRETE

In this Specification:

1. The grade of Designed mix concrete is denoted by the characteristic strength in MPa and the nominal maximum size of aggregate in mm with suffix "D";
2. The grade of Standardised designed mix concrete is denoted by the characteristic strength in MPa and the nominal maximum size of aggregate in mm with suffix "S";
3. The characteristic strength of Designed mix concrete with any type of cement is the 28 day cube strength below which not more than 5% of the test results are expected to fall;
4. For any clause of this Section where no suffice "D" or "S" is indicated in the concrete grade, the requirements of that particular clause shall deem to apply to both Designed mix and Standardised designed mix concrete;
5. Obtain CM's approval prior to the use of concrete of grade above 60 in the Works;
6. Where any grade of concrete is designated in other Worksections of this Specification, in Drawings, in design guidelines, in Bills of Quantities or in any other documents relating to this Contract, as one of the grades listed in column (1) of the Table below, such grade is deemed to be the grade of concrete set out in the corresponding column (2) below:

(1) Designated Grade	(2) Grade of Concrete	(1) Designated Grade	(2) Grade of Concrete	(1) Designated Grade	(2) Grade of Concrete
A	20/20	A1	20/40		
B	25/20	B1	25/40		
C	30/20	C1	30/40	C2	30/10
D	35/20	-	-	D2	35/10
H	15/20	H1	15/40		
K	10/20	K1	10/40		

CON1.M040.9 CEMENTITIOUS CONTENT

Cementitious content of concrete, for the purpose of this Specification, is defined as:

1. The mass of cement per cubic metre of compacted concrete if sub-clause (2) is not applicable; or
2. The combined mass of the mass of cement and the mass of either pulverised fuel ash (PFA) or ground granulated blastfurnace slag (GGBS) per cubic metre of compacted concrete, if either PFA or GGBS is used as a partial cement replacement.

CON1.M050.9 FREE WATER/CEMENT RATIO

Free water/cement ratio, for the purpose of this Specification, is defined as the ratio between the mass of the free water in the concrete mix and the cementitious content.

CEMENTS

CON1.M110.9 SUBMISSIONS

Submit to the CM for Approval, a sample for each type of cement, PFA and GGBS together with a certificate issued by an Approved laboratory within six months before the submission, showing the following:

1. For each type of cement:
   a. The manufacturer's name;
   b. The date and place of manufacture;
   c. With test results that the cement complies with the requirements of this Specification.
2. For PFA:
   a. The manufacturer's name (it must be stated explicitly if high lime PFA, as defined in CON1.M150 (1)(b), is submitted);
   b. The date and place of manufacture;
   c. With test results that the PFA complies with the requirements of this Specification and the tests required in Clause 14.1 of BS 3892:Part 1:1997.
3. For GGBS:
   a. The manufacturer's name;
   b. The date and place of manufacture;
   c. With test results that the GGBS complies with the requirements of this Specification and the tests required for factory production control as stipulated in CON1.M180.

CON1.M120.9 PORTLAND CEMENT (PC)

1. To BS EN 197-1:2011: type CEM I with strength class of cement for structural concrete to be 52.5N, unless otherwise approved by the CM;
2. Comply with the limiting values given in Table NB.1 of National annex NB of BS EN 197-1:2011 for acceptance inspection of cement at delivery.

CON1.M130.9 SULPHATE RESISTING PORTLAND CEMENT (SRPC)

1. To BS EN 197-1:2011: types CEM I-SR 0, CEM I-SR 3 or CEM I-SR 5 with strength class of cement for structural concrete to be 52.5N, unless otherwise approved by the CM;
2. Comply with the limiting values given in Table NB.1 of National annex NB of BS EN 197-1:2011 for acceptance inspection of cement at delivery.

CON1.M140.9 HIGH ALUMINA CEMENT (HAC)

Do not use high alumina cement in structural concrete.

CON1.M150.9 PULVERISED FUEL ASH (PFA)

To BS3892:Part 1:1997 with the following modifications:

1. Lime content in PFA:
   a. PFA shall contain up to 10% total lime content; or
   b. High lime PFA shall contain up to 20% total lime content and with soundness value not more than 10 mm.
2. Water requirement and strength factor at 28 days: not requirements of this Specification, but the values as determined shall be stated in the certificates for submission;
3. Cement to be used to determine water requirement, strength factor at 28 days, soundness and initial setting time: Portland cement CEM I (strength class 52.5N) to BS EN 197-1.

CON1.M160.9 PORTLAND FLY ASH CEMENT (PFAC)

1. To BS EN 197-1:2011: types CEM II/A-V and CEM II/B-V with strength class of cement for structural concrete to be 42.5N or higher, unless otherwise approved by the CM;
2. Comply with the limiting values given in Table NB.1 of National annex NB of BS EN 197-1:2011 for acceptance inspection of cement at delivery.

CON1.M170.A USE OF PULVERISED FUEL ASH

1. Incorporate PFA to Portland cement (PC) only, as a partial cement replacement:
   a. In all structural concrete for foundation works including bored piles, pile caps (including pile caps to driven piles), tie beams and footings of all structures. PFA content to be 35% by mass of the cementitious content of the concrete unless otherwise approved by the CM for the replacement of PFA by GGBS in accordance with CON1.M190;
   b. In all structural concrete shown as PFA concrete up to grade 60D on the Drawings. PFA content to be 25% by mass of the cementitious content of the concrete unless otherwise approved by the CM for the replacement of PFA by GGBS in accordance with CON1.M190;
   c. In all concrete, with the exception of sprayed concrete, for external works including concrete carriageway, other paving and hard landscaping unless otherwise specified. PFA content to be 25% by mass of the cementitious content of the concrete unless otherwise approved by the CM for the replacement of PFA by GGBS in accordance with CON1.M190;
   d. Notwithstanding the minimum striking period stipulated in CON2.W630, submit for the CM's agreement on the striking period of vertical formwork for PFA concrete in sub-clauses (1)(b) and (1)(c) above but in no case less than 1 day.
2. At the discretion of the Contractor and where approved by the CM, incorporate PFA to PC as a partial cement replacement in structural concrete not shown as PFA concrete on the Drawings. PFA content to be 25% by mass of the cementitious content of the concrete;
3. Prior to the use of PFA concrete in sub-clause (2) above:
   a. Carry out necessary tests and trials to provide evidence to the satisfaction of the CM that the use of PFA concrete shall not adversely affect the construction cycle, curing of the concrete and the application of finishes; and
   b. Submit details for sub-clause (3)(a) before carrying out the tests and trials for the Approval of the CM.
4. PFAC may be used where PFA concrete with PFA content of 25% by mass of the cementitious content of concrete is specified or permitted;

5. Use of PC in the works specified in sub-clauses (1)(a) to (1)(c) above may be accepted provided that:
   a. Satisfactory evidence can be furnished to the CM showing that supply of PFA or PFAC from all available sources cannot be obtained;
   b. The highest grade of PC concrete for caissons and bored piles shall not exceed 35/20D. For pile caps or footings and transfer structures submit a detailed method statement of the proposed temperature control and monitoring strategy as stipulated in CON1.W470 to the CM for approval at least 7 days before concreting;
   c. Where necessary, submit re-design of the foundation works resulting from such a change to the CM for approval at least 21 days before commencement of affected works. Submit re-design according to PIL1.D030 and any other requirement as detailed elsewhere in this Specification;
   d. Bear all associated costs and the extra time required for any such change. The Surveyor shall, if he considers that there is a saving in cost arising from any such change, determine the sum which in his opinion shall be deducted from the Contract Sum as result of such saving and certify in accordance with the General / Special Conditions of Contract.

CON1.M180.9 GROUND GRANULATED BLASTFURNACE SLAG (GGBS)

To BS EN 15167-1:2006 with the following modifications:

1. Cement to be used to determine initial setting time and activity indices at 7 days and 28 days: Portland cement CEM I (strength class 52.5N) to BS EN 197-1:2011;
2. Factory production control: In the absence of autocontrol testing, proof of the GGBS manufacturer's testing on the quality control for Class S95 in accordance with Chinese National Standard GB/T 18046:2017 is acceptable.

CON1.M190.B USE OF GGBS IN PRECAST CONCRETE, STRUCTURAL CONCRETE FOR FOUNDATION WORKS AND OTHER STRUCTURAL CONCRETE

1. Incorporate GGBS as a partial replacement of Portland cement (PC) in the production of precast facade, precast staircase, precast refuse chute, precast partition wall and precast concrete panel. GGBS content to be 35% by mass of the cementitious content of the concrete;
2. At the discretion of the Contractor and where approved by the CM, incorporate GGBS as a partial replacement of PC:
   a. In structural concrete for foundation works including bored piles, pile caps (including pile caps to driven piles), tie beams and footings of all structures not shown as GGBS concrete on the Drawings. GGBS content to be 50% to 75% by mass of the cementitious content of the concrete;
   b. In other structural concrete not shown as GGBS concrete on the Drawings. GGBS content to be 35% to 75% by mass of the cementitious content of the concrete;
   c. Notwithstanding the minimum striking period stipulated in CON2.W630, submit for the CM's agreement on the striking period of vertical formwork for GGBS concrete in sub-clauses (2)(b) above but in no case less than 1 day.
3. Prior to the use of GGBS concrete in sub-clause (2) above:
   a. Carry out necessary tests and trials to provide evidence to the satisfaction of the CM that the use of GGBS concrete shall not adversely affect the construction cycle, curing of the concrete and the application of finishes;
   b. Submit details for sub-clause (3)(a) before carrying out the tests and trials for the approval of the CM.

4. The use of PC concrete without GGBS to produce precast facade, precast staircase, precast refuse chute, precast partition wall and precast concrete panel for the period from December to March will be allowed. Inform the CM in advance if PC concrete will be used for the production of precast façade, precast staircase, precast refuse chute, precast partition wall and precast concrete panel in such period;
5. Bear all associated costs and the extra time required for any such change in sub-clause (4). The Surveyor shall, if he considers that there is a saving in cost arising from any such change, determine the sum which in his opinion shall be deducted from the Contract Sum as result of such saving and certify in accordance with the General / Special Conditions of Contract.

AGGREGATES

CON1.M210.9 SUBMISSIONS

Submit to the CM, for Approval, a sample of each type of aggregate together with a certificate showing that the aggregate producer has a quality assurance system certified to the ISO 9001, and a certificate for each nominal maximum aggregate size showing:

1. The name of the quarry / locality of the aggregate and documentary evidence from the supplier for subsequent verification;
2. Where available, evidence that the aggregates from the same source have been used in other HA Contracts in the past 12 months;
3. That the aggregate complies with the requirements of this Specification;
4. Results of tests carried out by HOKLAS laboratories and presented in HOKLAS endorsed test reports of all the typical properties listed in CS3:2013 Clause 6.2.2 with the following validity period on the test data:
    a. Issued within three months before the submission:
        i. Grading.
    b. Issued within six months before the submission:
        i. All other properties.

CON1.M215.9 RECYCLED COARSE AGGREGATES

1. Use recycled coarse aggregates produced by crushing old concrete and complying with the requirements in CON1.T410 for external works as specified in the Contract or as permitted by the CM. The concrete shall be with 100% recycled coarse aggregates for grade strength 20 MPa and 20% for grade strengths 25-35 MPa. Recycled coarse aggregates shall not be used in concrete above grade strength 35 MPa for Portland cement concrete and 30 MPa for PFA concrete;
2. Thoroughly wet recycled coarse aggregates before use;
3. Store recycled coarse aggregates in separate stockpiles or silos to prevent inadvertent mixing with natural aggregates. Provide a separate compartment for recycled coarse aggregates in the batching plant;
4. Obtain recycled coarse aggregates for incorporation into the Works from Approved source as specified or permitted by the CM.

CON1.M220.9 SOURCES OF AGGREGATES

1. Obtain crushed rock aggregates for each Approved Designed concrete mix from a single Approved source which may be either an Approved quarry or an Approved source of rock;
2. Where the aggregates are obtained through a crushing plant, the rock from which the aggregates for the Approved Designed concrete mix are obtained must be from the same single Approved source;

3. Obtain natural sand fine aggregates for each Approved Designed concrete mix from a single Approved locality within a defined boundary agreed with the CM;
4. Clear overburden as far as practicable from the working area prior to rock excavation. Overburden is defined as all unwanted material including vegetation, top soil and material of varying degrees of decomposition from the parent rock. The latter category may appear as intrusive bands between volumes of massive rock;
5. Remove rock from igneous intrusions as far as practicable from the working area;
6. Incorporate sufficient scalping and screening facilities in the aggregate production plant to remove all overburden from the aggregates;
7. Keep separate in clearly defined areas the materials both before and after processing where the aggregate production plant is rock from more than one quarry or rock source.

CON1.M230.9 COARSE AGGREGATE

1. Clean, hard, durable crushed rock complying with CS3:2013 except for the requirement of Aggregate Impact Value and Los Angeles Value;
2. The fine aggregates classified as alkali "Reactive" category in accordance with Section 22 or 23 of CS1:2010 shall not be used unless otherwise approved by the CM.

CON1.M240.9 FINE AGGREGATE

1. Clean, hard durable crushed rock, complying with CS3:2013;
2. Do not use natural sand unless with prior agreement of the CM;
3. The fine aggregates classified as alkali "Reactive" category in accordance with Section 22 or 23 of CS1:2010 shall not be used unless otherwise approved by the CM.

CON1.M250.9 ALL-IN AGGREGATE

Do not use all-in aggregate.

CON1.M260.9 LIGHTWEIGHT AGGREGATE

To BS 3797:1990 except not to use clinker and furnace bottom ash.

CON1.M270.9 AGGREGATES FOR AQUEOUS LIQUID RETAINING STRUCTURES

Having a water absorption, as measured in accordance with CS3:2013 Section 17 of not greater than 3%.

CON1.M280.9 GRADING OF COMBINED AGGREGATES

The grading of the combined fine and coarse aggregates must ensure a dense concrete of suitable workability, using the specified proportions of cement and water.

WATER

CON1.M310.9 WATER

1. In accordance with PRE.B10.1210 to PRE.B10.1260 or PRE.C11.090 as appropriate, and;
2. Use only clean fresh water from Water Supplies Department mains supply for making concrete. Unless otherwise specified, do not use recycled water;
3. If the water from Water Supplies Department mains supply is not available, submit to the CM for Approval:
   a. The source of water;
   b. A certificate showing that the water complies with the requirement of this Specification.

4. Where specified in the Contract, use recycled water to make concrete for minor structures.

CON1.M320.9 RECYCLED WATER

1. Where specified on the Drawings, use recycled water in the mixing of concrete of grade strength not exceeding 30 MPa for minor structures, including ground pavings not subjected to vehicular traffic, footpaths, benches and stools, planter walls and non-structural concrete fill;
2. Produce recycled water by combining clean fresh water from Water Supplies Department mains supply with wash water from mixer washout operations in compliance with the properties specified in CON1.T330;
3. Submit method of batching of the recycled water for Approval.

ADMIXTURES

CON1.M410.9 ADMIXTURES GENERALLY

Ensure that the chloride ion content of admixtures for concrete containing embedded metal or for concrete made with SRPC does not exceed 2% by mass of the admixture or 0.03% by mass of the cementitious content, whichever is the less.

CON1.M420.A SUBMISSIONS

Submit to the CM for Approval:

1. Manufacturer's information on admixtures;
2. Certificate issued within 6 months before the submission from the manufacturer that the admixtures comply with the requirements of this Specification;
3. Details of toxicity, proposed dosage, detrimental effects, if any, of under-dosage or over-dosage;
4. Details of chloride content and method of adding to the concrete mix;
5. One sample of each type of admixtures.

CON1.M430.9 PIGMENTS FOR PORTLAND CEMENT AND PORTLAND CEMENT PRODUCTS

To BS 1014:1975.

CON1.M440.9 ADMIXTURES AND SUPERPLASTICISERS

To BS EN 934-2:2009+A1:2012.

CURING COMPOUNDS

CON1.M510.9 GENERAL

1. Of an Approved type and:
   a. Having an efficiency index of at least 85% when tested to BS 7542:1992;
   b. Either wax or aluminised resin based and containing a fugitive dye.
2. Do not use curing compound containing organic solvents for public roads and bus terminuses which are to be handed over to the Highways Department of the HKSAR on completion.

CON1.M520.9 SUBMISSIONS

Submit to the CM for Approval:

1. Manufacturer's information on curing compounds showing that the curing compounds comply with the requirements of this Specification;

2. Test certificates prepared by an Approved testing laboratory, to show that the curing compounds will provide the required efficiency index;
3. A sample of each type of curing compound.

CON1.M530.9 PROPERTIES

The compound when applied according to the manufacturer's recommendations must:

1. Be stable and impervious to evaporation of water from the concrete surface within 60 minutes after application;
2. Not react chemically with the concrete to be cured and not crack, peel or disintegrate within 1 week after application;
3. Degrade completely within 3 weeks after application.

CON1.M540.9 CONCRETE CARRIAGEWAY CONSTRUCTION

Non-pigmented liquid resin or wax-resin based membrane curing compound of a proprietary brand, and available both with and without a fugitive dye.

CON1.M550.9 STRUCTURES TO CONTAIN POTABLE WATER

Concrete curing compound for use on concrete surfaces against which potable or fresh water will be stored or conveyed must be non-toxic and incapable of imparting a taste to the water.

ANCILLARY MATERIALS

CON1.M610.9 UNDERLAYS TO CONCRETE PAVINGS AND SLABS ON HARDCORE

Either:

1. Subsoil grade reinforced waterproof building paper to BS 1521:1972, grade B1F; or
2. 0.125 mm nominal thick impermeable polythene sheet.

CON1.M620.9 POLYETHYLENE SHEETING FOR CURING

Impermeable and of a minimum thickness of 0.125 mm.

CON1.M630.9 WATERPROOF ADHESIVE TAPE

Of proprietary manufacture.

CON1.M640.9 BITUMASTIC PAINT

Tar based complying with BS 1070:1993, type B.

CON1.M650.9 REPAIR MORTAR

1. Of proprietary manufacture and certified to the "Product Conformity Certification Scheme for Repair Mortars" (PCCS-RM) published by the Hong Kong Concrete Institute. The product conformity certificate shall be issued by a certification body accredited by Hong Kong Accreditation Service (HKAS) or its Multilateral Recognition Arrangement (MRA) partners;
2. Cement based product comprising Portland cement, fines /sand, admixture and/or non-shrink additives packed in bags and complying with the performance characteristics given in the Table below:

Properties	Testing method	Performance characteristics
Compressive strength at 28 days (MPa)	CS1:2010 Section 12, using 100 mm cube test specimens	≥ grade strength of parent concrete + 7

Elastic modulus (GPa)	CS1:2010 Section 17	≥ 23
Chloride ion content	CS1:2010 Section 21	≤ 0.05%
Expansion (H) within 24 hours	ASTM C827-16	0% ≤ H ≤ 4%
Expansion (V) between 3 days to 28 days	ASTM C1090-15	0% ≤ V ≤ 0.4%

3. The repair mortar shall not release substances hazardous to health, hygiene and environment;
4. Submit the following for CM's information:
   a. The original or a certified true copy of the product conformity certificate to PCCS-RM stipulated in sub-clause (1). Certified true copy shall be certified true by the issuer of the original copy or by the QCM;
   b. A summary of the results on tests stipulated in the 'initial type test' and 'audit testing' of the PCCS-RM. The summary shall be prepared by the accredited laboratory who carried out the testing or by the certified manufacturer. If so directed by CM, submit a full set of the audit test reports to CM for information.

CON1.M660.9 LOW VISCOSITY POLYMER RESIN

Of proprietary manufacture.

CON1.M670.9 EPOXY RESIN FOR INJECTION

Of proprietary manufacture.

CON1.M680.9 CAST IN STEEL INSERT CHANNELS

As MET1.M080.

SOURCES OF SUPPLY OF CONCRETE

CON1.M710.9 READY MIXED CONCRETE

Ready-mixed concrete and any concrete batched off site, may be used only with Approval and must comply with all requirements of this Specification in respect of materials, quality and strength of such concrete.

CON1.M720.9 SUBMISSION FOR APPROVAL

1. Submit the following information to CM for approval, upon commencement of the Contract or during the course of Contract when concrete supply from a new source is to be used, at a minimum time specified in sub-clause (2):
   a. A statement advising whether the concrete is to be site-batched or ready-mixed. In case on-site concrete batching is proposed, submit further details to the CM on suitability of the plant in relation with statutory requirements and possible effects on adjoining localities;
   b. The name(s) of the proposed concrete supplier(s) as specified in CON1.M730 (who may be the Contractor) and details of the concrete supply;
   c. The name of each supplier's Quality Representative taking specific responsibility and authority for ensuring compliance with the requirements of the following:
      i. "Quality Scheme for the Production and Supply of Concrete" (QSPSC) issued by the Hong Kong Quality Assurance Agency (HKQAA);

ii. ISO 14001 on environmental management.

d. For high strength concrete works (concrete of grade strength higher than 60 MPa), a quality assurance proposal with sufficient preliminary test results is required to confirm that reliable and consistent concrete can be produced. The proposal should include a detailed assessment of the concreting materials, the mix design and the quality control procedures of the batching plant. In this respect the designed mean resistance to crushing, it shall initially exceed the specified resistance to crushing by a margin of not less than 12 MPa. Details of any subsequent revision of the mix design are to be submitted.

2. The time of submission for Approval for the respective concrete shall be at least:
   a. Concrete to be ready-mixed: 7 days before placing concrete or 7 days before the trial mixes if trial mixes are made;
   b. Concrete to be site-batched: 52 days for the first submission and a further 45 days for each re-submission before the commencement of batching plant erection.
3. Where Approval has been given by the CM on site-batched concrete supply referred in sub-clause (1) above, submit to CM for approval the following documents certified by Registered Structural Engineer for the on-site concrete batching plant:
   a. Location plan of the on-site concrete batching plant;
   b. General arrangement plans with adequate details for construction;
   c. Structural and foundation plans and calculations;
   d. Approval from relevant Government Departments, where applicable.
4. Do not commence plant erection without written approval from CM;
5. Submit Form ICU 13 to CM for approval on commencement of operation of the plant at least 22 days before completion of plant erection;
6. Programme the Works by taking into account of the submission and re-submissions that may be required under sub-clauses (3) to (5);
7. Comply with sub-clauses (3) to (6) for any subsequent relocation of the on-site concrete batching plant.

CON1.M730.9 SUPPLIER'S CERTIFICATE

1. Obtain concrete only from suppliers who have achieved the following certification in respect of each batching plant supplying concrete under the Contract:
   a. QSPSC as stipulated in CON1.M720 for concrete production;
   b. ISO 14001 for environmental management.
2. Submit a copy of the certificates as stated in sub-clause (1) above in respect of each batching plant to the CM. All certification bodies shall be accredited by:
   a. The Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with HKAS to QSPSC in the category of product certification system;
   b. The HKAS or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS to ISO 14001 in the category of environmental management system.
3. Newly erected batching plant shall be deemed to have achieved the certification valid for the following period if evidence is provided to CM that the concrete supplier has given written notice to the concerned certification body:
   a. QSPSC: in accordance with the Administrative Regulations of QSPSC;
   b. ISO 14001: not more than 2 months or such lesser time that is required for assessment and certification.

CON1.M740.9 WITHDRAWAL OF CERTIFICATION

In the event that certification in CON1.M730 is not obtained, suspended or withdrawn in respect of any supplier or batching plant supplying concrete under the Contract:

1. Inform the CM immediately and cease using concrete from that supplier or batching plant;
2. Do not resume the supply of concrete from that supplier or batching plant without Approval, notwithstanding any suspended or withdrawn certification being subsequently reinstated.

CON1.M750.9 SITE BATCHING

Where site batching plant is used, concrete supply from plants as defined in CON1.M760 below may be acceptable under the following conditions provided that evidence can be furnished to the CM showing that supply from other sources, including the contingency measure proposal as required under CON1.M1110 complying with CON1.M730 cannot be obtained:

1. At the first two months from commencement before operation of the site batching plant;
2. After dismantling of the site batching plant with only minor concrete work including small concrete structures still outstanding.

CON1.M760.A SITE BATCHING PLANT

Concrete supplied by the following plants may be acceptable if CON1.M750 as given above is satisfied:

1. Plants operated in another Housing Authority contract by the same Contractor, and having achieved certification under the QSPSC for concrete production and ISO 14001 for environmental management as approved by the CM. Evidence must also be furnished to the CM to show that the proposal shall not affect the progress and works on the projects with the proposed plants;
2. Plants operated within the Contract, without a QSPSC and/or ISO 14001 certificate may only supply concrete under the condition as stated in sub-clause (2) of CON1.M750, provided that the following requirements are satisfied:
   a. The operation of the plants is to comply with the Technical Regulations of QSPSC and ISO 14001 for environmental management;
   b. Minor specific deviations from the Technical Regulations to cater for smaller plants may be acceptable. These may include tolerance on weighing equipments and use of single hopper for all constituent materials. All deviations must be submitted to the CM for approval;
   c. An Independent Qualified Person (IQP) holding the qualification of MHKIE, MIStructE or MICE shall be engaged and is responsible for monitoring the quality standards of the said plant. IQP is required to submit monthly statement to the CM to confirm that the required quality standards and environmental management system are maintained. Submit details of IQP to the CM for approval.
3. Comply with PNAP APP-120 and refer to PRE.B10.010 sub-clause (5) for the certification requirement of RSE.

CONCRETE MIXES GENERALLY

CON1.M810.9 CHLORIDE CONTENT

The total chloride content of the concrete must not exceed the limits shown in the Table below, expressed as a percentage relationship between chloride ion and cementitious content of mix:

Chloride content	
Type of concrete	Maximum total chloride content %
Prestressed concrete. Steam cured structural concrete	0.1
Reinforced concrete. Concrete with embedded metal	0.35
Concrete made with SRPC	0.2

CON1.M820.9 DESIGNED CONCRETE MIXES

Use Designed concrete mixes for all concrete.

CON1.M830.9 USE OF SULPHATE RESISTING PORTLAND CEMENT

Do not use pulverised fuel ash with sulphate resisting Portland cement.

CON1.M840.9 USE OF PFA AND PFAC

Do not use pulverised fuel ash in addition to Portland fly ash cement.

CON1.M850.9 CONTROL OF ALKALI-AGGREGATE REACTIONS

1. Submit measures to control the occurrence of alkali-aggregate reaction in concrete for Approval;
2. In the absence of Approved alternative proposals, the reactive alkali content of concrete expressed as the equivalent sodium oxide (Na_2O) content per cubic metre of concrete shall not exceed 3.0 kg:
   a. The equivalent Na2O shall be calculated by the expression:

      The equivalent sodium oxide (Na2O) content of the concrete shall be calculated by the following expression:

      Equivalent Na_2O content = A + B + C

      where A is the sum of the acid-soluble alkali content (expressed as equivalent Na_2O) of cement, admixtures and water;

      B is equal to either 1/6 the total alkali content of PFA (expressed as equivalent Na_2O) or 1/2 of the total alkali content of GGBS (expressed as equivalent Na_2O); and

      C is equal to 0.76 times the chloride ion (Cl^-) content of the aggregate.

   b. The acid-soluble alkali content of the cement shall be determined in accordance with BS EN 196-2:2005 and shall be taken as the average of the latest 25 daily determinations of equivalent sodium oxide plus twice the standard deviation of the results;
   c. The acid-soluble alkali content of admixtures shall be determined in accordance with BS 1881:Part 124:1988;
   d. The acid-soluble alkali content of water shall be determined in accordance with BS EN 1008:2002;
   e. The total alkali content of the PFA or the GGBS shall be determined in accordance with BS EN 196-2:2005 and shall be taken as the average of 25 weekly determinations plus twice the standard deviation of the results. For a casting yard where there are less than twenty-five weekly determinations available, use the average and the standard deviation of all the available weekly determinations for calculation;

f. The chloride ion (Cl^-) content of the coarse and fine aggregates shall be measured in accordance with CS3:2013.

3. Submit the following particulars for each concrete mix to the CM:
   a. At Contract commencement:
      i. HOKLAS-endorsed test certificates, issued in less than six months' time from the date of commencement of the Works, giving the results of tests required in sub-clauses (2)(b) to (2)(f) above;
      ii. Calculation of the reactive alkali content of the proposed mix;
      iii. Documentation of a quality system to control the reactive alkali content in the concrete.
   b. At quarterly intervals after Approval:
      i. HOKLAS-endorsed test certificates giving the results of tests required in sub-clauses (2)(b) to (2)(f) above;
      ii. Any further calculations necessary to demonstrate that the mix continues to comply with the limit on reactive alkali content given in sub-clause (2) above during the period of delivery of the Approved concrete mix to the Site.
4. When Instructed, arrange for the parallel sampling of constituent materials in sub-clauses (2)(b) to (2)(f) by the HDMTL or the DTC for testing.

NO FINES CONCRETE

CON1.M910.9 COMPOSITION

1. Cement: Portland cement;
2. Aggregate: nominal maximum size 20 mm of which not more than 15% by mass is retained on a 20 mm BS test sieve, and not more than 10% by mass passes a 10 mm BS test sieve.

CON1.M920.9 AGGREGATE/CEMENT CONTENT RATIO

Lying within the range 10 to 15 by weight.

CON1.M930.9 CEMENT CONTENT

The cement content is such that each particle of aggregate is coated with cement paste but the compacted concrete has an open texture which permits the flow of water through the hardened concrete.

STANDARDISED DESIGNED CONCRETE MIX PROPORTIONS

CON1.M1010.9 CEMENT

To be Portland cement type CEM I in BS EN 197-1:2011.

CON1.M1020.9 MIX PROPORTIONS

1. Except for concrete with recycled coarse aggregates, select the mix proportions for standardised designed mix concrete from Tables A and B below. Select the appropriate content of water and water-reducing admixtures in accordance with CON1.M1170 and CON1.M1040 respectively. If mix proportions are so selected, no trial mixes as stipulated in CON1.T010 to CON1.T120 are required:

Table A. Weights of any aggregate to be used with 100 kg cement				
Specified grade strength	Nominal maximum size of aggregate (mm)	40	20	10
(MPa)	Slump (mm)	85-170	75-150	65-130
10	Total Aggregate (kg)	800	690	-
15		550	500	400
20, 25		490	440	360
30		440	380	300

Table B. Percentage by weight of fine aggregate to total aggregate				
Specified Grade strength	Grading of fine aggregate	Nominal maximum size of aggregate (mm)		
(MPa)		40	20	10
10, 15	C, M or F	30-45	35-50	-
20, 25 or 30	C	30-40	35-45	45-55
	M	25-35	30-40	40-50
	F	25-30	25-35	35-45

2. For concrete of grade strength 20 MPa with recycled coarse aggregates, mix to give a slump value of 75 mm and in the following proportions:

Portland Cement	100 kg
Recycled Coarse aggregate	
20 mm	180 kg
10 mm	90 kg
Fine aggregate	180 kg

   a. Fine aggregates to be within the limits of grading M in Table 3.2 of CS3:2013;
   b. Do not derive fine aggregates from concrete rubble;
   c. Conduct laboratory trial mix for concrete with recycled coarse aggregates in accordance with CON1.T050 prior to Approval.

CON1.M1030.9 CONTRACTOR'S RESPONSIBILITY

Notwithstanding full compliance with the other provisions of this Worksection, the Contractor's attention is drawn to his full responsibility in ensuring compliance with the strength, workability and all other requirements for Designed concrete mixes, taking due consideration of the characteristics of the materials used in the mix, and the Specification provisions allowed for Contractor's design within specified ranges.

CON1.M1040.9 USE OF ADMIXTURES

Do not use admixtures, other than water-reducing admixtures, without Approval.

DESIGNED CONCRETE MIXES

CON1.M1110.9 SUBMISSIONS

Submit details of mix design to the CM for Approval at least 7 days before trial mixes are made or, if trial mixes are not required, at least 7 days before the mix is placed in the permanent work. Include the following:

1. Quantities of each constituent per m³ of compacted concrete;
2. Details of aggregates, including specific gravities and absorbencies, in support of sub-clause (1)(a) above;
3. Nominal grading details of fine and coarse aggregates in tabular and graphic form;
4. Nominal grading details, in tabular and graphic form, of the combined aggregate;
5. Free water / cement ratio by weight;
6. Designed workability, in terms of designed slump value or designed flow value;
7. Type of plant to be used, location of offsite ready-mixed plant, and a contingency proposal to demonstrate that continuous and adequate supply of concrete can be secured in the event of disruption to the planned supply. Include in such proposal measures to mitigate sudden break down of concrete supply during concreting;
8. System of mixing, i.e. what proportion of the minimum required mixing time will be carried out at the batching plant;
9. Total chloride ion content of mix;
10. Method of controlling the temperature of fresh concrete as stipulated in CON1.W465.

CON1.M1120.9 MAXIMUM CEMENTITIOUS CONTENT

1. The cementitious content of any mix up to Grade 60 must not exceed:
   a. 400 kg/m³ for concrete containing PC only, used for aqueous liquid retaining structures;
   b. 450 kg/m³ for concrete containing either (a) PFA and PC, or (b) GGBS and PC or (c) PFAC, used for aqueous liquid retaining structures;
   c. 550 kg/m³ for concrete used for any other structures.
2. Mass of cement of the cementitious content of any mix higher than Grade 60 should be limited to not more than 450 kg/m³.

CON1.M1130.9 MINIMUM CEMENTITIOUS CONTENT

Design mix of Grade 20 or greater in reinforced concrete or prestressed concrete to have the required minimum cementitious content, in kg/m³, given in the Table below:

PC/PFA /GGBS Reinforced Concrete	Grade Strength (MPa)		20	25	30	35	40	45	≥50
	Nominal maximum aggregate size	10 mm	330	330	350	370	390	415	440
		20 mm	290	290	310	330	350	375	400
		40 mm	260	260	280	300	320	345	370
Prestressed Concrete	Grade Strength (MPa)		35		40		45		
	Nominal maximum aggregate size	10 mm	400		420		445		
		20 mm	340		360		385		
		40 mm	340		360		385		

CON1.M1150.9 AQUEOUS LIQUID RETAINING STRUCTURES

Subject to the limits set out in the Table to CON1.M1130 above the minimum cementitious content for aqueous liquid retaining structures is 325 kg/m³. The maximum cementitious content for aqueous liquid retaining structures shall be in accordance with CON1.M1120.

CON1.M1160.9 INCREASING CEMENTITIOUS CONTENT

After Approval of the designed concrete mixes, the Approved cementitious content may be increased by up to 20 kg/m³ without the CM's consent, provided that the specified maximum and minimum limits for cementitious content are maintained.

CON1.M1170.9 MAXIMUM FREE WATER / CEMENT RATIO

Do not exceed the following maximum free water/cement ratio figures for concrete grades 20D and above:

1. Unreinforced concrete: 0.60 or the ratio stipulated in Table 4.4 of 'Code of Practice for Structural Use of Concrete 2013' issued by the Buildings Department, whichever is the less;
2. Reinforced concrete: 0.55 or the ratio stipulated in Table 4.2 of 'Code of Practice for Structural Use of Concrete 2013' issued by the Buildings Department, whichever is the less;
3. Aqueous liquid retaining concrete: 0.50.

CON1.M1180.9 MINIMUM SLUMP VALUE

The designed slump value must not be less than 75 mm except:

1. Blinding, unreinforced mass concrete and road pavement concrete;
2. Where otherwise agreed by the CM.

CON1.M1190.B CEMENT CONTENT IN CONCRETE WITH PFA OR GGBS

1. When PFA is used as a partial cement replacement and incorporated into the concrete as a separate material, ensure that:
   a. For foundation works, 65% by mass of the cementitious content of the mix is Portland cement to BS EN 197-1:2000: type CEM I;
   b. For all other works, 75% by mass of the cementitious content of the mix is Portland cement to BS EN 197-1:2000: type CEM I.
2. When GGBS is used as a partial cement replacement and incorporated into the concrete as a separate material, ensure that:
   a. For precast concrete including precast facade, precast staircase, precast refuse chute, precast partition wall and precast concrete panel, 65% by mass of the cementitious content of the mix is Portland cement to BS EN 197-1:2000: type CEM I;
   b. For foundation works including bored piles, pile caps (including pile caps to driven piles), tie beams and footings of all structures, the remaining cementitious content of the mix other than GGBS is Portland cement to BS EN 197-1:2000: type CEM I;
   c. For all other works not shown as GGBS concrete on the Drawings, the remaining cementitious content of the mix other than GGBS is Portland cement to BS EN 197-1:2000: type CEM I.

CON1.M1200.9 ADJUSTMENT OF FINE AND COARSE AGGREGATES IN DESIGNED CONCRETE MIXES

After Approval of the designed concrete mixes, the Approved fine and coarse aggregate content may be adjusted without the CM's consent up to a maximum of ±20 kg per 100 kg of cementitious content provided that the adjusted mixes comply with all requirements of this Specification in respect of materials, quality and strength of such mixes, and the aggregate / cementitious content ratio is kept unchanged. In the event that the Approved fine aggregate content is adjusted, the Approved coarse aggregate content shall be adjusted accordingly to keep the Approved aggregate / cementitious content ratio unchanged. The same is for the adjustment of the Approved coarse aggregate content.

MATERIALS FOR REMEDIAL WORK

CON1.M1210.9 GENERAL

Obtain Approval for all materials for remedial work.

WORKMANSHIP

HANDLING AND STORAGE OF MATERIALS

CON1.W010.9 BAGGED CEMENT

Store cement in bags:

1. In a dry, weatherproof store with a raised floor;
2. Cover every stock of more than 20 bags of cement or dry pulverized fuel ash (PFA) or dry ground granulated blastfurnace slag (GGBS) entirely with impervious sheeting or place them in an area sheltered on the top and the three sides;
3. With each delivery identified and kept separate;
4. For use in the order of delivery.

CON1.W020.9 BULK CEMENT, PFA AND GGBS

Store bulk cement, PFA and GGBS:

1. In dry, weatherproof and closed silos fitted with overflow detection device so that when the silo is approaching overflowing, a high level audible alarm is triggered and the material filling stops automatically within one minute. Do not overfill silos;
2. Carry out the loading, unloading, transfer, handling or storage of bulk cement or dry PFA or dry GGBS; or any cement or dry PFA during or after the debagging process in a totally enclosed system or facility and fit any vent or exhaust with fabric filter or equivalent air pollution control system or equipment;
3. Of different types and from different sources in separate silos clearly marked to identify the different contents of each.

CON1.W030.9 AGGREGATES

1. Do not handle or store aggregates in a manner which will result in the mixing of different types and sizes or in the segregation or contamination of the aggregates;
2. Store different types and sizes of aggregates in separate hoppers or in separate stockpiles. Provide the stockpiles with well drained concrete floors and dividing walls of sufficient height to keep the different aggregates separate.

CON1.W040.9 ADMIXTURES AND CURING COMPOUNDS

1. Store admixtures and curing compounds:
   a. In sealed containers, marked to identify the contents;
   b. Protected from exposure to conditions which may affect the material;
   c. In accordance with the manufacturers' recommendations.
2. Do not use the materials after the recommended shelf life has been exceeded.

BATCHING AND MIXING CONCRETE

CON1.W110.9 BATCHING PLANT

1. Maintain the weighing mechanisms for all batching plant in good working order and ensure their accuracy is maintained within the tolerances given in the "Quality Scheme for the Production and Supply of Concrete" (QSPSC) issued by the Hong Kong Quality Assurance Agency (HKQAA). Check them against accurate weights and volumes at least once per month when required by the CM. Use separate weighing equipment for cement and aggregates. Arrange for calibration of all weighing mechanisms, water meters and admixture dispensers at three monthly intervals by an Approved independent consultant;
2. Obtain Approval for all dispensing equipment for admixtures which shall be accurate to within ±5% of the quantity of any admixture being used. The weights of cement, PFA, water and each size of aggregate as indicated by the mechanisms employed shall be accurate to within ±2% of the respective weights per batch agreed by the CM.

CON1.W120.9 ALLOWANCE FOR WATER CONTENT OF AGGREGATES

Adjust the weights fine and coarse aggregates to allow for the free water contained in them.

CON1.W130.9 QUANTITY OF WATER

Add that quantity of water to the mix required to produce concrete of the Approved workability.

CON1.W140.9 CONCRETE MIXING PLANT

Mixing plant must comply with BS 1305:1974 and BS 4251:1980 for batch and truck type concrete mixers respectively, and the requirement in BS 4251:1980 for revolution counters on truck mixer drum is not mandatory.

CON1.W150.9 MIXING CONCRETE

1. Comply with the mixer manufacturer's recommended batch capacity, method of loading, mixing time and speed of operation and do not change mixing time without Approval;
2. For production of concrete using bagged cement, dry PFA or dry GGBS in a standard bag (not exceeding 50 kg), carry out de-bagging, batching and mixing processes in an area sheltered on the top and the three sides.

CON1.W160.9 CEMENT FROM DIFFERING SOURCES

The use of cement from differing sources in same concrete pour and same structure shall be subject to the standards stipulated in CON1.W165 and CON1.T075 and approved by the CM, unless:

1. At different locations without any physical contact;
2. In the same structure with a construction joint already formed in accordance with CON1.W510 to CON1.W570 prior to the placing of fresh concrete with different cement source against the hardened concrete.

CON1.W165.9 PRE-REQUISITES ON MIXING TWO CONCRETE MIXES WITH CEMENT FROM TWO DIFFERING SOURCES

1. Each of the two concrete mixes, when used individually, shall comply with all requirements in the Specification, including the strength, workability and durability requirements;
2. The grade of strength, workability, durability and maximum size of aggregate of the two concrete mixes must be the same;

3. The types and proportions of the cementitious materials used in the two concrete mixes must be the same;
4. The types and brand of admixtures used in the two concrete mixes must be the same. The difference in the dosages of the admixtures between the two concrete mixes shall not be more than 5%, unless otherwise approved by the CM;
5. The difference in the water / cementitious materials ratio between the two concrete mixes shall not be more than 0.02;
6. The two concrete mixes may be produced from different sources of aggregates provided that the sources of the two difference aggregates have each been approved before for concrete production and the aggregates are of the same type. The difference in the fines content of the fine aggregate between the two concrete mixes shall not be more than 5%.

CON1.W170.9 REMIXING

Do not remix partially hardened concrete with or without additional cement, aggregate or water.

CON1.W180.9 TRUCK MIXED CONCRETE

When using truck mixed concrete:

1. Add water at the batching plant as agreed by the CM;
2. Do not add water in transit;
3. Do not add water at the Site without Approval.

CON1.W190.9 CLEANLINESS OF MIXER

1. Do not load mixer in excess of its rated capacity and empty the mixer before recharging;
2. Clean mixers which have been out of use for more than 30 minutes before fresh concrete is mixed; and whenever there is a change in the type of cement being used.

CON1.W200.9 LIGHT-WEIGHT CONCRETE

Mix and place light-weight concrete as indicated on the Drawings in accordance with the aggregate manufacturer's instructions and as required by the CM.

CON1.W210.9 WATERPROOF CONCRETE

For concrete specified as "waterproof," incorporate water-proofing material strictly in accordance with the manufacturer's instructions, and complying with aqueous liquid retaining concrete.

PROGRAMME AND SITE RECORDS FOR CONCRETING

CON1.W305.9 PROGRAMME FOR CONCRETING

1. Provide monthly programme for concreting showing concreting works for the coming month for information and discussion at each Monthly Site Meeting;
2. Provide the monthly programme for concreting in sub-clause (1) above to the concrete supplier for advanced planning within one week after each Monthly Site Meeting;

3. Submit a summary report on concrete supply status monthly or at an agreed interval with the CM for record for any concrete pour larger than 100 m^3. The report shall include, but not be limited to, the name of the supplier, the quantities and the dates of each concrete grade ordered and delivered on Site, and the dates that the orders are placed within the reporting period. In case if any order is cancelled, the date that the cancellation order is placed and an explanation for the cancellation shall be provided in the report.

CON1.W310.A REQUIREMENTS ON SITE RECORDS FOR CONCRETING

1. Provide delivery notes with a QR code and the format shall be agreed with the CM for Development and Construction Site Mobile System (DCSMS) on Site, relating to each delivery of concrete available for inspection by the CM at all times and containing the following information:
   a. Serial number of delivery note;
   b. Date;
   c. Name of supplier and location of batching and mixing plant;
   d. Registration number of delivery vehicle;
   e. Name of purchaser;
   f. Name and location of the Site;
   g. Sources and actual quantities of each constituent, including admixtures, if any;
   h. Designation of concrete mix and approved workability value;
   i. Quantity of concrete;
   j. Time of introduction of cement to the mix.
2. Keep records of concreting operations on the Site available for inspection by the CM at all times, and containing the following details:
   a. Date;
   b. Designation of concrete mix and approved workability value;
   c. Serial number of delivery note;
   d. Arrival time of delivery vehicle;
   e. Time of completion of discharge;
   f. Position where concrete is placed;
   g. Results of workability tests in terms of measured slump or flow table values as appropriate;
   h. Details of test cubes markings, and whether test cubes were taken from the delivery;
   i. Total quantity of each concrete mix placed that day;
   j. Temperature of fresh concrete when it is placed in position where temperature control is required in accordance with CON1.W470. (For practical reasons the CM may accept that the temperature of concrete measured immediately before it is place in position is taken as the temperature of concrete when it is placed in position.)
3. For public roads and bus termini which will become the properties of the Highways Department of the HKSAR after the handing over of the works, submit all the related Delivery Notes and record book to the Employer on completion of the Works;
4. Certificates/documents issued within 6 months before the submission showing the source of constituent mentioned in sub-clause (1)(g) of this clause shall be kept on the Site available for inspection by the CM at all times.

TRANSPORTING AND PLACING CONCRETE

CON1.W410.9 GENERAL

1. Transport and place concrete by Approved methods which ensure that there is no contamination, segregation or loss of the constituent materials;
2. Place and compact concrete in such a way as to avoid disturbance to the formwork and reinforcement. Where sections of the work are carried out in lifts, support the reinforcement projecting above the lift being cast to prevent movement of the bars during the casting and setting of the concrete.

CON1.W420.9 CONCRETE BATCHED OFF-SITE

For concrete batched off-site:

1. Carry the concrete in purpose made agitators operating continuously, or in truck mixers;
2. Submit to the CM for verification details of the methods for agitating the concrete during transport and immediately prior to placing.

CON1.W430.9 CLEANLINESS

1. Clean all areas where concrete is to be placed and, except for concrete placed under water, remove all standing water immediately before placing the concrete;
2. Protect slab formwork surfaces from concrete droppings and spillage during concreting.

CON1.W440.9 APPROVAL BEFORE PLACING CONCRETE

1. Do not place concrete in any part of the structure until Approval has been given;
2. Obtain Approval again if concreting is not started within 24 hours of Approval being given.

CON1.W450.9 PROCEDURE

1. Place concrete continuously between construction joints as close as practicable to its final position;
2. Do not allow concrete to free fall in excess of 2.7 m unless otherwise Approved;
3. Deposit concrete in horizontal layers to a compacted depth not exceeding 450 mm where internal vibrators are used or 150 mm in all other cases unless otherwise Approved. Do not force concrete into place by vibrator;
4. Do not place fresh concrete against insitu concrete which has been in position for more than 30 minutes unless the insitu concrete has been kept damp with a layer of wet hessian and protected from the weather to the satisfaction of the CM;
5. When insitu concrete has been in place for 4 hours or in the opinion of the CM the concrete has stiffened to such an extent that it no longer responds to the action of an internal vibrator, do not place further concrete against it for a further 20 hours unless otherwise Approved and form a construction joint in accordance with CON1.W510 to CON1.W570 as appropriate;
6. Compact concrete in its final position within 2½ hours of the introduction of cement to the mix. Concrete, which in the opinion of the CM is no longer sufficiently workable, will be rejected;
7. Place concrete by skip or such other Approved methods as specified by the requirements of the Specifications;
8. Do not place concrete in flowing water.

CON1.W460.9 USE OF TRUNKING AND CHUTES

Keep trunking or chutes clean and use them in such a way as to avoid segregation.

CON1.W465.9 TEMPERATURE CONTROL IN FRESH CONCRETE

1. Submit to the CM for approval details of measures on control of fresh concrete to a temperature not higher than 30°C:
   a. For the structural elements with concrete grade strength greater than 60 MPa;
   b. For the massive structural elements as specified in CON1.W470;
   c. For mass concrete retaining walls with concrete grade strength greater than 60MPa.
2. The CM may reject any concrete for which the temperature, as measured on Site by the DTC, exceeds 30°C.

CON1.W470.9 TEMPERATURE CONTROL IN MASSIVE STRUCTURAL ELEMENTS

1. Comply with CON1.W465 and submit the following to the CM for approval on the temperature control for massive structural elements as specified in the Project Specific Specification at least two months before concreting:
   a. A method statement of the proposed temperature control;
   b. Calculations of the forecast concrete temperature, temperature gradients and resulting stresses. The calculation of temperature in concrete shall be in accordance with the CIRIA Report No. C660 "Early Age Thermal Crack Control in Concrete" or other Approved recognised method.

TRANSPORTING AND PLACING CONCRETE

CON1.W480.9 CONCRETING PLAN

Submit a concreting plan, supplemented by a soft copy in suitable Portable Document Format (PDF), for each concreting pour to the CM at least one week prior to commencement of concreting works of the respective pour for agreement. The concreting plan shall demonstrate that the concreting works is able to be completed within the statutorily permitted working hours, with content including but not limited to the following:

1. Volume of the pour and planned timeline of the concreting works; and
2. Contingency measures to be taken once there is a slippage in concreting affecting the timely completion of the scheduled concreting works within the permitted working hours. The contingency measures shall include planning and details of construction joint(s) to be formed if necessary;
3. Up-to-date Master Inspection Record covering the previous typical floor and other parts of the same floor (typical and non-typical) concerned.

FORMING CONSTRUCTION JOINTS

CON1.W510.9 LOCATION OF JOINTS

1. Obtain Approval for the position and details of any construction joints not specified in the Contract;
2. Arrange such joints so as to minimise the possibility of the occurrence of shrinkage cracks;
3. Arrange construction joints horizontally or vertically unless otherwise Approved.

CON1.W520.9 AQUEOUS LIQUID RETAINING STRUCTURES

1. Cast the bottom slab and walls of aqueous liquid retaining structures in one operation where no pre-determined construction joints are specified, unless otherwise Approved;

2. Where construction joints are shown on Drawings, provide Approved proprietary type waterstops at construction joints and:
   a. Securely fix waterstops in position to formwork in such a manner that compaction of the concrete will not be affected;
   b. Make in-situ joints in waterstops using methods and equipment recommended by the manufacturer;
   c. Protect exposed waterstops from exposure to conditions that may affect the waterstops; and
   d. Keep the waterstops free from rust, hydrocarbons and other deleterious material.

CON1.W530.9 WALLS AND COLUMNS

Finish the upper surface of lifts of concrete walls and columns horizontally and clean the formwork of adhering concrete before the next lift is placed.

CON1.W540.9 EXPOSING AGGREGATE

Remove laitance and all loose material and expose the aggregate by an Approved method as soon as is practical after casting, but:

1. Where an air jet is used-allow a minimum period of 4 hours after casting to elapse;
2. Where a water jet is used-allow a minimum period of 12 hours after casting to elapse.

CON1.W550.9 FOOTINGS AND PILE CAPS PREPARED BY OTHERS

Where the footings or pile caps have been constructed by others:

1. Hack off and expose aggregate by an Approved method of all construction joints of columns and walls on footings and pile caps prepared by a previous contractor;
2. Remove the cement slurry coating on column and wall starter bars.

CON1.W560.9 PLACING ADJACENT CONCRETE

Ensure the surface of the construction joint is clean and moist when fresh concrete is placed against it.

CON1.W570.9 INTERRUPTED POURS

Form construction joint(s) in accordance with the provisions of the preceding clauses of this subsection under the following circumstances:

1. Placing of concrete has to be unexpectedly stopped; or
2. There is a slippage in concreting which may affect the timely completion of the scheduled concreting works within the statutorily permitted working hours.

CON1.W580.9 CONSTRUCTION JOINTS FOR CONCRETE CARRIAGEWAY AND PAVED AREA

Arrange construction joints normal to the axis or plane of the element being constructed unless otherwise permitted by the CM.

COMPACTION

CON1.W610.9 GENERAL

Compact concrete to produce a dense homogeneous mass with vibrators unless otherwise Approved and:

1. Provide types of vibrating equipment which will effectively compact the concrete;
2. Provide a sufficient number of vibrators in serviceable condition on Site to ensure that reserves are always immediately available in the event of breakdowns.

CON1.W620.9 VIBRATING EQUIPMENT

The vibrating equipment shall::

1. Internal vibrators: operating at a minimum of 10,000 cycles per minute;
2. External vibrators: operating at a minimum of 3,000 cycles per minute;
3. Vibrating tables: operating at a minimum of 5,000 oscillations per minute may be used for pre-cast elements subject to Approval;
4. Do not use external clamp-on type vibrators without Approval.

CON1.W630.9 USING VIBRATORS

Use vibrators in such a manner that vibration is applied continuously and systematically during placing of the concrete until the expulsion of air has practically ceased and:

1. Do not use vibrators in a manner which will result in segregation;
2. Do not apply vibration by way of the reinforcement;
3. Where vibrators of the immersion type are used, avoid all contact with reinforcement, formwork and inserts as far as is practicable;
4. Do no use vibration as a means of distributing concrete into position.

CON1.W640.9 NEW CONCRETE

Do not vibrate concrete between 4 and 24 hours after compaction.

CON1.W650.9 COMPACTING NO-FINES CONCRETE

Compact using a minimum amount of punning.

PUMPING CONCRETE

CON1.W710.9 CM'S APPROVAL

Do not use concrete pumps without prior Approval.

CON1.W720.9 PUMPING EQUIPMENT

Operate and maintain concrete pumps in accordance with the manufacturer's recommendations and:

1. Keep pumps and pipelines maintained in a clean condition;
2. Do not use pipelines with internal surfaces of aluminium;
3. Ensure joints in pipelines are tightly fixed and do not permit grout loss.

CON1.W730.9 PIPELINES

Position concrete pumps such that pipelines are as short and straight as practicable and require as little repositioning as practicable and arrange bends in such a manner that the concrete, formwork, reinforcement or built-in components are not disturbed.

CON1.W740.9 LUBRICATING PIPELINES

Lubricate pipelines by passing cement grout or concrete through the pipeline before the concrete is pumped. Do not place the initial discharge of pumped concrete in the permanent work.

PLACING CONCRETE UNDER WATER

CON1.W810.9 GENERAL

Do not place concrete underwater without prior Approval.

CON1.W820.9 STANDARD

Place underwater concrete in accordance with the recommendations given in Code of Practice for Structural Use of Concrete 2013.

CON1.W830.9 TREMIES

Securely support tremies used to place concrete in position and ensure the joints are watertight. Use a temporary seal of an Approved type to keep the water and the concrete separate at the start of concreting.

CON1.W840.9 PROCEDURE

After the concrete is flowing, raise the tremie in a manner agreed by the CM and:

1. Keep the lower end of the tremie immersed in the concrete to a depth of a least 1 m;
2. Prevent water, mud and other deleterious material from entering the tremie after concreting has started.

CON1.W850.9 DEALING WITH BLOCKAGES

Unless otherwise permitted by the CM, stop concreting immediately if the tremie becomes blocked or is removed from the concrete and:

1. Do not recommence concreting for at least 24 hours without Approval;
2. Remove contaminated concrete before concreting recommences.

CON1.W860.9 SURCHARGE AND CONTAMINATED CONCRETE

1. Surcharge concrete placed by tremie above the specified level by an amount which is sufficient to allow for the removal of any contaminated concrete;
2. Remove contaminated concrete.

LAYING HOLLOW BLOCK FOR SLABS

CON1.W910.9 GENERAL

See CON2.W300.

WATERTIGHT BASEMENT CONSTRUCTION

CON1.W1010.9 GENERAL

Ensure that the completed work is free from leaks and damp patches.

CON1.W1020.9 BLINDING LAYER

Lay blinding layer to the grade and thickness shown on the Drawings, to form a clean and dry base for the main structural slab, ensuring that there is no loss of cement to, nor gain of water from the base.

CON1.W1030.9 WATER/VAPOUR PROOF MEMBRANE

Exercise special care to prepare the surface for application of asphalt waterproofing in accordance with Worksection WAT1 and to avoid damage to the membrane after application.

CON1.W1040.9 FORMWORK TIES

Use only formwork-ties which leave no open holes through the concrete.

CON1.W1050.9 CONCRETE SUPPLY

If ready-mixed concrete is used, supply to the site at regular intervals.

CON1.W1060.9 CONSTRUCTION JOINTS

1. Provide waterstops as specified in CON6.M210 and CON6.W210 to CON6.W230 for all construction joints, plan the positions of the construction joints according to planned daily production of concrete and keep their number to a minimum;
2. Position the joint between the base slab and the walls a minimum of 250 mm above the top of the base slab.

CON1.W1070.9 GROUND WATER

Keep ground water levels below the blinding level so that the cast concrete will not be subjected to water pressure until it has attained sufficient strength.

CON1.W1080.9 REMEDIAL WORK TO LEAKS ETC.

Carry out remedial work required to eliminate any leaks and damp patches that occur, and obtain Approval of method to be used.

MASS CONCRETE RETAINING WALLS

CON1.W1110.9 CONCRETE GRADE

Grade 20/20, unless otherwise specified.

CON1.W1120.9 ADDED STONES AND BOULDERS

The addition of granite stones or boulders will be Approved provided that their weight does not exceed 20% of that of the finished concrete and that any two stones or boulders are spaced at a clear distance of at least 225 mm.

CON1.W1130.9 WEEP HOLES

Build in 75 mm diameter plastic weep pipes through the full thickness of walls, falling to the outside and spaced at staggered centres of 1.5 m.

CON1.W1140.9 TEMPERATURE CONTROL

Comply with the provisions of CON1.W470 when specified grade strength greater than 20 MPa and up to 60 MPa.

GROUND SLABS

CON1.W1210.9 LAYING UNDERLAYS TO SLABS LAID ON HARDCORE

Lap and tape underlays at least 300 mm at joints.

CON1.W1220.9 BLINDING LAYER

Unless otherwise specified, provide a blinding layer of Grade 15/20 concrete to underside of all reinforced concrete works in contact with earth to the following thicknesses:

1. Pilecaps and footings: 75 mm;
2. All other cases: 50 mm.

KICKERS

CON1.W1310.9 WALLS AND COLUMNS

See CON2.W410 to CON2.W440.

CURING

CON1.W1410.9 METHODS OF CURING - GENERAL

1. Immediately after compaction, protect finished concrete against the harmful effects of weather, running water and drying out;
2. Close any cracks developed on the concrete surface immediately while the concrete is still plastic with suitable methods such as trowelling and brushing before curing;
3. Ensure proper protection by using one of the following methods which are minimum requirements and apply them for the minimum periods stated in CON1.W1490:
   a. Method A (as CON1.W1420): For all concrete slabs in domestic floors and transfer structures except for areas which in the opinion of the CM are of such irregular shape which renders the method impractical;
   b. Method F (as CON1.W1470): For caps or footings where the least dimension exceeds 500 mm;
   c. Methods B, C, D or E (as CON1.W1430 to CON1.W1460): At the Contractor's option for all other concrete elements including domestic floor slabs and transfer structures with irregular shapes.
4. Where concrete is to be kept moist by spraying water for curing methods stipulated in sub-clause (3), or during temporary removal of the protection to facilitate construction stipulated in CON1.W1500, take due consideration and necessary measures to avoid thermal shock to the concrete;
5. Agree with the CM within 4 weeks from the notified date of commencement of the Works on the format and size of site works photographic records. Submit one set of photographic records to the CM on each working day showing the concrete surfaces being cured at all locations.

CON1.W1420.9 CURING - METHOD A

Cover the concrete with waterproof Approved tarpaulin sheets of good quality and condition suitable for the intended purpose, and:

1. Make tarpaulin sheets to size to suit the shape, size and number of slab panels such that the number of tarpaulin sheets to cover the area is as few as is practical;
2. Lap tarpaulin sheets 600 mm (minimum) at joints;
3. Effectively hold down the tarpaulin sheets during the curing period in such a manner as not to damage the concrete surface;
4. Ensure the concrete is constantly moist;
5. For strips not more than 300 mm wide around walls or columns, use hessian or similar absorbent material in lieu of tarpaulin sheets and keep constantly wet.

CON1.W1430.9 CURING - METHOD B

Except for surfaces against which concrete or applied finishes have subsequently to be placed, cure the concrete by the application of an Approved liquid curing compound and apply:

1. By means of a low-pressure spray at the rate recommended by the manufacturer;
2. On horizontal surfaces immediately after finishing the concrete;
3. On vertical surfaces immediately after removing the formwork.

CON1.W1440.9 CURING - METHOD C

After thoroughly wetting, cover the concrete with polyethylene sheeting, lapped and securely held in position in such a manner as not to damage the concrete surface, and ensure the concrete is kept constantly moist.

CON1.W1450.9 CURING - METHOD D

Cover the concrete with a layer of fine aggregate minimum 25 mm thick, then hessian, sacking, canvas or similar absorbent material, lapped and securely held in position in such a manner as not to damage the concrete surface. Keep this covering layer constantly wet.

CON1.W1460.9 CURING - METHOD E

1. Cover the concrete with polythene sheeting, lapped and securely held in position in such a manner as not to damage the concrete surface, until the concrete has hardened sufficiently for water curing to be carried out;
2. Water cure by spraying the concrete surface continuously with water or by ponding immediately after the sheeting is removed.

CON1.W1470.9 CURING - METHOD F

1. Formwork is to be stripped at least 3 days after concreting;
2. After thoroughly wetting the concrete, cover the concrete with polyethylene sheeting, lapped and securely held in position in such a manner as not to damage the concrete surface, then cover the polyethylene sheeting with hessian bags, and ensure the hessian bags are kept wet throughout the curing period. This also applies to the locations of columns and walls with starter bars.

CON1.W1480.9 PROTECTION OF NEW CONCRETE FROM THE WEATHER

Provide adequate amount of polyethylene sheets to protect freshly placed concrete against heavy rain as required or directed by the CM.

CON1.W1490.9 MINIMUM PERIODS OF PROTECTION FOR CONCRETE

1. Maintain the following minimum curing periods after the concrete has been placed:

Minimum Periods of Protection of Concrete			
Type of Structure	Method of Protection	Minimum Period of Protection (Days)	
		Concrete not Containing PFA, PFAC or GGBS	Concrete Containing PFA, PFAC or GGBS
Aqueous liquid retaining and watertight structures	B	7	7
Aqueous liquid retaining and watertight structures	C, D, E	7	9
Cap or footing where the least dimension exceed 500 mm	B	7	7
	F	10	10
Others	B	7	7
Others	A, C, D, E	4	5
Transfer structure	A	10	10

2. The figures given in the above table may be reduced by the number of days during which formwork has been left in place.

CON1.W1500.9 TEMPORARY REMOVAL OF PROTECTION

Where protection to concrete slabs must temporarily be removed to facilitate setting out or other follow-up operations, ensure that the exposed concrete is adequately sprayed with water and kept moist for the duration of these operations and that the protective covering is restored as soon as practicable.

CON1.W1510.9 ENHANCED CURING CONTROL IN ROOF SLAB

1. In addition to the curing measures in CON1.W1410, provide the following enhanced curing control to the roof slab of domestic blocks:
   a. Artificial fogging from nozzles to the concrete slab surface immediately after concrete is cast until the slab is proper protected;
   b. Ensure that the protection is implemented at the shortest possible time but shall not be more than two hours under all circumstances.
2. Where specified in Project Specific Specification, cast the wing slabs and central core slab in separate pours and allow for late cast strips between the slabs.

LOADING NEW CONCRETE STRUCTURES

CON1.W1610.9 LIMITATIONS

Unless otherwise specified, do not subject concrete at any time to a loading which will induce a compressive stress exceeding 33% of the compressive strength of the concrete at the time of loading, or of the grade strength whichever is the least and:

1. When determining the loading, make due allowance for the self-weight of the concrete;
2. For the purpose of this clause, the assessment of the strength of concrete and the stresses produced by the loads is subject to Approval.

WORKED FINISHES TO CONCRETE

CON1.W1710.9 TYPES OF FINISH

Apply to the following finishes where shown or scheduled on the Drawings and execute in an Approved manner:

1. Wood float: to give an even textured surface;
2. Steel trowel or power float: to give a smooth untextured surface;
3. Scratch with a stiff brush: to give a slightly roughened even texture;
4. Tamp with the edge of a board: to give an even texture of parallel ribs.

CON1.W1720.9 ADDED CEMENT OR WATER

Do not, without Approval:

1. Wet the surface to assist working;
2. Add cement to produce the specified finish.

CON1.W1730.9 PROTECTION OF LIVING ROOM FLOORS

Protect from damage the power float finish of all living room floor slabs of domestic flats. Obtain Approval for method of protection.

APPLIED SURFACE FINISHES

CON1.W1810.9 HARDENING

Where shown or scheduled on the Drawings mix the concrete with an Approved hardening admixture in accordance with the manufacturer's recommendations.

CON1.W1820.9 SURFACE HARDENING

Where shown or scheduled on the Drawings, apply an Approved liquid surface hardener in accordance with the manufacturer's recommendations.

CON1.W1830.9 METALLIC OR MINERAL TREATMENTS

Where shown or scheduled on the Drawings, apply an Approved metallic or mineral surface treatment in accordance with the manufacturer's recommendations.

CRACK REPAIR

CON1.W1910.9 GENERAL

All visual cracks to hardened structural and non-structural concrete in domestic and non-domestic buildings discovered during the construction period and/or Maintenance Period, whether they are less than, equal to or greater than the calculated maximum crack width as stated in Code of Practice for Structural Use of Concrete 2013, shall be regarded as defects, imperfections or faults for which the Contractor is liable under GCC Clause 10.3(2), unless such cracks are proved by the Contractor to be due to a design fault of the Authority. If any cracks prove to be due to a design fault of the Authority, then the expense incurred in any investigation and remedial work carried out by the Contractor, as hereunder specified, will be valued in accordance with GCC Clause 10.3(3).

CON1.W1920.9 INVESTIGATION

Investigate all visual cracks as directed by the CM and repair in accordance with the classification methods described in the Table contained in CON1.W1990.

CON1.W1930.9 METHOD STATEMENT

Before commencement of repairs to cracks, submit, for Approval, a method statement detailing the materials and methods to be used.

CON1.W1940.9 CONTRACTOR'S RESPONSIBILITY

1. Take responsibility for initiating the inspection of cracks and the programming of subsequent remedial repairs to ensure all such cracks are repaired before hand-over of the structures to the Authority;
2. Likewise define and repair all visible cracks discovered during the Maintenance Period in accordance with the remaining clauses in this Section.

CON1.W1950.9 PROCEDURE FOR CLASSIFICATION - TYPE OF MEMBER

Types of elements are classified in this specification as follows:

1. (U) All concrete placed below ground level which is not part of a water-retaining structure or water barrier;
2. (S) Slabs (including ribbed slabs): horizontal or inclined elements of concrete in which two dimensions in the horizontal or inclined plane exceed the dimension in the vertical plane;
3. (B) Beams: horizontal elements of concrete in which one dimension in the horizontal plane exceeds the other dimension in the horizontal plane and also exceeds the dimension in the vertical plane;

4. (W) Walls: vertical elements of concrete in which one dimension in the vertical plane and one dimension in the horizontal plane both exceed the other dimension in the horizontal plane;
5. (C) Columns: vertical elements in which one dimension in the vertical plane exceeds the other two dimensions in the horizontal plane.

CON1.W1960.9 PROCEDURE FOR CLASSIFICATION - WIDTH OF CRACK

Determine the width of the crack at the surface of the concrete with the aid of a transparent sheet on which lines of different width are printed or by examining the crack with a low power microscope incorporating a measuring graticule. The classifications of crack width in this specification are:

1. F: maximum width at any point 0.3 mm or less.
2. C: maximum width at any point greater than 0.3 mm.

CON1.W1970.9 PROCEDURE FOR CLASSIFICATION - DEPTH OF CRACK

Determine the depth of a crack in one of the following ways:

1. Slabs: observe whether water on the top surface of the slab passes through the crack and can be seen as a moistened patch on the underside of the slab:
   a. If water is seen to pass through the slab, the crack is deemed to be a through crack of type T;
   b. In all other cases it is deemed to be a non-through crack of type NT.
2. In all other elements, if the line of the crack on one surface can be traced on another surface parallel to the first surface or in the case of a beam, if the crack can be seen to traverse two adjacent surfaces in different planes, it is deemed to be a through crack of type T;
3. If a crack follows an irregular pattern on one surface of an element only and is branched at least two points it is deemed to be a non-through crack of type NT.

CON1.W1980.9 METHODS OF REMEDIAL REPAIR

Use the following permissible methods for rectifying cracks according to the overall classification of the crack as given in the table in CON1.W1990:

1. Simply surface seal the crack by brushing into it, wherever it is visible, a coat of heavy grade bitumastic paint or other approved durable inert waterproof material;
2. Fill the crack by brushing in dry cement and moistening after the treatment;
3. Brush cement grout or cement paint into the crack until it appears to be filled;
4. Cut a V-groove and fill with repair mortar, applied in accordance with the manufacturer's recommendations, or other equivalent Approved material;
5. Seal by arranging for a low viscosity polymer resin to flow, under the influence of gravity or injection, into the crack to fill it and harden;
6. Inject epoxy resin under pressure into the crack until it exudes at weep holes located so as to ensure that when this occurs the crack may reasonably be expected to have been completely filled and all air to have been displaced by resin; and
7. Apply the method in sub-clause (6), and a coat of heavy grade bitumastic paint over the surface of the crack or other method as approved by CM.

CON1.W1990.9 REPAIR ACCORDING TO CLASSIFICATION

Carry out crack repair according to the treatment method in the following table unless otherwise instructed by CM:

Element	Width	Depth	Treatment Method
U: Underground S: Slabs B: Beams W-C: Wall/Columns	F: 0.3 mm or less C: >0.3 mm	NT: Non-through T: Through	Sub-clauses of CON1.W1980: (1), (2), (3), (4), (5), (6) or (7)
U	F C	NT, T NT, T	(1) (7)
S S (Soffit only) S S S	F F F C C	NT NT T NT T	(2) (3) (5) (3) (5)
B B B B	F F C C	NT T NT T	(3) (5) (4) (6)
W-C W-C W-C W-C	F F C C	NT T NT T	(3) (5) (4) (5)

CON1.W2000.N ASSESSMENT OF CUBE AND CORE TESTS RESULTS FOR PROPOSED HIGHER GRADE STRENGTH OF CONCRETE

1. Propose to use higher grade strength of concrete for superstructure and external works to enhance works quality and/or resolve construction difficulties for the CM's Approval when necessary at Contractor's own cost and time. The CM may approve the proposal at his own discretion and the Approval shall not relieve the Contractor from any responsibility imposed by the Contract;
2. The cube and core test results of the proposed higher grade concrete shall be assessed in accordance with the following:
   a. Cube tests of the concrete shall be assessed based on the proposed higher grade strength in accordance with Clauses CON1.T620 to CON1.T660. If any of the cube test results, except for the results from CON1.T640 (1)(d) and CON1.T660 (1), does not comply with the strength requirements for the proposed higher grade strength of concrete but comply with the grade strength of concrete as specified in the Drawings for the concrete structures concerned, no further concrete core test to CON1.T750 (3) is required;
   b. Core tests of the concrete shall be assessed based on the grade strength of concrete as specified in the Drawings in accordance with Clause CON1.T760.
3. Bear all associated costs and the extra time for complying with the requirements of this clause.

TOLERANCES

CON1.W2010.9 GENERAL

1. For tolerances other than civil engineering works and slopeworks, refer to:
   a. Code of Practice for Structural Use of Concrete 2013 published by the BD;

b. Appendix H "Schedule of Tolerances" to this Specification;

c. Where any ambiguity, discrepancy or conflict arises between sub-clauses 1(a) and 1(b) above, the provisions given in Appendix H shall prevail.

2. For any abrupt projections in excess of 5 mm at inner surfaces of liftwell walls:

   a. Use Approved non-shrink cementitious material to form a hard smooth surface to splay the abrupt projections, to an angle of not less than 75º from the horizontal plane, and extend for a distance of not less than 20 mm;

   b. Submit remedial details for the CM's approval.

3. For civil engineering works and slopeworks, tolerances given in this Worksection should be read in conjunction with additional tolerances given in Worksection FOR. Tolerances on joints:

   a. The best fit straight line of straight joints shall be within 25 mm of a specified line. The line of straight joints shall be within 10 mm of the best fit straight line;

   b. The best fit curved line of curved joints shall be as agreed by the CM and shall be within 25 mm of the specified line. The line of curved joints shall be within 10 mm of the best fit curved line;

   c. Joints shall be continuous across intersections of joints to within 5 mm of the best fit straight lines or best fit curved lines of each joint.

TESTING

TRIALS OF DESIGNED CONCRETE MIXES

CON1.T010.9 REQUIREMENT FOR TRIAL MIXES

1. Trial mixes are not required for Designed concrete mix of grade strength 20 MPa and below;
2. Where a Designed concrete mix of grade strength above 20 MPa is to be used, carry out trial mixes to determine the suitability of the proposed mix proportions for production of concrete of the required quality, at the intended workability for compaction of the concrete in the position, shape and location as described on the Drawings.

CON1.T020.9 TIMING OF TRIALS

Prepare trial mixes on receipt of the Approval of the mix design under CON1.M1110 and complete at least 35 days before commencement of concreting.

CON1.T030.9 PLANT AND LABORATORY TRIALS

Testing arrangements:

1. Make trial mixes for Approved mix designs details under CON1.M1110 using the plant proposed for the Works for Plant Trials and in an Approved Laboratory for Laboratory Mix Trials. Sample the concrete, make and test concrete cubes in accordance with CS1:2010;
2. Plant Trials may be required, if test or trial mix data for designed concrete mix of the proposed grade with similar materials to that of the proposed mix and produced in plant other than that proposed for the Works are submitted and are acceptable to the CM;
3. Laboratory Mix Trials may be required, if test or trial mix data for designed concrete mix of similar grade or with different materials to that of the proposed mix and produced in plant proposed for the Works are submitted and are acceptable to the CM;
4. Laboratory Mix Trials may be required in addition to Plant Trials, if no satisfactory test or trial mix data for designed mix concrete or if test or trial mix data submitted do not demonstrate the suitability of the proposed plant and mix design.

CON1.T040.B PROCEDURE OF PLANT TRIALS FOR CONCRETE FROM SINGLE BATCHING PLANT

Testing samples:

1. Make one trial mix on each of three different days for each mix design using materials typical of the proposed supply, the volume of each to be at least 60% of the nominal volume of the mixer's discharge;
2. Take three samples on each day from each mix in accordance with the sampling method stipulated in CS1:2010;
3. Allow sufficient size of each sample for the following:
   a. Carry out one slump test or one flow table test as instructed by the CM to determine the workability;
   b. Make two test cubes for compressive strength test at 28 days.
4. For the use of GGBS concrete in the production of concrete works, make two additional test cubes on each day for compressive strength test at the time of demoulding.

CON1.T045.9 PROCEDURE OF PLANT TRIALS FOR MIXING CONCRETES FROM TWO BATCHING PLANTS WITH DIFFERENT CEMENT SOURCES

The two concrete mixes from two different batching plants (plant A and plant B) shall be added with water and mixed at their batching plants within 10 minutes from each other. Upon delivery to testing area, the two concrete mixes shall be mixed together following the mix proportions shown below:

1. 100% from plant A + 0% from plant B (unmixed concrete A);
2. 80% from plant A + 20% from plant B;
3. 50% from plant A + 50% from plant B;
4. 20% from plant A + 80% from plant B;
5. 0% from plant A + 100% from plant B (unmixed concrete B).

Testing samples:

1. Make one trial mix on each of three different days for each mixed concrete of the three different mix proportions and each of the two unmixed concretes mentioned above, using materials typical of the proposed supply, the volume of each to be at least 60% of the nominal volume of the mixer's discharge;
2. Take three samples on each day from each mixed concrete of the three different mix proportions and each of the two unmixed concrete in accordance with the sampling method stipulated in CS1:2010;
3. Allow sufficient size of each sample for the following:
    a. Carry out one slump test or one flow table test as instructed by the CM to determine the workability;
    b. Make two test cubes for compressive strength test at 28 days.

CON1.T050.9 PROCEDURE OF LABORATORY MIX TRIALS

Testing samples:

1. Make 3 separate batches of concrete for each mix design using materials typical of the proposed supply;
2. Take one sample from each batch in accordance with the sampling method stipulated in CS1:2010;
3. Allow sufficient size of each sample for the following:
    a. Carry out two slump tests or two flow table tests as instructed by the CM to determine the workability;
    b. Make six test cubes for compressive strength test at 28 days.

CON1.T070.9 STANDARD FOR APPROVAL OF PLANT TRIALS FOR CONCRETE FROM SINGLE BATCHING PLANT

1. The results of tests for compressive strength at 28 days of the test cubes must comply with the following requirements:
    a. The average strength of the eighteen test cubes exceeds the specified characteristic strength by at least 12 MPa;
    b. The compressive strength of each individual test cube exceeds the specified characteristic strength by at least 5 MPa.
2. The results of tests for workability must comply with the following requirements:
    a. Slump test:
        i. The range of the three measured slump values for each of the three days must not exceed the average of the three measured slump values by ±20%;
        ii. The average of the nine measured slump values for the three days must fall within ±20 mm or ±25% of the designed slump value, whichever is the greater.

b. Flow table test:
   i. The range of the three measured flow values for each of the three days must not exceed the designed flow value by ±70 mm;
   ii. The average of the nine measured flow values for the three days must fall within ±50 mm of the designed flow value.

3. The results of tests on compressive strength of concrete in precast concrete components at demoulding of the test cubes must comply with the following requirement:
   a. The compressive strength of each individual test cube attains a compressive strength of at least 15 MPa.

CON1.T075.9 STANDARD FOR APPROVAL OF PLANT TRIALS FOR MIXING CONCRETE FROM TWO BATCHING PLANTS WITH DIFFERENT CEMENT SOURCES

1. The results of tests for compressive strength at 28 days of the five mixed concretes, consisted of the three different mix proportions and the two unmixed concretes, stipulated in CON1.T045 must comply with the following requirements:
   a. The average strength of the 90 test cubes, consisted of the 18 test cubes from each of the five mixed concretes prepared on the three days, exceeds the specified characteristic strength by at least 12MPa;
   b. The compressive strength of each individual test cube exceeds the specified characteristic strength by at least 5 MPa.
2. The results of tests for workability of the five mixed concretes, consisted of the three different mix proportions and the two unmixed concretes, stipulated in CON1.T045 must comply with the following requirements:
   a. Slump test:
      i. The range of the 15 measured slump values, consisted of the three measured slump values from each of the five mixed concretes taken on each of the three days, must not exceed the average of the 15 measured slump values by ±20%;
      ii. The average of the 45 measured slump values, consisted of the nine measured slump values from each of the five mixed concretes taken on the three days, must fall within ±20 mm or ±25% of the designed slump value, whichever is the greater.
   b. Flow table test:
      i. The range of the 15 measured flow values, consisted of the three measured slump values from each of the five mixed concretes taken on each of the three days, must not exceed the designed flow value by ±70 mm;
      ii. The average of the 45 measured flow values, consisted of the nine measured slump values from each of the five mixed concretes taken on the three days, must fall within ±50 mm of the designed flow value.

CON1.T080.9 STANDARD FOR APPROVAL OF LABORATORY MIX TRIALS

1. Except for concrete of grade strength 20 MPa with recycled coarse aggregates, the results of tests for compressive strength at 28 days of the test cubes must comply with the following requirements:
   a. The average strength of the eighteen test cubes exceeds the specified grade strength by at least 14 MPa, or 10 MPa if test data submitted show that the operating standard deviation of the proposed plant does not exceed 5.5 MPa and the data are acceptable to the CM;

b. The compressive strength of each individual test cube exceeds the specified grade strength by at least 7 MPa, or 3 MPa if test data submitted show that the operating standard deviation of the proposed plant does not exceed 5.5 MPa and the data are acceptable to the CM.

2. For concrete of grade strength 20 MPa with recycled coarse aggregates, the compressive strength of each individual test cube at 28 days shall exceed the specified grade strength by at least 6 MPa;
3. The results of tests for workability must comply with the following requirements:
   a. Slump test: the average of the six measured slump values for the three batches must fall within ±20 mm or ±25% of the designed slump value, whichever is the greater;
   b. Flow table test: the average of the six measured flow values for the three batches must fall within ±50 mm of the designed flow value.

CON1.T085.9 PROVISIONAL APPROVAL OF PLANT AND LABORATORY MIX TRIALS

Provisional approval of the proposed mixes based on 7-days cube results may be given provided that the following are satisfied:

1. Prepare test cubes (from the corresponding batch of concrete taken for 28-days strength test) for compressive strength test at 7 days in accordance with CON1.T040 and CON1.T050;
2. The results of tests for compressive strength at 7 days of the test cubes must comply with CON1.T070 and CON1.T080 except that the specified grade strength (and the difference between average strength/individual compressive strength and specified grade strength) given in CON1.T070 and CON1.T080 can be reduced by 25%;
3. The results of tests for workability comply with the specified requirements;
4. If the results of tests for compressive strength at 28 days of the test cubes are subsequently found not to comply with CON1.T070 and CON1.T080, the provisional approval of concrete shall be nullified. The concrete cast for the works based on the provisional approval shall be deemed to be unacceptable and where necessary, carry out Approved remedial works and bear all the cost and time of such works.

CON1.T090.9 NON-COMPLIANCE

If the result of any test for workability or strength of trial mix concrete, whether the trial mix concrete is as stated in CON1.T040 or as stated in CON1.T045, does not comply with the specified requirements, particulars of proposed changes to details of mix design under CON1.M1110 shall be submitted to the CM for Approval. Further trial mixes are to be made until the results of every test complies with the specified requirements of trial mix concrete.

CON1.T100.9 VARIATIONS TO APPROVED MIXES

When the mix has been Approved do not make variations in the proportions and sources of materials or in the type, size and grading of aggregates without the consent of the CM, who may require further trial mixes to be made.

CON1.T110.9 PRACTICAL TESTS FOR SUITABILITY OF THE MIX

The CM may also require practical tests to be made on Site by filling trial moulds or by pumping to confirm the suitability of the mix for the Works. Ensure that, in such tests, the type of plant used for mixing, transporting and placing, the method of compaction used, the formwork face to the mould and the size and disposition of reinforcement are similar in all respects to those intended for use in the Works.

CON1.T120.9 CERTIFIED EVIDENCE OF MIX SUITABILITY

Trial mixes need not be made, if test or trial mix data for designed concrete mix of the proposed grade with similar materials to that of the proposed mix and produced in the plant proposed for the Works are submitted and are acceptable to the CM.

SAMPLING AND TESTING GENERALLY

CON1.T205.9 GENERAL

When Instructed:

1. Arrange and provide attendance necessary for the sampling of cement, PFA, GGBS, aggregates (excluding recycled aggregates) and other concrete constituent materials by the DTC; and
2. Submit the samples to the CM in accordance with CON1.T220 to CON1.T240.

CON1.T210.9 DEFINITION OF "BATCH"

In this Specification:

1. A batch of cement, PFA, GGBS, aggregate, admixture or curing compound is defined as any quantity of the material of the same type, manufactured or produced at the same time in the same place, covered by the same certificates and delivered to the site, or stored at the ready-mixed concrete plant, at any one time;
2. A batch of fresh concrete for testing purposes is as defined in clause 1.2 of CS1:2010.

CON1.T220.9 SAMPLES FOR TESTING BY DIRECT TESTING CONTRACTOR (DTC)

When Instructed, arrange and submit to the CM, one sample of each type of material, from each specified concreting day that the concrete is placed in the permanent work, for testing by Direct Testing Contractors (DTC) employed by the Housing Authority.

CON1.T230.9 TESTING PROGRAMME

For recycled aggregates to be tested by DTC, ascertain and allow sufficient time for carrying out the tests and issue of test results by DTC.

CON1.T240.9 SAMPLE SIZES

When Instructed, take samples of the sizes and using the methods of sampling stated in the Table below:

Sample Sizes and Methods of Sampling		
Material	Size of Sample	Method of Sampling
Cement	20 kg	BS EN 196-7:2007
PFA	20 kg	BS EN 196-7:2007
GGBS	20 kg	BS EN 196-7:2007
PFAC	20 kg	BS EN 196-7:2007
Coarse Aggregate	50 kg	CS3:2013 Section 8
Fine Aggregate	10 kg	CS3:2013 Section 8
Water	10 litre	BS EN 1008:2002
Admixture (powdered) (liquid)	 1 kg 1 litre	 BS EN 934-2:2009+A1:2012 BS EN 934-2:2009+A1:2012
Curing compound	5 litre	BS EN 934-2:2009+A1:2012 / BS7542:1992

SAMPLING

CON1.T320.9 COARSE AND FINE AGGREGATES

1. Except for recycled coarse aggregates, the DTC shall sample coarse and fine aggregates at each stockpile and carry out sieve analyses only when instructed by the CM;
2. For recycled coarse aggregates from a particular source, the DTC shall carry out tests stipulated in CON1.T410 once at the start of the Contract and at weekly intervals thereafter.

CON1.T330.9 WATER FOR MAKING CONCRETE

1. If clean fresh water from Water Supplies Department mains supply is not available, provide:
   a. One sample of water at the same time as particulars of the water are submitted to the CM in accordance with PRE.B10.1230 or PRE.C11.090 as appropriate; and
   b. One sample of water, for testing by the DTC, during each month that the concrete is being placed in the permanent work unless otherwise Approved.
2. For recycled water specified in CON1.M320:
   a. Arrange to use laboratories which have obtained HOKLAS accreditation to carry out the required tests, unless otherwise permitted by the CM;
   b. Obtain samples of recycled water at each batching plant for testing by the Approved laboratory according to the test frequency in the following table:

Property		Limit	Test method	Test frequency
(i)	Density	≤ 1,030 kg/m³	BS 718:1991 Appendix E (Alternative test method may be used subject to the CM's approval)	At least once per day
(ii)	Initial setting time of cement with recycled water	Deviation not earlier than 1 hour and not later than 1.5 hour as from that of control cubes (Test in parallel with those using recycled water is required on control cubes using clean fresh water only to determine the initial setting time and the deviation)	BS EN 196-3:2005+A1:2008	Once every 3 months for the first year; once every 6 months for subsequent years
(iii)	Chloride content (as Cl) - Prestressed concrete or steam cured structural concrete - Concrete with reinforcement or other embedded metal	 ≤ 500 ppm ≤ 1,000 ppm	 American Public Health Association (APHA) Standard, APHA 4500-Cl-B, 18th edition (1992) APHA 4500-Cl-B, 18th edition (1992)	Once every week for the first two months; once every month for subsequent months
(iv)	Sulphate content (as SO_4)	≤ 3,000 ppm	APHA 4500-SO42-C, 18th edition (1992)	

(v)	Acid-soluble alkali content	≤ 600 ppm	BS EN 1008:2002	

c. Submit test reports to the CM to show that the recycled water is in compliance with this Specification;

d. If the test results do not comply with the limits:

i. Suspend the use of recycled water immediately and carry out investigation to propose remedial works;

ii. Submit two sets of consecutive satisfactory test results taken from the same source for the CM's consideration to resume the use of recycled water for subsequent concrete mixing.

CON1.T340.9 FRESH CONCRETE

Testing arrangements:

1. Sampling of concrete for testing will be carried out by the DTC in accordance with the requirements given in CS1:2010 and as follows:

a. Location of batches to be sampled: as required by the CM;

b. The times of day at which samples are taken will be at random;

c. Frequency of sampling for compressive strength testing:

i. Except for concrete of grade strength 20 MPa with recycled coarse aggregates or concrete of grade strength higher than 60MPa, the sampling rates are as set out in the table below, provided that a minimum of one sample is taken from each mix of concrete produced on any one day. Where the type of structure is not specified all concrete is deemed to be for 'other types' of structure;

Sampling Rates of Fresh Concrete for Compressive Strength Testing	
Types of Structure	Approximate quantity of concrete to be represented by each sample
Masts, Cantilevers with span ≥3 m, Prestressed elements, Columns and shear walls, Transfer beams and transfer plates, other critical elements	10 m³ or 10 batches whichever is the smaller volume
Other types	25 m³ or 25 batches whichever is the smaller volume
Solid rafts, Pile caps, Mass concrete	100 m³ or 100 batches whichever is the smaller volume

ii. For concrete of grade strength 20 MPa with recycled coarse aggregates, make four test cubes for compressive strength testing on each concreting day, two to be tested at 7 days and two at 28 days;

iii. For concrete of grade 15/20 or below, take a minimum of one sample per 100 m³, irrespective of concreting day, for compressive strength test;

iv. For high strength concrete of grade strength higher than 60 MPa, take at least one sample of concrete from every ready mixed vehicle arriving on Site. If the concrete is site batched, take a minimum of one sample per every 10 m³, irrespective of concreting day, for compressive strength test.

d. To determine the workability of the concrete: one sample of concrete from each batch of concrete;

e. The CM may agree to a reduced frequency of sampling for exceptionally large pours;

f. For concrete used for construction of hoardings and associated covered walkways and gantries, the frequency of sampling stated in the sub-clauses (1)(c) and 1(d) above may be reduced at the discretion of the CM;

g. For blinding layer concrete to underside of pile caps and suspended ground slabs / beams in contact with earth, the tests stated in sub-clauses (1)(c) and 1(d) above are not required.

2. Tests on workability, making and curing of concrete cubes for precast concrete components shall be carried out by the Contractor / manufacturer of the precast concrete components. Tests on compressive strength of concrete cubes shall be carried out by the DTC and / or HDMTL.

CON1.T350.9 FACILITIES FOR SAMPLING FRESH CONCRETE

Provide, at the normal point or points of discharge of the mixer, a mobile shelter/shelters to accommodate workability test and cube making processes.

TESTS ON AGGREGATES

CON1.T410.9 STANDARD

1. The DTC shall test recycled coarse aggregates for the following properties:

Requirements	Limits	Testing Method
Minimum dry particle density	2000 kg/m³	CS3:2013 Section 17
Maximum water absorption	10%	CS3:2013 Section 17
Maximum content of wood and other material less dense than water (by mass)	0.5%	Manual sorting in accordance with BRE Digest 433
Maximum content of other foreign material (e.g. metals, plastics, clay lumps, asphalt and tar, glass etc.) (by mass)	1.0%	Manual sorting in accordance with BRE Digest 433
Maximum fines (by mass)	4%	CS3:2013 Section 10
Maximum content of sand (<4 mm) (by mass)	5% m/m	CS3:2013 Section 10
Maximum content of sulphate (by mass)	1% m/m	CS3:2013 Section 21
Flakiness index	40%	CS3:2013 Section 11
10% fines test	100 kN	CS3:2013 Section 16
Grading	Table 3.1 of CS3:2013 for single-sized 20 mm and 10 mm aggregates	CS3:2013 Section 10
Maximum chloride content	Table 5.1 of CS3:2013 - 0.05% by mass of chloride ion of combined aggregate	CS3:2013 Section 21

Alkali-silica reactivity	Table 10 of CS1:2010 for ultra-accelerated mortar bar test Table 13 of CS1:2010 for concrete prism test	CS1:2010 Section 22 for ultra-accelerated mortar bar test CS1:2010 Section 23 for concrete prism test

2. Limits of acceptance in accordance with the values in the Table above.

CON1.T420.9 FURTHER ANALYSIS

The CM may require further analysis, including submission stated in CON1.M210, to be made if there is any alteration to the type of aggregate.

TESTS FOR WORKABILITY

CON1.T510.9 STANDARD

Testing arrangements:

1. Sample for workability testing shall:
   a. Be in accordance with CS1:2010;
   b. Not be taken from the first 0.3 m^3 and the last 0.3 m^3 of concrete discharged from the truck;
   c. Be remixed and divided into two specimens. Each specimen shall be tested by DTC to determine the workability of the concrete either by the slump test or by the flow table test all in accordance with CS1:2010.
2. Unless otherwise specified by the CM, adopt the testing method for workability as below:

Normal Workability (designed slump value from 20 mm to 200 mm)	High Workability (designed flow value from 340 mm to 600 mm)
Slump Test (For designed slump value exceeding 175mm and ≤ 200mm, see the Note to Clause 2.1.1 of CS1)	Flow Table Test

3. Notwithstanding the sampling requirement specified in sub-clause (1)(b) above, the first 0.3 m^3 discharged concrete may be used in the Works provided that:
   a. The discharged concrete is properly protected from contamination to CM's satisfaction; and
   b. The measured workability of the concrete is in compliance with this Specification.
4. For pre-batched concrete or concrete with volume less than 1 m^3 as defined in Clause 1.2 of CS1:2010, the requirement to disregard the first 0.3 m^3 and the last 0.3m^3 of concrete before sampling from a mixer for making concrete cube is waived.

CON1.T520.9 ACCEPTANCE VALUES FOR APPROVED MIXES

1. The Approved workability value is that used to produce the mix Approved under CON1.T010 to CON1.T120;
2. For standardised designed mixes: the average of two measured slumps shall be within the corresponding range specified in Table A of CON1.M1020;
3. For designed concrete mixes:

a. Where slump test is used to determine the workability, the average of the two measured slumps must fall within ±25 mm or ±33% of the Approved designed slump value, whichever is greater, up to the limit of ±50 mm. No correction to the nearest 5 mm shall be made in determining the average of the measured slumps and the acceptance limits;

b. Where flow table test is used, the average of the two measured flow values must fall within ±60 mm of the Approved designed flow value, and no correction to the nearest 10 mm shall be made in determining the average of the measured flow values.

4. The CM may reject any concrete for which the measured workability falls outside the limits specified in sub-clauses (2) and (3) as appropriate.

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CUBES

CON1.T610.9 STANDARD FOR CUBE TESTS

Testing arrangements:

1. For compressive strength testing on concrete cast on Site, the DTC will take samples, make, cure and test concrete cubes of 100 mm size in accordance with CS1:2010;
2. For compressive strength testing on concrete cast at manufacturer's factory, the Contractor / manufacturer of precast concrete components shall take samples, make and cure the concrete cubes of 100 mm size and the DTC and / or HDMTL shall test the concrete cubes in accordance with CS1:2010.

CON1.T620.9 SAMPLES FOR DESIGNED CONCRETE MIXES

Testing samples:

1. Prepare two cubes from a single sample taken at random from a batch of concrete selected at random as follows:
   a. At the point of discharge from the mixer; or,
   b. In the case of ready-mixed concrete, at the point of discharge from the delivery vehicle; or
   c. Elsewhere as directed by the CM;
   d. In no case to be from the first 0.3 m³ of concrete discharged from the truck.
2. For concrete cast on Site, Radio Frequency Identification (RFID) tag to be provided and installed on the surface of each cube by the Direct Testing Contractor, to authenticate the identity of the cube throughout the whole testing process. A typical RFID tag is shown on Sketch no. RFID/TAG/SK-01;
3. For concrete cast at manufacturer's factory where precast concrete components are constructed, Radio Frequency Identification (RFID) tag is to be provided by DTC or the CM or his representatives resident at manufacturer's factory, and is to be installed by the manufacturer's factory, to authenticate the identity of the cube throughout the whole testing process. A typical RFID tag is shown on Sketch no. RFID/TAG/SK-01;
4. On completion of curing for 28 days, the two tagged cubes will be tested and the average of the two results taken as the test result;
5. If requested, or if the CM instructs that the concrete be tested for compressive strength at ages other than 28 days, provide additional samples;
6. Take cubes with installed RFID tags for 7 days work cube compressive strength tests at a frequency of 2 cubes per concrete mix used per day for all concreting days, or at any other frequency as considered appropriate by the CM.

CON1.T630.A RESULTS FOR DESIGNED CONCRETE MIXES

1. The results of tests on compressive strength at 28 days of designed mix concrete must comply with the following requirements:
   a. Individual test results: to comply with the strength determined from limits given in Column B in the Table to CON1.T650 below;
   b. Average strength determined from any group of four consecutive test results: to comply with the strength determined from limits given in Column A in the Table in CON1.T650 below. Where there are less than four available test results, treat the average of the first two or first three consecutive test results in the same manner as groups of four consecutive test results.
2. If the difference between the compressive strengths of 2 test cubes made from one sample of designed mix concrete exceeds 15% but does not exceed 20% of the test result:
   a. Use the higher of the compressive strengths of the 2 test cubes to assess compliance as stated in sub-clause (1)(a) above;
   b. Do not use the test results for that sample to assess compliance as set out in sub-clause (1)(b) above nor to calculate the standard deviation.
3. If the difference between the compressive strengths of 2 test cubes made from one sample of designed mix concrete exceeds 20% of the test result:
   a. Discard the test result for that sample;
   b. Propose investigation for Approval to establish if the concrete represented by the sample is acceptable or not.

CON1.T640.A COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES

1. Except for concrete of grade strength 20 MPa with recycled coarse aggregates,
   a. Apply compliance criteria C1 or C2 given in the table to CON1.T650 for concrete of grade below 20;
   b. Adopt compliance criteria C2 under the following conditions for concrete of grade 20 and above:
      i. Before 40 test results are available, where there is sufficient previous production data using similar materials from the same plant under similar supervision to establish that the standard deviation for at least 40 test results will not exceed 5.5 MPa; or
      ii. Where the calculated standard deviation of 40 previous consecutive test results does not exceed 5.5 MPa.
   c. Adopt compliance criteria C1 if compliance criteria C2 in sub-clause (1)(b) is not applicable;
   d. For concrete grade 20 and above, the standard deviation is the standard deviation for each mix of concrete to be calculated after every test result using the last 40 test results judged by the same compliance criteria. Apply compliance criteria C2 to subsequent test results if the standard deviation does not exceed 5.5 MPa. Apply compliance criteria C1 to subsequent test results if the standard deviation exceeds 5.5 MPa.
2. For concrete of grade strength 20 MPa with recycled coarse aggregates, the result of any test on compressive strength shall not be less than:
   a. 70% of the grade strength when tested at 7 days; or
   b. The grade strength when tested at 28 days.

3. If the compliance criteria is changed from C1 to C2 or from C2 to C1, in the table to CON1.T650, apply the new compliance criteria from the 35th day after making the last pair of test cubes in the set of 40 on which the decision to change was based. For the purpose of sub-clause CON1.T630 (1)(b), treat test results immediately before and after the change separately.

CON1.T650.A TABLE OF COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES

The specified grade strength for concrete shall deem to have been attained if the test results comply with both of the requirements specified in Column A and Column B of the table below:

		Column A	Column B
Specified Grade Strength	Compliance Criteria	Average of any 4 consecutive test results must exceed the specified grade strength by	Individual test result must not be less than the specified grade strength by
20 and above	C1	7 MPa	2 MPa
	C2	5 MPa	2 MPa
Below 20	C1 or C2	3 MPa	2 MPa

CON1.T660.A NON-COMPLIANCE OF DESIGNED CONCRETE MIXES

1. When the following situation occurs, place no further concrete in the permanent work or unless otherwise approved by the CM, until an investigation of the materials, mix design and methods of production has been carried out and measures have been taken which, in the opinion of the CM, will result in restoring a satisfactory standard of quality control:
   a. For concrete grade not exceeding 60D, the calculated standard deviation exceeds 8.5 MPa;
   b. For concrete grade exceeding 60D, the coefficient of variation as calculated after every 40 test results exceeds 14%.
2. If the average strength determined from any group of four consecutive test results, or the first two or first three consecutive test results if applicable, fails to meet the requirement of Column A in table to CON1.T650, then all the concrete in all the batches represented by the samples to be deemed defective. For the purposes of this clause, the batches of concrete represented by a group of two, three or four consecutive test results include the batches from which the first and last samples in the group were taken together with all the intervening batches.

   When there is a period exceeding two weeks between any two consecutive test results in a group, the CM may direct that the test results immediately before and immediately after the intervening period be treated separately;
3. If any individual test result fails to meet the requirement in Column B of the Table to CON1.T650, then that result may be considered to represent only the particular batch of concrete from which the sample was taken, provided that the average of any 4 consecutive results, which contained the failed individual test result, satisfies the requirement of Column A of the Table.

CON1.T670.9 FURTHER TESTS ON DESIGNED CONCRETE MIXES

If the strength requirements of this Specification are not satisfied, comply with any Instruction of the CM for further testing, including chemical analysis of samples of hardened concrete in the structure, that he considers necessary.

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES

CON1.T710.9 GENERAL

Provide all necessary facilities and attendance for coring and testing of concrete cores carried out by DTC.

CON1.T720.9 STANDARD

1. Comply with CS1:2010 in respect of the method of preparing, inspecting and testing concrete cores to determine compressive strength;
2. Witness the sampling of cores by the DTC who shall avoid the following concrete as far as practicable:
   a. The top 50 mm or 20% layer of concrete in a lift, whichever is the greater, where the depth of lift is less than 1.5 m;
   b. The top 300 mm layer of concrete in a lift, where the depth of lift is 1.5 m or more.
3. Agree with the CM on the section of the core samples to be selected as test specimens, including those cores sampled from concrete in thin lift where such layer stated in sub-clause (2) cannot be avoided.

CON1.T730.9 SIZE AND NUMBER OF ROUTINE CORE TEST SAMPLES

Testing samples:

1. Provide necessary facilities and attendance for taking 3 Nos. or 12 Nos. of the following core samples for testing by DTC from finished concrete works for the same concreting day, at locations selected by the CM:
   a. 150 mm diameter core samples: for 40 mm aggregate concrete;
   b. 75 mm diameter core samples: early core test for volumetric precast bathroom (VPB), volumetric precast kitchen (VPK), volumetric precast lift shafts and volumetric precast lift machine room components as described under Worksection CON8, precast façades, precast structural walls, precast balconies and precast staircases as described under Worksections CON5 and CON7;
   c. 100 mm diameter core samples: for 20 mm aggregate concrete and all cases other than sub-clauses (1)(a) and (1)(b) above.
2. Provide necessary facilities and attendance for taking core samples by DTC from the finished high strength concrete works of which the concrete grade strength is higher than 60 MPa for each concreting day. The number of cores and locations are to be decided by the CM and in accordance with the coring proposal acknowledged by ICU;
3. The length of core samples shall be at least 95% of the core diameter after end preparation;
4. The ratio of core diameter to the maximum aggregate size shall be not less than 3;
5. The diameter of cores should preferably be 150 mm for 40 mm aggregate and 100 mm for 20 mm aggregate or less, and must not be less than 75 mm;
6. Agree with the CM within 4 weeks from the notified date of commencement of the Works on the format and size of site works photographic records. Submit one set of photographic records to the CM within 24 hours upon completion of the concrete coring work for each working day showing the concrete core positions at various stages (i.e. before, during and after the coring of concrete cores).

CON1.T740.9 AGE OF CORE SAMPLES

1. Do not take cores for strength test at ages less than 28 days except the cores for early core tests on volumetric precast bathroom (VPB), volumetric precast kitchen (VPK), volumetric precast lift shafts and volumetric precast lift machine room as described under Worksection CON8 and precast façades, precast structural walls, precast balconies and precast staircases as described under Worksections CON5 and CON7;
2. Do not make any adjustment to the measured strength in respect of the age of the core when tested.

CON1.T750.9 REQUIREMENT FOR FURTHER CONCRETE CORE SAMPLES

Carry out further concrete core tests if any of the following apply:

1. Failure of recycled aggregate:

   Should a test result on recycled aggregate used in the concrete fail to meet any of the properties as stipulated in CON1.T410, comply with any instruction of the CM for the taking of three core samples (these cores are exclusive from the routine core tests in CON1.T730), in each concreting day for further tests and bear all the cost and time of such extra work;

2. Low concrete core strength:

   Where 3 core samples have been taken in accordance with CON1.T730 or CON1.T750 (1), and the estimated insitu cube strength of any individual core is less than 85% of the specified grade strength, comply with any instruction of the CM for the taking of additional core samples to make up a total of 12 numbers of core samples in the same concreting day for further tests. Allow the time without any claim for extension of time and bear all the costs for such extra work;

3. Failure of concrete cube test:

   If concrete represented by test cubes in any concreting day fails to meet the standard of acceptance specified in CON1.T640 and CON1.T650, comply with any instruction of the CM for the taking of additional core samples (in addition to the routine cores required under CON1.T730) to make up a total of 12 numbers of cores in the same concreting day for further tests. Allow the time without any claim for extension of time and bear all costs for such extra work.

CON1.T760.9 ASSESSING COMPRESSIVE STRENGTH OF CONCRETE CORES

1. In assessing the results of compressive strength on concrete cores for cases other than that stated in sub-clause (2) below, all relevant concrete represented by the cores in the same concreting day is deemed not to comply with this Specification if the strength of the core, when adjusted for length / diameter ratio and converted to estimated insitu cube strength in accordance with CS1:2010, is either:
   a. Less than 85% of the specified grade strength, for an average result of twelve cores; or
   b. Less than 75% of the specified grade strength for any individual result.
2. In assessing the results of compressive strength of concrete cores for the case where a reduction factor of 0.8 is applied to the design stresses of concrete placed under water (Type 1(c) and Type 3 piles), all concrete represented by the cores in the same concreting day is deemed not to comply with this Specification if the compressive strength of the core, when adjusted for length / diameter ratio and converted to estimated in-situ cube strength in accordance with CS1:2010, is either:
   a. Less than 70% of the specified grade strength, for an average result of three cores; or
   b. Less than 60% of the specified grade strength for any individual result.

CON1.T770.9 MAKING GOOD CORE HOLES

Make good core holes to Approval with cement mortar or concrete of same concrete strength to that originally specified for the parent concrete.

ADDITIONAL TESTS

CON1.T810.9 GENERAL

1. During the progress of the Works, the CM has the power to order tests other than cube tests and core tests. Comply with CS1:2010 or with the relevant British Standard and Code of Practice where CS1:2010 does not apply;
2. The method of sampling, preparing and testing of hardened concrete to determine cement content is to be in accordance with CS1:2010.

CON1.T820.9 CEMENT CONTENT TEST

For Portland cement (PC) concrete, test all core samples taken in the same concreting day to determine their cement content should the estimated in-situ cube strength of any individual core taken in accordance with CON1.T710 to CON1.T760 be less than 85% of the specified strength. The test is to be carried out after the completion of the core compression test and by the Direct Testing Contractors employed by the Housing Authority.

CON1.T830.9 NON-COMPLIANCE OF CEMENT CONTENT TEST

Should the average of the test results of all core samples taken in the same concreting day be less than 83% of the minimum cement content stated in CON1.M1130 to CON1.M1160, all relevant concrete represented by these samples in the same concreting day to be deemed not to comply with Specification.

CON1.T840.9 AQUEOUS LIQUID RETAINING STRUCTURES

Test aqueous liquid retaining structures such as water tanks in accordance with clause 9.2 of BS 8007:1987.

CON1.T850.A SCHMIDT HAMMER TEST OF IN-SITU CONCRETE AT EARLY AGE

1. Carry out and provide attendance for the CM or his representatives to witness of schmidt hammer test on the following in-situ structural elements when the concreting age is between 7 and 10 days*;

Types of Structure Elements	**Minimum Test Frequency (per storey)**
Vertical Elements# (walls, columns) of higher concrete grade than the support at the base provided by pile cap / footing / raft foundation / transfer plate / transfer beam	50%
Vertical Elements (walls, columns) of higher concrete grade than the adjoining beams or slabs at the top	10%
Transfer beams	50%
Beams of higher concrete grade than the adjoining beams / slabs on the same floor	10%

* If the test cannot be conducted between the 7th and 10th day due to, for example, public holiday, the test should be carried out on the following working day.

If vertical elements are with continuous kickers, the test shall be performed to the kickers in addition to the vertical elements.

2. The Schmidt hammer test shall be performed in accordance with BS EN 12504-2:2021 by a person with a minimum qualification and experience of a Grade T1 TCP under Registered Contractor's stream in the CoPSS. The test locations are to be decided by the CM. The rebound hammer and accessories for the test shall comply with PRE.B10.500;
3. If the test result fails to meet 55% of specified characteristic strength for concrete containing either PFA or GGBS; or 65% of specified characteristic strength for concrete without containing PFA or GGBS, the Contractor shall notify the CM immediately and carry out follow-up actions in compliance with PNAP APP-167, and if necessary submit remedial works to the CM's satisfaction. Bear all associated costs and the extra time required of all follow-up actions and remedial works;
4. The test records are to be endorsed by the Contractor's representative and shall be kept on the Site available for inspection by the CM at all times.

FAILURE TO MEET REQUIRED CRITERIA

CON1.T910.9 AQUEOUS LIQUID RETAINING STRUCTURES

Non-compliance:

1. If any aqueous liquid retaining structure fails to meet the requirements of CON1.T630, CON1.T640 or CON1.T650 or evidence of seepage is observed during testing according to CON1.T840, then the structure is deemed defective.

TESTS FOR REPAIR MORTAR

CON1.T1010.9 SAMPLES FROM REPAIR MORTAR

When Instructed, take testing samples in accordance with the following sub-clauses:

1. A set of two 100 mm or a set of three 70.7 mm cubes from a single sample taken from a batch of repair mortar selected at random for compressive strength test for each testing age as directed by the CM;
2. RFID tag to be provided and installed on the surface of each cube by the Direct Testing Contractor, to authenticate the identity of the cube throughout the whole testing process. A typical RFID tag is shown on Sketch no. RFID/TAG/SK-01;
3. Take the average of the cube results in the set as the test result.

TESTS ON GGBS

CON1.T1110.B PURCHASER TESTS

1. Employ an Approved testing laboratory for carrying out the tests to verify the physical and chemical properties of GGBS in accordance with BS EN 15167-1:2006 before production of concrete works;
2. Submit the test reports to the CM in accordance with CON7.T010.

INVESTIGATION BY EXTENSIVE CORE TESTING

CON1.T1210.9 GENERAL

1. When concrete is deemed not complying with this Specification as assessed in accordance with CON1.T750 or CON1.T830, the CM shall issue a condemnation letter;
2. Apply the procedure in CON1.T1220 to CON1.T1260 to investigate the extent of non-compliance and re-execute the works;

3. The provisions stated hereinafter shall be without prejudice to the Employer's right, the CM's power and the Contractor's obligations in connection with the removal of unsatisfactory material and work, and subsequent re-execution of work under the Contract.

CON1.T1220.9 INVESTIGATION AND REPORTS

1. Within 14 days from the date of condemnation letter issued by the CM, submit the following for Approval:
   a. A statement of request to identify the extent of non-complying concrete in the affected structural elements on the concreting day(s) as stated in the condemnation letter;
   b. An investigation plan as stipulated in CON1.T1230;
   c. A statement of undertaking to complete the investigation and re-execution of works within a duration agreed by the CM; and
   d. A statement of confirmation to bear all costs and time so incurred in connection with or arising from the investigation.
2. Confirm in writing to accept the conditions, if any, as stipulated by the CM related to the Approval in sub-clause (1) before the investigation proceeds;
3. Within 7 days upon completion of the investigation, report to the CM with details as stipulated in CON1.T1250 for Approval;
4. Confirm in writing to accept the conditions, if any, as stipulated by the CM related to the Approval in sub-clause (3) before re-execution of works proceeds; and
5. Within 7 days upon completion of the re-execution of works, report to the CM with details as stipulated in CON1.T1260.

CON1.T1230.9 INVESTIGATION PLAN SUBMISSION

The investigation plan shall be endorsed by an Approved RSE and shall include the following details:

1. Delineation of concrete to be investigated;
2. Method statement of the extensive core testing and the details of a HOKLAS accredited laboratory, to be approved by the CM, responsible for sampling and carrying out the compressive strength test;
3. Volume of concrete represented by each core; and
4. Programme of the investigation works.

CON1.T1240.9 ASSESSMENT CRITERIA

1. Include the cores taken in accordance with CON1.T750 in addition to the cores obtained from the investigation plan in identifying the extent of non-complying concrete; and
2. The volume of concrete represented by an individual core is deemed not to comply with this Specification if the following test result of the individual core is found:
   a. Criterion applicable to all types of concrete: The estimated in-situ cube strength is less than 85% of the specified grade strength; or
   b. Criterion applicable to Portland Cement (PC) concrete only: The cement content is less than 83% of the minimum cement content stated in CON1.M1130 to CON1.M1160, for Portland cement (PC) concrete.

CON1.T1250.9 INVESTIGATION REPORT SUBMISSION

Submit an investigation report, endorsed by the Approved RSE in CON1.T1230, with the following details:

1. Delineation of non-complying concrete;
2. Method statement for the re-execution of works; and

3. Programme of the re-execution of works including verification testings.

CON1.T1260.9 RE-EXECUTION OF WORKS REPORT SUBMISSION

Submit a report, substantiated by results of verification testings and endorsed by the Approved RSE in CON1.T1230, to confirm that the Works subsequent to the re-execution of works comply with this Specification.

APPENDICES

CON1.APPEND1.9 FORM A

APPENDIX CON1/I - FORM A

NAME OF CONTRACT
CONTRACT NO. …….

RECEIPT OF RECYCLED COARSE AGGREGATES

Date: …… Receipt No. ……

Vehicle Reg. Mark: ……

Time In: …… Time Out: ……

Type(s) of Recycled Coarse Aggregates Received:

	10 mm	20 mm
Please tick		

Weight In: ……

Weight Out: …… Net Weight Unloaded: ……

Use of the Material Received: ……

Remarks:

Name and Authorised Chop of
Concrete Batching Operator on use of
Recycled Coarse Aggregates

CON2 FORMWORK

DESIGN

FORMWORK DESIGN GENERALLY

CON2.D010.A LOADINGS

Design and construct falsework and formwork to withstand any combination of the following loadings and to maintain the position and shape of the formwork to achieve the required shape and finish of the hardened concrete:

1. Total weight of formwork, falsework and wet concrete;
2. Construction loads including dynamic effects of placing, compacting and construction traffic;
3. Wind loads in accordance with the Code of Practice on Wind Effects in Hong Kong 2019 issued by the Buildings Department;
4. Any other relevant loading described in BS 5975:1982.

CON2.D020.9 STANDARD

Comply with the requirements of BS 5975:1982 regarding design, construction and dismantling of falsework and formwork.

CON2.D030.9 INCLINED SURFACES

Provide formwork to the top surface of concrete where inclined at a slope exceeding 15° to the horizontal.

CON2.D040.9 DISMANTLING AND REMOVAL

Design falsework and formwork so that they can be dismantled and removed without disturbing or overloading the finished concrete work or the structure.

CON2.D050.A BRIDGE AND TRANSFER STRUCTURE CONSTRUCTION

1. Appoint a Registered Structural Engineer to design and control the temporary works for the construction of the bridge and the transfer structure. Refer to PRE.B10.010 sub-clause (8) for the certification requirement of RSE;
2. The submission shall include drawings and supporting calculations and shall be submitted to the CM not less than 4 weeks before the Contractor proposes to put such work in hand. Do not commence the proposed work without the prior consent of the CM. Such consent shall, however, in no way relieve the Contractor of any of his responsibilities for the design of the falsework;
3. Monitor falsework levels and make any necessary adjustments for settlement or other deflection or movements;
4. Unless otherwise approved by the CM, the falsework supporting system for the transfer structure shall be carried down directly to the pile cap levels and shall not impose any additional loadings on the floors, columns and walls.

CON2.D060.9 FORMWORK FOR STRUCTURAL WALLS IN DOMESTIC BLOCKS

1. Design and use large panel formwork, in accordance with CON2.D310, for all structural walls in domestic floors between first domestic floor level and main roof level;

2. For domestic blocks without rotational symmetry and where the use of large panel formwork at critical areas of a domestic floor would lead to an unacceptable prolonged construction cycle, the Contractor may propose the use of small panel metal formwork, together with justification in the submission stipulated in CON2.D240, for CM's approval.

FALSEWORK SPANNING PUBLIC HIGHWAYS

CON2.D110.A DESIGN RESPONSIBILITY

Employ a Registered Structural Engineer to take responsibility for the design and construction of all temporary works and falsework spanning public highways. Refer to PRE.B10.010 sub-clause (9) for the certification requirement of RSE and ICC. No consent or dissent of the CM will relieve the Contractor of his sole responsibility for the falsework design, construction and obtaining approval from the CM.

CON2.D120.9 FALSEWORK SPANNING A PUBLIC HIGHWAY

Ensure the falsework system does not interfere with normal traffic flow and does not reduce the width of the traffic lanes. Design clearances to falsework spanning a public highway in accordance with Section 35 of the Transport Planning and Design Manual Volume 2 - Highway Design Characteristics.

CON2.D130.9 APPROVALS

1. Take responsibility for obtaining all necessary approvals of any proposed falsework design and construction, through the Authority, from the Highways Department, the Commissioner of Police and the Commissioner for Transport;
2. Do not commence any temporary works, including falsework spanning a public highway, unless the falsework design and construction method has been approved by the Highways Department and Commissioner of Police and Commissioner for Transport.

SUBMISSIONS

CON2.D210.9 TIMING

Submit details of formwork and falsework to the CM for information before commencement of construction.

CON2.D220.9 FALSEWORK SPANNING A PUBLIC HIGHWAY

Submit proposals for falsework spanning a public highway to the CM in the form of proper, numbered, fully dimensioned drawings accompanied by full structural calculations endorsed by the Contractor's Registered Structural Engineer. Make any amendments required by the CM and submit copies to the CM in order to obtain all necessary approvals from the Highways Department and Commissioners. See also CON2.D130 (2) above.

CON2.D230.9 PLYWOOD SHEATHING

Before commencement of the superstructure and where the sheathing is timber plywood, submit for Approval, details of the method of identifying and recording the number of uses to which the sheathing will be subjected to. Upon Approval, provide all labour and equipment and carry out marking and recording to the satisfaction of the CM.

CON2.D240.A LARGE PANEL FORMWORK AND SMALL PANEL METAL FORMWORK FOR DOMESTIC BLOCK

Submit the following information certified by QE as stipulated in PRE.B10.010 sub-clause (6) for the CM's approval:

1. Details of the system, including drawings and calculations;
2. Details of safety requirements regarding the designated storage yard for large panel formwork as stipulated in PRE.B8.262;
3. Details for holding down and stabilising the panels of the wallforms including horizontal ties at the top of wallforms;
4. Details of kicker construction, both for precast kicker blocks and cast-in-situ kickers, including proposed bedding and grouting material for precast kicker blocks;
5. Details of metal formwork, and its fixings, for slab edges which form an integral part of wall elevations;
6. Proposals for curing and protecting the concrete;
7. Method statement for placing and compacting the concrete;
8. Details of any relaxation to the minimum periods for retaining formwork and falsework in position before striking as stated in CON2.W630 which may be required to suit the proposed formwork systems;
9. Details of assembling and striking of any small panel metal formwork, including the maintenance of the panels for repeated uses;
10. Documentary evidence, such as previous project references, indicating that the finished concrete surface produced by the small panel metal formwork is not to be of a lesser standard than that produced by the large panel formwork, together with a method statement for applying skim coat to the wall joints in accordance with CON2.W315.

CON2.D250.A BRIDGE AND TRANSFER STRUCTURE CONSTRUCTION

Submit the following details of formwork and falsework to the CM at least 4 weeks before commencement of construction. Refer to PRE.B10.010 sub-clause (8) for the certification requirement of RSE:

1. Details of the system, including drawings and calculations;
2. Details of holding down and stabilising the system including horizontal ties;
3. Method statement for construction of the structure;
4. Proposal for curing and protecting the concrete;
5. Method statement for placing and compacting the concrete.

CON2.D260.9 INSPECTION RECORDS

Submit records of inspection on the completed formwork and falsework to the CM for information before carrying out any further works that may affect the stability of the formwork and falsework. Such records are to be certified by a contractor's superintendent holding qualification equivalent to TCP Grade T4 in civil or structural engineering discipline.

DESIGN OF LARGE PANEL FORMWORK FOR DOMESTIC BLOCK

CON2.D310.9 GENERAL DEFINITION

Large panel formwork refers to metal formwork complying clauses CON2.D320 to CON2.D450.

CON2.D320.9 WALLS NOT EXCEEDING 7.5 M LONG

For walls not exceeding 7.5 m long, design the whole of the formwork assembly for one face of the wall per storey as one complete reusable panel.

CON2.D330.9 WALLS EXCEEDING 7.5 M LONG WITHOUT OPENINGS

For walls exceeding 7.5 m long, without door or window openings, design the whole of the formwork assembly, for one face of the wall per storey, as one or two complete reusable panels.

CON2.D340.9 WALLS EXCEEDING 7.5 M LONG WITH OPENINGS

For walls exceeding 7.5 m long with door/window openings, the whole of the formwork assembly for one face of the wall per storey may comprise a no. of panels provided that any joints between panels must fall within the width of the door/window openings.

CON2.D350.9 JUNCTIONS

At any wall junction, where it is not practicable to position the edge of the formwork assembly at the junction, position the edge at a clear distance of not more than 300 mm from the junction line.

CON2.D360.9 USE OF OTHER TYPES OF FORMWORK

Where it is not practicable to use large panel formwork, e.g. at staircases, columns at wall ends etc, adopt other types of formwork, including small panel metal formwork or traditional formwork, and submit details for Approval.

CON2.D370.9 JOINTS IN SHEATHING

1. Design the sheathing of the formwork free of horizontal joints;
2. Position any vertical joints at minimum 1 m centres maintaining a continuous smooth surface across the joints.

CON2.D380.9 BACKING STRUCTURE

Support the sheathing with a backing structure of metal or other Approved material.

CON2.D390.9 SEALING BASE OF WALLFORMS

With the exception of where in-situ monolithic kickers are used, seal the toes of all wallforms with a compressible rubber hose placed between the floor slab and the base of the wallform, backed with a cement mortar seal to prevent grout loss.

CON2.D400.9 TOP BRACING

Securely brace every panel of wallform at the top by at least two horizontal ties to ensure vertical alignment.

CON2.D410.9 SLAB EDGES

Fabricate slab edge formwork in metal to match the wallform system where any part of a wall is formed as a slab edge.

CON2.D420.9 ACCESS WALKWAY

In addition to GCC Clauses 7.1(2):

1. Provide continuous walkway around the edges of the building under construction. Working platforms and table forms may be used;
2. Comply with details of safety requirements regarding working platforms as stipulated in PRE.B8.262;

3. Provide a minimum walkway width of at least 1000 mm with a minimum width of 650 mm at joints with any adjacent walkway. The walkway must be close boarded or planked in timber of 25 mm minimum thickness, plated or of metalwork;
4. Provide toe boards to a minimum height of 200 mm on the platform side where a person or object could fall for more than two metres;
5. Read this Specification in conjunction with drawing No. SES/LP/S/EG001 in Appendix B which details the access walkway.

CON2.D430.9 OTHER TYPES OF FORMWORK - ACCESS WALKWAY

Propose and provide alternative platforms and access walkway and maintain continuity where large panel formwork is not used in accordance with CON2.D360 and obtain Approval before use, provided that the alternative is not of a lesser standard in conforming to the requirements in CON2.D420.

CON2.D440.A PATENT WALLFORM SYSTEMS

Obtain prior approval from the CM for use of patent wallform systems not complying with this Specification, provided that the finished products produced by such system proposed are not to be of a lesser standard than that produced by formwork conforming to the above formwork design requirements. Refer to PRE.B10.010 sub-clause (8) for the certification requirement of RSE.

CON2.D450.9 ALTERNATIVE GROUT SEALING SYSTEMS

Obtain Approval before using any alternative grout sealing system:

1. The CM may Approve any other proposed system, provided that the Contractor can demonstrate that the finished product provided can match the requirements of the Specification before commencement of construction;
2. At any time the CM may withdraw such Approval of the proposed system if he considers that it will fail to produce the required finished product;
3. In such a case, revert to the system described in this Specification. No monetary claims whatsoever will be entertained or extensions of time granted in the event of such a withdrawal of Approval.

DESIGN OF SMALL PANEL METAL FORMWORK FOR DOMESTIC BLOCK

CON2.D510.9 GENERAL DEFINITION

Small panel metal formwork, e.g. aluminium formwork, refers to small metal formwork complying clauses CON2.D520 to CON2.D600.

CON2.D520.9 JUNCTIONS

As CON2.D350.

CON2.D530.9 JOINTS IN SHEATHING

Maintain a continuous smooth surface across all horizontal and vertical joints.

CON2.D540.9 BACKING STRUCTURE

As CON2.D380.

CON2.D550.9 SEALING BASE OF WALLFORMS

As CON2.D390.

CON2.D560.9 TOP BRACING

1. For walls not exceeding 7.5 m long, securely brace each wallform at the top by at least two horizontal ties to ensure vertical alignment;
2. For walls exceeding 7.5 m long, securely brace each wallform at the top by at least four horizontal ties to ensure vertical alignment.

CON2.D570.9 SLAB EDGES

As CON2.D410.

CON2.D580.9 ACCESS WALKWAY

As CON2.D420.

CON2.D590.9 PATENT WALLFORM SYSTEMS

As CON2.D440.

CON2.D600.9 ALTERNATIVE GROUT SEALING SYSTEMS

As CON2.D450.

MATERIALS

DEFINITIONS

CON2.M010.9 FORMWORK OR FORM

That section of the temporary works used to give the required shape and support to poured concrete, consisting of sheathing material in direct contact with the concrete and joists or stringers that directly support the sheathing.

CON2.M020.9 FALSEWORK

Any temporary structure used to support a permanent structure while it is not self-supporting.

CON2.M030.9 TRADITIONAL FORMWORK

Formwork assembled from individual elements comprising sheathing material as described in BS 5975:1982 and separate backing structure supporting the sheathing.

CON2.M040.9 PERMANENT OR LEFT IN FORMWORK

Formwork designed to remain in position as part of the permanent work.

CON2.M050.9 LARGE PANEL FORMWORK

Formwork as CON2.D310.

CON2.M060.9 SMALL PANEL METAL FORMWORK

Formwork as CON2.D510.

CON2.M080.9 TIMBER FOR FORMWORK

Use sustainable timber as specified in PRE.B8.2450 and reuse timber whenever possible as specified in PRE.B8.2460.

SHEATHING

CON2.M110.9 SUITABLE MATERIALS

Material against which the concrete will be cast must be suitable for providing the specified concrete finish, formed for example, in metal, timber, plywood, film faced plywood or plastic.

ANCILLARY MATERIALS

CON2.M210.9 RELEASE AGENT

An Approved type which will not:

1. Stain or colour the concrete;
2. Affect the adhesion between the concrete and any subsequent finishings.

CON2.M220.9 SURFACE RETARDERS

An Approved type which will not stain or colour the concrete.

CON2.M230.9 HOLLOW CONCRETE BLOCKS FOR SLABS

Manufactured as follows:

1. Concrete:
   a. Mix comprising cement, granite fines and granite aggregate passing a 10 mm sieve but retained on a 5 mm sieve;
   b. Grade: 20/10.
2. Dimensions:
   a. Outer casing and web: 25 mm thick;
   b. With a 25 mm x 5 mm groove formed along both sides for key.

CON2.M240.9 PRECAST KICKER BLOCKS

Of solid construction and:

1. Cast in the same grade of concrete as the wall into which they are to be cast. Provide evidence of the grade of concrete to CM for approval;
2. Having a length of 100 mm parallel to the wall face, the same thickness as the wall and a minimum height of 75 mm above the highest slab abutting the wall at the level at which the kicker is formed.

MATERIAL FOR SEALING FORMWORK TIE HOLES

CON2.M250.9 MORTAR

Shall be:

1. One-part prebagged non-shrink cementitious mortar made by mixing on Site with water to form a trowellable consistency in application;
2. In accordance with mortar manufacturer's specified application procedures (including bond cost if required by the mortar manufacturer);
3. All mortar shall be subject to tests specified in CON2.T110, CON2.T120, CON2.T130, CON2.T140 (2), CON2.T150 and CON2.T160 before approval by the CM.

CON2.M260.9 POLYURETHANE FOAM

1. The polyurethane foam shall be formed from a system of components which expands and sets to become a rigid foam;
2. The polyurethane foam shall be subjected to watertightness test specified in CON2.T140 (1) & (2)(b), before approval by the CM.

WORKMANSHIP

HANDLING AND STORAGE

CON2.W010.9 FORMWORK

1. For superstructure works:
   a. Store formwork, including large panel formwork and small panel metal formwork, off a levelled, well-drained and maintained hard-standing ground on level supports and in a manner which will not result in damage, deformation or contamination;
   b. Store large panel formwork and small panel metal formwork safely and securely with struts or supports according to the method statement approved;
   c. Comply with details of safety requirements regarding prevention of falling objects as stipulated in PRE.B8.262.
2. For works other than that in sub-clause (1):
   a. Store formwork off the ground on level supports and in a manner which will not result in damage or deformation to the formwork or in contamination of the formwork.

CON2.W020.9 ANCILLARY MATERIALS

Store:

1. Release agents and surface retarders in sealed containers marked to identify the contents and protected from exposure to conditions which may affect the material;
2. All materials in accordance with the manufacturer's recommendations and do not use the materials after the recommended shelf life has been exceeded.

SAFETY AND PROTECTION

CON2.W110.9 PERIMETER WALKWAY

Do not stack any materials or debris on the perimeter formwork walkway at any time.

ERECTING FORMWORK

CON2.W210.9 CHECKING AND INSPECTION

Check the alignment of all kickers and wallforms prior to concreting and:

1. Allow the CM to inspect the completed formwork before any work, including fixing reinforcement adjacent to formwork, makes access for inspection difficult;
2. Inform the CM 24 hours, or sooner if agreed with the CM, before carrying out such work.

CON2.W220.9 KICKERS

Fix wall and column forms tightly against kickers by an Approved method.

CON2.W230.9 JOINTS

Construct joints between formwork panels, stop ends and adjoining concrete to prevent loss of grout. Cut formwork in such a manner that reinforcement and built-in components passing through the formwork are maintained in position and grout loss is prevented.

CON2.W240.9 TEMPORARY ACCESS

Provide temporary openings in the formwork for cleaning or inspection if required.

CON2.W250.9 PIPE SLEEVES ETC

1. Provide galvanised mild steel or PVC pipe sleeves through floors and walls etc as required for all trades as specified elsewhere;
2. Fix pipe sleeves, inserts, void formers and box outs to specified sizes and in correct positions before placing concrete. Do not cut hardened concrete to provide holes or chases unless otherwise Approved;
3. Do not use polystyrene for void formers or box outs larger than 150 mm x 150 mm x 150 mm unless otherwise Approved.

CON2.W260.9 FORMWORK FIXINGS GENERALLY

Do not allow any devices for securing formwork and falsework to remain within the specified concrete cover.

CON2.W270.9 FORMWORK TIES

Fix formwork ties and components in such a manner that they do not touch reinforcement or any other built-in component. Any part left in the concrete must be at least 40 mm or the specified nominal cover to the reinforcement, whichever is greater, from the concrete surface.

CON2.W280.9 TIES IN STRUCTURAL ELEMENTS WITH WATERTIGHT FUNCTION

1. Use only ties which leave no open holes through the concrete having a watertight function, including:
   a. Aqueous liquid retaining structures;
   b. All structural elements constructed below finished ground level; and
   c. Roof parapets below the upturn level of waterproofing membrane as shown on Drawings.
2. Provide precautionary measures, which may be nylon, epoxy, plastics or other dielectric material coating, to ties left in aqueous liquid retaining structures to avoid damaging the epoxy coating of reinforcement bar.

CON2.W290.9 FORMING CONSTRUCTION JOINTS

Ensure formwork to construction joints is rigid and accommodates projecting reinforcement without bending or displacement.

CON2.W300.9 LAYING HOLLOW BLOCKS FOR SLABS

1. Do not use blocks within 28 days of their being cast;
2. Lay on formwork in straight rows with butt joints;
3. Seal exposed, open ends with similar concrete to a depth of 25 mm.

CON2.W310.9 JOINTS IN LARGE PANEL FORMWORK

Ensure close contact between the edges of panels used on the same wall side, with maximum tolerance measured perpendicular to the wall not to exceed 3 mm after concreting.

CON2.W315.9 JOINTS IN SMALL PANEL METAL FORMWORK

1. Ensure close contact between the edges of panels used on the same wall side, with maximum tolerance on abrupt changes/irregularities of a continuous fair-face finished concrete surface measured perpendicular to the wall tightened to not to exceed 2 mm after concreting;

2. Unless otherwise instructed by the CM, apply skim coat as specified in FIN7.M790 to the wall joints to cover up and smoothen any abrupt changes/irregularities notwithstanding that the tolerance on abrupt changes/irregularities is met. Bear all associated costs and no extension of time shall be allowed.

CON2.W320.9 ARRISES

Erect formwork to provide smooth arrises free from damage and cracks.

KICKERS FOR LARGE PANEL FORMWORK AND SMALL PANEL METAL FORMWORK

CON2.W410.9 DEFINITIONS

For the purposes of this Worksection the following apply:

1. An external wall is defined as a complete length or section of a wall which is abutted by a floor slab on one side only, at the level where the kicker is formed;
2. An internal wall is defined as a complete length or section of a wall which is abutted by floor slabs on both sides, at the level where the kicker is formed.

CON2.W420.9 PROVISION OF KICKERS

Provide kickers at the toes of all walls constructed by large panel formwork and/or small panel metal formwork for the purpose of maintaining correct alignment and preventing grout loss.

CON2.W430.9 KICKERS FOR EXTERNAL WALLS

1. Form in-situ kicker, using metal formwork, monolithically with the floor slab abutting the wall in one continuous casting operation;
2. The concrete grade of the kicker shall be the same as that of the abutting floor slab and the dimensional details are as follows:
   a. Length: over the whole length of the wall;
   b. Thickness: same as that of the wall;
   c. Top level: 100 mm above the highest level of the abutting floor slab.

CON2.W440.9 KICKERS FOR INTERNAL WALLS

Use evenly spaced precast blocks as specified in CON2.M240 to form the kickers of internal walls, with a minimum of two blocks provided per wall as follows:

1. Place the kicker blocks in position after the slabs abutting walls have been cast and bed to the correct level using an approved bedding material;
2. Fix the blocks firmly to the top of the slabs either by cast in or drilled anchor bolts. Fill any voids around bolts with an Approved grouting material. Ensure fixings prevent blocks being displaced during the wall construction;
3. Adjust reinforcement locally, and only with prior Approval, to enable precast kicker blocks to be fixed.

WORK BELOW GROUND

CON2.W510.9 FORMING AGAINST EXCAVATION FACES

Do not cast concrete below ground against sides of excavation unless with the CM's prior Approval.

STRIKING FORMWORK

CON2.W610.9 GENERAL

Strike formwork and falsework without disturbing, damaging or overloading the finished concrete work or the structure and without affecting other formwork and falsework.

CON2.W620.9 CONTRACTOR'S RESPONSIBILITY

Notwithstanding any other clauses in this Specification accept sole responsibility for the safe removal of formwork and falsework.

CON2.W630.9 MINIMUM PERIODS BEFORE STRIKING

Minimum periods for retaining formwork and falsework in position are as follows:

Striking Time	
Type of Formwork and Falsework	Period
Inclined formwork to top Surfaces	12 hours
Vertical formwork to columns, beams and walls (unloaded)	16 hours
Soffit formwork to Slabs (Props left under)	3 days
Props to slabs (unloaded)	7 days
Soffit formwork to beams (Prop left under)	7 days
Props to beams (unloaded)	16 days
Prop to cantilevers (unloaded)	28 days

CON2.W640.9 STRIKING AT LOW TEMPERATURE

Obtain instructions from the CM for increased striking times of formwork at lower temperatures. The periods stated in CON2.W630 are for Portland cement at 15°C ambient temperature and the conditions stated in the table.

CON2.W650.9 STRIKING LARGE PANEL FORMWORK AND SMALL PANEL METAL FORMWORK

Alternative minimum periods before striking large panel formwork and small panel metal formwork may be Approved, if the design allows, provided that:

1. Props for soffits of insitu slabs or combined precast and insitu slab construction, must remain in place for a minimum of five days and until the concrete has achieved two thirds of the required 28 day crushing strength;
2. The props supporting the floor immediately below the cast slab or soffit must remain in place for a minimum period of 2½ days after the upper floor is concreted and until the concrete has achieved a crushing strength of 10 MPa, or twice the stress to which the concrete will be subjected, whichever is the greater. No re-propping is permitted within the minimum periods;
3. In the event that a request for relaxation of the minimum periods before striking, if any, is not accepted by the CM, the design of the formwork system is deemed to have been prepared on the basis of the minimum periods detailed in CON2.W630 or this sub-clause, provided the conditions referred to are complied with;
4. As evidence that concrete placed insitu or in combined precast and insitu slabs has attained the minimum strengths specified, from test results obtained from the laboratory established on site in accordance with the requirements for testing contained in the Preliminaries PRE.B9 of this Specification.

CON2.W660.9 BACK PROPPING SOFFITS

Where the props are to be left in place whilst the soffit formwork to slabs and beams are removed, design such props either to remain in position throughout the striking process without having to be temporarily removed or alternatively, if agreed by the CM, so that a few can be removed at a time and replaced immediately.

CON2.W670.9 LOADING THE STRUCTURE

Do not place construction loads on any unshored portion of the structure under construction. Agree the number of floors requiring propping with the CM, according to the design loads of such floors.

TRIAL PANELS

CON2.W710.9 SAMPLES

Provide samples of any exposed formed or worked finishes as detailed in the Project Specific Specification, and obtain Approval.

CON2.W720.9 CONSTRUCTION OF TRIAL PANEL

Subject to CM's instruction, construct on Site a trial panel before the commencement of typical floor construction as detailed in the Project Specific Specification to demonstrate that the proposed formwork and falsework system is adequate in providing the required quality standard of finishes to concrete.

CON2.W730.9 SUB-STANDARD TRIALS

Should the finish to the trial panels not be to the standard specified and not to the satisfaction of the CM, modify the formwork system and construct further trial panels until, in the opinion of the CM, the finish to the concrete produced is satisfactory. Adopt the formwork system producing the required finish as the standard for all subsequent formwork used.

STANDARD PANEL

CON2.W810.9 INSITU STANDARD PANEL

As soon as is practical after commencement of superstructure work, select a sample area from the insitu works as being representative of the minimum standard of the specified finish for inspection by the CM. Upon agreement in writing by the CM the finish to the sample area will become the minimum standard for that specified finish for all subsequent concrete.

FORMED FINISHES FOR CONCRETE

CON2.W910.9 TYPE A : ROUGH BOARD FINISH

1. Formwork or formwork linings to consist of Approved rough textured seasoned wood boards with moisture content of between 10% and 20%;
2. Arrange boards of varying textures to give uniform overall effect;
3. Assemble boards to prevent leakage of grout between them;
4. Soak formwork with water before erecting, and keep damp until concrete is placed;
5. Position cover spacers and bolts to the satisfaction of the CM;
6. The number of uses of formwork lining will be limited to its ability to provide the required finish;
7. The finish to be left as struck. Do not make good until inspected by the CM;

8. Discoloration will not be permitted;
9. Fill minor voids and irregularities on surfaces with a matching mortar to Approval, using a sponge rubber face float.

CON2.W920.9 TYPE B : FAIR-FACED FINISH

1. Produce an even finish with a sheet material (e.g. plywood);
2. Arrange panels in pattern as specified;
3. The finish to be left as struck. Submit method statement for rectification works for approval prior to carrying out any remedial works. Do not make good until inspected by the CM;
4. Blowholes not exceeding 10 mm diameter will be permitted, but otherwise surface to be free from voids, honey-combing or other large defects;
5. Variations in colour will be permitted when the finished concrete is to receive an applied decoration;
6. Make good small defects, and fill blowholes and formwork tie holes with Approved materials.

MAINTENANCE OF FORMWORK

CON2.W1010.9 PREPARATION FOR RE-USE

Clean and repair formwork which has been previously used before it is re-erected.

CON2.W1020.9 DAMAGED AND DETERIORATED FORMWORK

Do not re-use formwork where strength and composition has so far deteriorated due to repeated use that, in the opinion of the CM, it will no longer adequately perform its function in accordance with the Specification but remove it from Site.

CON2.W1030.9 RUBBER SEALS

Properly maintain the rubber hose seals and replace when required or as Instructed but in no case subject seals to more than nine uses.

CON2.W1040.9 RE-USE OF TIMBER FORMWORK

Do not subject plywood sheathing to formwork to more than nine uses, irrespective of the use of one or both faces of such sheathing.

SEALING FORMWORK TIE HOLES

CON2.W1110.9 GENERAL

Seal all tie holes left in walls by formwork ties and components in accordance with Sketch no. SES/TB/S/SK-001/A.

CON2.W1120.9 SEALING THE TIE HOLES

1. Procedures for external walls with tile finishes:
   a. Knock out the PVC tubing;
   b. Drive in and secure a piece of minimum 30 mm thick cork at 40 mm from each end of a formwork tie hole;
   c. Wet thoroughly to achieve saturation and clean concrete surfaces inside the hole to remove dust and loose materials prior to applying mortar (and bond coat if required by the mortar manufacturer);

d. Using the cork as a backing, apply and completely fill the hole ends by prebagged non-shrink cementitious mortar as described and Approved in accordance with CON2.M250;

e. Cure the mortar to CON1.W1410 or in accordance with the mortar manufacturer's recommendations as Approved by the CM.

2. Procedures for external walls without tile finishes:

a. Knock out the PVC tubing;

b. Clean thoroughly concrete surfaces inside the hole to remove dust and loose materials prior to applying polyurethane foam;

c. Drive in and secure a piece of minimum 30 mm thick cork at 40 mm from the external side of the wall;

d. Using the cork as a backing, apply the polyurethane foam Approved by the CM in accordance with CON2.M260 from the internal side of the wall in such quantity that it expands, fills the hole entirely and moves it way out away from the backing cork. Allow adequate time for full development and setting of the foam rigidity as recommended by the manufacturer;

e. Cut back all excess polyurethane foam by 40 mm from the internal side of the wall. Remove all traces of foam remaining on the hole concrete surfaces;

f. Repeat procedures as described in CON2.W1120 (1)(c) to (1)(e) for application of mortar (and bond coat if required by the mortar manufacturer) at either end of the hole.

3. Procedures for internal walls:

a. Knock out the PVC tubing;

b. Wet thoroughly to achieve saturation and clean concrete surfaces inside the hole to remove dust and loose materials prior to applying mortar (and bond coat if required by the mortar manufacturer);

c. Apply and completely fill the hole by prebagged non-shrink cementitious mortar as described and Approved in accordance with CON2.M250;

d. Cure the mortar to CON1.W1410 or in accordance with the mortar manufacturer's recommendations as Approved by the CM.

TOLERANCES

CON2.W1210.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

TESTING

TESTING OF MORTAR FOR SEALING FORMWORK TIE HOLES

CON2.T110.9 LABORATORY TESTING

1. Submission requirements:
   a. Submit technical details and test reports done by Approved local independent testing laboratory at Contractor's own costs to demonstrate the following mortar characteristics:
      i. 1-4% of change in height of specimen tested to ASTM C827 - 95a(97);
      ii. Minimum value of 200 seconds for Figg air permeability.
2. Testing samples:
   a. Submit samples of mortar for carrying out one set of the tests as stated in CON2.T110 (1) by the Direct Testing Contractor to demonstrate the mortar characteristics for Approval and thereafter every 750 kg of mortar to be used on site for routine monitoring test as instructed by the CM;
   b. Unless otherwise Approved or specified elsewhere, testing of mortar shall be carried out by the Direct Testing Contractor;
   c. Allow sufficient time for testing of the materials by the Direct Testing Contractor.

CON2.T120.9 TESTING FOR CHARACTERISTICS OF MORTAR

Testing methods:

1. Early change in height test: test shall be carried out to C827 - 95a(97) as specified by American Society for Testing and Materials;
2. Permeability test: the permeability of the mortar shall be determined by the modified Figg air permeability test described in "Improvements to the Figg method for determining the air permeability of concrete" Cather, Figg, Marsden and O'Brien. Mag. Conc. Res 36 No. 129 Dec 1984. The specimen shall be a 100 mm cast cube conditioned at a temperature of 27± 2ºC and 55± 5% relative humidity, demoulded 72 hours after casting and kept in the same environment for a further 18 days. The permeability test shall be carried out after conditioning at 50ºC for 14 days.

CON2.T130.9 REQUIREMENT FOR FURTHER TEST

Non-compliance:

1. Two additional tests shall be carried out by the Direct Testing Contractor for each failure of the laboratory test result obtained for any one mortar characteristic;
2. The mortar is considered as not complying with the specified property if the result of any additional test fails to comply with the specified requirements for the property;
3. Submit another mortar for Approval.

CON2.T140.9 WATERTIGHTNESS TEST ON SITE

1. All watertightness tests made on Site are at Contractor's own costs, time and to be witnessed and certified both by the CM and the Contractor's representative. Testing procedures to carry out watertightness test as follows:
   a. Construct working platforms where necessary for carrying out water test safely;

b. A continuous jet of water is to be sprayed from a nozzle at water pressure of 210 to 240 KPa at the nozzle inlet to the joint and along the longitudinal axis of the formwork tie hole for a minimum of 5 minutes. The nozzle shall be stationary while an observer inspects carefully on the indoor side of the formwork tie hole with the assistance of adequate lighting where necessary. The nozzle used for the tests shall be to the requirements of Architectural Aluminium Manufacturers' Association (AAMA) 501.2-83, unless otherwise Approved.

2. Before sealing any formwork tie holes, carry out watertightness test on Site for the following:
   a. Watertightness test for mortar only: the CM to select 10 nos. of formwork tie holes sealed with mortar at one end of hole only and without polyurethane, prepared in accordance with CON2.W1120. Watertightness test to be applied on the mortar side for a minimum of 5 minutes;
   b. Watertightness test for polyurethane foam only: the CM to select 10 nos. of formwork tie holes sealed with polyurethane foam only and without mortar, prepared in accordance with CON2.W1120 (2)(a) to (2)(f). Watertightness test to be applied on the cork side for a minimum of 5 minutes.
3. Carry out watertightness test for completely sealed formwork tie holes on Site for 10% of formwork tie holes at each floor of every block sealed complete in accordance with CON2.W1120 (1) or CON2.W1120 (2) and selected by the CM. Watertightness test to be applied on one side of a wall only (external side if applicable) for a minimum of 5 minutes.

CON2.T150.9 FAILURE OF WATERTIGHTNESS TEST

If sign of water seeping through the hole, including sign of damp patches, is observed on the opposite side of the wall face subject to test during the test and within the subsequent 2 hours after the test, the watertightness test is deemed to have failed.

CON2.T160.9 ADDITIONAL TESTS UPON FAILURE OF WATERTIGHTNESS TEST

Is carried out in accordance with the following procedures:

1. For any one hole failed for the watertightness test made in accordance with CON2.T140 (2)(a) or (2)(b), two additional holes are selected by the CM for watertightness test in accordance with CON2.T140 (1);
2. The mortar or polyurethane foam is considered not complying with the specified field watertightness requirements when result of any additional test made upon mortar or polyurethane foam respectively according to CON2.T140 (2)(a) or (2)(b) fails in accordance with CON2.T150;
3. For any tests carried out according to CON2.T140 (3) and fails in accordance with CON2.T150 the Contractor shall carry out further tests progressively as described in CON2.T160 (1) above until all tests are successful.

CON2.T170.9 MAKE GOOD FORMWORK TIE HOLES

The work is carried out in accordance to the following:

1. Make good all formwork tie holes which have failed the watertightness test carried out in accordance with CON2.T140 (3) and CON2.T160 (3) to CM's satisfaction at Contractor's own costs and time;
2. All repaired holes shall be subject to watertightness test as specified in CON2.T140 (1).

CON2.T180.9 BLOWHOLES

All blowholes shall be filled with one-part prebagged non-shrink cementitious mortar Approved in CON2.M250.

CON3 REINFORCEMENT

MATERIALS

REINFORCEMENT GENERALLY

CON3.M010.9 STOCKIST'S OR SUPPLIER'S CERTIFICATION

Submission requirements:

1. For bar reinforcement, submit certificates from quality assured stockist and/or supplier to demonstrate that the bar reinforcement supplied complies with the requirements of CS2: 2012 Section 4 to the CM for Approval.
2. For fabric reinforcement, submit a certificate from the manufacturer to the CM for Approval, stating:
    a. That the fabric reinforcement supplied has been tested and complies with the requirements of BS 4449:2005, BS 4483:2005 and this Specification;
    b. Evidence that the cold reduced steel wire in fabric reinforcement has complied with the bond classification as specified in BS 4449:2005.

CON3.M020.9 VERIFICATION OF SOURCE

When Instructed provide evidence that each load of steel reinforcement which includes the bars for fabric reinforcement delivered to site forms part of the same consignment and originates from the same source as that in respect of which the specimen and the manufacturer's certificate relate.

CON3.M030.9 QUALITY ASSURANCE SCHEME FOR FABRIC REINFORCEMENT

1. Obtain a quality assurance scheme from the manufacturer and submit for Approval. Details of the scheme must include a routine inspection complying with BS 8666:2005 Annex A;
2. Unless the quality assurance scheme has been certified under ISO 9001, it shall be assessed by an Approved third party certification authority who shall audit the manufacturer's inspection records in accordance with BS 8666:2005 Annex B. If so directed by the CM, submit the audit report to the CM for information.

CON3.M035.9 PRODUCT CONFORMITY CERTIFICATION SCHEME FOR FABRIC REINFORCEMENT

1. Submit original or a certified true copy of the product conformity certificate to the "Product Conformity Certification Scheme For Mesh Reinforcements" (PCCS-MR) published by the Hong Kong Concrete Institute for Approval. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a multilateral recognition arrangement with HKAS. If a photocopy of the product conformity certificate is submitted, it shall be certified true by the certification body or by the QCM;
2. The product conformity certificate shall either be submitted before the first delivery to Site or precast concrete casting yard whichever the earlier, or at a time not later than 12 months from the date of commencement of the Works;
3. When directed by CM, submit full set of original or certified true copy of the test reports under the audit testing of the PCCS-MR:

a. The test reports shall be issued by a laboratory accredited by Hong Kong Laboratory Accreditation Scheme (HOKLAS) or an accredited laboratory which has entered into a mutual recognition arrangement with HOKLAS, showing full compliance with the requirements of PCCS-MR. If a photocopy of the test report is submitted, it shall be certified true by the accredited laboratory carried out the testing or by the QCM;

b. The date of the test report shall be within three years prior to the date of commencement of the Works.

CON3.M040.9 COLOUR CODE SYSTEM OF REINFORCEMENT

Submit for Approval a colour code system in the Quality Control System as stipulated in PRE.B8.1425 for identification of reinforcement unloaded to designated areas by the Contractor on Site:

1. For different batches, as defined in CON3.T010, before any testing:
   a. Use white, yellow, blue, grey or other specific colours at the ends of reinforcement bar as directed by the CM;
   b. Avoid to use any colours similar to rust and do not use green and/or red colours.
2. For each batch available with all test results, including the re-test results as permitted in the Specification, add:
   a. Green colour: for reinforcement conforming to the Specification;
   b. Red colour: for reinforcement not conforming to the Specification.

REINFORCEMENT

CON3.M110.9 BAR REINFORCEMENT

Quality requirements:

1. Hot rolled steel bars: to CS2:2012;
2. Cold reduced steel wire used for fabric reinforcement: to BS 4449:2005.

CON3.M130.9 FABRIC REINFORCEMENT

Quality Requirements: to BS4483:2005.

CON3.M140.9 REPLACING FABRIC REINFORCEMENT TO BAR REINFORCEMENT

Do not replace the fabric reinforcement by bar reinforcement. Where bar reinforcement proposed for replacement in the event of non-availability of fabric reinforcement, the bar reinforcement proposed for replacement conforming with the equivalent standards set for fabric reinforcement as shown on drawings will be acceptable subject to Approval.

ANCILLARY MATERIALS

CON3.M210.9 COVER SPACERS

Quality requirements:

1. Unless specified elsewhere, type as shown on Standard Drawing STD/FD/S/EG001 or STD/FD/S/EG001/A as appropriate, and as small as practicable, consistent with their purposes, capable of supporting the weight of reinforcement and construction loads without breaking, deforming or overturning;
2. Be one of the following types:
   a. Plastic: Approved type(s);
   b. Concrete (for foundations only): precast or proprietary concrete of strength and durability not less than that of the surrounding concrete. Provide evidence of the grade of concrete to CM for approval.

CON3.M220.9 CHAIRS AND SUPPORTS

Quality requirements:

1. To BS7973:Part 1:2001;
2. Unless otherwise shown on the Drawings, to be steel with plastic-coated feet or Approved anti-rust treatment if not properly protected by concrete. Steel is cut and bent to BS8666:2005.

CON3.M230.9 REINFORCEMENT TYING WIRE

Quality requirements:

1. Diameter of annealed iron wire:
   a. For bars up to and including 16 mm diameter: 0.9 mm;
   b. For bars of 20 mm diameter and over: 1.2 mm.

EPOXY COATED REINFORCEMENT

CON3.M250.9 MANUFACTURER'S DOCUMENT AND TEST RESULTS

Submission requirements:

1. Submit the following particulars, including certificates and test results, for each batch of epoxy coated reinforcement bars at least 60 days before the first delivery of the epoxy coated reinforcement bars to Site for Approval:
   a. Name and location of the coating factory;
   b. Mill sheets of the steel reinforcement bars complying with CS2:2012;
   c. Date and place of the coating application;
   d. Certificate of the coating materials in compliance with BS 7295:Part1:1990, including:
      i. Corrosion resistance;
      ii. Chemical resistance;
      iii. Cathodic disbonding of coating;
      iv. Adhesion;
      v. Abrasion resistance;
      vi. Impact strength;
      vii. Hardness.
   e. A contingency plan for dealing with epoxy coated reinforcement bars which are found to be non-conforming to the requirements of Worksection CON3.
2. Re-submit the particulars in sub-clause (1)(d) when the relevant tests have been carried out over 5 years before the submission or when there are changes in the composition of the coating materials, whichever the earlier.

CON3.M260.9 EPOXY COATING TO REINFORCEMENT

Quality requirements:

1. Epoxy coatings and patching materials for epoxy coating to BS 7295:Part 1 & 2:1990 except as stated in CON3.M260 (3), CON3.W250, CON3.T450, CON3.T460 and CON3.T470;
2. Epoxy coating applied by electrostatic spray method to BS 7295:Part 1:1990 at a factory approved by CM;
3. The bond classification of coated bars determined in bond performance tests not less than that of uncoated bars.

CON3.M270.9 CHAIRS, SUPPORTS AND SPACERS

Quality requirements:

1. Steel coated with nylon, epoxy, plastics or other dielectric material for epoxy coated reinforcement.

CON3.M280.9 TYING WIRE

Quality requirements:

1. 1.6 mm diameter soft annealed steel wire coated with nylon, epoxy, plastic or other dielectric material.

MECHANICAL COUPLER

CON3.M310.9 TYPE OF MECHANICAL COUPLER

Quality Requirements of mechanical coupler: Type 1 and Type 2 mechanical couplers as stipulated in the Code of Practice for Structural Use of Concrete 2013 published by the Buildings Department.

CON3.M320.9 SUBMISSION

1. Commencement of the mechanical coupler works is subject to CM's written permission;
2. Submit the following details to the CM for approval at least 30 days prior to the commencement of the mechanical coupler works:
   a. The name and model number of the mechanical coupler;
   b. The name of the manufacturer and the address of manufacturing factory;
   c. The information / documents of the quality assurance scheme as set out in CON3.M330;
   d. A description of the sampling procedures including the arrangement from collecting samples to delivery of samples to laboratory for testing the quality of the mechanical splice assemblies;
   e. For Type 2 mechanical coupler, the quality supervision plan as set out in CON3.W310.
3. Upon completion of the mechanical splice works, submit the following documents to the CM for record: -
   a. The inspection log book as detailed in CON3.W320;
   b. A copy of mill certificates of the constituent materials used to produce the couplers.

CON3.M330.9 QUALITY ASSURANCE SCHEME FOR MECHANICAL COUPLER

The quality assurance scheme of the manufacturer shall include the information as specified in the Project Specific Specification.

WORKMANSHIP

GENERAL

CON3.W010.9 STORAGE OF REINFORCEMENT

1. Store:
   a. All reinforcement clear of a levelled, well-drained and maintained hard-standing ground in a manner that will avoid damage, deformation and contamination of the reinforcement;
   b. Fabric reinforcement horizontally;
   c Different types and sizes of reinforcement separately.
2. Agree with the CM within 4 weeks from the notified date of commencement of the Works on the format and size of site works photographic records. Submit one set of photographic records to the CM on each working day showing the reinforcement at all storage locations.

CON3.W015.9 STORAGE OF FABRIC REINFORCEMENT IN FACTORY/STOCKYARD

Provide a fenced-off area in the manufacturer's factory or stockyard for the exclusive storage of fabric reinforcement.

CON3.W020.9 SURFACE CONDITION OF REINFORCING STEEL

Clean and free from loose mill scale, loose rust, oil, grease or any substance, which in the opinion of the CM, is likely to reduce the bond or affect the reinforcement or concrete chemically.

CON3.W030.9 CONTAMINATED OR HEAVILY RUSTED REINFORCEMENT

Remove contaminated or heavily rusted reinforcement from Site unless it has been cleaned or satisfactorily treated by an Approved method.

CON3.W040.9 PROTECTION OF EXPOSED REINFORCEMENT

Where specified or instructed by the CM, protect reinforcement left exposed after completion of the Works by the specified method or by other Approved methods.

CON3.W050.9 COLOUR MARKINGS OF REINFORCEMENT BY STOCKISTS OR SUPPLIERS PRIOR TO DELIVERY

1. Obtain reinforcement preferably without red and green colour markings from stockists /suppliers;
2. If reinforcement with red colour marking, or with a colour marking covering a previous red colour, or with green colour marking is to be supplied:
   a. Provide in advance an explanation to the CM before delivery to Site. In addition, for reinforcement with red colour marking or a colour marking covering a previous red colour, provide to the CM before delivery to Site confirmation each from the Contractor and the stockist /supplier that as far as it is aware, the reinforcement is not non compliant with CS2 and/or rejected by other project;
   b. The CM may refuse entry of reinforcement to Site if:
      i. No explanation is provided in advance; or
      ii. The provided explanation is not satisfactory.

FIXING REINFORCEMENT

CON3.W110.9 CUTTING AND BENDING REINFORCEMENT

Reinforcement bars are to be cut and bent in accordance with the dimensional requirements of BS 8666:2005 unless otherwise shown on Drawing.

CON3.W120.9 COLD BENDING

Bend bars cold, using a proprietary bending machine, and do not rebend unless permitted by the CM.

CON3.W130.9 SECURING REINFORCEMENT

1. Secure with tying wire of the correct gauge for the sizes of bars, steel clips of an Approved type, or where Approved, by tack welding;
2. Ensure that the tying wire, including the wire ends, tying devices and clips do not encroach into the nominal cover to the reinforcement;
3. Demonstrate the adequacy of the system employed when Instructed;
4. Submit method statement on the fabrication of reinforcement cages of Barrette or Large Diameter Bored Piles to the CM for approval. The method statement shall include:
    a. Set-up of the fabrication yard;
    b. Step-by-step procedures of reinforcement cage fabrication;
    c. Stability support system;
    d. Working platform arrangement;
    e. Safety plan.
5. The Contractor shall refer to the conceptual method for fixing single layer of reinforcement bars for Large Diameter Bored Piles as shown in Drawings No.CPT/LDBP/S/SK-001 to SK-004 and the conceptual method for fixing double layers of reinforcement bars for Large Diameter Bored Piles as shown in Drawings No. CPT/LDBP/S/SK-101 to SK-106 in Appendix C to this Specification. The Drawings are for reference only and are given in good faith without prejudice to the Contractor's responsibilities and liability under the Contract;
6. Riggers with Silver Card will also be accepted as skilled trade tested workers for fixing of U-bolts for the reinforcement cages.

CON3.W140.9 LOCATING REINFORCEMENT

Provide sufficient cover spacers, chairs and supports, having regard to Table 3 of BS 8000:Part 2:Section 2.2:1990, to maintain the reinforcement in its correct location and to maintain the specified cover at all positions.

CON3.W150.9 WELDING

1. Do not weld bars without Approval;
2. Where Approved, weld in accordance with BS EN ISO 17660-1:2006, and the relevant parts of Code of Practice for Structural Use of Concrete 2013.

CON3.W160.9 CONCRETE COVER

Provide minimum 25mm concrete cover to all reinforcement unless otherwise specified in Drawing.

CON3.W170.9 COMPLIANCE WITH DRAWINGS

Check that completed reinforcement complies with the drawings, in particular with respect to:

1. Bar conditions;

2. Size of bars;
3. Provision of trimming bars;
4. Number of bars;
5. Spacing;
6. Cover.

CON3.W180.9 CM'S INSPECTION

1. Ensure all completed reinforcement is inspected by the CM before carrying out any work, including erecting any formwork adjacent to the reinforcement, which makes access for inspection difficult;
2. Notify the CM 24 hours, or a shorter period agreed by the CM, prior to carrying out such work.

TOLERANCES

CON3.W210.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

EPOXY COATED REINFORCEMENT

CON3.W220.9 HANDLING OF REINFORCEMENT

1. Do not subject the reinforcement to rough handling, shock loading or dropping from a height;
2. Lift epoxy coated reinforcement with nylon, rope or padded slings and lift bundles with strongback or with multiple supports to prevent abrasion.

CON3.W230.9 STORAGE OF REINFORCEMENT

Store on wooden or padded cribbing.

CON3.W240.9 CUTTING AND BENDING REINFORCEMENT

1. Bend epoxy coated reinforcement cold;
2. Provide padded supports for bar cutting and bar bending equipment for epoxy coated reinforcement and fit all contact areas of the equipment with nylon or plastic mandrels.

CON3.W250.9 REPAIRS TO EPOXY COATING ON SITE

1. Do not use the epoxy reinforcement in the permanent work if the coating is delaminated, split or damaged:
   a. At any point by an amount exceeding 25 mm² in area or 50 mm in length;
   b. At more than three points in a 1 m length by amounts each even not exceeding 25 mm² in area and 50 mm in length;
   c. At more than six points in the cut and bent length of a bar by amounts each even not exceeding 25 mm² in area or 50 mm in length.
2. Repair all cut ends and damaged areas not exceeding 25 mm² in area or 50 mm in length with patching material applied in accordance with manufacturer's recommendations;
3. Carry out repairs to epoxy coatings within 8 hours of cutting or damage and remove traces of rust from the surface of the reinforcement before carrying out the repair.

MECHANICAL COUPLER

CON3.W310.9 QUALIFIED SUPERVISION

1. Assign a Mechanical Coupler Quality Control Coordinator (MCQCC), with a minimum qualification and experience of a Grade T1 TCP for Type 1 mechanical coupler and a Grade T3 TCP for Type 2 mechanical coupler under the Registered Contractor's stream in the CoPSS, to:
   a. Supervise mechanical splice works and ensure that these are all carried out in accordance with approved plans and comply with the requirements on quality and workmanship;
   b. Devise inspection check list of the mechanical couplers works;
   c. Provide full time continuous supervision of the manufacturing process of the connecting ends of the steel reinforcing bars and the installation of steel reinforcing bars to the mechanical couplers.
2. For Type 1 mechanical coupler, submit the details as specified in the Project Specific Specification to the CM for approval;
3. For Type 2 mechanical coupler, submit a quality supervision plan as specified in the Project Specific Specification to the CM for approval;
4. The duties of MCQCC can be taken up by SQCC as stipulated in PRE.B6.130.

CON3.W320.9 INSPECTION LOG BOOK

1. Record the following details in an inspection log book:
   a. The names and qualifications of the supervisory personnel assigned by the CM and by the Contractor as stipulated in CON3.W310;
   b. The date, time, items inspected and inspection results.
2. Keep the inspection log book on Site for CM's inspection when required and submit the inspection log book to CM upon completion of the mechanical splice works.

TESTING

DEFINITIONS

CON3.T010.9 BATCH OF BAR REINFORCEMENT

1. Subject to the maximum tonnage in sub-clause (2) below, a batch of bar reinforcement is the quantity of bar reinforcement delivered to Site within a week under one delivery order, of one nominal diameter, and one steel grade and produced by the same manufacturer;
2. The maximum tonnage of a batch shall not exceed:
   a. For bars of diameter 20 mm and above : 200 tonnes;
   b. For bars of diameter less than 20 mm : 100 tonnes..

CON3.T020.9 BATCH AND LOT OF FABRIC REINFORCEMENT

1. A batch of fabric reinforcement is any quantity of fabric reinforcement of the same combination of steel grades and diameters, produced by the same welding machine with defined bar pattern, covered by the same mill and testing certificates and produced and properly identified by the CM in an Approved fenced off area in factory or in the stockholder's yard under one consignment;
2. A lot of fabric reinforcement is any quantity of fabric reinforcement of the same combination of steel grades and diameters, produced by the same welding machine with defined bar pattern, covered by the same mill and testing certificates and delivered to Site at any one time.

CON3.T025.9 BATCH OF MECHANICAL COUPLER

In this Specification, a batch of mechanical coupler is any quantity of coupler of the same type and size delivered to the Site as one consignment and covered by the same mill and testing certificates.

CON3.T030.9 TESTING BY DIRECT TESTING CONTRACTOR (DTC) AND HOUSING DEPARTMENT'S MATERIALS TESTING LABORATORY (HDMTL)

Unless otherwise Approved or specified elsewhere, provide reinforcement samples to the CM for testing by the DTC or HDMTL.

CON3.T040.9 TESTING PROGRAMME

1. Allow sufficient time for the testing of specimens;
2. Do not cut, bend, fix or incorporate steel reinforcement into permanent works until all relevant test specimens have successfully passed all tests carried out by the DTC and HDMTL.

PURCHASERS TESTING

CON3.T110.9 RATE OF SAMPLING

1. For bar reinforcement, provide adequate test specimens from each batch delivered to the Site in accordance with CS2:2012. The number of test specimens taken from each batch and the rate of sampling shall be in accordance with Table 10 of CS2:2012;
2. For fabric reinforcement in factory/stockholder's yard, provide samples from each batch as follows:

Sampling Rate of Fabric Reinforcement	
Size of Batch	No. of Samples per Batch
0 - 50 tonnes	1
Each additional 50 tonnes or part of 50 tonnes	1

3. For reinforcement used for construction of hoardings and associated covered walkways and gantries, the rate of sampling stated in the sub-clauses (1) and (2) above may be reduced at the discretion of the CM.

CON3.T120.9 PROCEDURE

Testing arrangement:

1. Under the supervision of the CM,
   a. Cut and take test specimens selected at random from bar reinforcement on Site or samples selected at random from fabric reinforcement in factory/stockholder's yard;
   b. Ensure size of specimens/samples to be:
      i. Bar reinforcement: each specimen to be minimum 1 m long;
      ii. Fabric reinforcement: each sample to be 1.2 m long x 1.2 m wide containing at least four wires in each direction.
   c. Appropriately mark and deliver the test specimens or samples to the DTC for testing.

CON3.T130.9 TESTING BY HDMTL

Testing samples:

1. Provide additional bar reinforcement specimens to HDMTL for test as follows:
   a. Take specimens from bars adjacent to those from which specimens have been cut for testing by the DTC;
   b. Rate of sampling: approximately one-fifth of the rate specified in CON3.T110 with same number of test specimens or samples;
   c. Size of specimens/samples: in accordance with CON3.T120;
   d. Scope, number of tests and method of testing as specified in CON3.T210 and CON3.T220.
2. Provide additional samples from fabric reinforcement in factory/stockholder's yard under the same testing regime in sub-clause (1).

CON3.T140.9 ADDITIONAL SAMPLES OF FABRIC REINFORCEMENT DELIVERED TO SITE

When Instructed, provide additional samples of fabric reinforcement for testing by DTC. The rate of sampling shall be minimum one sample for every total 100 tonnes of fabric reinforcement delivered to Site, irrespective of batches/consignments numbers assigned in the factory/stockholder's yard. Each sample so selected by the CM represents the particular lot delivered to Site.

TESTING BY DTC

CON3.T210.9 SCOPE AND NUMBER OF TESTS

Testing samples:

1. Tests will be carried out on each specimen of bar reinforcement in accordance with CS2:2012;

2. Number of tests on each specimen of bar reinforcement in accordance with Table 10 of CS2:2012;
3. Tests will be carried out on each sample of fabric reinforcement to determine:
   a. Yield stress;
   b. Elongation;
   c. Tensile strength;
   d. Rebending and/or bending properties;
   e. Unit mass;
   f. Pitch dimension;
   g. Surface geometry (determination for relative rib area (f_R) only).
4. Number of tests on each sample of fabric reinforcement as follow:

Description	Type and Number of Tests					
	Tensile	Bend	Rebend	Unit Mass	Pitch Dimension	Surface Geometry
Steel fabric						
- fabric sheet	-	-	-	1	-	-
- longitudinal wire	1	-	1	-	1	1
- transverse wire	1	-	1	-	1	1

CON3.T220.9 METHODS OF TESTING

Tests will be carried out at a temperature between 5°C to 35°C and in accordance with the following standards:

1. CS2:2012: for hot rolled steel bars;
2. BS4449:2005: for cold reduced steel bars;
3. BS4483:2005: for steel fabric.

COMPLIANCE

CON3.T310.9 COMPLIANCE CRITERIA - BAR REINFORCEMENT

A batch of bar reinforcement is deemed to comply with the specification if the test results meet the requirements of CS2:2012. Any non-complying batch of bar reinforcement is to be removed from Site.

CON3.T320.A COMPLIANCE CRITERIA - FABRIC REINFORCEMENT

1. A batch of fabric reinforcement is deemed to comply with the Specification if the test results meet the requirements of BS 4483:2005, except the test for shear force of welded joint and measurement of unit mass as specified in sub-clause (2);
2. The mass of steel fabric shall be measured as mass of fabric per square metre. The requirements / tolerances are:

Type of Test	Requirement / Tolerance
Mass per square metre of steel fabric with diameter of bars / wires in either direction greater than 8mm	±4.5% of nominal mass
Mass per square metre of steel fabric with diameter of bars / wires in both directions less than or equal to 8mm	±6.0% of nominal mass

RE-TESTS

CON3.T410.9 REQUIREMENTS FOR BAR REINFORCEMENT

Non-compliance:

1. If the result of any test for bar reinforcement does not comply with the specified requirements for the property, provide additional test specimens from the same batch for additional tests for the property in accordance with CS2:2012. The number of additional specimens must be as stated in CS2:2012.

CON3.T420.9 REQUIREMENTS FOR FABRIC REINFORCEMENT

Non-compliance:

1. If the result of any test for fabric reinforcement for elongation, tensile strength, bending, rebending, unit mass, pitch dimension and surface geometry does not comply with the specified requirements for the property, provide additional samples from the same batch for additional tests for the property. The number of additional samples is the total number of samples taken in accordance with CON3.T110 and each additional sample shall comprise 2 pieces of 1200 mm x 1200 mm fabric reinforcement;
2. Test in accordance with the following:
   a. Number of tests on each additional sample of fabric reinforcement in accordance with the following table:

Description	Type and Number of Tests					
	Tensile	Bend	Rebend	Unit Mass	Pitch Dimension	Surface Geometry
Steel fabric						
- fabric sheet	-	-	-	2	-	-
- longitudinal wire	2	-	2	-	2	2
- transverse wire	2	-	2	-	2	2

CON3.T430.9 STANDARD FOR REJECTION

The batch or lot of reinforcement is considered as not complying with the specified requirements for any particular property if the result of any additional test does not comply with the specified requirements for that property, then:

1. The non-complying batch of bar reinforcement or lot of fabric reinforcement shall be removed from Site;
2. The non-complying batch of fabric reinforcement in the factory/stockholder's yard shall not be delivered to Site.

EPOXY COATED REINFORCEMENT

CON3.T440.9 ADDITIONAL TEST SPECIMENS FOR EPOXY COATING TEST FOR EACH BATCH

1. Provide and cut 2 test specimens each two metre length from each batch of reinforcement, as directed by CM for epoxy coating tests;
2. Cut each specimen at least 1 m from the ends of a 12 m length bar and select test specimens from different bundles of the reinforcement batch.

CON3.T450.9 TESTING OF THE EPOXY COATING

The DTC shall carry out thickness, adhesion and continuity tests on each additional test specimen as selected in accordance with CON3.T440:

1. Perform the tests in accordance with the following Standards:
   a. Adhesion and continuity tests: to BS 7295:Part 1:1990 with 180° bend test replaced by 90°;
   b. Thickness test for bars of 12 mm diameter or below: to Method No. 6Aa of BS 3900:Part C5:1992;
   c. Thickness test for bars of 16 mm diameter or above to: Method No. 6Aa or No. 6Ab of BS 3900:Part C5:1992.
2. Carry out tests on specimens within a temperature range of between 5 degree Celsius and 30 degree Celsius;
3. Take 5 pairs of readings along two opposite sides of each specimen for thickness test (a total of ten recorded measurements per bar). A single recorded thickness measurement is the average of three individual reading obtained in between the ribs of three consecutive deformations;
4. Perform two bend tests for adhesion at a uniform rate within 15 seconds.

CON3.T460.9 COMPLIANCE CRITERIA FOR EPOXY COATINGS TO REINFORCEMENT

Results of tests for thickness, adhesion and continuity for epoxy coatings to reinforcement to comply with the following requirements:

1. All coating thickness measured from the 2 specimens not less than 0.13 mm. The average of the recorded thickness measurements of coating not less than 0.18 mm and not exceed 0.30 mm;
2. Cracking or debonding of the coating not visible to the unaided eye on any part of the bent bar;
3. The continuity of the coating to BS 7295:Part 1:clause 4.2:1990.

CON3.T470.9 NON-COMPLIANCE FOR THICKNESS, ADHESION AND CONTINUITY TESTS

1. Retests of specimens of the same batch are permitted if one test specimen fails to meet the coating thickness, coating adhesion or coating continuity requirements;
2. Take two further specimens from the same batch for the test or tests in which the original specimens failed;
3. The batch is deemed to comply with the specification if both additional specimens pass the retests;
4. The batch is deemed not to comply with the specification if either or both specimens fails in the retests;
5. Reject and remove the non-complying batch from Site.

CON3.T480.9 TIME REQUIRED FOR TESTING OF THE EPOXY COATED REINFORCEMENT

1. Allow minimum 20 working days for the availability of test results after delivery of the test specimens to the DTC;
2. Do not use the epoxy coated reinforcement until the relevant test specimens have passed all tests.

MECHANICAL COUPLER

CON3.T510.A RATE OF SAMPLING

Provide splicing assemblies for testing by DTC, each with two reinforcing bars of the relevant diameter either threaded or grouted in sleeve in accordance with the manufacturer's recommended assembly method. Sampling should be from each batch of the same type and size, and covered by the same mill and testing certificates; and should be a continuous process and at a rate commensurate with the number of couplers to be used as follows:

1. For Type 1 mechanical coupler:

Number of couplers of each batch to be used (Nos.)	Minimum number of splicing assemblies
Fewer than or equal to 100	3
101st to 500th	3
501st to 1000th	3
Every 1st to 500th thereafter	2

2. For Type 2 mechanical coupler:

Number of couplers of each batch to be used (Nos.)	Minimum number of splicing assemblies	
	Tests as per clause 3.2.8.4 (b), (c) & (d) of the CoP for Structural Use of Concrete 2013 (per test)	Test as per clause 3.2.8.4(a) of the CoP for Structural Use of Concrete 2013
Fewer than or equal to 100	5	3
101st to 500th	2	3
501st to 1000th	2	3
Every 1st to 500th thereafter	2	2

CON3.T520.9 METHOD OF TESTING

The testing for splicing assemblies of Type 1 and Type 2 mechanical couplers shall be in accordance with the Code of Practice for Structural Use of Concrete 2013 published by the Buildings Department.

CON3.T530.9 COMPLIANCE CRITERIA

1. A batch of Type 1 mechanical coupler is deemed to comply with the specification if the test results of all the splicing assemblies meet the requirements of clause 3.2.8.3 of the Code of Practice for Structural Use of Concrete 2013;
2. A batch of Type 2 mechanical coupler is deemed to comply with the specification if the test results of all the splicing assemblies meet the requirements of clause 3.2.8.4 of the Code of Practice for Structural Use of Concrete 2013;
3. For Type 2 mechanical coupler, if any one of the tests as specified in sub-clause (2) above cannot be completed due to the reinforcement breakage with the testing load below 125% of the characteristic yield strength of the reinforcement, disregard the test result and provide another test specimen for repetition of that particular test;
4. For Type 2 mechanical coupler, further repetition of tests may be carried out if there is subsequent failure with reinforcement breakage at below 125% of the characteristic yield strength of the reinforcement;

5. Any non-complying batch is to be removed from Site.

CON3.T540.9 TIME REQUIRED FOR TESTING

1. Allow minimum 15 days for the availability of test results after delivery of the test specimens to the DTC;
2. Allow extra time for carrying out repetition of tests as mentioned in sub-clauses (3) and (4) of CON3.T530;
3. Do not use the batch of mechanical couplers until the relevant test specimens have passed all tests.

CON4 PRECAST CONCRETE

DESIGN

DESIGN PARAMETERS

CON4.D010.9 PRECAST CONCRETE

1. Design in accordance with this Worksection and Worksection CON1;
2. Where any ambiguity, discrepancy or conflict arises between this Worksection and any clauses in any other Worksections of this Specification, ensure that the provisions of this Worksection prevail.

CON4.D020.9 STRUCTURAL JOINT DESIGN

Design structural joints between precast concrete units and insitu concrete to transmit the worst anticipated combination of moment, shear, axial force, temperature stresses, shrinkage, creep and torsion in accordance with Worksection CON1 unless specified otherwise.

CON4.D030.A STEEL LIFTING FRAMES

1. Design and construct steel lifting frames in accordance with the Code of Practice for the Structural Use of Steel 2011 issued by the Buildings Department;
2. Refer to PRE.B10.010 sub-clause (7) for the certification requirement of QE and / or RSE.

CON4.D040.9 LIFTING POINTS

Submit for Approval the proposed positions of lifting holes and/or points of attachment of lifting slings to precast concrete units if not shown on the Drawings.

DRAWINGS AND CALCULATIONS

CON4.D110.9 GENERAL

All drawings and calculations relating to the structural design must be prepared and signed by a Registered Structural Engineer who is registered under the Buildings Department.

DESIGN SUBMISSIONS

CON4.D210.9 GENERAL

Where appropriate, submit all necessary design, calculation and drawings pertinent to CON4.D010 to CON4.D110, CON4.D310 to CON4.D530 for Approval.

CON4.D220.9 PROGRAMME FOR SUBMISSIONS

Agree a programme for all submissions during the Contract with the CM prior to the notified date for commencement of Works.

CON4.D230.9 SHOP DRAWINGS

Unless otherwise agreed, submit five sets of fully dimensioned shop drawings for Approval in accordance with CON4.D220.

JOINTS

CON4.D310.9 JOINTS

For application of back-up materials, bond breakers and sealants, see Worksection WAT5.

CON4.D320.9 GASKETS

Gasket may be used in weatherproofing joint provided that:

1. The joint is horizontal; and
2. The gasket is always under compression.

CON4.D330.9 MORTAR STOPS

Use backing rods or other Approved method as mortar stops in grouting panel joints when necessary.

WEATHERPROOF JOINTS

CON4.D410.9 JOINT DESIGN

Design weatherproof external joints to ensure airtightness and watertightness and in accordance with BS 6093:1993.

CON4.D420.9 TYPES OF JOINT

Use weatherproof joints of one of the following types and in accordance with BS 6093:1993:

1. Sealed joint (one-stage joint);
2. Drained joint (two-stage joint).

CON4.D430.9 DESIGN WIDTH OF JOINTS

Design the joint width in accordance with BS 6093:1993 and BS 6213:1982.

CON4.D440.9 CONTRACTOR'S RESPONSIBILITY

Approval of the proposed jointing system including the weatherproofing materials does not relieve the Contractor from any liability on the performance of the joints.

MODIFICATIONS TO THE BUILDING STRUCTURE

CON4.D510.9 CONTRACTOR'S RESPONSIBILITY

The Contractor's responsibility for the design of his proposed modification is covered under GCC Clauses 5.15 and 11.8 and the Appendix E to the Specification.

CON4.D520.9 COMPLIANCE WITH GUIDELINES AND REGULATIONS

Any proposed structural modifications must comply with the following:

1. The relevant structural design guidelines published by the Housing Department and included as Appendix E to this Specification; and
2. The Regulations currently in use.

CON4.D530.9 REINFORCEMENT CHANGES

Obtain CM's approval for any proposed changes to reinforcement details, as shown on the Drawings, required to suit the proposed method of casting and installation.

MATERIALS

GENERAL

CON4.M010.9 SUBSTITUTION OF NON-STRUCTURAL CONCRETE

Submission requirements:

1. Submit for Approval any proposal to substitute non-structural insitu concrete or non-structural partitions, excluding panel wall partitions, with precast concrete.

CON4.M020.9 PRECAST CONCRETE

Where precast work is proposed and Approved, comply with the relevant provisions of:

1. Worksection CON1;
2. Worksection CON2 or FOR; and
3. Worksection CON3.

CON4.M030.9 PRECAST CONCRETE COMPONENTS

See Worksection CON7.

CON4.M040.9 OFF-SITE MANUFACTURE

Obtain Approval for off-site manufacture. For precast concrete components, see CON7.D010.

SUBMISSIONS

CON4.M110.9 GENERAL

Submit the following details for Approval:

1. Drawings, calculations and any other information indicating the location and/or element of precast concrete and any changes resulting from the use of precast concrete;
2. Calculations which show all loading imposed on the precast concrete due to lifting, handling, stacking, shock or any other reason, complies with the relevant British Standards, unless specified otherwise;
3. A method for identifying and recording the daily production of precast concrete units and their final position after installation;
4. The joints required between the proposed precast concrete and insitu concrete;
5. Drawings and calculations of lifting frames for precast units where specified.

CON4.M120.9 REINFORCEMENT CHANGES

Obtain prior Approval for any proposed changes to reinforcement details, as shown on the Drawings and/or to the bar bending schedules, required to suit the proposed method of casting and installation.

CONCRETE GRADE

CON4.M210.9 CONCRETE FOR LINTELS

Cast precast lintels in concrete Grade 35/20, unless otherwise specified.

CON4.M220.9 CONCRETE FOR STAIRS

Cast precast stairs in concrete Grade 35/20, unless otherwise specified.

CON4.M222.9 CONCRETE FOR REFUSE CHUTE

Cast precast refuse chute in concrete Grade 35/20, unless otherwise specified.

NON-SHRINK GROUT FOR PRECAST STAIRS

CON4.M230.9 APPROVED MIX

For non-shrink grout, the submitted grout mix shall have the specified characteristic as stated in CON4.M260. Submit samples of non-shrink grout for carrying out the tests as stated in CON4.M260 by the Direct Testing Contractor for Approval.

CON4.M240.9 CONSTITUENT MATERIALS OF NON-SHRINK GROUT

To be a pre-packaged cement base product which contains Portland cement, selected sand and non-shrink additives.

CON4.M250.9 WATER/POWDER RATIO OR WATER CONTENT

For pre-packaged non-shrink grout product, comply with the manufacturer's recommendations.

CON4.M260.9 NON-SHRINK GROUT

Quality requirements:

1. To be pre-packaged cement based product which contains Portland cement, selected sand and non-shrink additives with the following required properties:
   a. A 28 days strength equal to or higher than the grade of the adjoining structures. The compressive strength shall be determined by compressive strength test as CON4.T080;
   b. Chloride content of grout shall not exceed 0.1% by mass of the cement. Submit documentary evidence that the summation of chloride contents of constituent materials complies with the aforesaid requirement;
   c. Setting time of the non-shrink grout when tested in accordance with ASTM C953 - 87(97) shall be greater than 1 hour for initial set and be less than 24 hours for final set;
   d. Free expansion within 24 hours shall be of maximum 4% when measured in accordance with ASTM C827 - 95a(97). Expansion between 3 to 28 days when measured in accordance with ASTM C1090 - 96 shall be between 0% to 0.4%.

CON4.M270.9 CONCRETE WITH NON-SHRINK ADDITIVES

Submit for Approval and:

1. Maximum aggregate size: 10 mm;
2. Grade strength: a 28 days strength equal to or higher than the grade strength of the adjoining structure;
3. To comply with the manufacturer's recommendations on non-shrink additives;
4. Do not contain chlorides.

WEATHER PROOF JOINTS

CON4.M310.9 GENERAL

Weatherproofing materials to comply with BS 6093:1993 and subject to Approval.

CON4.M320.9 SEALANTS

As WAT5.M180.

CON4.M330.9 MORTAR STOP BACKING RODS

Polyethylene foam or other Approved.

CON4.M340.9 DETAILS OF WEATHERPROOFING

Submission requirements:

1. Submit details of weatherproofing materials in accordance with CON4.M310 and CON4.M330 for Approval, including technical information, samples, test reports and proven performance records of proposed materials.

WORKMANSHIP

CASTING PRECAST UNITS

CON4.W005.9 QUALITY SYSTEMS AND QUALIFIED SUPERVISION

Comply with CON7.W010 to CON7.W120 and relevant provisions of Worksection CON7 on quality systems and qualified supervision for precast works.

CON4.W010.9 PLACING CONCRETE

Cast precast concrete in a single pour unless otherwise Approved.

CASTING LINTELS

CON4.W110.9 GENERAL

Except where unusual or exceptional loading conditions apply or specified elsewhere, construct lintels as shown below:

Lintels		
Clear Span (metres)	Depth of Lintel (mm)	No. and diameter of mild steel bars per 105 mm (or part) in width
0 - 1	150	one 12 mm
1 - 2	225	one 16 mm
2 - 3	300	one 20 mm

CON4.W120.9 COVER TO REINFORCEMENT

Unless otherwise specified, provide 25 mm minimum concrete cover to steel bar reinforcement.

CON4.W130.9 BEARING ALLOWANCE

Unless otherwise specified, allow for a minimum bearing of 150 mm over its full width at each end.

CASTING STAIRS

CON4.W210.9 CONSTRUCTION

Construct stairs in accordance with details given on the Drawings specified in the Project Specific Specification.

CON4.W220.9 FORMWORK

As CON2.W920, unless otherwise specified.

CURING

CON4.W310.9 GENERAL

Cure concrete in accordance with CON1.W1410 to CON1.W1490, unless otherwise Approved.

CON4.W320.9 OTHER CURING METHODS

Carry out a full scale trial, where curing methods other than those specified in CON4.W310 are proposed, to demonstrate satisfactory performance. Obtain Approval before precast concrete work commences.

STORAGE, TRANSPORTATION AND LIFTING OF UNITS

CON4.W410.9 STRENGTH OF UNITS

Unless otherwise specified, do not lift precast units for at least 24 hours after casting or until the concrete has attained a strength adequate to resist the resultant stresses without inducing cracking or other damage to the concrete.

CON4.W420.9 STORING UNITS

1. For superstructure works:
   a. Store units on a levelled, well-drained and maintained hard-standing ground which will not result in damage, contamination or injury to others, and separate using Approved methods. Store different types of precast units separately. Protect as necessary from the weather and from staining;
2. For works other than that in sub-clause (1):
   a. Store units on a clean, firm base and separate using Approved methods. Store different types of precast units separately. Protect as necessary from the weather and from staining.

CON4.W430.9 DAMAGED UNITS

Replace or repair all units damaged by handling, hoisting into position or during transporting.

CON4.W440.N TRANSPORTATION

Refer to PRE.B8.295 for the safety measures to be taken for the delivery of materials by vehicles to site including the loading and unloading of precast concrete units.

ERECTING PRECAST UNITS

CON4.W510.9 STANDARD AND SEQUENCE

Erect precast units in accordance with BS 5531:1988 and in an Approved sequence.

CON4.W520.9 TEMPORARY BRACING

Provide temporary bracing to units where appropriate.

CON4.W530.9 DOWEL FIXINGS FOR PRECAST STAIRS

Locate box cutouts of precast stairs over cast-in dowel bars and fill with non-shrink grout.

CON4.W540.9 BEDDING AND JOINTING PRECAST STAIRS

Bed and joint precast stairs in non-shrink grout or cement mortar where shown on Drawings.

ACCURACY AND TOLERANCES

CON4.W610.9 GENERAL

1. Refer to:

a. Code of Practice for Precast Concrete Construction 2016 published by the BD;
b. Appendix H "Schedule of Tolerances" to this Specification.

2. Where any ambiguity, discrepancy or conflict arises between sub-clauses (1)(a) and (1)(b) above, the provisions given in Appendix H shall prevail.

IDENTIFICATION FOR PRECAST UNITS

CON4.W710.9 IDENTIFICATIONS AND RECORDS

Submit a method for identifying and recording the daily production of precast concrete units and their final position after installation.

DEFECTS

CON4.W810.9 MINOR CHIPPING

Subject to Approval, carry out repairs to minor chipping only by patching up after installation.

CON4.W820.9 OTHER REPAIRS

For repairs to other damaged units, carry out any repair work to the satisfaction of the CM.

TESTING

SAMPLING AND TESTING

CON4.T010.9 FULL SCALE MOCK UP

Where required by the CM, provide full scale mock up to demonstrate the precast units and the system of joints proposed as detailed in the Project Specific Specification, all to the satisfaction of the CM.

CON4.T020.9 WATERTIGHTNESS TEST

Before Approval to use precast concrete as CON4.M110, carry out watertightness test on the mock up on the precast unit of a particular type, with the jointing system in place.

CON4.T030.9 SAMPLING FOR WATERTIGHTNESS TEST

Testing samples:

1. Carry out full scale watertightness test on the precast unit of a particular type, with the jointing system in place, at the rate of 0.5% or each type proposed or one precast unit, whichever is the greater.

CON4.T040.9 AGREED TEST PROCEDURES

Test with a water pressure, duration, frequency and procedure as agreed by the CM.

CON4.T050.9 CRITERIA FOR FAILURE

The precast units and joints will be deemed failures if any sign of water seeping through the joints or the body of the cast unit, including signs of damp patches, is observed during the test.

CON4.T060.9 REMEDIAL ACTION

Non-compliance:

1. Upon failure of the watertightness test as CON4.T050:
    a. Remove the precast unit and scrape out all jointing materials;
    b. Redesign the precast unit or the jointing system, if the CM considers appropriate; and
    c. Reconstruct and retest as directed by the CM.

CON4.T070.9 TESTING OF NON-SHRINK GROUT

Testing method and testing samples:

1. Test grout in accordance with CS1:2010 as follows:
    a. Provide one sample for each grout mix from every 10 batches of grout or every 10 m^3 of grout produced in a day, whichever is the lesser. At least one sample shall be provided for each grout mix produced on any one day or less than 10m^3 of grout produced. For the purpose of this clause, a batch of grout is any quantity of grout produced in one cycle of operations of a mixer;
    b. Each sample provided in sub-clause (1)(a) above shall not be taken at a time more than one hour after the grout is mixed and shall be protected from weather before test cubes are made.

CON4.T080.A COMPRESSIVE STRENGTH TEST FOR NON-SHRINK GROUT

1. The DTC shall prepare two grout cubes of 100 mm size from each sample, cure and test the grout cubes for crushing strength at 28 days in accordance with CS1:2010;

2. The average of the crushing strengths of the two grout cubes shall be taken as the test result. The compliance criteria C1 and C2 shall be adopted as appropriate for assessing compliance requirements stipulated in CON1.T640 and CON1.T660;
3. The test result shall comply with the following requirements:
   a. Individual test results: comply with the requirement given in Column B of the Table specified in CON1.T650;
   b. Average strength determined from any group of four consecutive test results: comply with the requirement given in Column A of the Table specified in CON1.T650. Where there are less than four available test results, treat the average of the first two or first three consecutive test results in the same manner as groups of four consecutive test results.
4. If the difference between the compressive strengths of two grout cubes made from one sample of grout mix exceeds 15% but does not exceed 20% of the test result:
   a. Use the higher of the compressive strengths of the two grout cubes to assess compliance as stated in sub-clause (3)(a) above;
   b. Do not use the test results for that sample to assess compliance as set out in sub-clause (3)(b) above nor to calculate the standard deviation.
5. If the difference between the compressive strengths of two grout cubes made from one sample of grout mix exceeds 20% of the test result:
   a. Discard the test result for that sample;
   b. Propose investigation for Approval to establish if the grout represented by the sample is acceptable or not.

TESTING FIXINGS

CON4.T110.9 TENSILE TESTING

Testing method:

1. When directed, test fixings and anchors to BS 5080:Part 1:1993.

CON4.T120.9 SHEAR TESTING

Testing method:

1. When directed, test fixings and anchors to BS 5080:Part 2:1986.

CON5 PRECAST FACADE UNITS (CONTRACTOR'S DESIGN)

DESIGN

GENERAL

CON5.D010.9 RELEVANCE OF OTHER SPECIFICATION WORKSECTIONS

1. Design and construct precast facades in accordance with this Worksection and with the relevant provisions of the following Worksections:
   a. CON1, Insitu Concrete;
   b. CON2, Formwork;
   c. CON3, Reinforcement;
   d. CON4, Precast Concrete;
   e. COM11, Radio Frequency Identification and Web-Based Database System for Building Components.
2. Where any ambiguity, discrepancy or conflict arises between this Worksection, and any clauses in any other Worksections of this Specification, ensure that the provisions of this Worksection prevail.

CON5.D020.9 STANDARD

Comply particularly with CON1.M010.

SCOPE OF THE WORK

CON5.D110.9 GENERAL

1. Refer to the Drawings for the definition of the extent of the precast facades including window installation;
2. For off-Site casting, coordinate with the precast facade supplier for the installation of windows, pre-formed holes, surface finishes, earthing lugs as shown on the Drawings;
3. Include the following with the precast facades delivered to or fabricated on Site:
   a. Precast concrete panel as shown on the Drawings;
   b. Aluminium or uPVC window obtained from a supplier approved by the CM;
   c. Pre-formed holes for the installation of drainage pipes;
   d. Earthing lugs as shown on the Drawings;
   e. Concealed electrical PVC conduit system installations as shown on Drawings and as specified;
   f. A certificate indicating the date of casting;
   g. Work completion certificate for pre-installed electrical conduit system installation;
   h. Embed Radio Frequency Identification tag as specified.

CON5.D120.9 INSITU CONCRETE ELEMENTS INCLUDED

In addition to the precast elements shown on the Drawings, any insitu facades at F1 and roof-minus-one floors and any other floor indicated as such on the Drawings, designed and cast as insitu concrete, also form part of the whole precast facade system. For such insitu facade elements, comply with Worksections CON1, CON2, CON3 and CON6 of this Specification and those provisions of this Worksection as may apply to insitu facades.

CON5.D130.9 SCOPE OF THE DESIGN

Include the following in the scope of the design of the precast facade system:

1. The structural design of the facade units to the dimensions shown on the Drawings;
2. The design of the structural connections by which the facade units are joined monolithically with the building structure;
3. The design of one-stage weatherproof joints between the facade units and the building structure;
4. The design of the connection to the supporting system for the air conditioning unit as shown on the Drawings, (maximum net weight 100 kg);
5. The design of the fixing of the windows to the openings;
6. The design of electrical conduit system installation.

DESIGN PARAMETERS

CON5.D210.9 GENERAL

Design the facade units generally as a one-piece design.

CON5.D220.9 MINIMUM THICKNESSES

Design each facade unit with the line of the inner side of the unit fixed as shown on the Drawings and:

1. With a general minimum thickness of not less than 150 mm;
2. With the thickness of the ledge for the air conditioning hood not less than 125 mm.

CON5.D230.9 OVERHANG AT BASE OF UNITS

Incorporate a 575 mm overhang at the base of each facade unit designed monolithically with the wall of that facade unit.

CON5.D240.9 WINDOW OPENINGS

Design openings for windows in the facade unit:

1. To the dimensions shown on the Drawings;
2. Restrained at the top with a beam and at either side with a wall or a post.

CON5.D250.A LOADINGS

Design facade units to sustain all possible loadings acting upon the units. In particular, take the following loading conditions into account:

1. Dead loads and superimposed loads;
2. Wind loads in accordance with the Code of Practice on Wind Effects in Hong Kong 2019 issued by the Buildings Department;
3. Eccentric loads which arise either as a result of the centre of gravity of the facade units being offset from the support or from random inaccuracies occurring during construction. Allow a minimum of 25 mm eccentricity in the design for such random inaccuracies;
4. Tensile loads if the facade units are designed to be hung from the top or from the sides;

5. Buckling loads if the facade units are subject to vertical compression;
6. Temperature stresses;
7. Temporary loads which arise during demoulding, storage, lifting, transporting and erection of the facade units. In particular, design for the complex stresses arising out of lifting from stacked position into lifting position.

CON5.D260.9 MINIMUM CONCRETE GRADE

For facade units: Grade 35/20.

CON5.D270.9 CONCRETE COVER TO REINFORCEMENT

Minimum cover to reinforcing bars in facade units:

1. External face: 30 mm;
2. Internal face: 25 mm.

CON5.D280.9 LIFTING AND LOCATING DEVICES

1. Design lifting and location devices for embedding or fixing to the facade units in accordance with the Code of Practice for Precast Concrete Construction 2016 issued by the BD;
2. Allow a minimum safety factor of 4 for lifting inserts under normal circumstances;
3. Check and make necessary provisions in the facade units to prevent local rupture or cracking as a result of using lifting and locating devices.

CON5.D290.9 LOCATION POINTS

1. Make provision on each facade unit for locating, plumbing and levelling to the designed location within acceptable tolerance limits;
2. Include details of location points as part of the submission under sub-clause (7) of CON5.D860.

CON5.D300.9 PERMANENT CONNECTIONS

Design permanent structural connections using one, or a combination of both, of the following methods:

1. Insitu connection by which the facade units are joined monolithically with the building structure;
2. Mechanical connections by which the facade units are secured to the building structure at attachment points using brackets, cleats and fixings.

CON5.D310.9 ERECTION RESTRAINTS

1. Design vertical and horizontal restraints for temporary connections of the facade units to the main structure such that displacement of the facade unit cannot occur before making the permanent structural connection;
2. Design horizontal restraint to resist a minimum horizontal live load of ± 0.5 kN/m run acting at 1.5 m from the base of the facade unit.

CON5.D320.9 ADJUSTMENT DEVICES

1. Provide the facade units with separate vertical and horizontal adjustment devices;
2. Do not use adjustment devices in the vertical plane for horizontal location devices or horizontal restraint and do not design such devices to take any permanent shear (horizontal) loads;
3. Do not design any adjustment devices in the horizontal plane to take permanent vertical loads.

CON5.D330.9 STRUCTURAL SUPPORT

1. Design the facade units at each floor to derive their support from the building structure at the same floor via the specified permanent structural connections;
2. Do not allow any permanent loading from the facade units to be transferred to the facade units above or below.

INSITU CONNECTION DESIGN

CON5.D410.9 GENERAL

Design the insitu connection as CON5.D130:

1. To withstand the stresses induced by the facade units described in CON5.D250, sub-clauses (1) to (6);
2. To be watertight;
3. In concrete of the same grade as that for the precast units.

CON5.D420.9 REINFORCEMENT, SHEAR CONNECTORS ETC

Ensure reinforcement, shear connectors, etc used for the insitu connection design are adequately embedded or anchored into the building structure.

CON5.D430.9 VERTICAL CONNECTIONS

For vertical insitu connections:

1. If the minimum dimension of the void to be in filled is more than 150 mm, use non-shrink grout or concrete with non-shrinking additives;
2. If the minimum dimension of the void is less than 150 mm, use only non-shrink grout.

CON5.D440.9 HORIZONTAL CONNECTIONS

Concrete with non-shrinking additives may be permitted for horizontal insitu connections, in lieu of non-shrink grout, subject to the provisions of CON5.M050.

MECHANICAL CONNECTIONS

CON5.D510.9 GENERAL

Design the mechanical connections referred to in sub-clause (2) of CON5.D130 to withstand the stresses transmitted by the facade units to the building structure, described in CON5.D250 sub-clauses (1) to (6), in one of the following two groups:

1. Tying back fixing;
2. Location fixing.

CON5.D520.9 LOAD BEARING FIXINGS

Adopt load bearing fixing where the facade unit is designed to bear upon the building structure. Design the fixing so that the supporting area is adequate to carry the weight of the facade unit.

CON5.D530.9 TYING BACK FIXINGS

Adopt tying back fixing for securing the facade units into position. Design the fixing and the facade units to sustain the forces due to the restraint of the relative movement between the facade units and the building structure including movements cause by the effect of temperature, moisture movement, shrinkage and creep based on Hong Kong conditions.

CON5.D540.9 LOCATION FIXINGS

Adopt location fixing for positioning and levelling the facade unit before it is connected. Allow for all handling and positioning loads.

CON5.D550.9 TYPES OF ATTACHMENT TO STRUCTURE

1. Fix the facade units to the building structure by one of the following methods:
   a. Cast in anchorages (Type A);
   b. Grouted in dowel bars (Type B);
   c. Expanding anchorages (Type C).
2. Comply with CON5.D530 to CON5.D540 for Type A and B anchorages;
3. For Type C anchorages, submit manufacturer's certificates and conduct pull out tests to check compliance with manufacturer's recommendations;
4. Submit for Approval any proposed alternative anchorage methods.

CON5.D560.9 LINKS BETWEEN ANCHORAGES

Angle cleats may be used to form the link between anchorages. Assembly adjustments may be made in three dimensions using horizontal and vertical slotted holes. Submit for Approval any proposed alternative devices to link between anchorages.

CON5.D570.9 CONCEALMENT OF FIXINGS

Conceal all permanent fixing connections by Approved methods.

CON5.D580.9 RESISTANCE TO CORROSION

All metal parts of connections must either be:

1. Corrosion resistant, being constructed of non-ferrous metal or stainless steel but avoiding any contact of such materials with the reinforcement; or
2. Protected against corrosion by an Approved method.

WEATHERPROOF JOINTS

CON5.D610.9 GENERAL

Design weatherproof joints between the facade units and the structure or between two adjacent facade units to ensure air and water tightness and in accordance with BS 6093:1993 and include joint seals in accordance with CON5.M110 and CON5.M120.

CON5.D620.9 TYPES OF JOINT

Use weatherproof joints of one of the following types:

1. Sealed joint (one-stage joint);
2. Drained joint (two-stage joint).

CON5.D630.9 DESIGN WIDTH OF JOINTS

Design the joint width in accordance with BS 6093:1993 and BS 6213:1982.

CON5.D640.9 COMBINATIONS OF JOINT TYPE AND STRUCTURAL CONNECTIONS

Use only the following combinations of weatherproof joint and permanent structural connection in the design of the precast facades:

1. Either one-stage or two-stage weatherproof joint with insitu connections specified in CON5.D300 (1);
2. Two-stage weatherproof joint with mechanical connections specified in CON5.D300 (2).

CON5.D650.9 CONTRACTOR'S RESPONSIBILITY

Approval of the proposed jointing system including the weatherproofing materials does not relieve the Contractor from any liability on the performance of the joints.

MODIFICATIONS TO THE BUILDING STRUCTURE

CON5.D710.9 CONTRACTOR'S RESPONSIBILITY

The Contractor's responsibility for the design of his proposed modification is covered under GCC Clauses 5.15 and 11.8 and the Appendix E to the Specification.

CON5.D720.9 TYPES OF MODIFICATION

Modification to the design of the building structure to accommodate the precast facade design is permitted under the following circumstances subject to detailed submissions and Approval:

1. Modification for constructing the permanent structural connections. Reinforcement may be required to be relocated and/or added to the building structure provided that the resulting reinforcement arrangements produce an equivalent or higher overall design strength to that of the original structure;
2. Modification to incorporate the weatherproof joints. Grooves may be required to be formed provided that the resulting section produces an equivalent or higher overall design strength to that of the original structure.

CON5.D730.9 COMPLIANCE WITH GUIDELINES AND REGULATIONS

Any proposed structural modifications to accommodate the precast facade design must comply with the Regulations currently in use.

CON5.D740.9 WIND LOADINGS

For the purposes of designing for wind, the values and requirements must be not less than those specified in relevant structural design guidelines published by the Housing Department and included as Appendix E to this Specification.

SUBMISSIONS

CON5.D810.9 TENDER DESIGN PROPOSAL

Submit for Approval, full details of tender design proposals including drawings, layouts, details, calculations and any other information required by the CM.

CON5.D820.9 REGISTERED STRUCTURAL ENGINEER

All structural drawings, layouts, details and calculations submitted to the CM, including those submitted with tender, must be prepared and signed by a Registered Structural Engineer registered under Buildings Department of Hong Kong Government.

CON5.D830.9 PROGRAMME FOR SUBMISSIONS

Agree a programme for all submissions during the Contract to the CM prior to the notified date for commencement of Works. Include in the programme, the CM's undertaking to reply to design submissions within the following periods:

1. Initial submission - Within 28 days;
2. Resubmission - Within 14 days.

CON5.D850.9 SHOP DRAWINGS

Within two months of the notified date for commencement of the Works, submit five sets of fully dimensioned shop drawings for each type of facade unit, including shop drawings for windows to COM2.D210 and electrical conduit system complete with its accessories, for approval.

CON5.D860.9 DRAWINGS AND METHOD STATEMENT

Within two months of the notified dated for commencement of the works, submit, for agreement, the following items:

1. Design of moulds, layout arrangements, casting methods (horizontal or vertical), tilting mechanism (if any), demoulding methods and the provision for attachments of openings for window fixing;
2. The complete procedures for fabrication, curing, demoulding, application of finishes, lifting, transporting, storage, erection and installation of weatherproof joints;
3. Method of protecting the facade units from damage at all times;
4. Minimum concrete strength required for the facade units for demoulding, handling, storage, transportation and erection;
5. Position and design of lifting points;
6. Calculated weights of the facade units;
7. The proposed Radio Frequency Identification tag and the fixing method as specified in the Worksection COM11.

CON5.D870.9 METHOD OF FIXING WINDOWS

Within two months of the notified date for the commencement of the Works, submit for agreement, the method of fixing window frames or windows before casting of the facade units commences. Obtain either aluminium or uPVC windows from a supplier approved by CM.

CON5.D880.9 DETAILS OF WEATHERPROOFING

Within two months of the notified dated for the commencement of the Works, submit details of weatherproofing materials in accordance with CON5.M110 and CON5.M120 for Approval, including technical information, samples, test reports and proven performance records of proposed materials.

CON5.D890.9 QUALITY ASSURANCE SCHEME

Within two months of the notified date for the commencement of the Works, submit details of the Quality Assurance Scheme for manufacturing the facade units, in accordance with CON5.W030 to CON5.W050 as applicable, for Approval.

CON5.D900.9 QUALITY CONTROL PROCEDURES

Within three months from the notified date for commencement of Works, submit for Approval, details of quality control procedures for erection of the facade units in accordance with CON5.W640.

CON5.D910.9 PROGRAMMES

Within one month of the notified date for the commencement of the Works, submit, for agreement:

1. When instructed by the CM, the programme for the design and the testing of the trial samples of the facade units;
2. The programme for manufacture of the facade units showing the rate of production for each month and the dates for clearing the area of casting yard and associated plant upon completion of the manufacture of the facade units;
3. The programme for the erection of facade units in accordance with CON5.W610.

CON5.D920.9 LOADING OF INSITU STRUCTURAL MEMBERS

Submit calculations to demonstrate that the insitu structural members are not subject to excessive stresses arising from the erection method of the facade units and to demonstrate the adequacy of any temporary supports which may be required.

SUBMISSIONS FOR PRECASTING

CON5.D1010.9 PRELIMINARY DESIGN

Submit preliminary design of moulds indicating the material to be used, layout arrangements, casting methods (horizontal or vertical), tilting mechanism (if any), demoulding methods of the main and side panels of the moulds and the provision for attachments of openings for window fixing.

CON5.D1020.9 METHOD STATEMENTS

Submit a method statement:

1. Describing the complete procedures for fabrication, curing, demoulding, application of finishes, lifting, transporting, storage, erection including fixing, grouting and installation of weatherproof joints;
2. Designed to ensure the dimensional accuracy both of the facade units and the structural elements adjoining them.

CON5.D1030.9 CASTING FACILITIES

Submit for Approval in accordance with CON5.W010.

CON5.D1040.9 PRELIMINARY PROGRAMME

Submit a preliminary programme for the design, manufacture, erection, testing and full size trial samples of the facade units including dates for clearing the area of any on-Site casting yard and associated plant upon completion of manufacture of the facade units.

MATERIALS

NON-SHRINK GROUT AND CONCRETE

CON5.M010.9 APPROVED MIX

For non-shrink grout, the submitted grout mix shall have the specified characteristic as stated in CON5.M040. Submit samples of non-shrink grout for carrying out the tests as stated in CON5.M040 by the Approved testing laboratory.

CON5.M020.9 CONSTITUENT MATERIALS OF NON-SHRINK GROUT

To be a pre-packaged cement base product which contains Portland cement, selected sand and non-shrink additives.

CON5.M030.9 WATER/POWDER RATIO OR WATER CONTENT

For pre-packaged non-shrink grout product, comply with the manufacturer's recommendations.

CON5.M040.9 NON-SHRINK GROUT

Quality requirements:

1. To be pre-packaged cement base product with the following required properties:
    a. A 28 days strength equal to or higher than the grade of the adjoining structures. The compressive strength shall be determined by compressive strength test as CON5.T260;
    b. Chloride content of grout shall not exceed 0.1% by mass of the cement. Submit documentary evidence that the summation of chloride contents of constituent materials complies with the aforesaid requirement;
    c. Setting time of the non-shrink grout when tested in accordance with ASTM C953 - 87(97) shall be greater than 1 hour for initial set and be less than 24 hours for final set;
    d. Free expansion within 24 hours shall be of maximum 4% when measured in accordance with ASTM C827 - 95a(97). Expansion between 3 to 28 days when measured in accordance with ASTM C1090 - 96 shall be between 0% to 0.4%.

CON5.M050.9 CONCRETE WITH NON-SHRINK ADDITIVES

Submit for Approval and:

1. Maximum aggregate size: 10 mm;
2. Grade strength: a 28 days strength equal to or higher than the grade strength of the adjoining structure;
3. To comply with the manufacturer's recommendations on non-shrink additives;
4. Do not contain chlorides.

WEATHERPROOFING

CON5.M110.9 GENERAL

Quality requirements:

1. Weatherproofing materials to comply with BS 6093:1993 and subject to Approval.

CON5.M120.9 SEALANTS

As shown or scheduled on the Drawings as WAT5.M180.

CON5.M130.9 MORTAR STOP BACKING RODS

Polyethylene foam or other Approved.

CONDUIT SYSTEM

CON5.M210.9 STANDARDS

1. For rigid plain polyvinyl chloride (PVC) conduits, conduit fittings and PVC boxes, comply with the following British Standards:

Conduits and Fittings	British Standards
PVC conduits:	BS 6099:Section 2.2:1982(1988)
PVC conduits fittings:	BS 4607:Part 1:1984(1993)& BS 4607:Part 5:1982(1988)
PVC circular conduit boxes:	BS 4607:Part 5:1982(1988)
PVC boxes for electrical accessories:	BS 4662:1970(1989)

2. Ensure that all PVC conduits, fittings and boxes are of the same make.

CON5.M220.9 COLOUR

PVC conduits, fittings and boxes: white in colour.

CON5.M230.9 FLAME RESISTANCE

PVC conduits, fittings and boxes: non-flame-propagating and self-extinguishing.

CON5.M240.9 TEMPERATURE CLASSIFICATION

1. For all PVC conduits, fittings and boxes, comply with the temperature classification of -5 in accordance with BS 6099:Section 2.2:1982(1988);
2. For PVC conduits, where the ambient temperature at the country of manufacture is likely to be below -5ºC, the temperature classification is -25.

RIGID PLAIN PVC CONDUITS

CON5.M310.9 CONSTRUCTION AND SIZE

1. PVC conduits: rigid, plain and of a non-threadable type;
2. Nominal diameter of PVC conduits: within the range of 20 mm to 32 mm unless otherwise specified.

CON5.M320.9 MECHANICAL PROPERTIES

PVC conduits are:

1. Of heavy mechanical strength;
2. Capable of withstanding the heavy compression and impact tests specified in BS 6099:Section 2.2:1982 (1988).

CON5.M330.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUITS

1. Rigid plain PVC conduits shall be type-tested for complete compliance with BS 6099:Section 2.2:1982(1988) by an Independent Accredited Laboratory or an Independent Short-Circuit Testing Organisation;
2. Upon request from CM, provide documentary evidence that the batch/consignment of PVC conduits delivered to Site have satisfied the requirement as stipulated in the relevant British Standards mentioned in sub-clause (1) above.

PVC CONDUIT FITTINGS

CON5.M410.9 CONSTRUCTION

1. Use plain, moulded slip-type couplers and expansion type couplers to BS 4607:Part 5:1982 (1988) in the jointing of conduits;
2. Use saddles and spacers in compliance with BS 4607:Part 1:1984 (1993) for fixing of conduits unless otherwise specified.

CON5.M420.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUIT FITTINGS

1. PVC conduit fittings shall be type-tested for complete compliance with the following British Standards by an Independent Accredited Laboratory or an Independent Short-Circuit Testing Organisation:

PVC Conduit Fittings	British Standards
Plain moulded slip type coupler	BS 4607:Part 5:1982(1988)
Male bush and female adaptor	BS 4607:Part 1:1984(1993)

2. Upon request from CM, provide documentary evidence that the batch/consignment of PVC conduit fittings delivered to Site have satisfied the requirement as stipulated in the relevant British Standards mentioned in sub-clause (1) above.

PVC CIRCULAR CONDUIT BOXES, PVC BOXES FOR ELECTRICAL ACCESSORIES AND PVC ADAPTABLE BOXES

CON5.M510.9 CONSTRUCTION AND DIMENSIONS

1. For PVC boxes and their covers, comply with the relevant British Standard specification listed in CON5.M210;
2. Fit all screw holes with metal inserts. Except for PVC adaptable boxes, provide each box with a brass earthing terminal complete with screw for the connection of circuit protective conductor (CPC);
3. Ceiling-mounted circular conduit boxes: deep pattern type having an internal depth of not less than 60 mm;
4. For extension rings, comply with BS 4607:Part 5:1982 (1988);
5. Mould each PVC box in one piece;
6. For dimensions of PVC adaptable boxes, comply with BS 4568:Part 2:1970 (1988).

CON5.M520.9 MECHANICAL PROPERTIES

1. For PVC boxes, comply with the requirements for mechanical properties stated in the relevant British Standard specification listed in CON5.M210;
2. PVC adaptable boxes are:
   a. Moulded;
   b. Of sufficient mechanical strength to withstand forces encountered in concealed conduit wiring system application;
   c. Complete with provision for prevention of deformation of the boxes where necessary.
3. Plastic boxes are of:
   a. Dimensions: can be interchangeable with steel boxes;
   b. Wall thickness: 2 mm minimum;
   c. Cover sizes: larger than the adaptable box on each edge by at least 5 mm.

4. Where considerable heat is produced, fit boxes for the suspension of luminaires or other equipment with steel insert clips;
5. Do not use plastic boxes where:
   a. Temperature of the box is likely to exceed 60ºC;
   b. The mass suspended from the box exceeds 3 kg.

CON5.M530.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUIT BOXES

1. PVC circular conduit boxes, PVC boxes for electrical accessories and PVC adaptable boxes shall be type-tested for complete compliance with the following British Standards by an Independent Accredited Laboratory or an Independent Short-Circuit Testing Organisation:

PVC Conduit Boxes	British Standards
PVC circular conduit boxes	BS 4607:Part 5:1982(1988) with the following conditions: a. The marking of the PVC circular conduit boxes shall be 60/10 kg. b. The PVC circular conduit boxes shall be type-tested to 10 kg suspended load.
PVC boxes for electrical accessories	BS 4662:1970(1989)
PVC adaptable boxes	a. BS 4568:Part 2:1970(1988) Clause 6 Dimensions b. BS 4607:Part 5:1982(1988) Clause 7.3 Safety on impact test Clause 8 Resistance to heat Clause 9 Resistance to burning Clause 10 Insulting characteristics

2. Upon request from CM, provide documentary evidence that the batch/consignment of PVC conduit boxes delivered to Site have satisfied the requirement as stipulated in the relevant British Standards mentioned in sub-clause (1) above.

WORKMANSHIP

GENERAL

CON5.W010.9 CASTING YARD

Within one month from the notified date for commencement of the Works, submit for Approval on the following:

1. For on-Site casting:
   a. The location of casting yard for manufacture of precast concrete components;
   b. Details of plant and equipment including the location, boom radii and lifting capacities of cranes, gantry capacities, curing facilities, number of moulds and means of transporting the concrete components within the Site.
2. For off-Site casting:
   a. The name, casting yard address with street maps and job reference of the manufacturer and the following:
      i. Details of organisation structure and top management;
      ii. Self-certified true copy of the business licence of the manufacturer;
      iii. Annual production capacity of the casting yard in terms of concrete volume, numbers of products and the current workload;
      iv. Details of the Quality Assurance Scheme required in CON5.W030;
      v. Details of the audit plan and previous audit report, if any, carried out by the Precast Concrete Construction Auditing Consultant required in CON5.W050;
      vi. Details of compliance with requirements of this specification on batching plant and concrete mixes in accordance with Worksection CON1;
      vii. Test results for quality tests being carried out for the precast concrete components to demonstrate the compliance with requirements of this specification;
      viii. Other details of construction quality as required in CON5.W090 (1).
   b. Scaled and dimensioned layout plan of the casting yard with fenced boundaries showing the office, the production lines for the products including hardstanding and covered casting yards, disposition of steel moulds, vibration plant, handling and lifting plants, steam or hot air curing room / facilities, storage areas for finished products, steel reinforcement storage and bending yards, storage sheds for incoming materials, samples room, batching plant if any, testing laboratory, concrete cubes curing facilities, means of transporting the concrete components to the Site;
   c. The laboratory for carrying out the tests and issuing test certificates shall be approved by the Housing Department, or accredited either by Hong Kong Accreditation Scheme (HKAS) under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS. All expenses / costs related to the tests carried out by the laboratory shall be borne by the Contractor.

CON5.W015.A MANAGEMENT SCHEMES FOR OFF-SITE CASTING

1. Ensure that the casting yards for the off-Site casting of precast concrete components are operating on the following management schemes:
   a. An Environmental Management Scheme certified under ISO 14001;

b. An Occupational Health and Safety Management Scheme certified under ISO 45001.

2. Submit the original or certified true copy of the respective certificates for the manufacturing plant within the following time frame:
   a. ISO 14001: At not later than 15 days before the commencement of the production of precast concrete components;
   b. ISO 45001: At not later than 12 months from the notified date for commencement of the Works.
3. When the photocopy of certificate is submitted, it shall be certified by the certification body or by the QCM. The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS for the respective certification.

CON5.W020.9 QUALITY ASSURANCE SCHEME FOR OFF-SITE CASTING

Ensure that casting yards for the off-Site casting of units are operating on an Approved Quality Assurance Scheme in accordance with CON5.W030 to CON5.W050.

CON5.W025.9 QUALITY ASSURANCE FOR ON-SITE CASTING

Within two months from the notified date for the commencement of the Works, submit for Approval details of the Quality Assurance Scheme for manufacturing the precast concrete components, in accordance with CON5.W030 to CON5.W040 as applicable.

CON5.W030.9 QUALITY ASSURANCE SCHEME

1. Ensure that the facade units are manufactured under a Quality Assurance Scheme which covers the following items and is certified under ISO 9001:
   a. Quality control tests of materials, including proprietary products such as lifting anchors for handling precast concrete components;
   b. Calibration of laboratory equipment for quality control tests;
   c. Efficiency and proper operation of equipment at the casting yard;
   d. Production process;
   e. Sampling / testing procedures and requirements by an independent Approved laboratory;
   f. Quality control procedures including the frequency and extent of inspection by manufacturer's staff and independent parties;
   g. Regular audits at a minimum frequency of once per month by manufacturer's staff and independent parties.
2. Endorse the Quality Assurance Scheme and submit to the CM for approval at least 15 days before the commencement of the production of precast facade.

CON5.W035.9 PRECAST CONCRETE CONSTRUCTION AUDITING CONSULTANT

1. Select a consultant on the Architectural and Associated Consultants Selection Board's (AACSB) List of Structural Engineering Consultants (the "List") for CM's approval as the Precast Concrete Construction Auditing Consultant to carry out technical audits at the manufacturer's factory in accordance with the Code of Practice for Precast Concrete Construction 2016 issued by the BD;
2. A Precast Concrete Construction Auditing Consultant on the "List" in sub-clause (1) appointed by the manufacturer may be proposed for Approval;
3. Notify the CM immediately if there is any subsequent change of the Precast Concrete Construction Auditing Consultant during the course of services.

CON5.W040.9 QUALIFIED SUPERVISION

1. Assign a Precast Quality Control Manager (PQCM), with a minimum qualification and experience of a Grade T4 TCP in the civil or structural engineering discipline under the Registered Contractor's stream in the CoPSS, to certify all control documentation or test certificates required for the QA Scheme;
2. Assign a Precast Quality Control Coordinator (PQCC), with a minimum qualification and experience of a Grade T3 TCP under the Registered Contractor's stream in the CoPSS, to provide continuous supervision of the precast concrete production works at the casting yard;
3. Submit the details of the PQCM and the PQCC for Approval. For on-Site casting, it is permissible for the PQCM to be the same person as the QCM and the PQCC to be the same person as the SQCC;
4. Provide attendance to an RSE who is nominated by the CM, to carry out audit checks to the casting yard at least once every month;
5. The Authorized Signatory as stipulated in PRE.B6.060 is to carry out inspection and audit checks to the casting yard at least once every month and submit a monthly audit report to the RSE as stipulated in sub-clause (4) above and then to the CM for endorsement and onward submission to ICU.

CON5.W050.9 RECTIFICATION TO QUALITY NON-COMPLIANCE

1. For off-Site casting in CON5.W010 (2), the manufacturer shall be under regular technical audits in a manner as stipulated in CON5.W030 (5) and supervision of the CM or his representatives resident at the manufacturer's factory;
2. The Contractor shall:
   a. Ensure that the manufacturer shall rectify any non-conformance to the Specification revealed by the audit or the supervision of the CM or his representatives resident at manufacturer's factory and if necessary, modify the QA Scheme and temporarily suspend the manufacture of the precast facade panels until the non-conformance is rectified;
   b. Report to the CM of the non-conformance and rectification carried out.
3. Notwithstanding sub-clause (2) above, bear full responsibility to assure that all the precast concrete components delivered to Site comply with the requirements of the Specification at all times.

CON5.W055.9 INSPECTION LOG BOOK

1. Record the following in an inspection log book:
   a. The names and qualifications of the supervisory personnel assigned by the CM and by the Contractor as stipulated in CON5.W040;
   b. The details of concrete production, inspection, auditing and testing.
2. Keep the inspection log book in the casting yard and provide a duplicate of the inspection log book on Site for CM's inspection when required.

CON5.W060.9 EQUIPMENT

Ensure casting yards, erected on-Site or off-Site are equipped with all the necessary facilities, including efficient vibration plant, necessary curing facilities, storage, handling and lifting facilities to secure compliance with all the provisions of this Specification.

CON5.W070.9 USE OF CASTING YARD

Do not use any on-Site casting yard for manufacture of any components for other sites. See PRE.B8.010.

CON5.W080.9 SUBMISSION AND PILOT PRODUCTION RUN BEFORE APPROVAL

1. Submission:

a. Submit the shop drawings, for the production of the precast components for Approval, including any proposed changes to the products so as to suit individual production process / plant;
b. Use concrete mix for the manufacture of precast components all in accordance with the requirements in Worksection CON1;
c. Provide relevant information / samples associated with the proposed precast components for Approval including:
i. Engraved manufacturer's logo and casting date;
ii. Printed precast concrete components identity numbers on surface of products;
iii. Schmidt hammer test certificate and covermeter tests record endorsed by the manufacturer's Quality Control Personnel;
iv. Delivery Order / Invoice;
v. Import and Export Manifests or Bill of Lading.

2. Before obtaining Approval for mass production, carry out a pilot production run with the CM on the proposed manufacturer to demonstrate the technical capability and effectiveness of the Quality Management System;
3. In the pilot production run:
a. Provide, for each category of products:
i. One sample with the reinforcement fixed in steel mould for the inspection of workmanship including reinforcement fixing and provision of bar spacers;
ii. One sample with concrete cast in steel mould for the inspection of conditions of the steel mould, checking of the finished sample.
b. Carry out trial run to demonstrate the manufacturing process including installation of windows, lifting operation, curing, storage, fixing of mosaic tiles, quality tests at factory laboratory, applied finishes and quality controls in accordance with the required drawings and specification;
c. Carry out verification check for engraved logo, casting date, identity number, Schmidt hammer test certificate and covermeter tests record, dimensions, size, spacing, position of starter bars and finishes.
4. The pilot production run may not be required, if the following documents are submitted and are acceptable to the CM:
a. Track records on similar types of precast concrete components supplied by the proposed manufacturer to other HA construction projects, within five years prior to the notified date for commencement of the Works; or
b. In the absence of the track records, detailed records of the pilot production run for similar types of precast concrete components carried out in other HA construction projects, within five years prior to the notified date for commencement of the Works.

CON5.W090.9 FIRST JOINT INSPECTION AT MANUFACTURER'S FACTORY

1. Prior to mass production, carry out the first joint inspection between the Contractor and the CM at factory for Approval on the minimum standard of the product for all subsequent concrete and the specified finish. Arrange for the transportation and provide all facilities for the first joint inspection;
2. Provide samples, including those samples in CON5.W080 (3)(a) and those accepted samples in previous pilot production run carried out in accordance with CON5.W080, for Approval as being representative of the minimum standard of the product for all subsequent concrete and the specified finish;

3. Maintain accepted facade sample at a minimum of one number, or as directed by the CM, in an area in the factory and do not remove the accepted samples from the area unless otherwise instructed by the CM. Incorporate a further set of samples to the trial panel on Site;
4. Carry out further joint inspections as in CON5.T710.

PRODUCING PRECAST UNITS

CON5.W110.9 MOULDS

1. Construct moulds from steel or other materials to produce a standard suitable for the 'Surface finishes' specified in CON5.W310 to CON5.W350;
2. Construct and maintain moulds so that:
   a. Dismantling and re-assembly of moulds after each casting allows the production of subsequent facade units within permitted tolerance limits;
   b. The positioning of securing components and fixings etc. are within the permitted tolerances;
   c. Adequate stiffness for the control of dimensional tolerances is maintained.

CON5.W120.9 DEFECTIVE MOULDS

Replace any mould which fails to produce facade units within the permitted tolerance limits as specified in Appendix H, the "Schedule of Tolerances", or to the standards of surface finishes as CON5.W310 to CON5.W350.

CON5.W130.9 HORIZONTAL CASTING

Provide moulds designed to facilitate horizontal casting with devices to enable rotation from horizontal to vertical through 90° so that the facade units can be lifted vertically on demoulding.

CON5.W140.9 USE OF RELEASE AGENTS

Apply mould release agent of an Approved type, to the surfaces of moulds either by brush or by spraying before the fixing of steel reinforcement at a rate in accordance with the manufacturer's recommendations.

CON5.W150.9 CONCRETING, COMPACTION AND CURING GENERALLY

See CON1.

CON5.W160.9 EXTERNAL VIBRATORS

Obtain Approval for the use of external vibrators.

CON5.W170.9 CURING BY APPLICATION OF HEAT

Obtain Approval for heat curing by means of steam, hot air, etc. and:

1. Ensure that the total chloride content of the concrete mix for facade units subject to heat curing, is less than 0.1% by weight of that of the cement;
2. Carry out a site trial to demonstrate the adequacy of the proposed method to the satisfaction of the CM.

CON5.W180.9 DEMOULDING GENERALLY

1. Unless otherwise Approved, do not disturb the facade units within 24 hours of casting;
2. Demould by means of an Approved method and:
   a. Do not use crowbars;
   b. Do not subject the mould to any form of impact.

CON5.W190.9 CONCRETE STRENGTH BEFORE DEMOULDING

1. Demould the facade units only after concrete has achieved the Approved strength;
2. To determine the concrete strength required for demoulding or handling:
   a. Make the necessary concrete cubes in pairs from the same batch of concrete used for casting the facade units and cure the concrete cubes under the same conditions as the concrete in the facade units;
   b. Specially identify the cubes and do not use them for normal quality control or for compliance testing;
   c. Determine the concrete cube strength by compression test as CON5.T210 and satisfy the CM that the concrete cubes have acquired the required strength before the demoulding or handling the facade units.
3. If Instructed, prepare beam specimens for determination of flexural strength for those facade units that are subject to bending during demoulding and lifting.

CON5.W200.9 IDENTIFICATION AND RECORDS

1. Mark all precast facade and precast acoustic balcony units with date of manufacture and a unique reference number;
2. Record in a master register the dates of casting, the concrete grades and the final locations of all facade and precast acoustic balcony units;
3. Update records specified in above sub-clause (2) for all precast facade and precast acoustic balcony units to the RFID Web-Based Database System;
4. Upon delivery on Site, carry out covermeter tests to precast façade and precast acoustic balcony at specified locations as instructed by the CM.
5. Agree with the CM within 4 weeks from the notified date of commencement of the Works on the format and size of site works photographic records of covermeter tests for precast façade and precast acoustic balcony units. Submit one set of photographic records to the CM within 24 hours after the day of covermeter test showing all measurement locations and results.

CON5.W210.9 HANDLING INSTRUCTIONS

If the facade units are designed for handling in a particular direction only, make this clear by means of instructions on shop drawings and appropriate markings on the facade units.

CON5.W220.9 REQUIREMENTS OF OTHER TRADES AND COMPONENTS

Incorporate the requirements of all trades such as blockouts, recesses, notches, embedded metal works or any other items before casting the facade units.

CON5.W230.9 WINDOWS FIXING TO FACADE UNITS

Fix window frames / windows complete with or without opening sashes before casting the facade units as specified in COM2 Worksection and:

1. Obtain Approval for the method of fixing window frames / windows;
2. Do not fix window frames / windows into preformed openings after casting;
3. For off-Site casting, coordinate with the PCF and window suppliers approved by the CM.

SURFACE FINISHES

CON5.W310.9 EXTERNAL FACE

Finish outside faces except edges and overhang soffits to give an even textured surface suitable for fixing glazed ceramic tiles by adhesive, or cast the tiles into the mould as required by the Contract.

CON5.W320.9 EDGES AND OVERHANG SOFFIT

Finish top, edge and soffit of overhang to give a smooth untextured surface suitable for applying acrylic paint.

CON5.W330.9 INTERNAL FACE - LIVING / DINING / BEDROOMS

Finish to give:

1. A smooth untextured surface suitable for applying plastic emulsion paint for rental blocks;
2. An even textured surface suitable for receiving internal cement lime plaster for SSF blocks as required by the Contract.

CON5.W340.9 INTERNAL FACE - BATHROOM

Finish to give an even textured surface suitable for fixing glazed ceramic tiles in accordance with FIN5.W210 and FIN5.W220 as appropriate.

CON5.W345.9 INTERNAL FACE - KITCHEN

Finish to give an even textured surface suitable for fixing glazed ceramic tiles in accordance with FIN5.W210 and FIN5.W220 as appropriate.

CON5.W350.9 INTERNAL FACE - UTILITY AREA

Finish to give an even textured surface suitable for fixing glass mosaic tiles by adhesive.

ACCURACY AND TOLERANCES

CON5.W410.9 MANUFACTURING AND ERECTION TOLERANCES

1. Refer to:
   a. Code of Practice for Precast Concrete Construction 2016 published by the BD;
   b. Appendix H "Schedule of Tolerances" to this Specification.
2. Where any ambiguity, discrepancy or conflict arises between sub-clauses (1)(a) and (1)(b) above, the provisions given in Appendix H shall prevail.

CON5.W420.9 CHECKING TOLERANCES

Check the manufacturing dimensional tolerances of the facade units by an Approved method at a rate of 1 in every 10 facade units produced and report the result to CM within two days of checking.

CON5.W430.9 DEFECTIVE UNITS

1. Any facade unit that falls outside the tolerance limits is considered defective and must be replaced as Instructed. Indelibly mark rejected facade units for identification purposes;
2. In the event of the CM agreeing to accept any defective facade unit, execute all necessary remedial and modification work to the CM's satisfaction.

HANDLING, TRANSPORTATION AND STORAGE

CON5.W510.A LIFTING FRAME

1. Lift facade units within the casting yard by means of a purpose-made steel lifting frame designed to the Code of Practice for the Structural Use of Steel 2011 issued by the Buildings Department;
2. Refer to PRE.B10.010 sub-clause (7) for the certification requirement of QE and / or RSE.

CON5.W520.9 LIFTING INSERTS AND SUPPORTS

Determine exact number, size and location of lifting inserts and proper supports with locations for transportation and storage.

CON5.W522.9 TEMPORARY SUPPORTS FOR TRANSPORTATION AND STORAGE

Determine proper supports with locations for transportation and storage.

CON5.W530.9 INSPECTION

Inspect each facade unit before lifting to ensure that neither damage nor hazard occurs during lifting.

CON5.W540.9 LIFTING

During lifting, keep the facade units vertical and:

1. Ensure that all connections between the lifting frame and lifting points remain vertical as far as possible;
2. Lift the facade units only at appropriate lifting points as shown on the Approved shop drawings;
3. Locate lifting points that the line of the resistant force passes through the centre of gravity of the facade unit.

CON5.W550.9 LIFTING PLANT AND EQUIPMENT

1. Ensure plant used for lifting including cranes, hoists, lifting frames, hooks, etc possess adequate safety margins, are maintained in good working order and are regularly tested. Provide details of plant and maintenance records and current test certificates when required by the CM;
2. Maintain crane rope in a sound condition. Discard all frayed bridle ropes or slings;
3. Notwithstanding sub-clause (1) above, provide test certificates of lifting anchors to the CM in accordance with CON5.T810 to CON5.T850.

CON5.W560.9 STORING UNITS

1. Store the facade units in the vertical plane on a level, well drained and maintained concrete surface and protect against staining or physical damage;
2. Support the facade units by an Approved method to prevent their warping, bowing, chipping or cracking;
3. Store different types of facade units separately;
4. The facade units shall be supported by a device in storage area to prevent toppling. For off-site casting yards, racks shall be used and detailed in the submitted QA scheme.

CON5.W570.A TRANSPORTING FROM CASTING YARD

Stack facade units vertically on vehicles during transportation from the casting yard and:

1. Support the units on special cradles so that the units are completely protected against damage and adverse stresses;
2. Provide the details of the support and the support locations to the CM for comment;
3. Refer to PRE.B8.295 for the safety measures to be taken for the delivery of materials by vehicles to site including the loading and unloading of precast facade units.

CON5.W580.9 LOADING AND OFF-LOADING

Carry out lifting for loading or off-loading the facade units in one movement. Lift off and re-position any facade unit which is not properly positioned after lifting, rather than levering it into place.

CON5.W590.9 TRANSPORT VEHICLES

Maintain lorries or trolleys used for the transportation of the facade units in a good condition. Ensure trolleys are equipped with suspension systems to minimise shock loading.

ERECTING UNITS

CON5.W610.9 PROGRAMME

Provide a programme for the erection of the facade units. showing the rate of erection for each month. Make due allowance for all restrictions on the age of concrete in the facade units for handling, storage, transportation and erection.

CON5.W620.9 SITE RECORDS

Provide, at the end of each week during erection of the facade units, records in a form to be agreed with the CM, showing:

1. Dates and the locations of structural connections completed;
2. Dates of removal and locations of props and temporary supports to the facade units.

CON5.W630.9 CM'S INSPECTION

Allow and facilitate inspection of the facade units at any time before erection and after installation.

CON5.W640.9 QUALITY CONTROL PROCEDURES

Carry out erection of the facade units under Approved quality control procedures covering the following:

1. Protective measures to avoid cracking and chipping of the facade units and damage to the applied finishes and to the built-in items such as window frames;
2. Checking the accuracy of the insitu structural members receiving the facade units, including location and level of all bearing surfaces, joints, bolts, horizontal and vertical restraining devices and adjustment devices. Carry out checking by means of a template or measurement frame or a similar Approved method;
3. Checking of erection tolerances;
4. Testing of the compressive strength of the grouting materials in accordance with CON5.T250.

CON5.W650.9 LIFTING UNITS INTO POSITION

1. Lift the facade units by steel lifting frame complying with CON5.W510 except otherwise stipulated in sub-clause (4) below;
2. Maintain all cables connecting the lifting frame and the lifting points of the facade units in a vertical direction. Provide the cables with devices for the adjustment of their length;
3. Do not allow devices such as sockets or bolts for lifting purposes to be used for fixing the facade units to the main structure;
4. Submit detailed method statement including the design, drawing and installation procedures with endorsement of the Contractor’s RSE demonstrating to the satisfaction of the CM that the precast concrete component will not subject to excessive stresses arising from their proposed erection method without the steel lifting frame, exemption from using the steel lifting frame as stated in sub-clause (1) above can be allowed only for the lifting of precast façade with the maximum horizontal dimension less than or equal to 1.8m;

5. In connection with sub-clause (4) above, address the safety use of the proposed lifting anchor system, including but not limited to the proprietary anchor bolt with clutch. The proposed lifting anchor system shall be flexible enough to allow for both vertical and slant lifting sling.

CON5.W660.A TEMPORARY SUPPORT

1. During fixing of the facade units, prop adjacent insitu structural members adequately to avoid excessive deflection or adverse stresses;
2. Maintain all temporary supports, props and restraints in position during casting of concrete / grout in the structural joint. Remove temporary supports, props and restraints upon satisfactory testing and calculation to approval from the CM;
3. Unless specifically designed for, do not allow temporary support to be derived from the facade units fixed at lower floors;
4. For off-site casting, coordinate with the supplier regarding the details of all temporary supports, props and inserts to suit the proposed lifting and installation method;
5. For the temporary support of the facade on the floor, refer to the drawings detailed in Project Specific Specification, which are provided for reference only;
6. Submit design calculations and detail drawings of installation and fixing certified by QE and / or RSE as stipulated in PRE.B10.010 sub-clause (6) for the CM's approval at least 4 weeks before commencement of constructing the temporary support.

CON5.W670.9 UNITS DAMAGED ON TRANSPORTATION, LIFTING OR ERECTION

Replace any facade unit which has been damaged on transportation, lifting or erection.

CON5.W680.9 APPROVAL FOR PERMANENT FIXING

Do not carry out permanent jointing or connection between any facade unit and another, or to any part of the insitu structure, without prior Approval.

CON5.W690.9 PREPARING AND PLACING GROUTING MATERIALS

Obtain Approval for the method of preparing and placing grouting materials in structural joints between the facade units and insitu structural members.

DEFECTS

CON5.W710.9 MINOR CHIPPING

Carry out repairs only to minor chipping by patching up after installation subject to Approval.

CON5.W720.9 OTHER REPAIRS

The CM may at his discretion approve other proposals for repairs to damaged facade units. Carry out any repair work to the satisfaction of the CM.

CON5.W730.9 REJECTED PANELS

Replace any defective or damaged facade panels rejected by the CM.

JOINTS

CON5.W810.9 GENERAL

1. Prepare and construct joints strictly in accordance with the Drawings and in accordance with the relevant manufacturer's recommendations so as to provide continuous weathertightness of buildings and give a neat, uniform and smooth appearance;

2. For application of back-up materials, bond breakers and sealants, see Worksection WAT5.

CON5.W820.9 GASKETS

Gasket may be used in weatherproofing joint provided that:

1. The joint is horizontal; and
2. The gasket is always under compression.

CON5.W830.9 MORTAR STOPS

Use backing rods or other Approved method as mortar stops in grouting panel joints when necessary.

CON5.W840.9 JOINT WIDTH

Unless otherwise Approved, the installed joint width must not be less than 6 mm nor greater than 30 mm.

CONDUIT SYSTEM

CON5.W910.9 APPLICATION

Supply and install conceal rigid plain PVC conduit system complete with steel draw wires for precast facade as indicated on the Drawings.

CON5.W920.9 SHOP DRAWINGS PREPARATION

Prepare shop drawings, coordinate and agree with the Nominated Sub-contractor for electrical installation and Supplier for precast facade before submitting shop drawings for Approval.

CON5.W930.9 SUBMISSION AND APPROVAL

Submit for Approval technical details, samples and type-tested certificates for the conduit system as specified in clauses CON5.M330, CON5.M420 and CON5.M530.

CON5.W940.9 COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION

1. All conduits, fittings and accessories installed have to be certified by at least Grade A2 of Registered Electrical Workers (REW);
2. When delivered to Site, the precast facade units must be accomplished with a Work Completion Certificate Form WR1(A) specified by Electrical and Mechanical Services Department which shall be duly signed by a Registered Electrical Contractor and a REW certifying that the conduit system installation is in full compliance with the Specification and the Code of Practice for the Electricity (Wiring) Regulations;
3. A single certificate can be issued for delivered lots of precast concrete components which are produced in each production lot. The certificate shall also carry information e.g. reference number etc. for traceability purpose;
4. Provide CM and the Nominated Sub-contractor for Electrical Installation each a copy of the Work Completion Certificate for record.

CONDUIT AND WIRING INSTALLATION

CON5.W1010.9 CONDUIT BENDS

Internal radius: At least 4 times the outside diameter of the conduit.

CON5.W1020.9 BENDING, JOINTING AND TERMINATING OF CONDUITS

Follow conduit manufacturers' recommendation for:

1. Method of carrying out the conduit bends and conduit joints;
2. Method of fixing conduits to boxes without spouts;
3. Use of tools and materials.

TESTING

SAMPLING AND TESTING GENERALLY

CON5.T010.9 RECORDS

1. Keep a complete record of all sampling and testing, in a form agreed with the CM;
2. Submit test reports and certificates to the CM within 14 days from the date of test.

CON5.T020.9 WITNESSING SAMPLING AND TESTING BY THE CM

The CM will witness any sampling and testing carried out under the Quality Assurance Scheme:

1. Make the records of sampling and testing available for inspection by the CM or his representatives resident at manufacturer's factory;
2. The CM or his representatives resident at manufacturer's factory is entitled to reject individual facade unit represented by any failed test result on the facade unit.

CON5.T030.9 TESTS AT MANUFACTURER'S FACTORY

Provide samples, all necessary facilities and attendance to the DTC or the CM or his representatives resident at manufacturer's factory to carry out the following tests:

1. Schmidt hammer tests and covermeter tests on the construction quality of precast concrete components;
2. Tests on concrete constituent materials, tests on compressive strength of concrete cubes and concrete cores, tests on reinforcement bars and tests on fabric reinforcement by the DTC and / or HDMTL.

CON5.T040.9 INSTALLATION OF RFID TAG IN CONCRETE CUBE FOR CUBE COMPRESSION TEST TO BE CARRIED OUT BY DTC OR HDMTL

1. Install a Radio Frequency Identification (RFID) tag as detailed on Sketch no. RFID/TAG/SK-01 onto the trowelled surface of each of the concrete cubes immediately after preparation of cubes at the manufacturer’s factory under the witness of the CM or his representatives resident at manufacturer's factory unless otherwise instructed by the CM;
2. The RFID tags are to be provided by DTC or the CM or his representatives resident at manufacturer's factory in batches;
3. Validate and scan the RFID tag with the Bluetooth RFID reader provided by DTC or the CM or his representatives resident at manufacturer's factory before use, and ensure that information such as tag unique identification (UID), electronic product code (EPC) number and timestamp have been uploaded to the PC provided by the DTC or the CM or his representatives resident at manufacturer's factory and incorporated into the DTC’s database system (through 3G or above internet service);
4. Input the mould number and / or sampling certificate number against the concerned tag EPC number through the DTC’s database system;
5. Before the tagged cubes are sent from the manufacturer’s factory to HDMTL or are collected by the DTC, scan the tag again using the Bluetooth RFID reader and ensure that information such as tag UID, EPC number and timestamp have been uploaded to the PC and incorporated into the DTC’s database system (through 3G or above internet service);
6. Deliver the tagged cubes to HDMTL or arrange the tagged cubes to be collected by the DTC with due care at a time such that a minimum of 4 days is allowed for curing the cubes in DTC or HDMTL before testing on compressive strength at 28 days by DTC or HDMTL;

7. In case any damaged RFID tags are discovered, report to the CM or his representatives resident at manufacturer's factory immediately without any delay;
8. Maintain an inventory record of all RFID tags including those damaged and submit the inventory record to the CM or his representatives resident at manufacturer's factory.

TRIAL UNITS

CON5.T110.9 GENERAL

Prior to mass production of the facade units:

1. Produce a full size trial sample for the Type T1 facade unit or as specified in the Project Specific Specification complete with joints, windows, glazing and the electrical conduit system installation etc. and all finishing at ground level for Approval;
2. Maintain the Approved sample facade unit as the yardstick for the standard and quality necessary for all facade units unless otherwise required under the terms of CON5.T120;
3. When construction of a trial panel is required in CON2.W720, structurally connect the trial sample to surrounding structural frames and with interfacing services as detailed on the Drawings.

CON5.T120.9 ADDITIONAL TRIAL UNITS

Non-compliance:

1. In the event that the trial sample, in the opinion of the CM, cannot represent any one of the other facade types due to different designs proposed or methods of manufacture and erection, the CM is entitled to order additional trial samples for those different facade types including the surrounding structural frames all at the Contractor's own expense and without detriment to the programme.

CON5.T130.9 PROTECTION AND DISPOSAL

Ensure that the Approved sample facade units remain undamaged and remove both the samples and surrounding structural frames upon the completion of erection of all facade units.

TESTS ON WORKABILITY

CON5.T131.9 STANDARD

As CON1.T510.

CON5.T132.9 ACCEPTANCE VALUES FOR APPROVED CONCRETE MIXES

As CON1.T520.

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CUBES

CON5.T210.9 STANDARD

As CON1.T610.

CON5.T211.9 SAMPLES FOR DESIGNED CONCRETE MIXES

As CON1.T620.

CON5.T212.9 RESULTS FOR DESIGNED CONCRETE MIXES

As CON1.T630.

CON5.T213.9 COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES

As CON1.T640.

CON5.T214.9 TABLES OF COMPLIANCE REQUIREMENT FOR DESIGNED CONCRETE MIXES

As CON1.T650.

CON5.T215.9 NON-COMPLIANCE OF DESIGNED CONCRETE MIXES

As CON1.T660.

CON5.T216.9 FURTHER TESTS ON DESIGNED CONCRETE MIXES

As CON1.T670.

TESTS ON COMPRESSIVE STRENGTH OF EARLY CORES FOR PRECAST FACADES

CON5.T221.9 GENERAL

1. Provide all necessary facilities and attendance for carrying out coring and testing of concrete cores by DTC, including the provision of a secure and lockable storage for DTC to store the coring machine and other associated equipment;
2. Tests are to be witnessed and endorsed by the Contractor's representative and the CM or his representatives resident at manufacturer's factory;
3. Allow 2-day advance notice for preparation by DTC before the taking of core samples at the manufacturer's factory;
4. Upon completion of the taking of core samples by DTC at the manufacturer's factory, allow a minimum of 6 more days and a maximum of 15 more days for DTC to provide the core test results;
5. Make due allowance in the programme for the aforesaid arrangement and no claim for extension of time shall be allowed;
6. Subject to CM's approval, omission of early core test may be permitted for a particular batch of precast facades in order not to affect the construction work on Site. In such case, core test shall be carried out in accordance with the procedures set out in CON1.T710 to CON1.T760 to prove the compliance of that particular batch of precast facades to compressive test on cores as stipulated in this Specification.

CON5.T222.9 STANDARD

Comply with CS1:2010 in respect of the method of preparing, inspecting and testing concrete cores to determine the compressive strength except the measurement of saturated density.

CON5.T223.9 SIZE AND NUMBER OF EARLY CORE SAMPLES

Testing samples:

1. Provide necessary facilities and attendance to the taking of 3 Nos. of core samples by the DTC from the precast facades of the same concreting day, at locations decided by the CM, for test as follows:
   a. 75 mm diameter core samples;
   b. For vertically casted precast facades, the length of core samples shall be at least 90 mm;

c. For horizontally casted precast facade, the length of core samples shall be at least 90 mm plus top 50 mm or 20% of depth of concrete being cored whichever is greater.

CON5.T224.9 AGE OF EARLY CORE SAMPLES

1. Do not take cores for compressive test at ages less than 3 days;
2. Do not carry out compressive test on the core samples at ages less than 9 days.

CON5.T225.9 ASSESSING COMPRESSIVE STRENGTH OF EARLY CORES

In assessing the compressive strength of early cores, the precast facades of the same concreting day represented by the early cores are deemed to comply with this Specification if the compressive strength of the early core, when adjusted for length / diameter ratio and converted to estimated insitu cube strength in accordance with CS1:2010, is:

1. Not less than 85% of the specified grade strength for any individual results.

CON5.T226.9 NON-COMPLIANCE AND FURTHER TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES FOR PRECAST FACADES

1. For precast facades of the same concreting day represented by the early cores that the compressive strength of the early cores comply with CON5.T225, their core test results are deemed to be acceptable under this Specification, and further coring test at 28 days is not necessary unless compressive strength test of concrete cube of the same batch of concrete not comply with CON5.T212 or instructed otherwise by the CM;
2. For precast facades of the same concreting day represented by the early cores that the compressive strength of the early cores do not comply with CON5.T225:
   a. if the concreting ages of the precast facades are less than 28 days, carry out further early core tests by DTC. If the result of the further early core test does not comply with CON5.T225, the precast facades are not allowed to be lifted into place or installed on Site, and further early core test may be carried out in accordance with this sub-clause;
   b. if the concreting ages of the precast facades are 28 days or over, carry out further core test by DTC in accordance with CON1.T710 to CON1.T760. If the result of this further core test does not comply with CON1.T760, the precast facades are not allowed to be lifted into place or installed on Site. All relevant concrete of precast facades represented by this further core test in the same concreting day is deemed not complying with this Specification. Investigate the extent of non-compliance and re-execute the works in accordance with CON1.T1210 to CON1.T1260.
3. Make due allowance in the programme for the aforesaid arrangement and bear all time and cost for compliance with this clause.

CON5.T227.9 MAKING GOOD CORE HOLES

As CON1.T770.

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES

CON5.T230.9 GENERAL

As CON1.T710.

CON5.T231.9 STANDARD

As CON1.T720.

CON5.T232.9 SIZE AND NUMBER OF CORE SAMPLES

Testing samples:

1. Provide necessary facilities and attendance for taking 3 Nos. of 100 mm diameter core samples from the facade units for the same concreting day, at the location selected by CM;
2. Take concrete cores at the rate of three per precast facade unit so selected.

CON5.T233.9 AGE OF CORE SAMPLES

As CON1.T740.

CON5.T234.9 REQUIREMENT FOR FURTHER CONCRETE CORE SAMPLES

As CON1.T750.

CON5.T235.9 ASSESSING COMPRESSIVE STRENGTH OF CONCRETE CORES

As CON1.T760.

CON5.T240.9 NON-COMPLIANCE AND FURTHER TESTING

Should any core fail to meet the requirements of compressive strength of concrete cores as specified in CON1.T760:

1. All relevant concrete represented by the cores in the same concreting day is deemed not to comply with this Specification;
2. The CM may order further tests on cores taken from the failed precast facade units or other precast facade units cast from the same batch of concrete used for casting the failed units all at the Contractor's own expense.

CON5.T245.9 MAKE GOOD CORE HOLES

As CON1.T770.

CON5.T250.9 TESTING ON NON-SHRINK GROUT

As CON4.T070.

CON5.T260.9 TESTS ON COMPRESSIVE STRENGTH OF GROUT CUBES

As CON4.T080.

CON5.T280.9 COUTINHO RING TEST

Testing method:

1. The mould for this test shall be formed from steel to provide an annular specimen with an inner diameter of 115 ± 0.1 mm, an outer diameter of 175 ± 0.1 mm and a depth of 50 ± 0.1 mm;
2. The grout shall be mixed in accordance with the manufacturer's specification and placed within the mould. Materials, moulds and specimens shall be kept at a temperature of 27°C ± 2°C and a relative humidity of 55% ± 5%;
3. After 72 hours the outer mould ring shall be removed from the hardened grout specimen and the specimen with the inner ring still in place shall be returned to the conditioning environment.
4. The grout specimen shall be examined at 7, 14, 21 and 28 days and any cracking shall be reported.

SCHMIDT HAMMER TESTS

CON5.T290.9 TESTING FREQUENCY

1. Provide all necessary facilities and attendance for carrying out of Schmidt hammer test on all precast facades by the CM or his representatives resident at manufacturer's factory when the concreting age of the precast facades is at least 3 days;
2. Subject to CM's approval, the testing frequency may be reduced when satisfactory and consistent standard is established.

LABORATORY WATERTIGHTNESS TEST

CON5.T310.9 NATURE AND PURPOSE OF TEST

Testing arrangements:

1. Prior to the Approval of the proposed jointing system, carry out the watertightness test at an Approved independent laboratory to demonstrate that the proposed jointing system within the facade unit resists water penetration as CON5.T450;
2. Where an insitu connection, specified in CON5.D410 to CON5.D440, is designed in combination with joint sealing compound specified in CON5.M120, carry out the watertightness test without the joint sealing compound in place to test the watertightness of the insitu connection.

CON5.T320.9 EXEMPTION FROM TEST

Laboratory testing of the proposed jointing system is not required if satisfactory test evidence relating to a similar joint system can be furnished to the CM. Test data for such a similar jointing system made from the Works or used on other Authority contracts may be accepted for this purpose.

CON5.T330.9 TEST PROCEDURE

Arrange for testing to be carried out generally in accordance with the procedure stipulated in BS 5368:Part 2:1980 with the following modifications:

1. Test specimen prepared according to the Drawings and submitted to the Approved independent laboratory for testing;
2. The water-spraying system employed according to method No. 2 of BS 5368:Part 2:1980 but installed with additional nozzles to provide uniformity of water spray at the jointing system of the test specimen;
3. The spray set to apply water at a minimum rate of 5.0 litres/m²/min;
4. A maximum pressure difference Pmax maintained, as stated in BS 5368:Part 2:1980 Clause 8, of 1 kPa, together with the water spray for 15 minutes.

CON5.T340.9 JOINT PERFORMANCE

Do not cast or manufacture facade units prior to the proposed jointing system performing satisfactorily in the laboratory tests.

SITE WATERTIGHTNESS TESTS

CON5.T410.9 TESTING TRIAL UNIT

Testing arrangements:

1. Carry out watertightness tests to the jointing system of the full size trial samples specified in CON5.T110 in accordance with the procedures set out in CON5.T430;
2. Extend the watertightness tests to cover testing on joints of windows fixed to the full size trial sample all to the requirements specified in COM2.T210.

CON5.T420.A TESTING INSTALLED JOINTS

Testing samples:

1. Carry out watertightness tests in accordance with the procedures set out in CON5.T430 to all joints of the properly installed facade units not connected monolithically to in-situ concrete at the rate of 50% of each particular type, unless otherwise agreed by the CM, in locations as instructed by the CM or his representatives;
2. Where a jointing system is constructed in combination with joint sealing compound specified in CON5.M120, carry out the watertightness test prior to the application of the sealing compound to test the watertightness of the joint.

CON5.T430.9 TEST PROCEDURE

Test joints of each selected facade unit according to the procedures as follows:

1. Construct working platforms where necessary for carrying out water test safely;
2. Working from the exterior, wet the facade unit selectively, starting from the lowest horizontal joint, followed by the vertical joints and then the horizontal joint above;
3. Spray a continuous jet of water from a nozzle at a water pressure of 210 to 240 kPa at the nozzle inlet to the joint and perpendicular to the face of the facade unit. Move the nozzle slowly along the joint, at a distance of 300 mm from it, for a period of 5 minutes in every 1.5 metre of joint length while an observer carefully inspects on the interior side of the facade unit with the assistance of adequate lighting where necessary;
4. Unless otherwise Approved, use a nozzle to the requirements of the Architectural Aluminium Manufacturer's Association (AAMA) 501.2-83;
5. Repeat the process specified in sub-clause (3) above on all joints and joint intersections using increments of exposed joint length not exceeding 1.5 metres upward until all the joints are covered.

CON5.T440.9 WITNESSES TO TEST

All watertightness tests carried out on Site must be witnessed and certified both by the CM and the Contractor's representative.

CON5.T450.9 FAILURE OF UNITS

The facade units and joints are deemed to have failed if signs of water seeping through the joints or through the facade unit, including signs of damp patches, are observed during the test and within the subsequent 2 hours after the test.

CON5.T460.9 REMEDIAL WORK TO UNITS FOR RE-TEST AND ADDITIONAL TESTING

Non-compliance:

1. Carry out remedial work to facade units and joints which have failed the watertightness test. Methods of carrying out the remedial work are subject to Approval;
2. After the remedial work is completed, re-test the facade units and joints in accordance with the procedures set out in CON5.T430;
3. Repeat sub-clauses (1) & (2) above until the facade unit and joint comply with the specified criteria of watertightness;
4. For any one facade unit fails the watertightness test, carry out additional tests as follows:
    a. Select three additional samples as instructed by the CM or his representatives for testing. Each sample shall comprise three facade units of the same type as the failed facade unit;

b. Carry out watertightness test to the additional samples in accordance with the procedures set out in CON5.T430;

c. When any facade unit fails the test, repeat sub-clauses (1) & (2) above until the facade unit and joint comply with the specified criteria of watertightness.

5. Repeat sub-clause (4) above until all testing facade units and joints have complied with specified criteria of watertightness;
6. Bear all associated costs for the re-tests and additional tests as specified in the above sub-clauses. No extension of time will be allowed.

TESTING FIXINGS

CON5.T510.9 TENSILE TESTING

Testing method:

1. When directed test fixings and anchors to BS 5080:Part 1:1993.

CON5.T520.9 SHEAR TESTING

Testing method:

1. When directed test fixings and anchors to BS 5080:Part 2:1986.

SURVEILLANCE INSPECTION

CON5.T710.9 JOINT INSPECTION AT MANUFACTURER'S FACTORY AND BREAKING UP INSPECTION

For off-site casting:

1. Arrange transportation for the CM and/or his representatives and carry out joint inspections at the manufacturer's factory;
2. Carry out up to 4 breaking-up inspections which may be instructed by the CM, each comprising the following:
   a. Provide a sample of precast standard facade unit randomly selected by the CM or his representatives, break up the unit for inspection and remove the broken unit after inspection;
   b. Carry out the following inspection in the presence of the CM or his representatives:
      i. Reinforcement details including total number of bars and bar size in accordance with standard design drawings;
      ii. Bar pattern of the reinforcement used against the Mill Certificate and the requirements of purchaser test in CS2:2012;
      iii. The installation, markings and brand name of concealed electrical conduit, fittings and conduit accessories etc. when pre-installed electrical conduit system is installed.
3. In the event of sample failing to meet any one of the requirements in the breaking-up inspection above, take further samples according to the following formula until all samples satisfy the requirements as above:

   Nos. of further samples = $(n^2 - 2n + 3)$

   where n is equal to the total number of unsuccessful components;
4. Bear the costs of all further breaking up inspections that may be required under sub-clause (3) above and no extension of time will be allowed.

LIFTING ANCHOR

CON5.T810.9 DEFINITION OF BATCH

In this Specification, a batch is defined as any quantity of lifting anchor of the same type and same working load capacity, delivered to the casting yard as one consignment and covered by the same test certificate issued by the lifting anchor manufacturer.

CON5.T820.9 TYPE AND LOAD CAPACITY

Unless otherwise specified on Drawings, lifting anchors shall be either eye anchor type or foot anchor type, and with a working load of 0.25 times the ultimate load capacity.

CON5.T830.9 RATE OF SAMPLING

1. The rate of sampling for ultimate load capacity for each batch of lifting anchor shall be a minimum of one sample, which comprises three test specimens, for every 3,000 anchors or part thereof;
2. When Instructed, provide an additional sample comprising three test specimens for testing by DTC.

CON5.T840.9 COMPLIANCE CRITERION

No test result of ultimate load capacity of individual test specimen shall be less than 4 times the working load as stipulated in CON5.T820.

CON5.T850.9 SUBMISSION

Prior to the production of precast concrete components, provide test certificates issued by:

1. The lifting anchor manufacturer/agent supplier; and
2. An Approved testing laboratory employed by the manufacturer of precast concrete component on the ultimate load capacity of lifting anchors for each batch under the Quality Assurance System as stipulated in CON5.W030.

CON6 MOVEMENT JOINTS

MATERIALS

JOINT FILLERS

CON6.M010.9 COMPRESSIBLE JOINT FILLER

Quality requirements:

1. Firm, compressible, single thickness, non-rotting proprietary type approved by the CM.

CON6.M020.9 INORGANIC COMPRESSIBLE JOINT FILLERS, BOND BREAKERS AND BACKUP MATERIALS

Quality requirements:

1. Sheet form or strip and cord sections of an Approved type.

SEALANTS

CON6.M110.9 GENERAL

Refer to Worksection WAT5 for all sealants, primers, back-up materials and bond breakers.

WATER STOPS

CON6.M210.9 WATER STOPS

Quality requirements:

1. Of an Approved type made with prefabricated angle and intersection pieces with details on the type of materials required, its intended location and purpose of use as specified in the Project Specific Specification and on the Drawings.

PROPRIETARY EXPANSION JOINTS

CON6.M310.9 MECHANICAL EXPANSION JOINTS

Quality requirements:

1. From an Approved manufacturer with details on the type of materials required, its intended location and purpose of use as specified in the Project Specific Specification and on the Drawings.

ANCILLARY MATERIALS

CON6.M410.9 ADHESIVE FOR JOINT FILLER

Quality requirements:

1. Bituminous type recommended by the joint filler manufacturer.

WORKMANSHIP

GENERAL

CON6.W010.9 JOINT CONSTRUCTION

1. Construct joints strictly in accordance with the drawings and in accordance with the relevant manufacturer's recommendations;
2. Keep edges true, free from cracks, spalling or other imperfections. Ensure that edges or joints are clean and free from dust or grease immediately before fixing fillers or applying sealants.

CON6.W020.9 APPLYING SEALANTS

Refer to the Workmanship section of Worksection WAT5 for the application of primers, back-up materials bond breakers and sealants.

MOVEMENT JOINTS

CON6.W110.9 FIXING JOINT FILLER

Fix joint filler to the concrete with bituminous adhesive before casting the adjoining bay. Form a sealing slot by casting in a removable former.

CON6.W120.9 PLACING CONCRETE

Do not place concrete on both sides of a movement joint simultaneously.

WATER STOPS

CON6.W210.9 INSTALLATION

Adequately install waterstops to ensure their correct position is maintained during concrete placement.

CON6.W220.9 JOINTING

Make all joints using hot or cold vulcanizing.

CON6.W230.9 CONCRETING

Compact concrete fully around waterstops to ensure that no voids or porous areas remain.

CON7 PRECAST CONCRETE COMPONENTS (ENGINEER'S DESIGN)

DESIGN

GENERAL

CON7.D010.9 SCOPE OF THE WORK

Precast concrete components specified in this Worksection include:

1. Precast facades (including precast roof parapet);
2. Semi-precast slabs (including semi-precast roof slabs and semi-precast corridor slabs);
3. Precast balconies;
4. Precast staircases (including precast roof staircases);
5. Precast structural walls; and
6. Precast partition walls.

Refer to the Drawings for the extent of fixtures, finishing, fittings and building services installations associated with precast concrete components.

Refer to the Drawings and relevant Specification clauses for the scope of builders, structural and building services works to be prefabricated in off-site yards.

SUBMISSIONS

CON7.D110.9 LOADING OF INSITU STRUCTURAL MEMBERS

Submit calculations to demonstrate that the insitu structural members are not subject to excessive stresses arising from the erection method of the precast concrete components and to demonstrate the adequacy of any temporary supports which may be required.

PRECAST FAÇADE / PRECAST BALCONY - DESIGN PARAMETERS

CON7.D210.9 ERECTION RESTRAINTS

1. Design vertical and horizontal restraints for temporary connections of the precast façade / precast balcony to the main structure such that displacement of the precast façade / precast balcony unit cannot occur before making the permanent structural connection;
2. Design horizontal restraint to resist a minimum horizontal live load of ±0.5 kN/m run acting at 1.5 m from the base of the precast façade / precast balcony unit.

CON7.D220.9 ADJUSTMENT DEVICES

1. Provide the precast façade / precast balcony units with separate vertical and horizontal adjustment devices;
2. Do not use adjustment devices in the vertical plane for horizontal location devices or horizontal restraint and do not design such devices to take any permanent shear (horizontal) loads;

3. Do not design any adjustment devices in the horizontal plane to take permanent vertical loads.

MATERIALS

GENERAL

CON7.M010.9 RELEVANCE OF OTHER SPECIFICATION WORKSECTIONS

1. Construct precast concrete components for Standards Domestic in accordance with this Worksection and with the relevant provisions of the following Worksections:
   a. CON1, Insitu Concrete;
   b. CON2, Formwork;
   c. CON3, Reinforcement;
   d. CON4, Precast Concrete;
   e. COM11, Radio Frequency Identification and Web-Based Database System for Building Components.
2. Construct aluminium window or uPVC window frames in accordance with Worksections COM2 or COM3 respectively;
3. Where any ambiguity, discrepancy or conflict arises between this Worksection and any clauses in any other Worksections of this Specification, ensure that the provisions of this Worksection prevail.

PRECAST FACADE, PRECAST BALCONY, SEMI-PRECAST SLAB, PRECAST STRUCTURAL WALL AND PRECAST PARTITION WALL - CONDUIT SYSTEM

CON7.M110.9 STANDARDS

1. For rigid plain polyvinyl chloride (PVC) conduits, conduit fittings and PVC boxes, comply with the following British Standards:

Conduits and Fittings	British Standards
PVC conduits:	BS 6099:Section 2.2:1982(1988)
PVC conduits fittings:	BS 4607:Part 1:1984(1993)& BS 4607:Part 5:1982(1988)
PVC circular conduit boxes:	BS 4607:Part 5:1982(1988)
PVC boxes for electrical accessories:	BS 4662:1970(1989)

2. Ensure that all PVC conduits, fittings and boxes are of the same make.

CON7.M120.9 COLOUR

PVC conduits, fittings and boxes: white in colour.

CON7.M130.9 FLAME RESISTANCE

PVC conduits, fittings and boxes: non-flame-propagating and self-extinguishing.

CON7.M140.9 TEMPERATURE CLASSIFICATION

1. For all PVC conduits, fittings and boxes, comply with the temperature classification of -5 in accordance with BS 6099:Section 2.2:1982(1988);

2. For PVC conduits, where the ambient temperature at the country of manufacture is likely to be below -5ºC, the temperature classification is -25.

PRECAST FACADE, PRECAST BALCONY, SEMI-PRECAST SLAB, PRECAST STRUCTURAL WALL AND PRECAST PARTITION WALL - RIGID PLAIN PVC CONDUITS

CON7.M210.9 CONSTRUCTION AND SIZE

1. PVC conduits: rigid, plain and of a non-threadable type;
2. Nominal diameter of PVC conduits: within the range of 20 mm to 32 mm unless otherwise specified.

CON7.M220.9 MECHANICAL PROPERTIES

PVC conduits are:

1. Of heavy mechanical strength;
2. Capable of withstanding the heavy compression and impact tests specified in BS 6099:Section 2.2:1982(1988).

CON7.M230.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUITS

1. Rigid plain PVC conduits shall be type-tested for complete compliance with BS 6099:Section 2.2:1982(1988) by an Independent Accredited Laboratory or an Independent Short-Circuit Testing Organisation;
2. Upon request from CM, provide documentary evidence that the batch/consignment of PVC conduits delivered to Site have satisfied the requirement as stipulated in the relevant British Standards mentioned in sub-clause (1) above.

PRECAST FACADE, PRECAST BALCONY, SEMI-PRECAST SLAB, PRECAST STRUCTURAL WALL AND PRECAST PARTITION WALL - PVC CONDUIT FITTINGS

CON7.M310.9 CONSTRUCTION

1. Use plain, moulded slip-type couplers and expansion type couplers to BS 4607:Part 5:1982 (1988) in the jointing of conduits;
2. Use saddles and spacers in compliance with BS 4607:Part 1:1984 (1993) for fixing of conduits unless otherwise specified.

CON7.M320.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUIT FITTINGS

1. PVC conduit fittings shall be type-tested for complete compliance with the following British Standards by an Independent Accredited Laboratory or an Independent Short-Circuit Testing Organisation:

PVC Conduit Fittings	British Standards
Plain moulded slip type coupler	BS 4607:Part 5:1982(1988)
Male bush and female adaptor	BS 4607:Part 1:1984(1993)

2. Upon request from CM, provide documentary evidence that the batch/consignment of PVC conduit fittings delivered to Site have satisfied the requirement as stipulated in the relevant British Standards mentioned in sub-clause (1) above.

PRECAST FACADE, PRECAST BALCONY, SEMI-PRECAST SLAB, PRECAST STRUCTURAL WALL AND PRECAST PARTITION WALL - PVC CIRCULAR CONDUIT BOXES, PVC BOXES FOR ELECTRICAL ACCESSORIES AND PVC ADAPTABLE BOXES

CON7.M410.9 CONSTRUCTION AND DIMENSIONS

1. For PVC boxes and their covers, comply with the relevant British Standard specification listed in CON7.M110;
2. Fit all screw holes with metal inserts. Other than for PVC adaptable boxes, provide each box with a brass earthing terminal complete with screw for the connection of circuit protective conductor (CPC);
3. Ceiling-mounted circular conduit boxes: Deep pattern type having an internal depth of not less than 60 mm. Extension rings shall comply with BS 4607:Part 5:1982 (1988);
4. Mould each PVC box in one piece;
5. For dimensions of PVC adaptable boxes, comply with BS 4568:Part 2:1970 (1988).

CON7.M420.9 MECHANICAL PROPERTIES

1. For PVC boxes, comply with the requirements for mechanical properties stated in the relevant British Standard specification listed in CON7.M110;
2. PVC adaptable boxes are:
   a. Moulded;
   b. Of sufficient mechanical strength to withstand forces encountered in concealed conduit wiring system application;
   c. Complete with provision for prevention of deformation of the boxes where necessary.
3. Plastic boxes are of:
   a. Dimensions: can be interchangeable with steel boxes;
   b. Wall thickness: 2 mm minimum;
   c. Cover sizes: larger than the adaptable box on each edge by at least 5 mm.
4. Fit boxes for the suspension of luminaires or other equipment, where considerable heat will be produced with steel insert clips;
5. Do not use plastic boxes where:
   a. Temperature of the box is likely to exceed 60ºC; or
   b. The mass suspended from the box exceeds 3 kg.

CON7.M430.9 TYPE-TESTING FOR ELECTRICAL PVC CONDUIT BOXES

1. PVC circular conduit boxes, PVC boxes for electrical accessories and PVC adaptable boxes shall be type-tested for complete compliance with the following British Standards by an Independent Accredited Laboratory or an Independent Short-Circuit Testing Organisation:

PVC Conduit Boxes	British Standards
PVC circular conduit boxes	BS 4607:Part 5:1982(1988) with the following conditions: a. The marking of the PVC circular conduit boxes shall be 60/10 kg; b. The PVC circular conduit boxes shall be type-tested to 10 kg suspended load.

PVC boxes for electrical accessories	BS 4662:1970(1989)
PVC adaptable boxes	a. BS 4568:Part 2:1970(1988) Clause 6 Dimensions b. BS 4607:Part 5:1982(1988) Clause 7.3 Safety on impact test Clause 8 Resistance to heat Clause 9 Resistance to burning Clause 10 Insulating characteristics

2. Upon request from CM, provide documentary evidence that the batch/consignment of PVC conduit boxes delivered to Site have satisfied the requirement as stipulated in the relevant British Standards mentioned in sub-clause (1) above.

WORKMANSHIP

GENERAL

CON7.W010.9 CASTING YARD

Within one month from the notified date for commencement of the Works, submit for Approval on the following:

1. For on-Site casting:
   a. The location of casting yard for manufacture of precast concrete components;
   b. Details of plant and equipment including the location, boom radii and lifting capacities of cranes, gantry capacities, curing facilities, number of moulds and means of transporting the concrete components within the Site;
2. For off-Site casting:
   a. The name, casting yard address with street maps and job reference of the manufacturer and the following:
      i. Details of organisation structure and top management;
      ii. Self-certified true copy of the business licence of the manufacturer;
      iii. Annual production capacity of the casting yard in terms of concrete volume, numbers of products and the current workload;
      iv. Details of the Quality Assurance Scheme required in CON7.W030;
      v. Details of the audit plan and previous audit report, if any, carried out by the Precast Concrete Construction Audit Consultant required in CON7.W060;
      vi. Details of compliance with requirements of this specification on batching plant and concrete mixes in accordance with Worksection CON1;
      vii. Test results for quality tests being carried out for the precast concrete components to demonstrate the compliance with requirements of this specification;
      viii. Other details of construction quality as required in CON7.W120 (1).
   b. Scaled and dimensioned layout plan of the casting yard with fenced boundaries showing the office, the production lines for the products including hardstanding and covered casting yards, disposition of steel moulds, vibration plant, handling and lifting plants, steam or hot air curing room / facilities, storage areas for finished products, steel reinforcement storage and bending yards, storage sheds for incoming materials, samples room, batching plant if any, testing laboratory, concrete cubes curing facilities, means of transporting the concrete components to the Site;
   c. The laboratory for carrying out the tests and issuing test certificates shall be approved by the Housing Department, or accredited either by Hong Kong Accreditation Scheme (HKAS) under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS. All expenses / costs related to the tests carried out by the laboratory shall be borne by the Contractor.

CON7.W015.A MANAGEMENT SCHEMES FOR OFF-SITE CASTING

1. Ensure that the casting yards for the off-Site casting of precast concrete components are operating on the following management schemes:
   a. An Environmental Management Scheme certified under ISO 14001;

b. An Occupational Health and Safety Management Scheme certified under ISO 45001.

2. Submit the original or certified true copy of the respective certificates for the manufacturing plant within the following time frame:
   a. ISO 14001: At not later than 15 days before the commencement of the production of precast concrete components;
   b. ISO 45001: At not later than 12 months from the notified date for commencement of the Works.
3. When the photocopy of certificate is submitted, it shall be certified by the certification body or by the QCM. The certification body shall be accredited by the Hong Kong Accreditation Service (HKAS), or the China National Accreditation Service (CNAS), or an accreditation body which has entered into a mutual recognition agreement with HKAS for the respective certification.

CON7.W020.9 QUALITY ASSURANCE FOR ON-SITE CASTING

Within two months from the notified date for the commencement of the Works, submit for Approval details of the Quality Assurance Scheme for manufacturing the precast concrete components, in accordance with CON7.W040 to CON7.W050 as applicable.

CON7.W030.9 QUALITY ASSURANCE FOR OFF-SITE CASTING

Ensure that casting yards for the off-Site casting of precast concrete components are operating on a Quality Assurance Scheme certified under ISO 9001 in accordance with CON7.W040 to CON7.W060.

CON7.W040.9 QUALITY ASSURANCE SCHEME

1. Ensure that the precast concrete components are manufactured under a Quality Assurance Scheme which covers the following items and is certified under ISO 9001:
   a. Quality control tests of materials, including proprietary products such as lifting anchors for handling precast concrete components;
   b. Calibration of laboratory equipment for quality control tests;
   c. Efficiency and proper operation of equipment at the casting yard;
   d. Production process;
   e. Sampling/testing procedures and requirements by an independent Approved laboratory;
   f. Quality control procedures including the frequency and extent of inspection by manufacturer's staff and independent parties;
   g. Regular audits at a minimum frequency of once per month by manufacturer's staff and independent parties.
2. Endorse the Quality Assurance Scheme and submit to CM for approval at least 15 days before the commencement of the production of precast concrete components.

CON7.W045.9 PRECAST CONCRETE CONSTRUCTION AUDITING CONSULTANT

1. Select a consultant on the Architectural and Associated Consultants Selection Board's (AACSB) List of Structural Engineering Consultants (the "List") for CM's approval as the Precast Concrete Construction Auditing Consultant to carry out technical audits at the manufacturer's factory in accordance with the Code of Practice for Precast Concrete Construction 2016 issued by the BD;
2. A Precast Concrete Construction Auditing Consultant on the "List" in sub-clause (1) appointed by the manufacturer may be proposed for Approval;
3. Notify the CM immediately if there is any subsequent change of the Precast Concrete Construction Auditing Consultant during the course of services.

CON7.W050.9 QUALIFIED SUPERVISION

1. Assign a Precast Quality Control Manager (PQCM), with a minimum qualification and experience of a Grade T4 TCP in the civil or structural engineering discipline under the Registered Contractor's stream in the CoPSS, to certify all control documentation or test certificates required for the QA Scheme;
2. Assign a Precast Quality Control Coordinator (PQCC), with a minimum qualification and experience of a Grade T3 TCP under the Registered Contractor's stream in the CoPSS, to provide continuous supervision of the precast concrete production works at the casting yard;
3. Submit the details of the PQCM and the PQCC for Approval. For on-Site casting, it is permissible for the PQCM to be the same person as the QCM and the PQCC to be the same person as the SQCC;
4. Provide attendance to an RSE who is nominated by the CM, to carry out audit checks to the casting yard at least once every month;
5. The Authorized Signatory as stipulated in PRE.B6.060 is to carry out inspection and audit checks to the casting yard at least once every month and submit a monthly audit report to the RSE as stipulated in sub-clause (4) above and then to the CM for endorsement and onward submission to ICU.

CON7.W055.9 INSPECTION LOG BOOK

1. Record the following in an inspection log book:
   a. The names and qualifications of the supervisory personnel assigned by the CM and by the Contractor as stipulated in CON7.W050;
   b. The details of concrete production, inspection, auditing and testing.
2. Keep the inspection log book in the casting yard and provide a duplicate of the inspection log book on Site for CM's inspection when required.

CON7.W060.9 RECTIFICATION TO QUALITY NON-COMPLIANCE

1. For off-Site casting in CON7.W010 (2), the manufacturer shall be under regular technical audits in a manner as stipulated in CON7.W040 (1)(g) and supervision of the CM or his representatives resident at the manufacturer's factory;
2. The Contractor shall:
   a. Ensure that the manufacturer shall rectify any non-conformance to the Specification revealed by the audit or the supervision of CM's resident representatives and if necessary, modify the QA Scheme and temporarily suspend the manufacture of the precast concrete components until the non-conformance is rectified;
   b. Report to the CM of the non-conformance and rectification carried out.
3. Notwithstanding sub-clause (2) above, bear full responsibility to assure that all the precast concrete components delivered to Site comply with the requirements of the Specification at all times.

CON7.W070.9 DRAWINGS AND METHOD STATEMENT FOR ON-SITE CASTING

Within two months of the notified date for commencement of the Works, submit, for agreement, the following items:

1. Details of moulds, layout arrangements, casting methods (horizontal or vertical), tilting mechanism (if any), demoulding methods and the provision for attachments of openings for window fixing (if any);
2. The complete procedures for fabrication, curing, demoulding, application of finishes, lifting, transporting, storage, erection, grouting (if any);
3. Method of protecting the precast concrete components from damage at all times;

4. The proposed Radio Frequency Identification tag and the fixing method as specified in the Worksection COM11.

CON7.W080.9 PROGRAMME

Provide a programme for manufacture of the precast concrete components showing the rate of production for each month. For on site precasting, the dates for clearing the area of casting yard and associated plant upon completion of the manufacture of the precast concrete components must also be shown.

CON7.W090.9 EQUIPMENT

Ensure casting yards, erected on-Site or off-Site are equipped with all the necessary facilities, including efficient vibration plant, necessary curing facilities, storage, handling and lifting facilities to secure compliance with all the provisions of this Specification.

CON7.W100.9 USE OF CASTING YARD

Do not use any on-Site casting yard for manufacture of any components for other sites. See PRE.B8.010.

CON7.W110.9 SUBMISSION AND PILOT PRODUCTION RUN BEFORE APPROVAL

1. Submission:
   a. Submit the shop drawings, for the production of the precast components for Approval, including any proposed changes to the products so as to suit individual production process / plant;
   b. Use concrete mix for the manufacture of precast components all in accordance with the requirements in Worksection CON1;
   c. Provide relevant information / samples associated with the proposed precast components for Approval including:
      i. Engraved manufacturer's logo and casting date;
      ii. Printed precast concrete components identity numbers on surface of products;
      iii. Schmidt hammer test certificate and covermeter tests record endorsed by the manufacturer's Quality Control Personnel;
      iv. Delivery Order / Invoice;
      v. Import and Export Manifests or Bill of Lading.
   d. The proposed Radio Frequency Identification tag and the fixing method as specified in the Worksection COM11.
2. Before obtaining Approval for mass production, carry out a pilot production run with the CM or his representatives on the proposed manufacturer to demonstrate the technical capability and effectiveness of the Quality Management System;
3. In the pilot production run:
   a. Provide, for each category of products:
      i. One sample with the reinforcement fixed in steel mould for the inspection of workmanship including reinforcement fixing and provision of bar spacers;
      ii. One sample with concrete cast in steel mould for the inspection of conditions of the steel mould, checking of the finished sample.
   b. Carry out trial run to demonstrate the manufacturing process including installation of windows, lifting operation, curing, storage, fixing of mosaic tiles, quality tests at factory laboratory, applied finishes and quality controls in accordance with the required drawings and specification;
   c. Carry out verification check for engraved logo, casting date, identity number, Schmidt hammer test certificate and covermeter tests record, dimensions, size, spacing, position of starter bars and finishes.

4. The pilot production run may not be required, if the following documents are submitted and are acceptable to the CM:
   a. Track records on similar types of precast concrete components supplied by the proposed manufacturer to other HA construction projects, within five years prior to the notified date for commencement of the Works; or
   b. In the absence of the track records, detailed records of the pilot production run for similar types of precast concrete components carried out in other HA construction projects, within five years prior to the notified date for commencement of the Works.

CON7.W120.9 FIRST JOINT INSPECTION AT MANUFACTURER'S FACTORY

1. Prior to mass production, carry out the first joint inspection between the Contractor and the CM at factory for Approval on the minimum standard of the product for all subsequent concrete and the specified finish. Arrange for the transportation and provide all facilities for the first joint inspection;
2. Provide samples, including those samples in CON7.W110 (3)(a) and those accepted samples in previous pilot production run carried out in accordance with CON7.W110, for Approval as being representative of the minimum standard of the product for all subsequent concrete and the specified finish;
3. Maintain accepted sample of precast façade / precast balcony and semi-precast slab at a minimum of one number, or as directed by the CM, in an area in the factory and do not remove the accepted samples from the area unless otherwise instructed by the CM. Incorporate a further set of samples to the trial panel on Site;
4. Carry out further joint inspections as in CON7.T510.

PRODUCING PRECAST UNITS

CON7.W210.9 MOULDS

Construct and maintain moulds so that:

1. Dismantling and re-assembly of moulds after each casting allows the production of subsequent precast concrete components within permitted tolerance limits;
2. The positioning of securing components and fixings etc. are within the permitted tolerances;
3. Adequate stiffness for the control of dimensional tolerances is maintained.

CON7.W220.9 DEFECTIVE MOULDS

Replace any mould which fails to produce precast concrete components within the permitted tolerance limits as specified in Appendix H, the "Schedule of Tolerances".

CON7.W230.9 USE OF RELEASE AGENTS

Apply mould release agent of an Approved type, to the surfaces of moulds either by brush or by spraying before the fixing of steel reinforcement at a rate in accordance with the manufacturer's recommendations.

CON7.W240.9 CONCRETING, COMPACTION AND CURING GENERALLY

See CON1.

CON7.W250.9 EXTERNAL VIBRATORS

Obtain Approval for the use of external vibrators.

CON7.W260.9 CURING BY APPLICATION OF HEAT

Obtain Approval for heat curing by means of steam, hot air, etc. and:

1. Ensure that the total chloride content of the concrete mix for precast concrete components subject to heat curing, is less than 0.1% by weight of that of the cement;
2. Carry out a site trial to demonstrate the adequacy of the proposed method to the satisfaction of the CM.

CON7.W270.9 DEMOULDING GENERALLY

Demould by means of an Approved method and:

1. Do not use crowbars;
2. Do not subject the mould to any form of impact.

CON7.W280.9 CONCRETE STRENGTH BEFORE DEMOULDING

1. Demould the precast concrete components only after concrete has achieved the required strength;
2. To determine the concrete strength required for demoulding or handling:
   a. Make the necessary concrete cubes in pairs from the same batch of concrete used for casting the concrete components and cure the concrete cubes under the same conditions as the concrete in the precast concrete components;
   b. Specially identify the cubes and do not use them for normal quality control or for compliance testing;
   c. Determine the concrete cube strength by compression test as CON7.T110 and satisfy the CM that the concrete cubes have acquired the required strength before the demoulding or handling the precast concrete components.

CON7.W290.9 IDENTIFICATION AND RECORDS

1. Mark all precast concrete components with date of manufacture and a unique reference number;
2. Record in a master register the dates of casting, the concrete grades and the final locations of all precast concrete components;
3. Update records specified in above sub-clause (2) for all precast façade / precast balcony units to the RFID Web-Based Database System;
4. Upon delivery on Site, carry out covermeter tests to precast façade and precast acoustic balcony at specified locations as instructed by the CM.
5. Agree with the CM within 4 weeks from the notified date of commencement of the Works on the format and size of site works photographic records of covermeter tests for precast façade and precast acoustic balcony units. Submit one set of photographic records to the CM within 24 hours after the day of covermeter test showing all measurement locations and results.

CON7.W300.9 REQUIREMENTS OF OTHER TRADES AND COMPONENTS

Incorporate the requirements of all trades such as blockouts, recesses, notches, embedded metal works or any other items before casting the precast concrete components units.

ACCURACY AND TOLERANCES

CON7.W410.9 MANUFACTURING AND ERECTION TOLERANCES

1. Refer to:
   a. Code of Practice for Precast Concrete Construction 2016 published by the BD;
   b. Appendix H "Schedule of Tolerances" to this Specification.
2. Where any ambiguity, discrepancy or conflict arises between sub-clauses (1)(a) and (1)(b) above, the provisions given in Appendix H shall prevail.

CON7.W420.9 CHECKING TOLERANCES

Check the manufacturing dimensional tolerances of the precast concrete components by an Approved method for each type of components at a rate of 1 in every 10 units produced and report the result to CM within two days of checking.

CON7.W430.9 DEFECTIVE UNITS

1. Any precast concrete components that falls outside the tolerance limits is considered defective and must be replaced as Instructed. Indelible mark on rejected units for identification purposes;
2. In the event of the CM agreeing to accept any defective precast concrete components, execute all necessary remedial and modification work to the CM's satisfaction.

HANDLING, TRANSPORTATION AND STORAGE

CON7.W510.A LIFTING FRAME

1. Lift precast concrete components within the casting yard by means of a purpose-made steel lifting frame designed to the Code of Practice for the Structural Use of Steel 2011 issued by the Buildings Department;
2. Refer to PRE.B10.010 sub-clause (7) for the certification requirement of QE and / or RSE.

CON7.W520.9 INSPECTION

Inspect each precast concrete components before lifting to ensure that neither damage nor hazard occurs during lifting.

CON7.W530.9 LIFTING

Lift the precast concrete components only at appropriate lifting points as shown on the Drawings.

CON7.W540.9 LIFTING PLANT AND EQUIPMENT

1. Ensure plant used for lifting including cranes, hoists, lifting frames, hooks, etc possess adequate safety margins, are maintained in good working order and are regularly tested. Provide details of plant and maintenance records and current test certificates when required by the CM;
2. Maintain crane rope in a sound condition. Discard all frayed bridle ropes or slings;
3. Notwithstanding sub-clause (1) above, provide test certificates of lifting anchor to the CM in accordance with CON7.T610 to CON7.T650.

CON7.W550.9 LOADING AND OFF-LOADING

Carry out lifting for loading or off-loading the precast concrete components in one movement. Lift off and re-position any precast concrete components which is not properly positioned after lifting, rather than levering it into place.

CON7.W560.A TRANSPORT VEHICLES

Maintain lorries or trolleys used for the transportation of the precast concrete components in a good condition. Ensure trolleys are equipped with suspension systems to minimize shock loading. Refer to PRE.B8.295 for the safety measures to be taken for the delivery of materials by vehicles to site including the loading and unloading of precast concrete components.

ERECTING UNITS

CON7.W610.9 PROGRAMME

Provide a programme for the erection of the precast concrete components showing the rate of erection for each month. Make due allowance for all restrictions on the age of concrete in the precast concrete components for handling, storage, transportation and erection.

CON7.W620.9 SITE RECORDS

Provide, at the end of each week during erection of the precast concrete components, records in a form to be agreed with the CM, showing:

1. Dates and the locations of structural connections completed;
2. Dates of removal and locations of props and temporary supports to the precast concrete components.

CON7.W630.9 CM'S INSPECTION

Allow and facilitate inspection of the precast concrete components at any time before erection and after installation.

CON7.W640.9 QUALITY CONTROL PROCEDURES

Within three months from the notified date of commencement of Works, submit for Approval, details of erection of the precast concrete components under Approved quality control procedures covering the following:

1. Protective measures to avoid cracking and chipping;
2. Checking the accuracy of the insitu structural members receiving the precast concrete components, including location and level of all bearing surfaces, joints, bolts, horizontal and vertical restraining devices and adjustment devices. Carry out checking by means of a template or measurement frame or a similar Approved method;
3. Checking of erection tolerances.

CON7.W650.9 LIFTING UNITS INTO POSITION

1. Lift the precast concrete components by steel lifting frame complying with CON7.W510 except otherwise stipulated in sub-clause (4) and (5) below;
2. Maintain all cables connecting the lifting frame and the lifting points of the precast concrete components in a vertical direction. Provide the cables with devices for the adjustment of their length;
3. Do not allow devices such as sockets or bolts for lifting purposes to be used for fixing the precast concrete components to the main structure;
4. Submit detailed method statement including the design, drawing and installation procedures with endorsement of the Contractor's RSE demonstrating to the satisfaction of the CM that the precast concrete component will not subject to excessive stresses arising from their proposed erection method without the steel lifting frame, exemption from using the steel lifting frame as stated in sub-clause (1) above can be allowed only for the lifting of the following precast concrete components.
   a. Vertically lifting precast elements:

      Precast façade, precast balcony, precast structural wall, precast partition wall, precast refuse chute, lost form (semi-precast wall), precast roof parapet and precast A/C hood with the maximum horizontal dimension less than or equal to 1.8m;

   b. Horizontally lifting precast elements:

Full precast slab, semi-precast slab, precast staircase and precast tie beam with the maximum horizontal dimension less than or equal to 6m.

5. In connection with sub-clause (4) above, address the safety use of the proposed lifting anchor system, including but not limited to the proprietary anchor bolt with clutch. The proposed lifting anchor system shall be flexible enough to allow for both vertical and slant lifting sling.

CON7.W660.9 UNITS DAMAGED ON TRANSPORTATION, LIFTING OR ERECTION

Replace any precast concrete components which has been damaged on transportation, lifting or erection.

TRIAL UNIT

CON7.W710.9 GENERAL

Prior to mass production of the precast concrete component units:

1. Produce a full size trial sample for the precast façade / precast balcony unit and semi-precast slabs (if any) complete with joints, windows and glazing and the electrical conduit system installation and all finishing;
2. Maintain the Approved sample units as the yardstick for the standard and quality necessary for all precast concrete components;
3. When construction of a trial panel is required in CON2.W720, structurally connect the trial sample to surrounding structural frames and with interfacing services as detailed on the Drawings.

PRODUCING PRECAST FAÇADE / PRECAST BALCONY UNITS

CON7.W810.9 SCOPE OF WORK

For off-Site casting, coordinate with the precast concrete components supplier and include the following provisions with the precast facades and / or precast balconies delivered to Site.

1. Aluminium windows or uPVC windows obtained from a supplier approved by the CM in accordance with COM2.M005 or COM3.M010 respectively;
2. Pre-formed holes for the installation of drainage pipes;
3. Earthing lugs as shown on the Drawings;
4. Concealed electrical PVC conduit system installations as shown on the Drawings and as specified;
5. A certificate indicating the date of casting;
6. Work completion certificate for pre-installed electrical conduit system installation;
7. Embed Radio Frequency Identification tag as specified.

CON7.W820.9 MOULDS

Construct moulds from steel or other materials to produce a standard in accordance with the 'Surface finishes' specified in CON7.W850 to CON7.W900. Replace any mould which fails to comply with the standard.

CON7.W830.9 HORIZONTAL CASTING

Provide moulds designed to facilitate horizontal casting with devices to enable rotation from horizontal to vertical through 90° so that the precast façade / precast balcony units can be lifted vertically on demoulding.

CON7.W840.9 WINDOWS FIXING TO PRECAST FAÇADE / PRECAST BALCONY UNITS

Fix window frames / windows complete with or without opening sashes before casting the precast facade / precast balcony units as specified in COM2 Worksection and:

1. Obtain Approval for the method of fixing window frames / windows;
2. Do not fix window frames / windows into preformed openings after casting.

CON7.W850.9 SURFACE FINISHES TO EXTERNAL FACE

Finish outside faces except edges and overhang soffits to give an even textured surface suitable for fixing glazed ceramic tiles by adhesive, or cast the tiles into the mould.

CON7.W860.9 SURFACE FINISHES TO EDGES AND OVERHANG SOFFIT

Finish top, edge and soffit of overhang to give a smooth untextured surface suitable for applying acrylic paint.

CON7.W870.9 SURFACE FINISHES TO LIVING / DINING / BEDROOMS

Finish to give:

1. A smooth untextured surface suitable for applying plastic emulsion paint for rental blocks;
2. An even textured surface suitable for receiving internal cement lime plaster for SSF blocks as required by the Contract.

CON7.W880.9 SURFACE FINISHES TO BATHROOM

Finish to give an even textured surface suitable for fixing tiles by method as shown or specified on the Drawings.

CON7.W890.9 SURFACE FINISHES TO KITCHEN

Finish to give an even textured surface suitable for fixing tiles by method as shown or specified on the Drawings.

CON7.W900.9 SURFACE FINISHES TO UTILITY AREA

Finish to give an even textured surface suitable for fixing glass mosaic tiles by adhesive.

CON7.W910.9 STORING UNITS

1. Store the precast facade / precast balcony units in the vertical plane on a level, well drained and maintained concrete surface and protect against staining or physical damage;
2. Support the precast facade / precast balcony units by an Approved method to prevent their warping, bowing, chipping or cracking;
3. Store different types of precast facade / precast balcony units components separately;
4. The precast facade / precast balcony units shall be supported by a device in storage area to prevent toppling. For off-site casting yards, racks shall be used and detailed in the submitted QA scheme.

CON7.W920.9 TRANSPORTING FROM CASTING YARD

Stack precast facade / precast balcony units vertically, on vehicles during transportation from the casting yard and:

1. Support the precast facade / precast balcony units on special cradles so that the units are completely protected against damage and adverse stresses;
2. Provide the details of the support and the support locations to the CM for comment.

CON7.W930.9 PROTECTIVE MEASURE FOR ERECTING UNITS

Provide protective measures to avoid cracking and chipping of the precast facade / precast balcony units and damage to the applied finishes and to the built-in items such as window frames.

CON7.W940.A TEMPORARY SUPPORT

1. During fixing of the precast facade / precast balcony units, prop adjacent insitu structural members adequately to avoid excessive deflection or adverse stresses;
2. Maintain all temporary supports, props and restraints in position during casting of concrete in the structural joint. Remove temporary supports, props and restraints upon satisfactory testing and calculation to approval from the CM;
3. Unless specifically designed for, do not allow temporary support to be derived from the precast facade / precast balcony units fixed at lower floors;
4. For off-site casting, coordinate with the supplier regarding the details of all temporary supports, props and inserts to suit the proposed lifting and installation method;
5. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE and / or RSE.

CON7.W950.9 APPROVAL FOR PERMANENT FIXING

Do not carry out permanent jointing or connection between any precast facade / precast balcony unit and another, or to any part of the insitu structure, without prior Approval.

CON7.W960.9 CONDUIT INSTALLATION

Supply and install conceal rigid plain PVC conduit system complete with steel draw wires for precast facade and / or precast balcony as indicated on the Drawings.

CON7.W970.9 SHOP DRAWINGS OF CONDUITS

Prepare shop drawings, coordinate and agree with the Nominated Sub-contractor for electrical installation and Supplier for precast facade and / or precast balcony before submitting shop drawings for Approval.

CON7.W980.9 SUBMISSION AND APPROVAL OF CONDUITS

Submit for Approval technical details, samples and type-tested certificates for the conduit system as specified in clauses CON7.M230, CON7.M320 and CON7.M430.

CON7.W990.9 CONDUIT BENDS

Internal radius: at least 4 times the outside diameter of the conduit.

CON7.W1000.9 BENDING, JOINTING AND TERMINATING OF CONDUITS

Follow conduit manufacturers' recommendation for:

1. Method of carrying out the conduit bends and conduit joints;
2. Method of fixing conduits to boxes without spouts;
3. Use of tools and materials.

CON7.W1010.9 COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION

1. All conduits and accessories installed have to be certified by at least Grade A2 of Registered Electrical Workers (REW);

2. When delivered to Site, the precast concrete components must be accompanied with a Work Completion Certificate Form WR1(A) specified by Electrical and Mechanical Services Department which shall be duly signed by a Registered Electrical Contractor and a REW certifying that the pre-installed conduit system installation is in full compliance with the Specification and the Code of Practice for the Electricity (Wiring) Regulations;
3. A single certificate can be issued for delivered lots of precast concrete components which are produced in each production lot. The certificate shall also carry information e.g. reference number etc. for traceability purpose;
4. Provide CM and the Nominated Sub-contractor for Electrical Installation each a copy of the Work Completion Certificate for record.

PRODUCING AND ERECTING SEMI-PRECAST SLAB

CON7.W1105.9 ERECTION OF SEMI-PRECAST SLAB

1. For erection of semi-precast slab, refer to the drawings detailed in Project Specific Specification, which are provided for reference only;
2. Submit design calculations and detail drawings of the shoring layouts and details for CM's approval at least 4 weeks before commencement of constructing the erection support.

PRODUCING AND ERECTING SEMI-PRECAST SLAB

CON7.W1110.9 STORING AND TRANSPORTING

1. Unless otherwise Approved, the semi-precast slabs must be stacked and separated by 75 mm x 75 mm timber joints to the full length of the elements symmetrically placed next to the lifting hook and vertically aligned;
2. Provide details of the support and the support locations to the CM for comment;
3. Ensure that stacking of semi-precast slab does not generate unintended bearing, compressive, tensile or flexural stresses on the prefabricated reinforcement and conduit system.

CON7.W1120.9 CLEANSING AND CRACK INSPECTION BEFORE INSITU CONCRETE TOPPING

1. Remove all laitance, loose materials, dirt and grease from the top surface of the semi-precast slab to the satisfaction of the CM before applying insitu concrete topping:
   a. Use water jet with a minimum pressure of 10,000 kPa (100 bar) for cleansing;
   b. Maintain the cleansing as specified in sub-clause (a) above for a minimum period of 4 minutes per flat of about 30 m² and adjust the operation duration for different flat size.
2. After water-jet cleansing in sub-clause (1) above, check for cracks at the underside of semi-precast slab:
   a. Through cracks are deemed to exist if signs of water seepage or damp patches are observed at the bottom of semi-precast slab;
   b. Carry out crack remedial work under CON1.W1980 before applying insitu concrete topping to the semi-precast slabs.

CON7.W1130.9 CONDUIT INSTALLATION

Supply and install concealed rigid plain PVC conduit system completed with draw wires for semi-precast slab as shown on Drawings.

CON7.W1140.9 SHOP DRAWINGS OF CONDUITS

Submit to the CM for approval within two months prior to production, 5 sets shop drawings of conduits mounted on semi-precast slab, which have been coordinated and agreed with all relevant building services Nominated Sub-contractors and suppliers.

CON7.W1150.9 SUBMISSION AND APPROVAL OF CONDUITS

Submit for approval technical details, samples and type-tested certificates for the conduit system as specified in clauses CON7.M230, CON7.M320 and CON7.M430.

CON7.W1160.9 CONDUIT BENDS

Internal radius: at least 4 times the outside diameter of the conduit.

CON7.W1170.9 BENDING, JOINTING AND TERMINATING OF CONDUITS

Follow conduit manufacturers' recommendation for:

1. Method of carrying out the conduit bends and conduit joints;
2. Method of fixing conduits to boxes without spouts;
3. Use of tools and materials.

CON7.W1180.9 COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION

1. All conduits and accessories installed have to be certified by Registered Electrical Workers (REW) of Grade A2 or above;
2. When delivered to Site, the precast concrete components shall be accompanied with a Work Completion Certificate Form WR1(A) specified by Electrical and Mechanical Services Department which shall be duly signed by a Registered Electrical Contractor and a REW certifying that the conduit system installation is in full compliance with the Specification and the Code of Practice for the Electricity (Wiring) Regulations;
3. A single or multiple certificates shall be issued for delivered lots of precast concrete components which are produced in each production lot. The certificate shall also carry information, e.g. reference number, etc., for traceability purpose;
4. Provide the CM and the Nominated Sub-contractor for Electrical Installation each a copy of the Work Completion Certificate for record.

ERECTING PRECAST STAIRS

CON7.W1210.9 DOWEL FIXING

Locate box cutouts of precast stairs over cast-in dowel bars and fill with non-shrink grout.

CON7.W1220.9 BEDDING AND JOINTING

Bed and joint precast stairs in non-shrink grout or cement mortar where shown on Drawings.

PRODUCING AND ERECTING PRECAST STRUCTURAL WALL / PRECAST PARTITION WALL

CON7.W1310.9 STORING AND TRANSPORTING

Unless otherwise Approved, the precast structural walls / precast partition walls must be stacked and separated by 75 mm x 75 mm timber joints to the full length of the elements symmetrically placed next to the lifting hook and vertically aligned.

CON7.W1320.9 CLEANSING AND INSPECTION OF JOINTS BEFORE POURING SLAB CONCRETE

1. Before fixing the concealed conduits and void formers, remove all laitance, loose materials, dirt and grease from the top of the precast structural walls / precast partition walls by using high pressure waterjet with minimum pressure of 10,000 Kpa (100 bar) to the satisfaction of the CM;
2. Allow and facilitate inspection of joints by the CM before applying insitu concrete topping to the semi-precast slabs.

CON7.W1330.A TEMPORARY SUPPORT

1. During fixing the precast structural walls / precast partition walls, prop adjacent insitu structural members adequately to avoid excessive deflection or adverse stresses;
2. Maintain all temporary supports, props and restraints in position during applying insitu concrete topping to the semi-precast slabs. Remove temporary supports, props and restraints upon satisfactory testing and calculation to approval from the CM;
3. Do not use precast partition walls as temporary or permanent supports for other structural and non-structural members;
4. For off-site casting, coordinate with the supplier regarding the details of all temporary supports, props and inserts to suit the proposed lifting and installation method;
5. Refer to PRE.B10.010 sub-clause (6) for the certification requirement of QE and / or RSE.

CON7.W1340.9 PROTECTIVE MEASURE FOR ERECTING UNITS

Provide protective measures to avoid cracking and chipping of the precast structural walls / precast partition walls and damage to the applied finishes and to the built-in items such as fabricated U-channels and embedded steel plates.

CON7.W1350.9 BEDDING AND JOINTING

Locate embedded steel plates of precast structural walls / precast partition walls over cast-in locking steel plates. Bed and joint precast structural walls / precast partition walls in non-shrink cement mortar where shown on Drawings.

CON7.W1360.9 APPROVAL FOR PERMANENT FIXING

Do not carry out permanent jointing or connection between any precast structural walls / precast partition walls and another, or to any part of the insitu structure, without prior Approval.

CON7.W1370.9 CONDUIT INSTALLATION

Supply and install concealed rigid plain PVC conduit system completed with draw wires for precast structural walls / precast partition walls / precast lift shafts / volumetric precast concrete components etc. as shown on Drawings.

CON7.W1380.9 SHOP DRAWINGS OF CONDUITS

Submit to the CM for approval within two months prior to production, 5 sets shop drawings of conduits mounted on precast structural walls / precast partition walls, which have been coordinated and agreed with all relevant building services Nominated Sub-contractors and suppliers.

CON7.W1390.9 SUBMISSION AND APPROVAL OF CONDUITS

Submit for approval technical details, samples and type-tested certificates for the conduit system as specified in clauses CON7.M230, CON7.M320 and CON7.M430.

CON7.W1400.9 CONDUIT BENDS

Internal radius: at least 4 times the outside diameter of the conduit.

CON7.W1410.9 BENDING, JOINTING AND TERMINATING OF CONDUITS

Follow conduit manufacturers' recommendation for:

1. Method of carrying out the conduit bends and conduit joints;
2. Method of fixing conduits to boxes without spouts;
3. Use of tools and materials.

CON7.W1420.9 COMPLETION CERTIFICATION FOR ELECTRICAL CONDUIT SYSTEM INSTALLATION

1. All conduits and accessories installed have to be certified by at least Grade A2 of Registered Electrical Workers (REW);
2. Where delivered to Site, the precast concrete components must be accompanied with a Work Completion Certificate Form WR1(A) specified by Electrical and Mechanical Services Department which shall be duly signed by a Registered Electrical Contractor and a REW certifying that the conduit system installation is in full compliance with the Specification and the Code of Practice for the Electricity (Wiring) Regulations;
3. A single certificate can be issued for delivered lots of precast concrete components which are produced in each production lot. The certificate shall also carry information e.g. reference number etc. for traceability purpose;
4. Provide CM and the Nominated Sub-contractor for Electrical Installation each a copy of the Work Completion Certificate for record.

TESTING

SAMPLING AND TESTING GENERALLY

CON7.T010.9 RECORDS

1. Keep a complete record of all sampling and testing, in a form agreed with the CM;
2. Submit test reports and certificates to the CM within 14 days from the date of test.

CON7.T020.9 WITNESSING SAMPLING AND TESTING BY THE CM

The CM will witness any sampling and testing carried out under the Quality Assurance Scheme:

1. Make the records of sampling and testing available for inspection by the CM or his representatives resident at manufacturer's factory;
2. The CM or his representatives resident at manufacturer's factory is entitled to reject individual precast concrete components represented by any failed test result on the precast concrete component.

CON7.T030.9 TESTS AT MANUFACTURER'S FACTORY

Provide samples, all necessary facilities and attendance to the DTC or the CM or his representatives resident at manufacturer's factory to carry out the following tests:

1. Schmidt hammer tests and covermeter tests on the construction quality of precast concrete components;
2. Tests on concrete constituent materials, tests on compressive strength of concrete cubes and concrete cores, tests on reinforcement bars and tests on fabric reinforcement by the DTC and / or HDMTL.

CON7.T040.9 INSTALLATION OF RFID TAG IN CONCRETE CUBE FOR CUBE COMPRESSION TEST TO BE CARRIED OUT BY DTC OR HDMTL

1. Install a Radio Frequency Identification (RFID) tag as detailed on Sketch no. RFID/TAG/SK-01 onto the trowelled surface of each of the concrete cubes immediately after preparation of cubes at the manufacturer’s factory under the witness of the CM or his representatives resident at manufacturer's factory unless otherwise instructed by the CM;
2. The RFID tags are to be provided by DTC or the CM or his representatives resident at manufacturer's factory in batches;
3. Validate and scan the RFID tag with the Bluetooth RFID reader provided by DTC or the CM or his representatives resident at manufacturer's factory before use, and ensure that information such as tag unique identification (UID), electronic product code (EPC) number and timestamp have been uploaded to the PC provided by the DTC or the CM or his representatives resident at manufacturer's factory and incorporated into the DTC’s database system (through 3G or above internet service);
4. Input the mould number and / or sampling certificate number against the concerned tag EPC number through the DTC’s database system;
5. Before the tagged cubes are sent from the manufacturer’s factory to HDMTL or are collected by the DTC, scan the tag again using the Bluetooth RFID reader and ensure that information such as tag UID, EPC number and timestamp have been uploaded to the PC and incorporated into the DTC’s database system (through 3G or above internet service);

6. Deliver the tagged cubes to HDMTL or arrange the tagged cubes to be collected by the DTC with due care at a time such that a minimum of 4 days is allowed for curing the cubes in DTC or HDMTL before testing on compressive strength at 28 days by DTC or HDMTL;
7. In case any damaged RFID tags are discovered, report to the CM or his representatives resident at manufacturer's factory immediately without any delay;
8. Maintain an inventory record of all RFID tags including those damaged and submit the inventory record to the CM or his representatives resident at manufacturer's factory for endorsement.

TESTS ON WORKABILITY

CON7.T050.9 STANDARD

As CON1.T510.

CON7.T051.9 ACCEPTANCE VALUES FOR APPROVED CONCRETE MIXES

As CON1.T520.

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CUBES

CON7.T052.9 STANDARD

As CON1.T610.

CON7.T053.9 SAMPLES FOR DESIGNED CONCRETE MIXES

As CON1.T620.

CON7.T054.9 RESULTS FOR DESIGNED CONCRETE MIXES

As CON1.T630.

CON7.T055.9 COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES

As CON1.T640.

CON7.T056.9 TABLES OF COMPLIANCE REQUIREMENT FOR DESIGNED CONCRETE MIXES

As CON1.T650.

CON7.T057.9 NON-COMPLIANCE OF DESIGNED CONCRETE MIXES

As CON1.T660.

CON7.T058.9 FURTHER TESTS ON DESIGNED CONCRETE MIXES

As CON1.T670.

COMPRESSIVE TEST ON CONCRETE CUBES

CON7.T110.9 GENERAL

Testing arrangements:

1. Carry out tests on workability, make and cure concrete cubes made from the concrete used for casting the precast concrete components, by the Contractor / manufacturer for precast concrete components;

2. All details, including sampling frequency, of the concrete cubes tests must be in accordance with Worksection CON1;
3. The tests on compressive strength of concrete cubes shall be carried out by the DTC and / or HDMTL.

TESTS ON COMPRESSIVE STRENGTH OF EARLY CORES FOR PRECAST CONCRETE COMPONENTS EXCEPT SEMI-PRECAST SLAB AND PRECAST PARTITION WALL

CON7.T121.9 GENERAL

1. Provide all necessary facilities and attendance for carrying out coring and testing of concrete cores by DTC, including the provision of a secure and lockable storage for DTC to store the coring machine and other associated equipment;
2. Tests are to be witnessed and endorsed by the Contractor's representative and the CM or his representatives resident at manufacturer's factory;
3. Allow 2-day advance notice for preparation by DTC before the taking of core samples at the manufacturer's factory;
4. Upon completion of the taking of core samples by DTC at the manufacturer's factory, allow a minimum of 6 more days and a maximum of 15 more days for DTC to provide the core test results;
5. Make due allowance in the programme for the aforesaid arrangement and no claim for extension of time shall be allowed;
6. Subject to CM's approval, omission of early core test may be permitted for a particular batch of precast concrete components in order not to affect the construction work on Site. In such case, core test shall be carried out in accordance with the procedures set out in CON1.T710 to CON1.T760 to prove the compliance of that particular batch of precast concrete components to compressive test on cores as stipulated in this Specification.

CON7.T122.9 STANDARD

Comply with CS1:2010 in respect of the method of preparing, inspecting and testing concrete cores to determine the compressive strength except the measurement of saturated density.

CON7.T123.9 SIZE AND NUMBER OF EARLY CORE SAMPLES

Testing samples:

1. Provide necessary facilities and attendance to the taking of 3 Nos. of core samples by the DTC from each of the following precast concrete components for the same concreting day, at locations selected by the CM:
   a. Precast facades (including precast roof parapet);
   b. Precast balconies;
   c. Precast staircases (including precast roof staircases);
   d. Precast structural walls;
   e. Other precast elements as directed by the CM.
2. Size of core samples:
   a. 75 mm diameter core samples for precast concrete components;
   b. For vertically casted precast concrete components, the length of core samples shall be at least 90 mm;

c. For horizontally casted precast concrete components, the length of core samples shall be at least 90 mm plus top 50 mm or 20% of depth of concrete being cored whichever is greater.

CON7.T124.9 AGE OF EARLY CORE SAMPLES

1. Do not take cores for compressive test at ages less than 3 days;
2. Do not carry out compressive test on the core samples at ages less than 9 days.

CON7.T125.9 ASSESSING COMPRESSIVE STRENGTH OF EARLY CORES

In assessing the compressive strength of early cores, the precast concrete components of the same concreting day represented by the early cores are deemed to comply with this Specification if the compressive strength of the early core, when adjusted for length / diameter ratio and converted to estimated insitu cube strength in accordance with CS1:2010, is :

1. Not less than 85% of the specified grade strength for any individual results.

CON7.T126.9 NON-COMPLIANCE AND FURTHER TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES FOR PRECAST CONCRETE COMPONENTS

1. For precast concrete components of the same concreting day represented by the early cores that the compressive strength of the early cores comply with CON7.T125, their core test results are deemed to be acceptable under this Specification, and further coring test at 28 days is not necessary unless compressive strength test of concrete cube of the same batch of concrete not comply with CON7.T054 or instructed otherwise by the CM;
2. For precast concrete components of the same concreting day represented by the early cores that the compressive strength of the early cores do not comply with CON7.T125:
   a. if the concreting ages of the precast concrete components are less than 28 days, carry out further early core tests by DTC. If the result of the further early core test does not comply with CON7.T125, the precast concrete components are not allowed to be lifted into place or installed on Site, and further early core test may be carried out in accordance with this sub-clause;
   b. if the concreting ages of the precast concrete components are 28 days or over, carry out further core test by DTC in accordance with CON1.T710 to CON1.T760. If the result of this further core test does not comply with CON1.T760, the precast concrete components are not allowed to be lifted into place or installed on Site. All relevant concrete of precast concrete components represented by this further core test in the same concreting day is deemed not complying with this Specification. Investigate the extent of non-compliance and re-execute the works in accordance with CON1.T1210 to CON1.T1260.
3. Make due allowance in the programme for the aforesaid arrangement and bear all time and cost for compliance with this clause.

CON7.T127.9 MAKING GOOD CORE HOLES

As CON1.T770.

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES EXCEPT PRECAST PARTITION WALL

CON7.T128.9 GENERAL

As CON1.T710.

CON7.T129.9 STANDARD

As CON1.T720.

CON7.T130.9 SIZE AND NUMBER OF CORE SAMPLES

1. Testing samples:
   a. Provide necessary facilities and attendance for taking 3 Nos. 100 mm diameter cores by DTC from each of the following precast concrete components for the same concreting day, at the location selected by the CM:
      i. Precast facades (including precast roof parapets);
      ii. Semi-precast slabs with insitu concrete topping;
      iii. Precast balconies;
      iv. Precast staircases (including precast roof staircases);
      v. Volumetric precast bathroom (VPB) and / or Combined VPB components;
      vi. Volumetric precast kitchen (VPK) and / or Combined VPK and / or Combined VPB and VPK components;
      vii. Volumetric precast lift shafts;
      viii. Volumetric precast lift machine room;
      ix. Other precast elements as directed by the CM.
   b. Provide necessary facilities and attendance for taking 3 Nos. 75 mm diameter cores by DTC from the precast structural walls for the same concreting day, at the location selected by the CM.

CON7.T135.9 AGE OF CORE SAMPLES

As CON1.T740.

CON7.T136.9 NON-COMPLIANCE AND FURTHER TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES FOR SEMI-PRECAST SLAB

1. In the event that any of the core samples taken from the semi-precast slab with the insitu concrete topping debonds at the location between the semi-precast slab and insitu concrete topping, the core is deemed to be unacceptable for compression test. Take core from another slab that its insitu topping was cast on the same concreting day as the semi-precast slab with debonded core sample for compression test;
2. For the semi-precast slab panel with debonded core sample, the slab panel is deemed to be unacceptable. In addition, to confirm that debonding will not occur in other semi-precast slab panel of the same concreting day when insitu topping was cast, take further cores according to the following formula:

   Nos. of further cores = (n^2-2n+3).

   Where n is equal to the total number of unsuccessful cores, progressively until all cores are satisfactory (i.e. no debonding occurs). All semi-precast slab panels at which the cores had deboned shall be demolished and recast to the satisfaction of the CM all at contractor's own expense.

CON7.T140.9 CORE TESTING FOR SEMI-PRECAST SLAB

In respect of semi-precast slab, the concrete represented by the cores is to include:

1. The insitu concrete for the same concreting day;
2. The precast concrete slabs manufactured in the casting yard within the same casting day.

CON7.T150.9 REQUIREMENT FOR FURTHER CORE SAMPLES

As CON1.T750.

CON7.T160.9 ASSESSING COMPRESSIVE STRENGTH OF CONCRETE CORES

As CON1.T760.

CON7.T180.9 MAKE GOOD OF CORE HOLES

As CON1.T770.

CON7.T190.9 TESTING OF NON-SHRINK GROUT

As CON4.T070.

CON7.T200.9 TESTS ON COMPRESSIVE STRENGTH OF GROUT CUBES

As CON4.T080.

SCHMIDT HAMMER TESTS

CON7.T205.9 TESTING FREQUENCY

1. Provide all necessary facilities and attendance for carrying out of Schmidt hammer test on all structural element(s) of precast concrete components by the CM or his representatives resident at manufacturer's factory when the concreting age of the precast concrete components is at least 3 days;
2. Subject to CM's approval, the testing frequency may be reduced when satisfactory and consistent standard is established.

SITE WATERTIGHTNESS TESTS TO PRECAST FAÇADE / PRECAST BALCONY

CON7.T210.9 TESTING TRIAL UNIT

Testing arrangements:

1. Carry out watertightness tests to the jointing system of the full size trial samples specified in CON7.W710 in accordance with the procedures set out in CON7.T230;
2. Extend the watertightness tests to cover testing on joints of windows fixed to the full size trial sample all to the requirements specified in COM2.T210.

CON7.T220.A TESTING INSTALLED JOINTS

Testing samples:

1. Carry out watertightness tests in accordance with the procedures set out in CON7.T230 to all joints of the properly installed precast facade units not connected monolithically to in-situ concrete at the rate of 10% of each particular type in locations as instructed by the CM or his representatives;
2. Carry out watertightness tests in accordance with the procedures set out in CON7.T230 to all joints of the properly installed precast balcony units not connected monolithically to in-situ concrete at the rate of 50% of each particular type in locations as instructed by the CM or his representatives.

CON7.T230.9 TEST PROCEDURE

Test joints of each selected precast facade / precast balcony unit according to the procedures as follows:

1. Construct working platforms where necessary for carrying out water test safely;
2. Working from the exterior, wet the precast facade / precast balcony unit selectively, starting from the lowest horizontal joint, followed by the vertical joints and then the horizontal joint above;

3. Spray a continuous jet of water from a nozzle at a water pressure of 210 to 240 kPa at the nozzle inlet to the joint and perpendicular to the face of the precast facade / precast balcony unit. Move the nozzle slowly along the joint, at a distance of 300 mm from it, for a period of 5 minutes in every 1.5 metre of joint length while an observer carefully inspects on the interior side of the precast facade / precast balcony unit with the assistance of adequate lighting where necessary;
4. Unless otherwise Approved, use a nozzle to the requirements of the Architectural Aluminium Manufacturer's Association (AAMA) 501.2-83;
5. Repeat the process specified in sub-clause (3) above on all joints and joint intersections using increments of exposed joint length not exceeding 1.5 metres upward until all the joints are covered.

CON7.T240.9 WITNESSES TO TEST

All watertightness tests carried out on Site must be witnessed and certified both by the CM and the Contractor's representative.

CON7.T250.9 FAILURE OF UNITS

The precast facade / precast balcony units and joints are deemed to have failed if signs of water seeping through the joints or through the precast facade / precast balcony unit, including signs of damp patches, are observed during the test and within the subsequent 2 hours after the test.

CON7.T260.9 REMEDIAL WORK TO UNITS FOR RE-TEST AND ADDITIONAL TESTING

Non-compliance:

1. Carry out remedial work to precast facade / precast balcony units and joints which have failed the watertightness test. Methods of carrying out the remedial work are subject to Approval;
2. After the remedial work is completed, re-test the precast facade / precast balcony units and joints in accordance with the procedures set out in CON7.T230;
3. Repeat sub-clauses (1) & (2) above until the precast facade / precast balcony unit and joint comply with the specified criteria of watertightness;
4. For any one precast facade / precast balcony unit fails the watertightness test, carry out additional tests as follows:
    a. Select three additional samples as instructed by the CM or his representatives for testing. Each sample shall comprise three precast facade / precast balcony units of the same type as the failed precast facade / precast balcony unit;
    b. Carry out watertightness test to the additional samples in accordance with the procedures set out in CON7.T230;
    c. When any precast facade / precast balcony unit fails the test, repeat sub-clauses (1) & (2) above until the precast facade / precast balcony unit and joint comply with the specified criteria of watertightness.
5. Repeat sub-clause (4) above until all testing precast facade / precast balcony units and joints have complied with specified criteria of watertightness;
6. Bear all associated costs for the re-tests and additional tests as specified in the above sub-clauses. No extension of time will be allowed.

CORE TEST AND CRACK INSPECTION FOR SEMI-PRECAST SLAB

CON7.T410.9 CORE TEST IN SAMPLE FLAT UNIT

1. Testing samples:

The CM may select 3 Nos. of samples of standard cores through the roof slab at Trial Panels in CON7.W710 to determine the cleansing standard of semi-precast slab.

2. Non-compliance:

   If debonding is observed at the interface between the semi-precast slab and topping concrete, the cleansing standard under CON7.W1120 should be reviewed and the roof slab at Trial Panels recast for further core testing to the satisfaction of the CM.

SURVEILLANCE INSPECTION

CON7.T510.9 JOINT INSPECTION AT MANUFACTURER'S FACTORY AND BREAKING UP INSPECTION

For off-site casting:

1. Arrange transportation for the CM and/or his representatives and carry out joint inspections at the manufacturer's factory;
2. Carry out up to 4 breaking-up inspections which may be instructed by the CM, each comprising the following:
   a. Provide samples of precast concrete component randomly selected by the CM or his representatives, break up the component for inspection and remove the broken component after inspection;
   b. Carry out the following inspection in the presence of the CM or his representatives:
      i. Reinforcement details including total number of bars and bar size in accordance with standard design drawings;
      ii. Bar pattern of the reinforcement used against the Mill Certificate and the requirements of purchaser test in CS2:2012;
      iii. The installation, markings and brand name of concealed electrical conduits, fittings and conduit accessories etc. when pre-installed electrical conduit system is installed.
3. In the event of samples of a type of components failing to meet any one of the requirements in the breaking-up inspection above, take further precast concrete components of that particular type according to the following formula until all precast concrete components satisfy the requirements as above:

   Nos. of further samples = $(n^2 - 2n + 3)$

   where n is equal to the total number of unsuccessful components;
4. Bear the costs of all further breaking-up inspections that may be required under sub-clause (3) above and no extension of time will be allowed.

LIFTING ANCHOR

CON7.T610.9 DEFINITION OF BATCH

In this Specification, a batch is defined as any quantity of lifting anchor of the same type and same working load capacity, delivered to the casting yard as one consignment and covered by the same test certificate issued by the lifting anchor manufacturer.

CON7.T620.9 TYPE AND LOAD CAPACITY

Unless otherwise specified on Drawings, lifting anchors shall be either eye anchor type or foot anchor type, and with a working load of 0.25 times the ultimate load capacity.

CON7.T630.9 RATE OF SAMPLING

1. The rate of sampling for ultimate load capacity for each batch of lifting anchor shall be a minimum of one sample, which comprises three test specimens, for every 3,000 anchors or part thereof;
2. When Instructed, provide an additional sample comprising three test specimens for testing by DTC.

CON7.T640.9 COMPLIANCE CRITERION

No test result of ultimate load capacity of individual test specimen shall be less than 4 times the working load as stipulated in CON7.T620.

CON7.T650.9 SUBMISSION

Prior to the production of precast concrete components, provide test certificates issued by:

1. The lifting anchor manufacturer/agent supplier; and
2. An Approved testing laboratory employed by the manufacturer of precast concrete component on the ultimate load capacity of lifting anchors for each batch under the Quality Assurance System as stipulated in CON7.W040.

CON8 VOLUMETRIC PRECAST CONCRETE COMPONENTS FOR DOMESTIC BLOCKS

DESIGN

GENERAL

CON8.D010.9 DEFINITION OF VOLUMETRIC PRECAST CONCRETE CONSTRUCTION

Construction of three-dimensional precast concrete building components or units, with fixtures, fittings and finishes, but excluding the following precast concrete components:

1. Precast facades (including precast roof parapet) (refer to CON7);
2. Semi-precast slabs (including semi-precast roof slabs and semi-precast corridor slabs) (refer to CON7);
3. Precast balconies (refer to CON7);
4. Precast staircases (including precast roof staircases) (refer to CON7);
5. Precast structural walls (refer to CON7);
6. Precast partition walls (refer to CON7);
7. Precast refuse chutes (refer to CON4).

CON8.D020.9 USE OF VOLUMETRIC PRECAST CONCRETE COMPONENTS

Volumetric precast concrete components, including but not limited to the following, are covered by the specification in this Worksection:

1. Volumetric precast lift lobbies;
2. Volumetric precast kitchens;
3. Volumetric precast lift shafts;
4. Volumetric precast bathrooms;
5. Volumetric precast roof water tanks;
6. Volumetric precast ground floor water tanks;
7. Volumetric precast lift machine room.

CON8.D030.9 RELEVANCE OF OTHER SPECIFICATION WORKSECTIONS

1. Comply with the requirements of this Worksection and relevant provisions of the Specification, in particular, the following Worksections:
   a. CON1, In-situ Concrete;
   b. CON2, Formwork;
   c. CON3, Reinforcement;
   d. CON4, Precast Concrete;
   e. CON6, Movement Joints;
   f. CON7, Precast Concrete Components;
   g. COM2, Aluminium Windows and Louvres;
   h. COM3, uPVC Windows;
   i. COM5, Timber Doorsets;

j. COM11, Radio Frequency Identification and Web-based Database System for Building Components;
k. DRA1, Drainage Above Ground;
l. FIN1, Plastered and Rendered Finishes;
m. FIN3, Screeds;
n. FIN5, Floor and Wall Tiles and Slabs;
o. FIN6, Flexible Sheet and Tile Finishes;
p. FIN7, Painting;
q. MAS1, Brickwork, Blockwork and Panel Partitions;
r. MAS3, Mortar;
s. MET1, General Metalwork;
t. STR1, Structural Steel;
u. PLU1, Water Supply;
v. PLU2, Sanitary Appliances;
w. WAT5, Sealants;
x. WAT6, Proprietary Tanking and Waterproofing Systems.

2. Where building services installations are associated with volumetric precast concrete components, comply with the requirements and relevant provisions of the following Worksections:
   a. ELE1 - ELE31, Electrical Installation;
   b. FWP1 - FWP14, Fire Services & Water Pump Installation;
   c. LTE1 - LTE2, Lift Installation.
3. Where any ambiguity, discrepancy or conflict arises between this Worksection and any clauses in any other Worksections, the provisions of this Worksection prevail.

CON8.D040.9 DESIGN STANDARDS

1. For reinforced concrete structures, comply with CON1.M010;
2. For precast concrete, comply with CON4.D010 and Code of Practice for Precast Concrete Construction 2016 published by Buildings Department;
3. For structural joint design, comply with CON4.D020;
4. Where any ambiguity, discrepancy or conflict arises between this Worksection and any clauses in any other Worksections or standards, the most onerous conditions shall apply. Agree with the CM on the interpretation in advance of design.

SCOPE OF WORK

CON8.D110.9 GENERAL (ENGINEER'S DESIGN)

1. Refer to the Drawings for the extent of volumetric precast concrete components including the identification of parts of the component that will function as facades;
2. Refer to the Drawings for the extent of fixtures, finishing, fittings and building services installations associated with volumetric precast concrete components;
3. Refer to the Drawings and relevant Specification clauses for the scope of builders, structural and building services works to be prefabricated in off-site yards.

CON8.D120.9 SCOPE OF THE DESIGN (CONTRACTOR'S DESIGN)

Design the volumetric precast concrete components in accordance with the requirements specified in this Worksection, Worksections CON4 and CON7 as appropriate. Include the following in the scope of the design of those components:

1. The structural design of the volumetric precast concrete components;

2. The design of permanent structural connections between volumetric precast concrete components and/or building structure;
3. The design of the waterproof joints between volumetric precast concrete components functioning as a facade and/or the building structure;
4. The design of the installation of fixtures and finishes, including the finishing textures, associated with volumetric precast concrete components;
5. Building services installations as required and included in the fabrication of volumetric precast concrete components as a whole module;
6. Inspection method.

DESIGN PARAMETERS (CONTRACTOR'S DESIGN)

CON8.D210.9 STABILITY

Design the volumetric precast concrete components to be stable at all times. Provide designs for both the component and for any necessary temporary props, ties and supports.

CON8.D220.9 RESISTANCE TO PROGRESSIVE COLLAPSE

Design the volumetric precast concrete components in two ways, both as an assembly of individual walls and floors, and also as a complete unit in a progressive collapse design situation, providing additional ties to the rest of the structure for each case.

CON8.D230.9 DEFORMATIONS

Design the volumetric precast concrete components to be located in the structure without deforming excessively before all of the joints and permanent structural connections are made. Include consideration of any temporary stiffening, support jigs or frames in the design.

CON8.D240.9 INTERFACE WITH OTHER STRUCTURAL COMPONENTS

Design the volumetric precast concrete components so that all interfaces between other volumetric precast concrete components or the rest of the structure can be made neatly to the required standards of finish and tolerance.

CON8.D250.9 EXTERNAL FACES

Design the volumetric precast concrete components so that any external faces can be inspected before erection and the main jointing can be made safely from within the structural envelope.

CON8.D260.9 LOADING

1. Design the volumetric precast concrete components to be either load bearing or non load bearing to sustain all possible loading acting upon them;
2. If load bearing, then design the component to carry the loads placed on it in both the temporary and permanent situations taking into consideration of any creep on vertical shortening of walls which may be more highly stressed than outer adjacent precast or in-situ vertical load bearing elements;
3. Submit calculations to demonstrate that in-situ structural members are not subject to excessive stresses arising from the erection method of the volumetric precast concrete components and to demonstrate the adequacy of any temporary supports which may be required;
4. Where volumetric precast concrete components include a facade element, the loading conditions should be determined in accordance with CON5.D250.

CON8.D270.9 MINIMUM CONCRETE GRADE

Where volumetric precast concrete components include a facade element, the minimum concrete grade shall be Grade 35/20.

CON8.D280.9 CONCRETE COVER TO REINFORCEMENT

Minimum cover to reinforcing bars in the facade elements of the volumetric precast concrete components:

1. External face: 30 mm;
2. Internal face: 25 mm.

CON8.D290.9 CONCRETE COVER TO PVC CONDUIT

Minimum cover to PVC conduits concealed within volumetric precast concrete components: 30 mm.

CON8.D300.9 CONCEALMENT OF FIXINGS

Conceal all permanent fixing connections by Approved methods.

JOINTS

CON8.D410.9 JOINTS

Apply back-up materials, bond breakers and sealants in accordance with Worksection WAT5.

CON8.D420.9 GASKETS

Gaskets may be used in weatherproofing joints provided that:

1. The joint is horizontal; and
2. The gasket is always under compression.

CON8.D430.9 MORTAR STOPS

Use backing rods or other Approved methods as mortar stops in grouting panel joints when necessary.

WEATHERPROOF JOINTS (CONTRACTOR'S DESIGN)

CON8.D510.9 JOINT DESIGN

Design weatherproof external joints to be maintenance free, and ensure airtightness and watertightness in accordance with BS 6093:1993.

CON8.D520.9 TYPES OF JOINT

Use one of the following types of weatherproof joints in accordance with BS 6093:1993:

1. Sealed joint (one-stage joint);
2. Drained joint (two-stage joint).

CON8.D530.9 DESIGN WIDTH OF JOINTS

Design the joint width in accordance with BS 6093:1993 and BS 6213:1982.

PERMANENT STRUCTURAL CONNECTIONS

CON8.D610.9 GENERAL (CONTRACTOR'S DESIGN)

Design the permanent structural connections:

1. To withstand the stresses induced by the volumetric precast concrete components described in CON8.D260;
2. To be watertight;
3. To be of the same grade of concrete as that for the volumetric precast concrete components.

CON8.D620.9 REINFORCEMENT, SHEAR CONNECTORS ETC

Ensure reinforcement, shear connectors, etc used for the permanent structural connections are adequately embedded or anchored into the building structure.

CON8.D630.9 VERTICAL PERMANENT STRUCTURAL CONNECTIONS

At the vertical permanent structural connections between volumetric precast concrete components that are to be infilled,

1. Use non-shrink grout or concrete with non-shrinking additives if the minimum dimension is more than 150 mm;
2. Use only non-shrink grout if the minimum dimension is less than 150 mm.

CON8.D640.9 HORIZONTAL PERMANENT STRUCTURAL CONNECTIONS

For horizontal permanent structural connections, concrete with non-shrinking additives in lieu of non-shrink grout may be permitted subject to the provisions of CON4.M270.

DESIGN TOLERANCES

CON8.D710.9 OVERALL TOLERANCES (CONTRACTOR'S DESIGN)

1. Design the volumetric precast concrete components and the associated joints/connections to the in-situ structure, other volumetric precast concrete components, precast concrete components, architectural and building services installations, including all cast in elements, to conform with the relevant tolerances given in Appendix H and the Code of Practice for Precast Concrete Construction 2016;
2. Where any ambiguity, discrepancy or conflict arises between the tolerances given in Appendix H and the CoP for Precast Concrete Construction, the provisions given in Appendix H shall prevail.

CON8.D720.9 VOLUMETRIC PRECAST CONCRETE COMPONENTS MANUFACTURE TOLERANCE (CONTRACTOR'S DESIGN)

Design the volumetric precast concrete components and propose the manufacture tolerances in order to satisfy the overall tolerances given in Appendix H and Code of Practice for Precast Concrete Construction 2016, taking into account the erection tolerances.

CON8.D730.9 VOLUMETRIC PRECAST CONCRETE COMPONENTS ERECTION TOLERANCE

Propose a set of erection tolerances that is in compliance with the overall tolerance allowed when taken together with the set of manufacture tolerances proposed taking into consideration all possible interfaces with adjacent precast units or in situ elements.

LIFTING OF VOLUMETRIC PRECAST CONCRETE COMPONENTS

CON8.D810.9 LIFTING DESIGN

1. Ensure that the design of the lifting mechanism for volumetric precast concrete components provides a safe and robust means of lifting and holds the component in a truly vertical position and is adjustable to ensure verticality if necessary;
2. Submit for Approval the proposed lifting positions and any points of attachments on the components for lifting slings if not shown on the drawings.

CON8.D820.A STEEL LIFTING FRAMES

1. Design and construct steel lifting frames in accordance with the Code of Practice for the Structural Use of Steel 2011 issued by the Buildings Department;
2. Refer to PRE.B10.010 sub-clause (7) for the certification requirement of QE and / or RSE.

CON8.D830.9 LIFTING METHOD

Ensure that:

1. The design for lifting takes into account all loads on the component, friction against mould faces, snatch, impact and self weight of all fittings, lifting frame and equipment with an appropriate factor of safety;
2. Any lifting system that has a number of bolts, chains or ropes that work in parallel, is either designed such that all internal loads are calculable and statically determinate or, if not, that each bolt, chain, or rope possesses sufficient reserve of strength for any likely load distribution;
3. The equipment is capable of supporting the component if any single individual fastening, chain or bolt fails, taking into account any realignment of the component as it moves to place the centre of gravity under the new lifting arrangement.

SUBMISSIONS

CON8.D910.9 TENDER DESIGN PROPOSAL

Submit for Approval, full details of tender design proposals including drawings, specifications, layouts, details, calculations and any other information required.

CON8.D920.9 REGISTERED STRUCTURAL ENGINEER

All structural drawings, layouts, details and calculations submitted, including those submitted with tender, must be prepared and signed by a Registered Structural Engineer registered under Buildings Department of the Government of Hong Kong Special Administrative Region.

CON8.D930.9 PROGRAMME FOR SUBMISSIONS

1. Agree with the CM a programme for all submissions during the Contract prior to the notified date for commencement of Works;
2. Agree with the CM a programme for all ICU submissions for building works prior to the notified date for commencement of Works;
3. Within one month after the notified date for commencement of the Works, submit to the CM for approval, a programme for the design, planning and coordination with NSCs, ICU approval, manufacturing, erection and testing of a study mock up of the volumetric precast concrete components;
4. No extension of time will be allowed for any delay related to ICU's approval.

CON8.D940.9 DRAWINGS AND METHOD STATEMENT (CONTRACTOR'S DESIGN)

Within two months after the notified date for commencement of the Works, submit the following to the CM for review and comment:

1. 5 sets of design drawings;
2. 5 sets of shop drawings including, but not limited to, coordinated services drawings, combined builder's works drawings, building services drawings, fixtures and fittings drawings. All shop drawings shall be fully dimensioned with tolerances and properly coordinated;
3. Calculations and any other information indicating the location of the volumetric precast concrete components and any changes resulting from the use of volumetric precast concrete components;
4. Calculations which show all loading imposed on the volumetric precast concrete components due to lifting, handling, stacking, shock or any other reason, complies with the relevant standards, unless specified otherwise;
5. Jointing details and/or permanent structural connections, which can accommodate building movements, between the proposed volumetric precast concrete components and insitu concrete;
6. Design of moulds with tolerance, layout arrangements, casting methods (horizontal or vertical), tilting mechanism, demoulding methods and the provision for attachments of openings for door and / or window fixing;
7. The complete procedures for fabrication, curing, demoulding, application of finishes, lifting, transporting, storage, erection of volumetric precast concrete components, installation of weatherproof joints, and its associated temporary works;
8. Method for identifying and recording the daily production of volumetric precast concrete components and their final position after installation;
9. Method of protecting the volumetric precast concrete components, including all building services installations and associated equipment fabricated within the units, from damage at all times;
10. Minimum concrete strength required for the volumetric precast concrete components for demoulding, handling, storage, transportation and erection;
11. Position and design of lifting points with tolerances;
12. Calculated weight and size, including projections beyond transportation vehicles, of each type of volumetric precast concrete components;
13. The proposed Radio Frequency Identification tag and the associated fixing method as stipulated in Worksection COM11.

CON8.D950.9 DRAWINGS AND METHOD STATEMENT (ENGINEER'S DESIGN)

Within two months after the notified date for commencement of the Works, submit the following to the CM for review and comment:

1. Design of moulds with tolerance, layout arrangements, casting methods (horizontal or vertical), tilting mechanism, demoulding methods and the provision for attachments of openings for door and/or window fixing;
2. The complete procedures for fabrication, curing, demoulding, application of finishes, lifting, transporting, storage, erection of volumetric precast concrete components, installation of weatherproof joints and its associated temporary works;
3. Method for identifying and recording the daily production of volumetric precast concrete components and their final position after installation;
4. Method of protecting the volumetric precast concrete components, including all building services installations and associated equipment fabricated within the units, from damage at all times;
5. The proposed Radio Frequency Identification tag and the associated fixing method as stipulated in Worksection COM11;

6. 5 sets shop drawings of volumetric precast concrete components, which have been coordinated and agreed with all relevant building services Nominated Sub-contractors and suppliers.

STRUCTURAL MODIFICATIONS TO THE BUILDING STRUCTURE (ENGINEER'S DESIGN)

CON8.D1010.9 CONTRACTOR'S RESPONSIBILITY (ENGINEER'S DESIGN)

The Contractor's responsibility for the design of his proposed modification is covered under GCC Clauses 5.15 and 11.8 and the Appendix E to the Specification.

CON8.D1020.9 COMPLIANCE WITH GUIDELINES AND REGULATIONS (ENGINEER'S DESIGN)

Any proposed structural modifications to the building structure must comply with the following:

1. The structural design guidelines as appropriate to the building structure published by the Housing Department and included as Appendix E to this Specification;
2. The relevant Regulations, PNAP, CoP, etc. currently in use.

CON8.D1030.9 REINFORCEMENT CHANGES (ENGINEER'S DESIGN)

Obtain CM's Approval for any proposed changes to reinforcement details, as shown on the Drawings, required to suit the proposed method of casting and installation.

STUDY MOCK-UP

CON8.D1110.9 GENERAL

1. Set up a study mock-up in order to demonstrate, prior to mass production, that the use of the proposed volumetric precast concrete components is feasible and that the volumetric precast concrete components are constructable, structurally safe, architecturally and functionally satisfactory when gauging against the following aspects:
   a. Buildability - speed, safety, structural & building services connections & interfaces, safe system of working;
   b. Tolerances, accuracy;
   c. Quality;
   d. Manufacturing process;
   e. Joint integrity;
   f. Testing on watertightness, strength and, structural integrity.
2. Implement any improvements shown to be necessary to the proposed volumetric precast concrete components in a timely manner to ensure that mass production of such components will meet the required standards and to minimise risk associated with new construction processes and methods.

CON8.D1120.9 LOCATION OF CASTING YARD

Within one month of the notified date for the awarded tender, state the location of the casting yard for the manufacture of the study mock-up for CM's approval.

CON8.D1130.9 SIZE OF STUDY MOCK-UP

1. Unless otherwise agreed by the CM, the study mock-up should be at least 2 storeys high, comprising all the different types of volumetric precast concrete components (except volumetric precast lift shafts) that will be adopted for construction in a typical floor with modular layout, for demonstrating all interfaces and joints with adjacent units, either in-situ or precast elements;
2. The study mock-up shall be in accordance with the overall size, shape, layout and external envelope of the typical floor. For Engineer's design, the actual extent of the study mock up is as shown on Drawings.

CON8.D1140.9 EXTENT OF COVERAGE OF STUDY MOCK-UP

Unless otherwise agreed by the CM, the study mock-up should include all internal and external finishes, doors and windows, electrical lighting, fittings, sockets, concealed conduits, sanitary fittings, internal and external services, plumbing and drainage, and any other accessories required for the proper functioning of the volumetric precast concrete components.

CON8.D1150.9 RESPONSIBILITIES OF THE CONTRACTOR

1. Be responsible for the design, submission, manufacture, transportation and installation of the proposed volumetric precast concrete components for the study mock-up;
2. All structural submissions, such as design principles, calculation and construction details, etc. shall be prepared and endorsed by a Registered Structural Engineer (RSE), registered with the Buildings Department as mentioned in CON8.D920;
3. Demonstrate that the design of the study mock-up can sustain the required dead, imposed, wind load and any other loads;
4. Design and execute any temporary works for the safe erection of the study mock-up;
5. Coordinate the interfacing works of the building services installation contained within the proposed volumetric precast concrete components of the study mock-up;
6. Allow adequate time for the application of design approval from the ICU prior to mass production of the volumetric precast concrete components;
7. Acquire the necessary approval from the relevant Authorities related to the following aspects:
   a. Architectural;
   b. Structural;
   c. Building services;
   d. Safety;
   e. Environmental.
8. Submit a method statement, together with all necessary shop drawings, for the study mock-up for review and comment by the CM prior to its execution. The method statement shall contain details on the manufacturing and transportation of the volumetric precast concrete components as well as their construction methodology, construction cycle, labour force required, major machineries and plants to be employed, and detailed work program;
9. Construct the study mock-up in strict accordance with the commented shop drawings and all methods of the study mock-up joint assembly are to faithfully represent actual job conditions. Do not use special measures or techniques that are not representative of those to be used on the building;
10. After the completion of the erection of the study mock-up, submit a report detailing the following:
    a. Assessment of the performance of the study mock-up and identification of any deficiencies or defects, conflicts or interface with building services;

b. Proposed improvement measures, covering the design, manufacture, transportation and erection aspects of the study mock-up;
c. Dimensional checking results;
d. Test results;
e. RSE's appraisal of the jointing system;
f. Digital photographs and video records of the erection procedures, in particular the fixing of the jointing system, and any in-situ testing.

11. Bear all costs for any required laboratory and field tests, including any additional fees, penalties or retest costs, and no extension of time will be allowed for any delay related to ICU's approval.

CON8.D1160.9 SHOP DRAWINGS

1. Coordinate the study mock-up drawings in order to construct the mock-up including adjacent interfacing elements, either in-situ or other precast components;
2. Submit 2 sets of shop drawings of the study mock-up, which include plans, elevations, sections and jointing details for review and comment by the CM prior to its manufacturing;
3. Submit 2 sets of Coordinated Services Drawings (CSD) and/or Combined Builders Work (CBW) Drawings of the study mock-up, demonstrating the proper coordination of interfacing works of the building services installation, for review and comment by the CM prior to its manufacturing.

CON8.D1170.9 CM'S COMMENT AND INSPECTION OF STUDY MOCK-UP

1. Do not commence the manufacturing and erection of the study mock-up until the comments from CM on the submitted shop drawings and proposed method statement had been received;
2. Alter or revise the study mock-up as directed upon CM's inspection.

CON8.D1180.9 AS-BUILT DRAWINGS FOR APPROVAL

1. Submit one set of as-built drawings, including as-built CSD and/or CBW, immediately upon completion of the study mock-up for Approval;
2. Incorporate and clearly shown on the as-built drawings any changes made to the study mock-up or deviations from the previously commented shop drawings.

CON8.D1190.9 MAINTENANCE MANUAL

Submit a maintenance manual for the replaceable structural items of the volumetric precast concrete components. This should be developed in parallel with the study mock-up and should include, but not be limited to, the following information:

1. Name, address and telephone number of each firm and/or Sub-contractor involved in the supply of materials, components and/or assemblies of the replaceable structural items;
2. A clear and concise description of the method used to construct the concerned replaceable structural items;
3. Copies of certification and test reports of the material and/or component of the replaceable structural items;
4. A method statement covering the procedures for replacement of damaged or otherwise defective materials or components of the structural items, and materials and components that have a design life less than the design life of the volumetric precast concrete components and will therefore require replacement during the life of the volumetric precast concrete components;

5. Recommendations for routine maintenance, cleaning, suitable cleaning agents and any special inspection method of the materials and/or components of the replaceable structural items;
6. A full set of Approved as-built drawings, described in CON8.D1180, with particular emphasis on the details of the replaceable structural items;
7. The terms and conditions of any guarantees or warranties associated with the installed materials or components of the replaceable structural items.

CON8.D1200.9 CM'S APPROVAL TO PROCEED

Obtain CM's Approval to proceed with the mass production of volumetric precast concrete components.

CON8.D1210.9 VALIDATION OF DESIGN ON STUDY MOCK-UP

1. Conduct testing to the study mock-up in accordance with the relevant clauses of Worksections CON4, CON7 and CON8, subject to CM's agreement;
2. All joints and permanent structural connections, as demonstrated on the study mock-up which are designed to withstand any loadings, shall be tested in a HOKLAS laboratory to demonstrate their effectiveness in the transfer of loadings;
3. Carry out watertightness test to all external vertical and horizontal joints and permanent structural connections, as demonstrated on the study mock-up, in accordance with the procedures set out in CON8.T320;
4. Where a joint or permanent structural connection, as demonstrated on the study mock-up, is designed in combination with joint sealing compound specified in WAT5.M180, carry out the watertightness test prior to the application of the sealing compound to test the watertightness of the joint or permanent structural connection;
5. Conduct all necessary tests to the study mock-up in the presence of the CM or his representatives.

CON8.D1310.9 CORE TEST TO STUDY MOCK-UP

1. Upon completion of grouting of joints and permanent structural connections, with large box out, of the study mock-up, provide all necessary facilities and attendance for concrete cores to be taken out from the grouted joints and permanent structural connections;
2. Take 3 nos. 100 mm diameter cores from selected grouted joints or permanent structural connections, as demonstrated on the study mock-up, to validate the effectiveness of the proposed grouting procedure for the joints or permanent structural connections;
3. In the event that any of the cores taken show any signs of irregularity or voids, such core and grouting procedure are deemed to be unacceptable. Review and revise the grouting procedures accordingly;
4. Replace and re-grout all such joints or permanent structural connections on the study mock-up, at which the cores show signs of irregularity or voids, and repeat the core test as described in sub-clause (2) above to the satisfaction of the CM;
5. Bear all costs of any further cores and no extension of time will be allowed.

MATERIALS

GENERAL

CON8.M010.9 RELEVANCE OF OTHER SPECIFICATION WORKSECTIONS

1. Construct volumetric precast concrete components in accordance with this Worksection and the relevant provisions of the following Worksections:
   a. CON1, In-situ Concrete;
   b. CON2, Formwork;
   c. CON3, Reinforcement;
   d. CON4, Precast Concrete;
   e. CON6, Movement Joints;
   f. CON7, Precast Concrete Components;
   g. COM11, Radio Frequency Identification and Web-based Database System for Building Components.
2. Construct architectural, plumbing & drainage and structural works in accordance with the Worksections listed in CON8.D030;
3. Construct building services installations in accordance with the Worksections listed in CON8.D030;
4. Where any ambiguity, discrepancy or conflict arises between this Worksection and any clauses in any other Worksections of this specification, the provisions of this Worksection shall prevail.

SUBMISSIONS

CON8.M110.9 CONCRETE MIX

As CON1.

CON8.M120.9 DETAILS OF WEATHERPROOFING

Within two months of the notified date for the commencement of Works, submit details of weatherproofing materials in accordance with CON4.M310 and CON4.M320 for Approval, including technical information, samples, test reports and proven performance records of proposed materials.

CON8.M130.9 CONDUIT SYSTEM

Submit technical details and samples of the conduit system for Approval before commencement of works.

CONCRETE

CON8.M210.9 CONCRETE MIX

The concrete mix shall satisfy the requirements of CON1.M810 - CON1.M850, CON1.M1010 - CON1.M1040, CON1.M1110 - CON1.M1200, the functional and durability requirements of the volumetric precast concrete components, and comply with the relevant provisions of CON1.M730.

CON8.M220.9 CONCRETE STRENGTH

Design the mix to have a sufficient compressive and tensile strength. The compressive strength of the mix in load bearing components shall be compatible with the strength of other adjacent load bearing components.

CON8.M230.9 DURABILITY

Use the appropriate concrete mix for volumetric precast concrete components which is compatible with the defined exposure conditions of the internal and external faces of the components.

CON8.M240.9 NON-SHRINK GROUT AND CONCRETE WITH NON-SHRINK ADDITIVES

As CON4.M230 to CON4.M270.

JOINTS

CON8.M310.9 WEATHERPROOF JOINTS

As CON4.M310 to CON4.M340.

PERMANENT STRUCUTURAL CONNECTIONS

CON8.M410.9 RESISTANCE TO CORROSION

All metal parts of permanent structural connections must either be:

1. Corrosion resistant, being constructed of non-ferrous metal or stainless steel but avoiding any contact of such materials with the reinforcement; or
2. Protected against corrosion by an Approved method.

CONDUIT SYSTEMS

CON8.M510.9 GENERAL

Conduit systems incorporated into volumetric precast concrete components shall comply in general with the requirements of clauses CON7.M110 to CON7.M430 inclusive.

DIMENSIONS AND TOLERANCES

CON8.M610.9 DIMENSIONAL CHECK

1. Ensure that manufacture tolerances are met by checking the volumetric precast concrete components using suitably designed jigs and gauges;
2. Provide a means of checking the jigs and gauges which cannot be damaged.

ON SITE DELIVERY VERIFICATION

CON8.M710.9 INSPECTION

1. Carry out the following verifications for volumetric precast concrete components upon delivery on Site in the presence of the CM or his representatives:
   a. Method:

Verification Items	Method	Acceptance Standards
Date of manufacture and unique reference number	Visual inspection, document check against master register	No anomalies, evidence of QA checks
Required finishes (both internal and external), provisions and fixtures	Visual inspection	Full compliance with Approved as-built drawings for the study mock-up, no damage, no substandard repair
Sharp corners	Visual inspection	No damage, no substandard repair
Embedded conduits	Visual inspection	Open ends properly plugged; availability of draw wire inside conduits, correct brand name, size, alignment and setting out as per Approved as-built drawings of the study mock-up
Conduit boxes	Visual inspection	Properly sealed, no signs of inflow of concrete
Socket / switch boxes	Visual inspection	No damage, correct brand name and size as per Approved as-built drawings of the study mock-up
Starter bars	Visual inspection	Correct size and numbers as per Approved as-built drawings of the study mock-up

b. Frequency:

Verification Items	Sampling Frequency	Representative Consignment
Date of manufacture and unique reference number	100%	All volumetric precast concrete components delivered to Site
Required finishes (both internal and external), provisions and fixtures	100%	All volumetric precast concrete components delivered to Site
Sharp corners	100%	All volumetric precast concrete components delivered to Site
Embedded conduits	100%	All volumetric precast concrete components delivered to Site
Conduit boxes	100%	All volumetric precast concrete components delivered to Site
Socket / switch boxes	100%	All volumetric precast concrete components delivered to Site

Starter bars	100%	All volumetric precast concrete components delivered to Site

c. Keep proper record of inspections, together with photographs, for CM's inspection at any time.

2. Non-compliance:

a. In case of non-compliance, identify clearly such volumetric precast concrete components;

b. Repair such identified volumetric precast concrete components in accordance with the Approved repair methods / procedures as per CON8.W420.

CON8.M720.9 BREAKING-UP INSPECTION

1. When instructed, provide a sample of volumetric precast concrete components randomly selected by the CM or his representatives upon delivery on Site, break up the component, carry out the following verifications in the presence of the CM or his representatives and remove the broken component after verification:

a. Method:

Verification Items	Method	Acceptance Standards
Reinforcement details including total no. of bars and bar size	Visual inspection	Full compliance with Approved as-built drawings for the study mock-up
Bar pattern of reinforcement	Visual inspection	Compliance with Mill Certificate and the requirements of purchaser test in CS2:2012
Cover to reinforcement	By measurement	Full compliance with Approved as-built drawings of the study mock-up
Concrete strength	Coring and compressive test	Compressive strength in compliance with required concrete strength
Embedded conduit cover and bends	By measurement	Full compliance with Approved as-built drawings of the study mock-up
Sizes and routing of embedded conduit	By measurement	Full compliance with Approved as-built drawings of the study mock-up
Embedded conduits, accessories and adaptable boxes	Visual inspection	Bearing the same marking, brand name or standard as per Approved sample
Embedded conduits and / or connections with accessories	Visual inspection	Connections are properly jointed in compliance with Approved sample
Conduits and accessories	Visual inspection	Properly fixed to reinforcement in compliance with Approved sample

b. Frequency:

Verification Items	Sampling Frequency	Representative Consignment

Reinforcement details including total no. of bars and bar size	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site
Bar pattern of reinforcement	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site
Cover to reinforcement	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site
Concrete strength	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site
Embedded conduit cover and bends	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site
Sizes and routing of embedded conduit	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site
Embedded conduits, accessories and adaptable boxes	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site
Embedded conduits and / or connections with accessories	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site
Conduits and accessories	1 no. per type of volumetric precast concrete components per domestic block	All volumetric precast concrete components delivered to Site

2. Non-compliance:
    a. In the event of samples failing to meet any of the requirements given above:
        i. Remove the broken volumetric precast concrete components off site;
        ii. Take further volumetric precast concrete components as sample for re-test progressively according to the formula $n^2 - 2n + 3$ where n = total number of unsuccessful volumetric precast concrete components and the maximum value of n is limited to 3; until all samples satisfy the requirements as above;

iii. In the event that n = 3 and not all samples satisfy the above requirements, all volumetric precast concrete components of the same type cast on the same date as per those samples that failed the breaking-up inspection shall be condemned and removed off site.

b. Bear all associated costs of any further breaking-up inspections that are instructed by the CM and no extension of time will be allowed.

WORKMANSHIP

GENERAL

CON8.W010.9 OFF SITE CASTING YARD

Unless otherwise specified in this Worksection, comply with the requirements of CON7.W010 to CON7.W090 pertaining to off-site casting.

CON8.W020.9 ARCHITECTURAL WORKS

Comply with the relevant requirements of architectural works as given in the Worksections in CON8.D030 unless specified otherwise in this Worksection.

CON8.W030.9 BUILDING SERVICES INSTALLATION

Comply with the relevant requirements of building services installation as given in the Worksections listed in CON8.D030.

CON8.W040.9 QUALIFIED SUPERVISION FOR VOLUMETRIC PRECAST CONCRETE COMPONENTS

1. For production of volumetric precast concrete components, assign a Precast Quality Control Co-ordinator (PQCC), with a minimum qualification and experience of a Grade T3 TCP under the Registered Contractor's stream in the CoPSS, to provide full time supervision at the casting yard;
2. Submit the details of the PQCC for Approval;
3. It is permissible for the PQCC assigned under sub-clause (1) above to be the same person assigned as the PQCC under CON5.W040 or CON7.W050 provided that the qualification and experience of the PQCC assigned under CON5.W040 or CON7.W050 can satisfy the qualification and experience stipulated in the sub-clause (1) above;
4. For off site casting, subject to CM’s approval, the PQCC assigned under sub-clause (1) above may supervise the production of volumetric precast concrete components for more than one HA Contract of the same Contractor at the same casting yard.

SUBMISSIONS

CON8.W110.9 MOULDS

1. Submit for CM's approval details of the mould for volumetric precast concrete construction showing its support and design to fulfil the functional requirements. Comply with the provisions given in CON7.W210;
2. Obtain CM's approval before casting any components.

CON8.W120.9 METHOD STATEMENT

Submit a method statement, covering the following, for CM's approval:

1. Mould set up, inspection, approved mix, demoulding, curing, finishing and lifting;
2. Method of fixing window frames or windows, in accordance with CON7.W840, before casting of the volumetric precast concrete components commences;
3. Repair methods / procedures to typical defective components likely to be encountered;
4. Method to rectify starter bars which are out of position but within tolerances;
5. Details of the proposed means of support and storage of volumetric precast concrete components in the casting yard;

6. A layout of the storage yard which allows any components to be removed without disturbing other components on demand and minimises the need to sequence stacking and removal;
7. Erection of volumetric precast concrete components at their final locations in the structure;
8. The proposed Radio Frequency Identification tag and the associated fixing method as stipulated in Worksection COM11.

CON8.W130.9 CONDUIT SYSTEM SHOP DRAWINGS

Prepare shop drawings, coordinate and agree on the interfacing and connection method with the Nominated Sub-contractor for electrical installation before submitting shop drawings for Approval.

CON8.W140.9 PROGRAMMES

Within one month after the notified date for commencement of the Works, submit, for Approval, the following:

1. Programme for manufacturing volumetric precast concrete components showing the rate of manufacture for each month and the dates for clearing the area of casting yard and associated plant upon completion of the manufacture of the components;
2. Programme for the erection of the volumetric precast concrete components showing the rate of erection for each month. Make due allowance for all restrictions on the age of concrete in the volumetric precast concrete components for handling, storage, transportation and erection.

CON8.W150.9 QUALITY ASSURANCE SCHEME FOR MANUFACTURE OF VOLUMETRIC PRECAST CONCRETE COMPONENTS

Within two months after the notified date for commencement of the Works, submit details of the Quality Assurance Scheme for manufacturing the volumetric precast concrete components, in accordance with CON7.W040 to CON7.W060 as applicable, for Approval.

CON8.W160.9 QUALITY CONTROL PROCEDURES FOR ERECTING VOLUMETRIC PRECAST CONCRETE COMPONENTS

Within three months after the notified date for commencement of the Works, submit for Approval, details of erection of the volumetric precast concrete components under Approved quality control procedures covering the following:

1. Protective measures to avoid cracking and chipping;
2. Checking the accuracy of the insitu structural members receiving the volumetric precast concrete components, including location and level of all bearing surfaces, joints, bolts, horizontal and vertical restraining devices and adjustment devices. Carry out checking by means of a template or measurement frame or a similar Approved method;
3. Checking of erection tolerances;
4. Provision and removal of temporary works;
5. Procedure for grouting of permanent structural connections with details to prevent air lock.

MOULD ASSEMBLY

CON8.W210.9 TOLERANCE

Ensure that the mould is capable of manufacturing a component that, after erection, will be within the overall tolerances and manufacture tolerances for volumetric precast concrete components.

CON8.W220.9 GROUT SEALS

Ensure that:

1. The mould has grout seals appropriate to avoid leakage, or
2. If the concrete is to be vibrated, the seal design is appropriate to the means of filling and vibration.

CON8.W230.9 GAUGES

Provide details of gauges and fittings to check the correct set up of the mould before casting.

CON8.W240.9 FITTINGS

Ensure that the means of securing fittings to the mould is robust, suitable for repeated use, and will result in achieving the required tolerances without damage to the component.

CON8.W250.9 EXTERNAL FACES

Ensure that any concrete surfaces that will be external to the structure have, after casting, no metal fixings exposed and any holes have been filled.

CON8.W260.9 DEFECTIVE MOULDS

Replace any part of the mould system that fails to manufacture volumetric precast concrete components within the permitted tolerance limits.

CON8.W270.9 USE OF RELEASE AGENTS

Apply mould release agent, in accordance with CON2.M210, to the surfaces of moulds either by brush or by spraying before the fixing of steel reinforcement at a rate in accordance with the manufacturer's recommendations.

MANUFACTURING OF VOLUMETRIC PRECAST CONCRETE COMPONENTS

CON8.W310.9 GENERAL

Unless otherwise specified in this Worksection, comply with the provisions for manufacturing volumetric precast concrete components as given in Worksection CON7.

CON8.W320.9 CONCRETE MIX

1. Provide concrete in quantities such that casting is continuous using the Approved mix and method statement;
2. Arrange back up supplies for large volumetric precast concrete components if breaks in main supply are possible.

CON8.W330.9 CONCRETING, COMPACTION AND CURING GENERALLY

As CON1.

CON8.W340.9 CONSTRUCTION JOINTS

Demonstrate, for CM's approval, that if the volumetric precast concrete components have construction joints within it, the detail and form of those joints will satisfy the requirements for the finishes requirement.

CON8.W350.9 EXTERNAL VIBRATORS

Obtain Approval for the use of external vibrators.

CON8.W360.9 CURING BY APPLICATION OF HEAT

Obtain Approval for heat curing by means of steam, hot air, etc. and:

1. Ensure that the total chloride content of the concrete mix for volumetric precast concrete components, subject to heat curing, is less than 0.1% by weight of that of the cement;
2. Carry out a trial to demonstrate the adequacy of the proposed method to the satisfaction of the CM.

CON8.W370.9 DEMOULDING AND STRIPPING MOULDS

Demould by means of an Approved method:

1. Do not use crowbars;
2. Do not subject the mould to any form of impact;
3. Fully, or partially, strip moulds when the concrete has gained sufficient strength, measured on specimens kept with the mould after casting;
4. Prove the stripping strength by test as given in CON8.W380 and check against the method statement.

CON8.W380.9 CONCRETE STRENGTH BEFORE DEMOULDING

1. Demould the volumetric precast concrete components only after concrete has achieved the required strength;
2. To determine if the concrete has achieved the strength required for demoulding or handling:
   a. Make the necessary concrete cubes in pairs from the same batch of concrete used for casting the volumetric precast concrete components and cure the concrete cubes under the same conditions as the concrete in the volumetric precast concrete components;
   b. Specially identify the cubes and do not use them for normal quality control or for compliance testing;
   c. Determine the concrete cube strength by compression test as CON7.T110 and satisfy the CM that the concrete cubes have acquired the required strength before the demoulding or handling the volumetric precast concrete components.

CON8.W390.9 IDENTIFICATION AND RECORDS

1. Mark all volumetric precast concrete components with date of manufacture and a unique reference number;
2. Record in a master register the dates of casting, the concrete grades and the final locations of all volumetric precast concrete components;
3. Where required by the CM, each of the volumetric precast concrete components is to be delivered to Site with an appropriate QA certificate endorsed by the Quality Control Engineer;
4. Update the records stipulated in above sub-clause (2) above for all volumetric precast concrete units to the RFID Web-Based Database System.

CON8.W400.9 REQUIREMENTS OF OTHER TRADES AND COMPONENTS

Incorporate the requirements of all trades such as blockouts, recesses, notches, embedded metal works, building services installations or any other items etc. before casting the volumetric precast concrete components.

CON8.W410.9 SCOPE OF MINOR REPAIR

1. Use suitable filler to fill blow holes, small voids and repair non structural damage in accordance with the Approved procedures as given in the method statement required under CON8.W120;

2. Test those procedures and, if required by the CM, demonstrate the procedures on the study mock-up.

CON8.W420.9 DEFECTIVE COMPONENTS

1. Any volumetric precast concrete components that falls outside the manufacture tolerance is considered defective and must be rejected. Apply indelible mark on rejected units for identification purposes;
2. For other defects, including but not limited to minor chipping, damage to finishes or exposed conduits, etc., quarantine for inspection in accordance with the Approved QA scheme within the casting yard. Agree with the CM special repair methods or rejection of any defective volumetric precast concrete components that cannot be repaired and finished by the Approved repair methods / procedures as required under CON8.W120;
3. In the event of the CM agreeing to accept any quarantined volumetric precast concrete components, execute all necessary remedial and modification work to CM's satisfaction.

CON8.W430.9 CLEANING

1. Ensure that all fittings that will be used to make connections in-situ are cleaned and checked prior to delivery of the volumetric precast concrete components to Site;
2. Ensure that all internal surfaces of the volumetric precast concrete components are cleaned to the standard agreed with the CM before the components are delivered to Site.

CON8.W440.9 PROTECTION

Protect volumetric precast concrete components to ensure that no damage is done during and after storage, lifting, transportation or erection.

CON8.W450.9 LIFTING

1. Lift volumetric precast concrete components only when the concrete has achieved the required lifting strength, measured on specimens kept with the volumetric precast concrete components in accordance with the Approved method statement required under CON8.D940 and CON8.W380;
2. Lift volumetric precast concrete components within the yard by means of a lifting system designed in accordance with CON8.D810 to CON8.D830;
3. Ensure that lifting plant and equipment complies with the requirements of CON7.W540.

CON8.W460.9 SIZE AND WEIGHT OF VOLUMETRIC PRECAST CONCRETE COMPONENTS FOR TRANSPORTATION AND CRANEAGE

1. Indicate, in the method statement required under CON8.D940, the maximum projected horizontal and vertical dimensions of the component, including any protection, packing or protruding steel, beyond transportation vehicles, to ensure compliance with the limitations stipulated by local legislation;
2. Indicate, in the method statement required under CON8.D940, the maximum weight of the component including the weight of any props, supporting frame, protection or packing. Make clear any lifting or other components that are not included in this value. This weight shall not be exceeded;
3. Weigh each type of volumetric precast concrete components prototype component and any subsequent components as required by the CM.

CON8.W470.9 TEMPORARY STORAGE SUPPORT

1. Provide temporary support for storage of volumetric precast concrete components that does not place excessive bearing, compressive, tensile or flexural stresses on the component or cause spalling, cracking or unintended deformations;
2. Provide calculations to demonstrate that the likely deformation of volumetric precast concrete components, temporarily supported in the storage yard, is not detrimental to the manufacture tolerances, and, after erection, to the overall tolerance;
3. Ensure that stacking of volumetric precast concrete components does not generate unintended bearing, compressive, tensile or flexural stresses on the component or cause spalling, cracking or unintended deformations;
4. Store volumetric precast concrete components in the vertical plane on a levelled, well-drained and maintained concrete surface and protect against staining or physical damage.

CON8.W480.A TRANSPORTATION

1. Provide a transportation system, complying with CON7.W510 to CON7.W560, such that damage to the component is prevented preferably without reliance on any protection cover;
2. Maintain lorries or wagons used for the transportation of the volumetric precast concrete components in a good condition. Ensure wagons are equipped with suspension systems to minimize shock loading;
3. Ensure all lifting of volumetric precast concrete components during transportation, including loading and unloading from lorries or wagons, comply with the lifting method as per CON8.W450;
4. Refer to PRE.B8.295 for the safety measures to be taken for the delivery of materials by vehicles to site including the loading and unloading of volumetric precast concrete components.

ERECTING VOLUMETRIC PRECAST CONCRETE COMPONENTS

CON8.W510.9 SITE RECORDS

Provide, at the end of each week during erection of the volumetric precast concrete components, records in a form to be agreed with the CM, showing:

1. Delivery and installation dates, and the locations of joints and permanent structural connections completed on a location plan for each floor;
2. Dates of removal and locations of any props and temporary supports to the volumetric precast concrete components.

CON8.W520.9 CM'S INSPECTION

Allow and facilitate inspection of the volumetric precast concrete components at any time before and after erection.

CON8.W530.A LIFTING UNITS INTO POSITION

1. Submit detailed method statement including the design, drawing and installation procedures with endorsement of the Contractor's RSE demonstrating to the satisfaction of the CM that the volumetric precast concrete component will not subject to excessive stresses arising from their proposed erection method;
2. Prove, by demonstration, that the lifting method is capable of meeting the design requirements given in CON8.D810 to CON8.D830;
3. Lift the volumetric precast concrete components using the lifting system complying with CON8.W450;

4. Maintain all cables connecting the lifting frame and the lifting points of the volumetric precast concrete components in a vertical direction. Provide the cables with devices for the adjustment of their length;
5. Do not allow devices such as sockets or bolts for lifting purposes to be used for fixing the volumetric precast concrete components to the main structure.

CON8.W540.9 UNITS DAMAGED ON TRANSPORTATION, LIFTING OR ERECTION

Repair or replace as agreed with the CM any volumetric precast concrete components which have been damaged on transportation, lifting or erection in accordance with the Approved repair methods / procedures as required under CON8.W120.

JOINTS AND PERMANENT STRUCTURAL CONNECTIONS

CON8.W610.9 GENERAL

Prepare and construct joints strictly in accordance with the Approved drawing details and in accordance with the relevant manufacturer's recommendations so as to provide continuous weathertightness of buildings and give a neat, uniform and smooth appearance.

CON8.W620.9 GROUTING OF PERMANENT STRUCTURAL CONNECTION

Clean the connection by methods approved by the CM before the grout is placed. Take measures to prevent the accumulation of dirt and other material at the connection and the presence of air lock.

CON8.W630.9 JOINT WIDTH

Unless otherwise Approved, the installed joint width must not be less than 6 mm nor greater than 30 mm.

CONDUIT SYSTEM

CON8.W710.9 APPLICATION

Supply and install concealed rigid plain PVC conduit system complete with steel draw wires for volumetric precast concrete components as shown on Drawings.

CON8.W720.9 COMPLETION CERTIFICATION

Comply with CON7.W1010.

CONDUIT AND WIRING INSTALLATION

CON8.W810.9 CONDUIT BENDS

As CON7.W990.

CON8.W820.9 BENDING, JOINTING AND TERMINATING OF CONDUITS

As CON7.W1000.

PROTOTYPE MOCK-UP

CON8.W910.9 PROTOTYPE MOCK-UP

1. Erect a prototype mock-up on Site, in full accordance with the Approved as-built drawings of the study mock-up;

2. If proposed by the Contractor and approved by the CM, the prototype mock-up can be part of the permanent works;
3. Obtain Approval from the CM upon inspection of the completed prototype mock-up to set the standard and quality of workmanship necessary for all volumetric precast concrete components;
4. Do not alter, move, or destroy the Approved prototype mock-up unless permitted by the CM.

CON8.W920.9 REMOVAL OF PROTOTYPE MOCK-UP

Subject to CM's approval, remove the prototype mock-up as well as the surrounding structural frames upon completion of erection of all the volumetric precast concrete components.

CON8.W930.9 VERIFICATION OF PROTOTYPE MOCK-UP

1. Carry out watertightness tests on the jointing system of the full size prototype mock-up specified in CON8.W910 in accordance with the procedures set out in CON8.T320;
2. Extend the watertightness tests to cover testing on joints of windows fixed to the full size prototype mock-up all to the requirements specified in COM2.T210;
3. Conduct tests to finishes in accordance with the relevant clauses in Worksections FIN1 to FIN7 as referred to in CON8.D030.

TESTING

SAMPLING AND TESTING

CON8.T010.9 RECORDS

1. Keep a complete record of all sampling and testing, in a form agreed with the CM;
2. Submit test reports and certificates to the CM within 14 days from the date of test.

CON8.T020.9 WITNESSING SAMPLING AND TESTING BY THE CM

The CM will witness any sampling and testing carried out under the Quality Assurance Scheme:

1. Make monthly records of sampling and testing available for inspection by the CM or his representatives resident at manufacturer's factory.

CON8.T030.9 TESTS AT MANUFACTURER'S FACTORY

Provide samples, all necessary facilities and attendance to the DTC or the CM or his representatives resident at manufacturer's factory to carry out the following tests:

1. Schmidt hammer tests and cover meter tests on the construction quality of precast concrete components;
2. Tests on concrete constituent materials, tests on compressive strength of concrete cubes and concrete cores, tests on reinforcement bars and tests on fabric reinforcement by the DTC and / or HDMTL.

CON8.T035.9 INSTALLATION OF RFID TAG IN CONCRETE CUBE FOR CUBE COMPRESSION TEST TO BE CARRIED OUT BY DTC OR HDMTL

1. Install a Radio Frequency Identification (RFID) tag as detailed on Sketch no. RFID/TAG/SK-01 onto the trowelled surface of each of the concrete cubes immediately after preparation of cubes at the manufacturer’s factory under the witness of the CM or his representatives resident at manufacturer’s factory unless otherwise instructed by the CM;
2. The RFID tags are to be provided by DTC or the CM or his representatives resident at manufacturer’s factory in batches;
3. Validate and scan the RFID tag with the Bluetooth RFID reader provided by DTC or the CM or his representatives resident at manufacturer's factory before use, and ensure that information such as tag unique identification (UID), electronic product code (EPC) number and timestamp have been uploaded to the PC provided by the DTC or the CM or his representatives resident at manufacturer's factory and incorporated into the DTC’s database system (through 3G or above internet service);
4. Input the mould number and / or sampling certificate number against the concerned tag EPC number through the DTC’s database system;
5. Before the tagged cubes are sent from the manufacturer’s factory to HDMTL or are collected by the DTC, scan the tag again using the Bluetooth RFID reader and ensure that information such as tag UID, EPC number and timestamp have been uploaded to the PC and incorporated into the DTC’s database system (through 3G or above internet service);
6. Deliver the tagged cubes to HDMTL or arrange the tagged cubes to be collected by the DTC with due care at a time such that a minimum of 4 days is allowed for curing the cubes in DTC or HDMTL before testing on compressive strength at 28 days by DTC or HDMTL;
7. In case any damaged RFID tags are discovered, report to the CM or his representatives resident at manufacturer’s factory immediately without any delay;

8. Maintain an inventory record of all RFID tags including those damaged and submit the inventory record to the CM or his representatives resident at manufacturer's factory for endorsement.

CON8.T040.9 FULL SCALE MOCK UP FOR VPB AND VPK

1. Where required by the CM, design and provide full scale mock up as detailed in the Project Specific Specification to demonstrate that the volumetric precast bathroom (VPB) and volumetric precast bathroom (VPK) components, the installation of the VPB and VPK, and the workmanship of jointing are adequate, all to the satisfaction of the CM;
2. If agreed by the CM, the requirements of this full scale mock up shall be provided and demonstrated by the study mock-up as stipulated under CON8.D1110 to CON8.D1310.

TESTS ON WORKABILITY

CON8.T045.9 STANDARD

As CON1.T510.

CON8.T050.9 ACCEPTANCE VALUES FOR APPROVED CONCRETE MIXES

As CON1.T520.

TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CUBES

CON8.T060.9 STANDARD

As CON1.T610.

CON8.T061.9 SAMPLES FOR DESIGNED CONCRETE MIXES

As CON1.T620.

CON8.T062.9 RESULTS FOR DESIGNED CONCRETE MIXES

As CON1.T630.

CON8.T063.9 COMPLIANCE CRITERIA FOR DESIGNED CONCRETE MIXES

As CON1.T640.

CON8.T064.9 TABLES OF COMPLIANCE REQUIREMENT FOR DESIGNED CONCRETE MIXES

As CON1.T650.

CON8.T065.9 NON-COMPLIANCE OF DESIGNED CONCRETE MIXES

As CON1.T660.

CON8.T066.9 FURTHER TESTS ON DESIGNED CONCRETE MIXES

As CON1.T670.

MIX TESTS

CON8.T110.9 GENERAL

Unless otherwise specified in this Worksection, comply with the requirements for trial concrete mixes and associated tests of both concrete and grout as given in Worksections CON1, CON4 and CON7.

SCHMIDT HAMMER TESTS

CON8.T120.9 TESTING FREQUENCY

1. Provide all necessary facilities and attendance for carrying out of Schmidt hammer test on the volumetric precast concrete components by the CM or his representatives resident at manufacturer's factory when the concreting age of the volumetric precast concrete components is at least 3 days;
2. Subject to CM's approval, the testing frequency may be reduced when satisfactory and consistent standard is established.

TESTS ON COMPRESSIVE STRENGTH ON EARLY CORES FOR VPB, VPK, VOLUMETRIC PRECAST LIFT SHAFT AND VOLUMETRIC PRECAST LIFT MACHINE ROOM COMPONENTS

CON8.T130.9 GENERAL

1. Provide all necessary facilities and attendance for carrying out coring and testing of concrete cores by DTC, including the provision of a secure and lockable storage for DTC to store the coring machine and other associated equipment;
2. Tests are to be witnessed and endorsed by the Contractor's representative and the CM or his representatives resident at manufacturer's factory;
3. Allow 2-day advance notice for preparation by DTC before the taking of core samples at the manufacturer's factory;
4. Upon completion of the taking of core samples by DTC at the manufacturer's factory, allow a minimum of 6 more days and a maximum of 15 more days for DTC to provide the core test results;
5. Make due allowance in the programme for the aforesaid arrangement and no claim for extension of time shall be allowed;
6. Subject to CM's approval, omission of early core test may be permitted for a particular batch of volumetric precast bathroom (VPB), volumetric precast kitchen (VPK), volumetric precast lift shaft and volumetric precast lift machine room components in order not to affect the construction work on Site. In such case, carry out core test in accordance with the procedures set out in CON1.T710 to CON1.T760 to prove the compliance of that particular batch of VPB, VPK, volumetric precast lift shaft and volumetric precast lift machine room components to compressive test on cores as stipulated in this Specification.

CON8.T140.9 STANDARD

Comply with CS1:2010 in respect of the method of preparing, inspecting and testing concrete cores to determine the compressive strength except the measurement of saturated density.

CON8.T150.9 SIZE AND NUMBER OF EARLY CORE SAMPLES

Testing samples:

1. Provide necessary facilities and attendance to the taking of 3 Nos. of core samples by the DTC from each of the following volumetric precast components of the same concreting day, at locations decided by the CM:
   a. Volumetric precast bathroom (VPB) including Combined VPB components;
   b. Volumetric precast kitchen (VPK) including Combined VPK and Combined VPB and VPK components;
   c. Volumetric precast lift shaft components;
   d. Volumetric precast lift machine room.
2. Size of core sample:
   a. 75 mm diameter core samples;
   b. For vertically casted VPB, VPK, volumetric precast lift shaft and volumetric precast lift machine room components, the length of core samples shall be at least 90 mm;
   c. For horizontally casted VPB, VPK, volumetric precast lift shaft and volumetric precast lift machine room components, the length of core samples shall be at least 90 mm, plus top 50 mm or 20% of depth of concrete being cored whichever is greater.

CON8.T160.9 AGE OF EARLY CORE SAMPLES

1. Do not take cores for compressive test at ages less than 3 days;
2. Do not carry out compressive test on the core samples at ages less than 9 days.

CON8.T170.9 ASSESSING COMPRESSIVE STRENGTH ON EARLY CORES

In assessing the results of compressive strength on early cores, the volumetric precast bathroom (VPB), volumetric precast kitchen (VPK), volumetric precast lift shaft and volumetric precast lift machine room components of the same concreting day represented by the early cores are deemed to comply with this Specification if the strength of the early core, when adjusted for length / diameter ratio and converted to estimated insitu cube strength in accordance with CS1:2010, is:

1. Not less than 85% of the specified grade strength for any individual results.

CON8.T180.9 NON-COMPLIANCE AND FURTHER TESTS ON COMPRESSIVE STRENGTH OF CONCRETE CORES FOR VPB, VPK, VOLUMETRIC PRECAST LIFT SHAFT AND VOLUMETRIC PRECAST LIFT MACHINE ROOM COMPONENTS

1. For volumetric precast bathroom (VPB), volumetric precast kitchen (VPK), volumetric precast lift shaft and volumetric precast lift machine room components of the same concreting day represented by the early cores that the compressive strength of the early cores comply with CON8.T170, their core test results are deemed to be acceptable under this Specification, and further coring test at 28 days is not necessary unless compressive strength test of concrete cube of the same batch of concrete not comply with CON8.T062 or instructed otherwise by the CM;
2. For VPB, VPK, volumetric precast lift shaft and volumetric precast lift machine room components of the same concreting day represented by the early cores that the compressive strength of the early cores do not comply with CON8.T170:
   a. if the concreting ages of the VPB, VPK, volumetric precast lift shaft and volumetric precast lift machine room components are less than 28 days, carry out further early core tests by DTC. If the result of the further early core test does not comply with CON8.T170, the VPB, VPK, volumetric precast lift shaft and volumetric precast lift machine room components are not allowed to be lifted into place or installed on Site, and further early core test may be carried out in accordance with this sub-clause;

b. if the concreting ages of the VPB, VPK, volumetric precast lift shaft and volumetric precast lift machine room components are 28 days or over, carry out further core test by DTC in accordance with CON1.T710 to CON1.T760. If the result of this further core test does not comply with CON1.T760, the VPB. VPK, volumetric precast lift shaft and volumetric precast lift machine room components are not allowed to be lifted into place or installed on Site. All relevant concrete of the VPB, VPK, volumetric precast lift shaft and volumetric precast lift machine room components represented by this further core test in the same concreting day is deemed not complying with this Specification. Investigate the extent of non-compliance and re-execute the works in accordance with CON1.T1210 to CON1.T1260.

3. Make due allowance in the programme for the aforesaid arrangement and bear all time and cost for compliance with this clause.

CON8.T190.9 MAKING GOOD CORE HOLES

As CON1.T770.

CON8.T195.9 TESTING ON NON-SHRINK GROUT

As CON4.T070.

CON8.T200.9 TESTS ON COMPRESSIVE STRENGTH OF GROUT CUBES

As CON4.T080.

TESTING FIXINGS

CON8.T210.9 TENSILE AND SHEAR TESTING

As CON4.T110 and CON4.T120.

SITE WATERTIGHTNESS TESTS TO EXTERNAL FACES ELEMENT OF VOLUMETRIC PRECAST CONCRETE COMPONENTS

CON8.T310.9 TESTING INSTALLED JOINTS

Carry out watertightness tests to the jointing system of the external faces of the properly installed volumetric precast concrete components at the rate of 100% of each particular type in accordance with the procedures set out in CON8.T320.

CON8.T320.9 TEST PROCEDURE

Test joints on each selected external face of volumetric precast concrete components according to the procedures as follows:

1. Construct working platforms where necessary for carrying out water test safely;
2. Working from the exterior, wet the external face of the volumetric precast concrete components selectively, starting from the lowest horizontal joint, followed by the vertical joints and then the horizontal joint above;
3. Spray a continuous jet of water from a nozzle at a water pressure of 210 to 240 kPa at the nozzle inlet to the joint and perpendicular to the external face of the volumetric precast concrete components. Move the nozzle slowly along the joint, at a distance of 300 mm from it, for a period of 5 minutes in every 1.5 metre of joint length while an observer carefully inspects on the interior side of the external face of the volumetric precast concrete components with the assistance of adequate lighting where necessary;

4. Unless otherwise Approved, use a nozzle to the requirements of the Architectural Aluminium Manufacturer's Association (AAMA) 501.2-83;
5. Repeat the process specified in sub-clause (3) above on all joints and joint intersections using increments of exposed joint length not exceeding 1.5 metres upward until all the joints are covered.

CON8.T330.9 WITNESSES TO TEST

All watertightness tests carried out on Site must be witnessed and certified both by the CM and the Contractor's representative.

CON8.T340.9 FAILURE OF UNITS

The volumetric precast concrete components and joints are deemed to have failed if signs of water seeping through the joints or through the external face of the volumetric precast concrete components, including signs of damp patches, are observed during the test and within the subsequent 2 hours after the test.

CON8.T350.9 REMEDIAL WORK TO VOLUMETRIC PRECAST CONCRETE COMPONENTS FOR RE-TEST

Carry out remedial work to volumetric precast concrete components and joints which fail in the watertightness test. Methods of carrying out the remedial work are subject to Approval. After the remedial work is completed, re-test the external face of the volumetric precast concrete components and joints as CON8.T320 until all specified criteria have been satisfied.

SITE TESTING OF JOINTS AND PERMANENT STRUCTURAL CONNECTIONS

CON8.T410.9 SITE TESTING OF JOINTS AND PERMANENT STRUCTURAL CONNECTIONS

1. When instructed, carry out the following tests on Site in the presence of the CM or his representatives:
   a. Prior to grouting the joints or permanent structural connections:
      i. Check integrity of welds of any structural steelworks, for connection purpose, present at the permanent structural connections in accordance with STR1.T120, as appropriate, against the acceptance criteria as stipulated in STR1.T130.
   b. Upon completion of grouting:
      i. Check location and cover of rebars, with the use of Approved steel reinforcement detector or cover meter, against Approved drawings.
2. Non-compliance:
   a. In the event that any test result on a weld does not comply with the acceptance criteria, conduct further weld test in accordance with STR1.T120 (5);
   b. Cut out and repair all defective welds in accordance with STR1.T140 and re-test the welds in accordance with STR1.T120;
   c. Bear all costs of any further tests and no extension of time will be allowed.

LIFTING ANCHOR

CON8.T510.9 DEFINITION OF BATCH

In this Specification, a batch is defined as any quantity of lifting anchor of the same type and same working load capacity, delivered to the casting yard as one consignment and covered by the same test certificate issued by the lifting anchor manufacturer.

CON8.T520.9 TYPE AND LOAD CAPACITY

Unless otherwise specified on Drawings, lifting anchors shall be either eye anchor type or foot anchor type, and with a working load of 0.25 times the ultimate load capacity.

CON8.T530.9 RATE OF SAMPLING

1. The rate of sampling for ultimate load capacity for each batch of lifting anchor shall be a minimum of one sample, which comprises three test specimens, for every 3,000 anchors or part thereof;
2. When Instructed, provide an additional sample comprising three test specimens for testing by DTC.

CON8.T540.9 COMPLIANCE CRITERION

No test result of ultimate load capacity of individual test specimen shall be less than 4 times the working load as stipulated in CON8.T520.

CON8.T550.9 SUBMISSION

Prior to the production of precast concrete components, provide test certificates issued by:

1. The lifting anchor manufacturer/agent supplier; and
2. An Approved testing laboratory employed by the manufacturer of precast concrete component on the ultimate load capacity of lifting anchors for each batch under the Quality Assurance System as stipulated in CON7.W040.

FACTORY VERIFICATION TESTS

CON8.T610.9 WATER FLOOD TEST TO INTERNAL INSTALLATIONS

1. Testing Arrangements:
   a. Carry out water flood test on the completed internal waterproofed volumetric precast bathroom (VPB) components at a rate of 1 to 25 numbers at the manufacturer's factory;
   b. Place the VPB component on an elevated temporary support platform and connect the floor drains where necessary for carrying out water flood test;
   c. Submit three copies of the test reports, or other number of copies as required by the CM for the water flood tests for record.
2. Testing Methods:
   a. Seal all outlets and do not permit any debris to enter into the drainage pipeworks;
   b. Carefully flood the internal floor of the VPB component to levels agreed with the CM or his representatives resident at manufacturer's factory, generally no less than 50 mm, but in no case higher than the curb levels and maintain for 24 hours;
   c. Mark the top water level at clearly visible locations and regularly inspect for leaks;
   d. Carry out joint inspections with the CM or his representatives resident at manufacturer's factory at the external side of the walls and at the underside of the floor slab to check that there is no water leakage, water seepage or visible damp patch within half an hour after the flooding has maintained for 24 hours;

e. If required by the CM, provide records in the form of photos or video clips to prove that the inspected surfaces are free from water leakage, water seepage or visible damp patch;

f. Subject to CM's approval, in case the test results cannot be verified due to wet weather, record such condition in the test report and the whole batch of VPB components can be exempted from this test.

3. Non-compliance:

a. In the event that any VPB component fails to meet the requirement stipulated in sub-clause (2)(d) above:

i. Carry out re-test to the non-complying VPB component, after repaired according to the Approved remedial works, and until the criteria stipulated in sub-clause (2)(d) above are complied with;

ii. Carry out further water flood tests to the batch of VPB components represented by the non-complying VPB component according to the following formula:

Nos. of further water flood tests = (n^2-2n+3)

Where n is equal to the total number of the failed water flood tests progressively until all the water flood tests complied with the criteria specified;

iii. Bear all associated costs and expenses incurred for the re-tests and further tests. No extension of time will be allowed.

CON9 OFF-SITE STEEL REINFORCING BAR PREFABRICATION YARD

GENERAL

SCOPE AND TYPES

CON9.G005.9 APPLICATION

1. Subject to any exclusions specified in sub-clause (3) of CON9.G010, prefabricated steel reinforcing bar products supplied by a Type 1 Yard as defined in CON9.G020 may be used for any part or parts of the Works. The Contractor shall not use prefabricated steel reinforcing bar products supplied by yards other than a Type 1 Yard for any parts of the Works;
2. Notwithstanding sub-clause (1) above, in the event that special circumstance arises which renders the Contractor unable to comply with the requirement under sub-clause (1) above, the Contractor shall submit an alternative proposal on the use of prefabricated steel reinforcing bar products with justification to the CM for approval. The CM may at his sole discretion approve or reject such alternative proposal. The Contractor shall not be entitled to any extension of time, additional payment or compensation arising out of or in connection with his inability for whatsoever reason to comply with the requirement under sub-clause (1) above or arising out of or in connection with the execution of the Contractor's alternative proposal.

CON9.G010.9 SCOPE OF OFF-SITE STEEL REINFORCING BAR PREFABRICATION YARD

1. Worksection CON9 applies where off-site steel reinforcing bar prefabrication yard (OSRPY) is adopted;
2. The scope of OSRPY in this Worksection covers the following:
   a. Storage of steel reinforcing bar, where steel reinforcing bar is defined in Clause 1.2.18 of CS2:2012;
   b. Cutting and bending of steel reinforcing bar;
   c. Fabrication of reinforcement cage; and
   d. Threading of steel reinforcing bar for coupling with reinforcement connectors.
3. This Worksection is not applicable to the prefabrication of the following:
   a. Precast concrete component produced outside the Hong Kong Special Administrative Region; and
   b. All fabric reinforcement.

CON9.G020.A TYPES OF OFF-SITE STEEL REINFORCING BAR PREFABRICATION YARD

The OSRPY shall be one of the following:

1. An OSRPY on the "List of Approved Steel Reinforcing Bar Prefabrication Yards" (the "List"), referred to as "Type 1 Yard". The List has been set up and maintained by the Civil Engineering and Development Department (CEDD) in accordance with the Development Bureau Technical Circular (Works) No. 10/2018. All prefabricated steel reinforcing bar products supplied from a Type 1 Yard shall be tested and fabricated under the supervision by CEDD prior to delivery;
2. An OSRPY not on the List which includes:

a. An OSRPY at the Contractor's workshop and run by the Contractor, referred to as "Type 2 Yard";

b. An OSRPY other than the types in sub-clauses (1) and 2(a) above referred to as "Type 3 Yard".

SUBMISSION

CON9.G110.9 GENERAL

1. For Type 1 Yard, submit the following within one month from the notified date for commencement of the Works for CM's information:
   a. The name, address with street map of the OSRPY;
   b. Details of the organisation structure of the OSRPY, including the management and supervision teams;
   c. Self-certified true copy of the valid registration document under the List as stated in CON9.G020 (1);
   d. Monthly production capacity of the OSRPY in terms of tonnage and the current workload;
   e. Where carrying out of the fabrication of reinforcement cage or threading for steel reinforcing bar using reinforcement connector is involved, records showing separate approval from the Government has been obtained for such fabrication process to be carried out at this prefabrication yard; and
   f. The storage and traceability system of steel reinforcing bar products within the Site for identifying the steel reinforcing bar and the prefabricated steel reinforcing bar products produced by this prefabrication yard and other steel reinforcing bar for on-site cutting and bending or for fabrication of reinforcement cage or threading for steel reinforcing bar using reinforcement connector for on-site installation. Approval from the CM shall be obtained for such storage and traceability system prior to the delivery of prefabricated products to the Site.
2. For Type 2 Yard, submit the following within one month from the notified date for commencement of the Works for CM's approval:
   a. The address with street map of the OSRPY and details of the quality management system as stipulated in CON9.G120;
   b. A scaled and dimensioned layout plan of the OSRPY with fenced boundaries showing locations of entrances, exits, designated storage areas for incoming steel reinforcing bar, and prefabricated steel reinforcing bar products, and areas for prefabrication;
   c. Details of the security and traceability requirements as stated in CON9.G310 and CON9.G320 respectively.
3. For. Type 3 Yard, submit the following within one month from the notified date for commencement of the Works for CM's approval:
   a. The name, address with street maps, organisation structure, and job reference of the OSRPY and details of the quality management system as stipulated in CON9.G120;
   b. A scaled and dimensioned layout plan of the OSRPY with fenced boundaries showing locations of entrances, exits, designated storage areas for incoming steel reinforcing bar and prefabricated steel reinforcing bar products, and areas for prefabrication;
   c. Details of the security and traceability requirement as stated in CON9.G310 and CON9.G320 respectively.

CON9.G120.9 QUALITY MANAGEMENT SYSTEM

1. The Type 3 Yard shall be certified to the requirements of ISO 9001 and ISO 14001 by a relevant certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into mutual recognition agreement with HKAS for key operations of the yard with a scope relating but not limited to storage, handling, fabrication, sampling, testing and supply of prefabricated steel reinforcing bar products in accordance with the requirements stipulated in the CS2:2012, BS4449:2005+A2:2009, BS4482:2005, BS 8666:2005, etc. where appropriate;
2. Both the Type 2 and Type 3 Yards, shall establish, document and maintain a quality management system complying with the relevant provisions of Worksection CON3.

TYPE 1 YARD

CON9.G210.9 SURVEILLANCE AUDIT / INSPECTION

The CM or his representatives shall be allowed to enter the OSRPY to carry out surveillance audit / inspection at any time without advance notice. They shall be allowed to:

1. Check and make copy, if necessary, of all quality control records, test reports and certificates associated with the prefabricated steel reinforcing bar products of the Contract, which have been or will be delivered to the Site;
2. Inspect and take photo of, if necessary, all the steel reinforcing bars and prefabrication steel reinforcing bar products of the Contract at the designated storage area and the prefabrication lines.

CON9.G220.9 TRACEABILITY

When the prefabricated steel reinforcing bar products are delivered to Site, they shall be affixed firmly with traceability tags which shall include, but not be limited to, the information such as contract title, contract number, delivery note number / stockist certificate number, test report number, bending schedule number, bar marks, shape, bar size quantity and fabrication date.

CON9.G230.9 PREFABRICATED STEEL REINFORCING BAR PRODUCTS SUMMARY REPORT

Submit a summary report on the prefabricated steel reinforcing bar products monthly or at an interval agreed by the CM. The report shall include, but not be limited to, the following:

1. Quantities of each size of each type of prefabricated steel reinforcing bar products delivered to the Site but not yet installed at the beginning of the reporting period;
2. Quantities of each size of each type of prefabricated steel reinforcing bar products delivered to the Site within the reporting period;
3. Tentative quantities of each size of each type of prefabricated steel reinforcing bar products planned to be delivered to the Site in the next reporting period;
4. Accumulated quantities of each size of each type of prefabricated steel reinforcing bar products delivered to the Site since the notified date for commencement of the Works;
5. Bending schedule of each size of each type of prefabricated steel reinforcing bar products delivered to the Site within the reporting period with details of bar marks, bar types, bar size, quantities, dimensions, bending shape codes and weights;

6. Copy of mill certificates issued by the stockist suppliers and the test report issued by the Direct Testing Contractor (DTC) and / or Housing Department's Materials Testing Laboratory (HDMTL) and / or CEDD's Public Works Laboratories showing that the test results of the prefabricated steel reinforcing bar products delivered to the Site within the reporting period meet the requirements of CS2:2012 or BS4449:2005+A2:2009 as appropriate.

CON9.G240.9 OFF-SITE STEEL REINFORCING BAR PREFABRICATION YARD REMOVED FROM THE LIST

All prefabricated steel reinforcing bar products produced by the Type 1 Yard and delivered to the Site shall be attached with a certificate issued by the OSRPY confirming that all the products are fabricated under a valid registration of the List. In the event that the OSRPY is removed from the List, all of the OSRPY's products, fabricated on and after the removal date, whether or not delivered to the Site shall not be used. Bear all time and cost for, including but not be limited to, the removal of non-conforming prefabricated steel reinforcing bar products delivered on Site, dismantling the non-conforming prefabricated steel reinforcing bar products that were installed, reinstating and making good all damages to the Works arising out of or in connection with the removal of the OSRPY from the List and no extension of time or monetary claims will be entertained under the Contract.

TYPE 2 AND TYPE 3 YARDS

CON9.G310.9 REQUIREMENTS ON SECURITY PROCEDURE

1. The CM and his representatives shall be allowed to enter the OSRPY to carry out inspection at any time without advance notice. They shall be allowed to:
   (a) Check and make copy, if necessary, of all quality control records, test reports and certificates associated with the prefabricated steel reinforcing bar products of the Contract, which have been or will be delivered to the Site;
   (b) Inspect and take photo of, if necessary, all the steel reinforcing bars and prefabrication steel reinforcing bar products of the Contract at the designated storage area and the prefabrication lines.
2. At least two closed circuit television (CCTV) cameras shall be provided at opposite corner of the designated storage area to monitor and video record all of the steel reinforcing bar stored at the designed storage area at all times subject to CM's satisfaction that the Contractor's proposed number and / or position of the cameras(s) can have clear and full view of the designed storage area. The CCTV cameras shall also be positioned in such a way that they can record the arrival and departure of the steel reinforcing bar to and from the designated storage area. Sign(s) shall be put up indicating the steel reinforcing bar is to be used for HA's contracts with the contract information, i.e. contract title, contract number, contractor's name, etc., of each contract clearly shown to the CCTV for ease of identification and monitoring;
3. The internal transportation of the steel reinforcing bar between designated storage area and prefabrication lines shall be monitored by CCTV camera(s) at all times. If this cannot be achieved throughout the whole route, then the movement of the steel reinforcing bar shall be monitored and recorded by a car video recorder or an equivalent equipment at all times during the transportation. Sign(s) shall be put up on top of the steel reinforcing bar or attached at suitable location of the steel reinforcing bar with the contract information, i.e. contract title, contract number, contractor's name, etc., and clearly shown to the CCTV or equivalent equipment for ease of identification and monitoring during the transportation process;

4. The steel reinforcing bar at the prefabrication lines shall be monitored by CCTV camera(s) or equivalent equipment at all times. The video recording at the prefabrication lines shall include the recording of the arrival of the steel reinforcing bar from the designated storage area, the prefabrication process at the prefabrication lines, and the departure of the steel reinforcing bar and prefabricated steel reinforcing bar products from the prefabrication lines. Sign(s) shall be put up on top or attached at suitable location of the steel reinforcing bar and / or the prefabricated steel reinforcing bar products with the contract information, i.e. contract title, contract number, contractor's name, etc., and clearly shown to the CCTV or equivalent equipment for ease of identification and monitoring during the transportation and prefabrication process;
5. The prefabrication of the steel reinforcing bar shall be executed in a designated time slot. No prefabrication of reinforcement of other non-HA contract(s) shall be carried out in this designated time slot and in this prefabrication lines to avoid the mixing up of the steel reinforcing bar. A schedule showing the designated time slot for the prefabrication of the steel reinforcing bar shall be submitted to the CM one month prior to the commencement of prefabrication of the steel reinforcing bar or at a time interval agreed by the CM. Any revised schedule(s) shall be submitted to the CM at least one week or at a time interval agreed by the CM prior to the prefabrication of the steel reinforcing bar;
6. The external transportation of the prefabricated steel reinforcing bar products from the OSRPY to the Site shall be monitored and recorded by a car video recorder or an equivalent equipment at all times during the transportation. Sign(s) shall be put up on top or attached at suitable location of the prefabricated steel reinforcing bar products with the contract information, i.e. contract title, contract number, contractor's name, etc., and clearly shown to the car video recorder or equivalent equipment for ease of identification and monitoring during the transportation process;
7. Video records of all CCTV cameras, car video recorders and equivalent equipment, if any, shall have the date and time shown in the video, and shall be retained for 60 days. Moreover, a copy of all video records shall be submitted to the CM within 24 hours of the recording or at a time interval agreed by the CM for monitoring / inspection; and
8. Photo records as means of recording the storage and internal and external transportation of steel reinforcing bar or prefabricated steel reinforcing bar products are not acceptable unless under unforeseen incident, i.e. sudden breakdown of CCTV or video recorder. Any such incident shall be reported with the photo records to the CM within 3 days and a written report shall be submitted to the CM within 7 days of the incident. Any breakdown of CCTV or video recorder shall have their functions restored within 24 hours or a period agreed by the CM.

CON9.G320.9 REQUIREMENTS ON TRACEABILITY PROCEDURE

1. All steel reinforcing bars shall be stored in designated storage areas. Sign(s) shall be put up at the designated storage area indicating the steel reinforcing bar is to be used for HA's contracts with the contract information, i.e. contract title, contract number, contractor's name, etc., of each contract clearly shown for ease of identification and monitoring;
2. All steel reinforcing bar shall be traceable with unique tags or equivalent means (Unique Tags) affixed firmly when the steel reinforcing bar is delivered to OSRPY. The Unique Tags shall include information such as, but not limited to, the identification that the reinforcement is to be used for HA's contract, the contract title, the contract number, the contractor's name, the delivery note number / stockist certificate number, the steel reinforcing bar's type and size and length, the bundle weight and / or number of bars, and the heat / lot number;

3. All Unique Tags shall always be available and kept in good condition for inspection throughout the period from delivery, storage, internal transportation and up to prefabrication processes;
4. After prefabrication, the Unique Tags shall be updated, or a second set of traceability tags (Traceability Tags) for the prefabricated steel reinforcing bar products shall be provided, to include information such as the contract title, the contract number; the contractor's name, the delivery note number / stockist certificate number, the testing report number, the bar bending schedule number, the bar mark, the shape, the bar size, and the quantity.

CON9.G330.9 PREFABRICATED STEEL REINFORCING BAR PRODUCTS SUMMARY REPORT

Submit a summary report on the prefabricated steel reinforcing bar products monthly or at an interval agreed by the CM. The report shall include, but not be limited to, the following:

1. Quantities of each size of each type of prefabricated steel reinforcing bar products delivered to the Site but not yet installed at the beginning of the reporting period;
2. Quantities of each size of each type of prefabricated steel reinforcing bar products delivered to the Site within the reporting period;
3. Tentative quantities of each size of each type of prefabricated steel reinforcing bar products planned to be delivered to the Site in the next reporting period;
4. Accumulated quantities of each size of each type of prefabricated steel reinforcing bar products delivered to the Site since the notified date for commencement of the Works;
5. Bending schedule of each size of each type of prefabricated steel reinforcing bar products delivered to the Site within the reporting period with details of bar marks, bar types, bar size, quantities, dimensions, bending shape codes and weights;
6. Copy of mill certificates issued by the stockist suppliers and the test report issued by the Direct Testing Contractor (DTC) and / or Housing Department's Materials Testing Laboratory (HDMTL) and / or CEDD's Public Works Laboratories showing that the test results of the prefabricated steel reinforcing bar products delivered to the Site within the reporting period meet the requirements of CS2:2012 or BS4449:2005+A2:2009 as appropriate.

MATERIALS

REINFORCEMENT GENERALLY

CON9.M010.9 STOCKIST'S OR SUPPLIER'S CERTIFICATION

Submission requirements:

1. For bar reinforcement delivered to the OSRPY, submit certificates from quality assured stockist and / or supplier to demonstrate that the bar reinforcement supplied complies with the requirements of Section 4 of CS2: 2012;
2. For reinforcement delivered in the form of coil (coil reinforcement) to the OSRPY, submit certificate from quality assured stockist and / or supplier to demonstrate the coil reinforcement supplied complies with the requirements of Section 4 of CS2: 2012 or alternatively compliance of the following requirements:
    a. The coil reinforcement has been manufactured and tested to comply with the requirements of BS 4449:2005+A2:2009 Sections 7 and 8;
    b. The coil reinforcement is produced by a manufacturer certified by a third party certification body. The certification body shall be accredited by the Hong Kong Accreditation Service or its 'Multilateral Recognition Agreements / Arrangements'(MLA) partner(s) to the requirements of ISO 9001 for its quality management system with a scope related to good practices of reinforcing steel production to meet requirements of BS 4449:2005+A2:2009.

CON9.M020.9 VERIFICATION OF SOURCE

When Instructed, provide evidence that each load of steel reinforcing bar delivered to the OSRPY forms part of the same consignment and originates from the same source as that in respect of which the specimen and the manufacturer's certificate are related.

CON9.M030.9 COLOUR CODE SYSTEM OF REINFORCEMENT

Submit for Approval a colour code system in the Quality Control System as stipulated in PRE.B8.1425 for identification of steel reinforcing bar unloaded to designated areas in the OSRPY:

1. For different batches, as defined in CON9.T110, before any testing:
    a. Use white, yellow, blue, grey or other specific colours for marking at the ends of reinforcement bar or at an agreed location with the CM for the coil reinforcement;
    b. Avoid to use any colours similar to rust and do not use green and / or red colours.
2. For each batch available with all test results, including the re-test results as permitted in the Specification, add markings in:
    a. Green colour: for reinforcement conforming to the Specification;
    b. Red colour: for reinforcement not conforming to the Specification.

REINFORCEMENT

CON9.M110.9 BAR / COIL REINFORCEMENT

Quality requirement:

1. Bar reinforcement of hot rolled steel reinforcement shall be in accordance with CS2:2012;
2. Coil reinforcement of hot rolled steel reinforcement shall be in accordance with CS2:2012 or BS 4449:2005+A2:2009;
3. The bar / coil reinforcement shall be classified as follows:

a. Class 1 steel reinforcing bar that is fully traceable to their manufacturer and production data;
b. Class 2 steel reinforcing bar that is traceable to their manufacturers and production data except their heat / cast number.

ANCILLARY MATERIALS

CON9.M210.9 COVER SPACERS

Cover spacers shall be in accordance with CON3.M210.

CON9.M220.9 CHAIRS AND SUPPORTS

Chair and supports shall be in accordance with CON3.M220.

CON9.M230.9 REINFORCEMENT TYING WIRE

Reinforcement tying wire shall be in accordance with CON3.M230.

WORKMANSHIP

GENERAL

CON9.W010.9 STORAGE OF STEEL REINFORCING BAR DELIVERED TO OSRPY BEFORE PREFABRICATION

Store:

1. All steel reinforcing bar in designated storage area(s);
2. All steel reinforcing bar on a levelled, well-drained and maintained hard-standing ground in a manner that will avoid damage, deformation and contamination of the steel reinforcing bar;
3. Different types and sizes of steel reinforcing bar separately.

CON9.W020.9 SURFACE CONDITION OF STEEL REINFORCING BAR

Surface condition of steel reinforcing bar shall be in accordance with CON3.W020.

CON9.W030.9 CONTAMINATED OR HEAVILY RUSTED REINFORCEMENT

Remove contaminated or heavily rusted reinforcement from the designated area of the OSRPY unless it has been cleaned or satisfactorily treated by an Approved method.

CON9.W040.9 COLOUR MARKINGS OF STEEL REINFORCING BAR BY STOCKISTS OR SUPPLIERS PRIOR TO DELIVERY TO THE OSRPY

1. Obtain steel reinforcing bar preferably without red and green colour markings from stockists / suppliers;
2. If steel reinforcing bar with red colour marking, or with a colour marking covering a previous marking in red, or with green colour marking is to be supplied, then:
   a. Provide in advance an explanation to the CM before delivery to the OSRPY. In addition, for steel reinforcing bar with red colour marking or a colour marking covering a previous marking in red, provide to the CM before delivery to the OSRPY confirmation from each of the Contractor, the stockist / supplier and owner of the OSRPY as far as it is aware, the reinforcement is not non-compliant with CS2:2012 or BS4449:2005+A2:2009 whichever is appropriate and / or is rejected by other project;
   b. The CM may reject the use of the steel reinforcing bar if:
      i. No explanation is provided in advance; or
      ii. The provided explanation is not satisfactory.

FIXING REINFORCEMENT

CON9.W110.9 CUTTING AND BENDING STEEL REINFORCING BAR

1. Steel reinforcing bar shall be cut and bent in accordance with the dimensional requirements of BS 8666:2005 unless otherwise shown on the Drawing;
2. For coil reinforcement, it shall be straightened before cutting and bending in accordance with sub-clause (1) above. The straightening process shall be done by Quality Assured (QA) Coil Processor with an automated machine made for this purpose.

CON9.W120.9 COLD BENDING

Bend steel reinforcing bar in accordance with CON3.W120.

CON9.W130.9 SECURING REINFORCEMENT

Secure reinforcement in accordance with CON3.W130.

CON9.W140.9 LOCATING REINFORCEMENT

Provide sufficient cover spacers, chairs and supports in accordance with CON3.W140 where appropriate.

CON9.W150.9 WELDING

Welding of reinforcement shall be in accordance with CON3.W150.

CON9.W160.9 CONCRETE COVER

The provision of concrete cover shall be in accordance with CON3.W160.

CON9.W170.9 COMPLIANCE WITH DRAWINGS

Checking of completed reinforcement shall be in accordance with CON3.W170.

CON9.W180.9 CM'S INSPECTION

1. Ensure all prefabricated steel reinforcing bar products delivered to the Site are inspected by the CM before carrying out any work, including erecting any formwork adjacent to the reinforcement, which makes access for inspection difficult;
2. Notify the CM within 24 hours, or a shorter period agreed by the CM, prior to carrying out the inspection work.

FIXING REINFORCEMENT

CON9.W190.9 QUALIFIED SUPERVISION

Assign an OSRPY Quality Control Coordinator (OSRPY-QCC), with a minimum qualification and experience of a Grade T1 TCP under the Registered Contractor's stream in the CoPSS, to:

1. Supervise steel reinforcing bar prefabrication works and ensure that these are all carried out in accordance with approved plans and comply with the requirements on quality and workmanship;
2. Devise inspection check list of the off-site steel reinforcing bar prefabrication works;
3. Provide full time continuous supervision of the off-site steel reinforcing bar prefabrication works, including sampling of steel reinforcing bars.

CON9.W200.9 INSPECTION LOG BOOK

1. Record the following details in an inspection log book:
   a. The names and qualifications of the supervisory personnel assigned by the CM and by the Contractor as stipulated in CON9.W190;
   b. The date, time, items inspected and inspection results.
2. Keep the inspection log book in the prefabrication yard and a copy of it on Site for CM's inspection when required and submit the inspection log book to the CM upon completion of the works.

TOLERANCES

CON9.W210.9 GENERAL

The tolerances shall comply with CON3.W210.

TESTING

GENERAL

CON9.T010.9 TESTING ARRANGEMENT

Unless otherwise stated, testing arrangement of steel reinforcing bar in the OSRPY as defined in CON9.G020 shall be in accordance with this Worksection.

DEFINITIONS

CON9.T110.9 BATCH OF STEEL REINFORCING BAR

1. Subject to the maximum tonnage in sub-clause (2) below, a batch of steel reinforcing bar is the quantity of steel reinforcing bar delivered to the OSRPY within a week under one delivery order, of one nominal diameter, and one steel grade and produced by the same manufacturer;
2. The maximum tonnage of a batch shall not exceed:
   a. For steel reinforcing bars of diameter 20 mm and above : 200 tonnes;
   b. For steel reinforcing bars of diameter less than 20 mm : 100 tonnes.

CON9.T120.9 TESTING BY DIRECT TESTING CONTRACTOR (DTC) AND HOUSING DEPARTMENT'S MATERIALS TESTING LABORATORY (HDMTL)

Unless otherwise Approved or specified elsewhere, provide steel reinforcing bar samples to the CM for testing by the DTC and / or HDMTL.

CON9.T130.9 TESTING PROGRAMME

1. Allow sufficient time for the testing of specimens;
2. For Type 1 Yard, do not commence any steel reinforcing bar prefabrication work until all relevant test specimens have successfully passed all tests carried out by the DTC and / or HDMTL and / or CEDD's Public Works Laboratories;
3. For Type 2 Yard and Type 3 Yard, do not commence any steel reinforcing bar prefabrication work until all relevant test specimens have successfully passed all tests carried out by the DTC and HDMTL.

PURCHASERS TESTING

CON9.T210.9 RATE OF SAMPLING

1. For bar reinforcement and coil reinforcement complying CS2:2012, provide adequate test specimens from each batch delivered to the OSRPY in accordance with CS2:2012. The number of test specimens taken from each batch and the rate of sampling shall be in accordance with Table 10 of CS2:2012;
2. For coil reinforcement complying BS 4449:2005+A2:2009, provide samples from each batch as follows:
   a. Class 1 coil reinforcement:

Description	No. of test specimens per batch					
	Size of batch	Tensile properties	Bend performance	Mass per metre	Chemical composition (product analysis)	Bond property

Coil Reinforcement nominal size 10 mm - 16 mm	0 - 60 tonnes	3	1	3	1	1
	each additional 60 tonnes or part of 60 tonnes	1	Nil	1	Nil	Nil
Coil Reinforcement nominal size 20 mm - 25 mm	0 - 80 tonnes	3	1	3	1	1
	each additional 80 tonnes or part of 80 tonnes	1	Nil	1	Nil	Nil

b. Class 2 coil reinforcement:

Description	No. of test specimens per batch					
	Size of batch	Tensile properties	Bend performance	Mass per metre	Chemical composition (product analysis)	Bond property
Coil Reinforcement nominal size 10 mm - 16 mm	0 - 35 tonnes	3	1	3	1	1
	each additional 35 tonnes or part of 35 tonnes	3	Nil	3	Nil	Nil
Coil Reinforcement nominal size 20 mm - 25 mm	0 - 45 tonnes	3	1	3	1	1
	each additional 45 tonnes or part of 45 tonnes	3	Nil	3	Nil	Nil

3. For steel reinforcing bar used for construction of hoardings and associated covered walkways and gantries, the rate of sampling stated in the sub-clause (1) above may be reduced at the discretion of the CM.

CON9.T220.9 PROCEDURE

Testing arrangement:

1. Under the supervision of the CM or his representatives,
   a. Cut and take test specimens selected at random from steel reinforcing bar in the OSRPY as defined in CON9.G020;
   b. Each steel reinforcing bar specimen shall be minimum 1 m long;
   c. Test specimens taken from coil reinforcement shall have been straightened according to BS EN ISO 15630-1:2010 Clause 4 or CS2:2012. The means of straightening the test specimen (manual, machine) shall be indicated in the test request form;
   d. Appropriately mark and keep the test specimens or samples on yard for collection and testing by the DTC and / or HDMTL;
   e. The test specimens or samples shall be stored in a lockable steel box before collection.

CON9.T230.9 TESTING BY HDMTL

Testing samples:

1. Provide additional steel reinforcing bar specimens to HDMTL for test as follows:
   a. Take specimens from steel reinforcing bars adjacent to those from which specimens have been cut for testing by the DTC;
   b. Rate of sampling: approximately one for every five batches selected randomly with the same number of test specimens to be tested by the DTC for each test type as specified in CON9.T210, and the cumulative total number of specimens tested by HDMTL shall be approximately one-fifth of that tested by DTC;
   c. Size of specimens / samples: in accordance with CON9.T220;
   d. Scope, number of tests and method of testing as specified in CON9.T310 and CON9.T320.

TESTING BY DTC

CON9.T310.9 SCOPE AND NUMBER OF TESTS

Testing samples:

1. Tests shall be carried out on each specimen in accordance with
   a. CS2:2012 for bar reinforcement; and
   b. CS2:2012 or BS 4449:2005+A2:2009 for coil reinforcement.
2. Number of tests on each specimen shall be in accordance with
   a. Table 10 of CS2:2012 for bar reinforcement; and
   b. CON9.T210 (2) for coil reinforcement.

CON9.T320.9 METHODS OF TESTING

Tests will be carried out at room temperature between 5°C and 35°C and in accordance with the following standards:

1. CS2:2012 for bar reinforcement;
2. CS2:2012 or BS4449:2005+A2:2009 for coil reinforcement.

COMPLIANCE

CON9.T410.9 COMPLIANCE CRITERIA – STEEL REINFORCING BAR

1. Bar reinforcement

   A batch of bar reinforcement is deemed to comply with the Specification if the test results meet the requirements of CS2:2012. Any non-complying batch of bar reinforcement shall not be used and shall be removed from the designated area in the OSRPY;

2. Coil reinforcement

   A batch of coil reinforcement is deemed to comply with the Specification if the test results meet the requirements of CS2:2012 or BS 4449:2005+A2:2009. Any non-complying batch of coil reinforcement shall not be used and shall be removed from the designated area in the OSRPY.

RE-TESTS

CON9.T510.9 REQUIREMENTS FOR STEEL REINFORCING BAR

Non-compliance:

1. Bar reinforcement

If the result of any test for bar reinforcement does not comply with the specified requirements for the property, provide additional test specimens from the same batch for additional tests for the property in accordance with CS2:2012. The number of additional specimens must be as stated in CS2:2012;

2. Coil reinforcement

   For each test specimen taken in accordance with CON9.T210 and failing to meet the requirement for the mass per meter, chemical composition, tensile properties and bend performance or bond property, two additional test specimens shall be taken from the remainder of the same batch and be subjected to the test or tests which the original specimen failed.

CON9.T520.9 STANDARD FOR REJECTION

1. Bar reinforcement

   A batch of bar reinforcement shall be deemed not complying with the specified requirements for any particular property if the result of any additional test in accordance with CON9.T510 (1) does not comply with the specified requirements for that property. The non-complying batch of bar reinforcement shall not be used and shall be removed from the designated area in the OSRPY;

2. Coil reinforcement

   For properties other than chemical composition, a batch of coil reinforcement shall be deemed not complying with the Specification if any of the additional tests in accordance with CON9.T510 (2) fails. For chemical composition, a batch of coil reinforcement shall be deemed not complying with the Specification if any of them fails unless it is demonstrated to the CM's satisfaction by alternative method acceptable under the International Standards listed in the bibliography of BS EN ISO 15630-1:2010. The non-complying batch of coil reinforcement shall not be used and shall be removed from the designated area in the OSRPY.

EAR EARTHWORK

EAR1 EXCAVATION AND FILLING 7

DESIGN 7

GENERAL 7

EAR1.D010.9 DESIGN RESPONSIBILITY 7
EAR1.D020.9 METHOD STATEMENT FOR TEMPORARY WORKS 7
EAR1.D030.9 EXCAVATION AND LATERAL SUPPORT PLAN (ELSP) 8
EAR1.D040.9 SHORING AND EXCAVATION PROCEDURE DETAILS 10
EAR1.D050.9 DESIGN PARAMETERS 10
EAR1.D060.9 EFFECT OF WORKS ON OTHERS 12
EAR1.D070.9 INFORMATION PROVIDED BY THE AUTHORITY 12
EAR1.D080.9 GEOTECHNICAL STUDY AND GROUND INVESTIGATION 13
EAR1.D090.9 BUILDING REGULATIONS 13
EAR1.D100.9 DESIGN OF LOAD CARRYING ELEMENTS 13
EAR1.D110.9 TRENCH EXCAVATION 13
EAR1.D120.A SELF-COMPACTING BACKFILL MATERIAL (SCM) 13

MATERIALS 15

DEFINITIONS 15

EAR1.M005.9 INERT CONSTRUCTION AND DEMOLITION MATERIAL 15
EAR1.M010.9 EARTHWORKS MATERIAL 15
EAR1.M020.9 OWNERSHIP OF EARTHWORKS MATERIAL 15
EAR1.M030.9 SUITABLE MATERIAL 15
EAR1.M040.9 PUBLIC FILL 15
EAR1.M045.9 GRADE 200 RECYCLED ROCK FILL 15
EAR1.M050.9 UNSUITABLE MATERIAL 16
EAR1.M055.9 MARINE MUD 16
EAR1.M060.9 ROCK 16
EAR1.M070.9 TOPSOIL 16
EAR1.M080.9 EMBANKMENT 16
EAR1.M090.9 TRENCH EXCAVATION 16
EAR1.M100.9 BULK EXCAVATION 17
EAR1.M110.A SELF-COMPACTING BACKFILL MATERIAL (SCM) 17

FILL MATERIALS 17

EAR1.M210.9 GENERAL 17
EAR1.M220.9 PARTICLE SIZE DISTRIBUTION AND TYPES OF FILL MATERIAL 17
EAR1.M230.9 FILTER MATERIAL 18
EAR1.M240.9 HARDCORE 19
EAR1.M250.9 HYDROSEEDING 19
EAR1.M260.9 SOFT LANDSCAPING 19

WORKMANSHIP 20

DEFINITIONS AND SUBMISSIONS 20

EAR1.W010.9 AREAS OF FILL 20
EAR1.W020.9 EARTHWORKS FINAL SURFACE 20
EAR1.W030.9 FORMATION 20
EAR1.W040.9 INTERMEDIATE AREAS OF FILL 20
EAR1.W050.9 SUBMISSION OF PARTICULARS 20
EAR1.W060.A SUBMISSION OF PARTICULARS OF SELF-COMPACTING BACKFILL MATERIAL (SCM) 20

USE OF BLASTING 22

EAR1.W110.9 USE OF BLASTING METHOD 22

SURVEYS **22**
EAR1.W210.9 DATUM 22
EAR1.W220.9 COMMENCEMENT SURVEY 22
EAR1.W230.9 INTERIM AND FINAL SURVEYS 22
EAR1.W240.9 SURVEY INFORMATION 22
TEMPORARY WORKS, SLOPES AND GROUND DRAINAGE **23**
EAR1.W310.9 TEMPORARY DRAINAGE SYSTEM 23
EAR1.W320.9 TEMPORARY SUPPORTS TO EARTHWORKS 23
EAR1.W330.9 GENERAL SAFETY PRECAUTIONS 23
EAR1.W340.9 SAFETY PRECAUTIONS FOR OPEN EXCAVATION EARTHWORKS 24
GENERAL **24**
EAR1.W410.9 EXCAVATION AND EARTHWORKS 24
EAR1.W420.9 PROTECTION FROM WATER AND WEATHER 24
EAR1.W430.9 WORK NEAR SLOPES 25
EAR1.W440.9 UNSUITABLE EARTHWORKS MATERIAL 25
EAR1.W450.9 ADDITIONAL EXCAVATION AND STABILIZATION 25
EAR1.W460.9 HANDLING AND STORAGE OF EARTHWORKS MATERIAL 26
EAR1.W470.9 EXISTING DRAINS AND SERVICES 26
EAR1.W480.9 EXCAVATION ADJACENT EXISTING STRUCTURES 26
EAR1.W490.9 TRIMMING 26
EAR1.W500.9 EXCAVATION OF TRENCHES FOR UTILITIES 26
OBSTRUCTIONS **27**
EAR1.W610.9 BURIED OBSTRUCTIONS 27
EAR1.W620.9 DISUSED DRAINS AND MANHOLES 27
EAR1.W630.9 OLD UNDERGROUND STRUCTURES 27
EAR1.W640.9 BOULDERS 27
EAR1.W650.9 PILED FOUNDATIONS 27
CUTTINGS **27**
EAR1.W710.9 SURFACES OF CUTTINGS 27
EAR1.W720.9 DEPTH OF REMOVAL 27
EAR1.W730.9 MAKING GOOD 27
DISPOSAL OF EXCAVATED MATERIAL **28**
EAR1.W810.9 UNSUITABLE AND SURPLUS MATERIAL 28
EAR1.W820.9 SUITABLE MATERIAL 28
EAR1.W830.9 DUMPING OF UNSUITABLE AND SURPLUS MATERIALS 28
EAR1.W835.9 DISPOSAL OR REUSE OF MARINE MUD 28
EAR1.W840.9 ON SITE SORTING OF CONSTRUCTION AND DEMOLITION MATERIALS 28
EAR1.W845.9 TRIP-TICKET SYSTEM 28
RETAINING WALLS, SHALLOW FOUNDATIONS AND OTHER STRUCTURES **29**
EAR1.W910.9 SIZE OF EXCAVATIONS 29
EAR1.W920.9 APPROVAL OF EXCAVATION BOTTOMS 29
EAR1.W930.9 FOUNDING OF SHALLOW FOUNDATIONS 29
EAR1.W940.9 PROVING BEDROCK FOR FOOTINGS (RAFTS AND PADS) 30
REMEDIAL WORKS **30**
EAR1.W1010.9 EXCAVATION BOTTOMS DAMAGED AFTER APPROVAL 30
EAR1.W1020.9 OVER EXCAVATION 30
EAR1.W1030.9 DAMAGED SURFACES 31
FILLING GENERALLY **31**
EAR1.W1110.9 USE OF ROCK CRUSHING PLANT 31
EAR1.W1115.9 USE OF GRADE 200 RECYCLED ROCK FILL 31
EAR1.W1120.9 HAULAGE OF FILL MATERIAL 31
EAR1.W1130.9 REMOVAL OF EARTHWORKS MATERIAL 31

PREPARATION FOR FILLING 31
EAR1.W1210.9 EXISTING GROUND 31
EAR1.W1220.9 WATER-COURSES 31
EAR1.W1230.9 SLOPING GROUND 31
EAR1.W1240.9 AVAILABILITY OF PLANT 32
EAR1.W1250.9 SCARIFYING 32
FILLING OPERATIONS 32
EAR1.W1310.9 DISPOSAL OF WATER 32
EAR1.W1320.9 APPROVAL 32
EAR1.W1330.9 ADVERSE WEATHER CONDITIONS 32
EAR1.W1340.9 APPROVAL OF REMEDIAL MEASURES 32
EAR1.W1350.9 REMEDIAL MEASURES FOR DAMAGED FILL AREAS 32
EAR1.W1360.9 REMEDIAL MEASURES WHERE FILL OVERLAID 32
EAR1.W1370.9 RESTRICTIONS ON USE OF FILL MATERIAL 32
EAR1.W1380.9 MIX PROPORTIONS, MIXING AND PLACING RECONSTITUTED SOIL 33
EAR1.W1390.9 SETTLEMENT 33
FILLING FOUNDATION PITS AND TRENCHES ETC 33
EAR1.W1410.9 ADJACENT UTILITIES OR STRUCTURES 33
EAR1.W1420.9 FILLING AROUND WATER, SEWERAGE AND DRAINAGE PIPES 33
EAR1.W1430.9 BACKFILLING TO FOUNDATIONS 34
EAR1.W1440.9 BACKFILLING TO TRENCHES FOR AUTOMATED REFUSE COLLECTION SYSTEM (ARCS) 34
FILLING EXISTING WATERCOURSES 34
EAR1.W1510.9 PREPARATION 34
EAR1.W1520.9 FILLING 34
BACKFILLING BEHIND RETAINING WALLS 34
EAR1.W1610.9 PLACING FILTER MATERIAL 34
EAR1.W1620.9 FILLING 34
FORMING EMBANKMENTS AND PLATFORMS 34
EAR1.W1710.9 MATERIAL SELECTION 34
EAR1.W1720.9 DEPOSITION OF FILL MATERIAL 34
EAR1.W1730.9 COMPACTION 35
EAR1.W1740.9 ROCK FILL EMBANKMENTS AND PLATFORMS 35
EAR1.W1750.9 BLINDING ROCK FILL EMBANKMENTS AND PLATFORM 35
EAR1.W1760.9 ISOLATED BOULDERS 35
EAR1.W1770.9 CULVERTS AND DRAINS ETC 36
EAR1.W1780.9 SURFACES USED BY CONSTRUCTION TRAFFIC 36
REUSE OF MARINE MUD FOR BACKFILLING 36
EAR1.W1785.9 REUSE OF MARINE MUD FOR BACKFILLING 36
USE OF SELF-COMPACTING BACKFILL MATERIAL 38
EAR1.W1790.A USE OF SELF-COMPACTING BACKFILL MATERIAL (SCM) 38
COMPACTION BY PERFORMANCE SPECIFICATION 40
EAR1.W1810.A PROCEDURE 40
EAR1.W1820.9 TESTING 40
EAR1.W1830.X DELETED 41
EAR1.W1840.9 FIELD DENSITY 41
EAR1.W1850.9 STANDARD OF COMPACTION 41
EAR1.W1860.9 STANDARD OF COMPACTION BETWEEN PILE CAPS AND SUSPENDED SLABS AND AROUND PILE CAPS 41
COMPACTION BY METHOD SPECIFICATION 41
EAR1.W1910.9 ADOPTION 41
EAR1.W1920.9 ROLLERS 41

EAR1.W1930.9 COMPACTION METHOD 41
EAR1.W1940.9 COMPACTION OF GENERAL FILL MATERIAL WITH A LARGE PORTION OF COARSE MATERIAL 41

INTERMEDIATE AREAS OF FILL 43
EAR1.W2010.9 DEPOSITING 43
EAR1.W2020.9 COMPACTION 43

COMPLETION OF GENERAL EARTHWORKS SURFACES 43
EAR1.W2110.9 GENERAL 43
EAR1.W2120.9 COMPACTION 43
EAR1.W2130.9 PROOF ROLLING 43
EAR1.W2140.9 MAKING GOOD DEFECTS 43
EAR1.W2150.9 PAVEMENT FORMATIONS 44
EAR1.W2160.9 PROTECTION OF FORMATIONS 44
EAR1.W2170.9 HYDROSEEDING 44

ADDITIONAL REQUIREMENTS FOR SOFT LANDSCAPING 44
EAR1.W2210.9 GENERAL 44

ADDITIONAL REQUIREMENTS FOR SURFACE PREPARATION OF ROAD FORMATIONS 44
EAR1.W2310.9 SEQUENCE 44
EAR1.W2320.9 FORMATIONS OTHER THAN ROCK FILL 44
EAR1.W2330.9 ROCK FILL FORMATIONS 45

ADDITIONAL REQUIREMENTS FOR FILL SLOPES 45
EAR1.W2410.9 GENERAL 45

REMOVAL OF TEMPORARY WORKS 46
EAR1.W2510.9 DISMANTLING AND REMOVAL 46

TOLERANCES 46
EAR1.W2610.9 GENERAL 46

TESTING 47

FILL MATERIAL - GENERAL REQUIREMENTS 47
EAR1.T020.9 BATCH 47
EAR1.T030.9 SAMPLES 47
EAR1.T040.9 SAMPLE SIZE 47

SITE TESTS FOR SOIL AND GROUNDWATER 47
EAR1.T110.9 GENERAL 47
EAR1.T115.9 COMPACTION TEST FOR FILL SLOPES 47

FILL MATERIAL - PARTICLE SIZE DISTRIBUTION, LIQUID LIMIT, PLASTICITY INDEX, COEFFICIENT OF UNIFORMITY AND SULPHATE CONTENT 48
EAR1.T210.9 GENERAL 48
EAR1.T220.9 TESTING CRITERIA 48
EAR1.T230.9 TEST METHODS 49
EAR1.T240.9 NON-COMPLIANCE WITH TESTS 49

FILL MATERIAL - OPTIMUM MOISTURE CONTENT AND MAXIMUM DRY DENSITY 49
EAR1.T310.9 GENERAL 49
EAR1.T320.9 LOCATION 49
EAR1.T330.9 ADDITIONAL SAMPLES 49
EAR1.T340.9 MATERIALS NOT FOR SAMPLING 50
EAR1.T350.9 TESTING METHODS 50
EAR1.T370.9 INCONSISTENT MATERIALS 50

FILL MATERIAL - MOISTURE CONTENT 50
EAR1.T410.X DELETED 50
EAR1.T420.A TESTING METHODS 50

EAR1.T430.X DELETED 51
EAR1.T440.A NUMBER OF TESTS FOR RELATIVE COMPACTION 51

FILL MATERIAL - RELATIVE COMPACTION 51
EAR1.T510.9 REQUIREMENT FOR TESTING 51
EAR1.T520.9 LOCATION OF TESTS 51
EAR1.T530.9 METHODS 51
EAR1.T540.9 IN-SITU BULK DENSITY AND IN-SITU DRY DENSITY 52
EAR1.T550.9 NON-COMPLIANCE OF RELATIVE COMPACTION TEST 52

TEST METHODS FOR FILL MATERIALS 52
EAR1.T710.9 GENERAL 52
EAR1.T720.9 ABBREVIATIONS AND SYMBOLS 52
EAR1.T730.9 GROUPING OF MATERIALS 53

DETERMINATION OF THE MOISTURE CONTENT OF FINE GRAINED AND MEDIUM GRAINED MATERIAL BY THE MICROWAVE OVEN DRYING METHOD 53
EAR1.T810.9 SCOPE 53
EAR1.T820.9 APPARATUS 53
EAR1.T830.9 PROCEDURE 53
EAR1.T840.9 CALCULATION 54
EAR1.T850.9 REPORTING 54

DETERMINATION OF THE MAXIMUM CONVERTED BULK DENSITY BY THE HILF METHOD 54
EAR1.T860.9 SCOPE 54
EAR1.T870.A APPARATUS 54
EAR1.T880.A PROCEDURE 54
EAR1.T890.A CALCULATION 57
EAR1.T900.A REPORTING 57

ADJUSTMENT OF THE MAXIMUM CONVERTED BULK DENSITY FOR DETERMINATION OF RELATIVE COMPACTION 58
EAR1.T910.9 SCOPE 58
EAR1.T920.9 APPARATUS 58
EAR1.T930.A PROCEDURE 58
EAR1.T940.A CALCULATION 59
EAR1.T950.9 REPORTING 59

SELF-COMPACTING BACKFILL MATERIAL 59
EAR1.T960.A TESTING 59
EAR1.T1010.N SCOPE 62
EAR1.T1020.N APPARATUS 62
EAR1.T1030.N PROCEDURE 62
EAR1.T1040.N CALCULATION 63
EAR1.T1050.N REPORTING 63

EAR2 BLASTING 64

MATERIALS 64

EXPLOSIVES 64
EAR2.M010.9 NITRO-GLYCERINE BASED EXPLOSIVES 64
EAR2.M020.9 PRE-SPLIT BLASTING EXPLOSIVES 64

WORKMANSHIP 65

GENERALLY 65
EAR2.W010.9 STATUTORY REQUIREMENTS 65
EAR2.W020.9 TRAFFIC CONTROL 65
EAR2.W030.9 RESTRICTIONS ON TIMING 65
EAR2.W040.9 PARTICULARS OF BLASTING 65

EAR2.W050.9 PARTICULARS OF PRE-SPLIT BLASTING 66
EAR2.W060.9 BLASTING ASSESSMENT 66
EAR2.W070.9 GEOTECHNICAL ENGINEERING OFFICE (GEO) REQUIREMENTS 66
SAFETY PRECAUTIONS, RESTRICTIONS AND BLASTING PROCEDURES 67
EAR2.W110.9 SAFETY PRECAUTIONS AND RESTRICTIONS 67
EAR2.W120.9 GENERAL PROCEDURES 67
EAR2.W130.9 SURFACE PREPARATION 67
EAR2.W140.9 PROTECTIVE SCREENS 68
EAR2.W150.9 PLASTER BLASTING 68
EAR2.W160.9 BLAST HOLES 68
EAR2.W170.9 DETONATORS 68
EAR2.W180.9 DELAY BLASTING 68
EAR2.W190.9 PROXIMITY TO CERTAIN STRUCTURES 68
EAR2.W200.9 VIBRATIONS TO INSTALLATIONS OR STRUCTURES 68
EAR2.W210.9 VIBRATIONS TO ADJOINING LAND 68
EAR2.W220.9 RECORDING VIBRATIONS 69
PRE-SPLIT BLASTING 69
EAR2.W310.9 FORMING FINAL SURFACES 69
EAR2.W320.9 METHODOLOGY 69
EAR2.W330.9 HOLES FOR PRE-SPLITTING 69
TRIAL BLASTS 70
EAR2.W410.9 REASON FOR TRIAL BLASTS 70
EAR2.W420.9 PARTICULARS OF TRIAL BLASTING 70
EAR2.W430.9 PRE-SPLIT BLASTING TRIALS 70
EAR2.W440.9 RESULTS OF BLAST TRIALS 70
EAR2.W450.9 CHANGES IN PROCEDURE 70
EAR2.W460.9 COMPLETION OF TRIAL BLASTS 70
EAR2.W470.9 COMMENCEMENT OF BLASTING 70
TOLERANCES 70
EAR2.W510.9 GENERAL 70

EAR1 EXCAVATION AND FILLING

DESIGN

GENERAL

EAR1.D010.9 DESIGN RESPONSIBILITY

1. Submit for Approval, within 7 days of the notified date for commencement of the Works, the name and particulars of the Registered Structural Engineer (RSE) and Registered Geotechnical Engineer (RGE) who will be employed on the Project in accordance with the Preliminaries Worksection. The RSE and RGE must have relevant experience to design, supervise and control all temporary works, excavation, dewatering and any specified design and built items. Comply with PNAP APP-141 for the division of responsibilities between RSE and RGE in connection with the excavation and lateral support works;
2. Prior to the notified date for commencement of the Works, the CM has provided reference design for the Excavation and Lateral Support Works (ELSW) for permanent works construction as specified in sub-clause (2) of EAR1.D030. The Contractor shall review and decide whether to dispense with, adopt in full or modify the reference design provided by the CM;
3. Should the Contractor choose to adopt in full the reference design provided by the CM, the procedures for submitting the Excavation and Lateral Support Plan (ELSP) to the CM as stipulated in sub-clause (3) of EAR1.D030 shall be followed;
4. Should the Contractor choose to dispense with or modify the reference design provided by the CM, the procedures for obtaining the CM's approval of the Contractor's design or the modified design as stipulated in sub-clause (4) of EAR1.D030 shall be followed;
5. If the reference design provided by the CM is adopted in full by the Contractor, the Contractor shall assume full design responsibility for the said ELSW in sub-clause (2);
6. If the Contractor decides to dispense with or modify the reference design provided by the CM, the Contractor shall be solely responsible for the design of ELSW or the modified design (including submission of ELSP).

EAR1.D020.9 METHOD STATEMENT FOR TEMPORARY WORKS

1. Prior to commencement of the temporary work submit a method statement which takes account of geotechnical considerations and gives full details of all materials, plant and timing and sequence of operations involved in the construction of the temporary work, for the structures as specified in the Project Specific Specification;
2. As part of the information provided with the method statement submit for Approval full details of the temporary earth support systems it is proposed to use associated with the construction of the structures listed above;
3. Give due considerations to any drainage pipe works and existing retaining walls nearby along any Estate Roads;
4. Ensure particulars include, but are not limited to, the following:

a. A detailed programme for the works showing phases of construction with associated traffic arrangements and provision for the existing utility services necessitated by the method of construction;

b. Details of construction method including:

i. Plant, equipment and labour to be deployed;

ii. Sequence for temporary works installation and excavation;

iii. Sequence for temporary works removal and backfilling;

iv. Temporary drainage measures to prevent flooding during rainstorms.

c. The workmanship submission requirements specified at EAR1.W050.

5. Allow adequate time in the construction programme for the CM's processing of the specified submissions. The time allowed must be in no circumstances less than 42 days. Do not commence the temporary work without the CM's consent.

EAR1.D030.9 EXCAVATION AND LATERAL SUPPORT PLAN (ELSP)

1. Submit ELSP and allow at least the number of days as specified in the Project Specific Specification for obtaining CM's approval. Allow a further number of days as specified in the Project Specific Specification for granting of approval by CM for each ELSP re-submission. The structural calculations and drawings submitted are prepared and signed by the RSE referred to in sub-clause (1) of EAR1.D010. The geotechnical report / supporting documentation for the ELSP shall be prepared and signed by the RGE appointed in accordance with the Preliminaries Worksection in case of having excavation depth deeper than 4.5 m and / or involving significant geotechnical elements. ELSP submission is required where the excavation is one of the following types:

a. Deeper than 2.5 m and greater than 5 m in length;

b. Liable to affect any road, building, structure, slope steeper than 30 degrees or water main 75 mm in diameter or greater, the affected area being defined as within the 45 degree line up from the base of the excavation to the ground surface;

c. Of substantial depth, the collapse of which would cause serious consequences to public safety as per PNAP APP-57;

d. Any other ELSW requiring ELSP submission as specified by CM.

Notwithstanding the approval of the ELSP, the commencement of the ELSW shall be subject to the CM's written permission referred to in PRE.B4.050.

2. The reference design for the ELSW is provided for the location(s) as specified in the Project Specific Specification with details in reference drawings listed in Appendix U to this Specification. The reference drawings are given in good faith for the Contractor's information and reference only, and are by no means exhaustive nor represent the design provided therein or any part thereof being in compliance with the Specification. Notwithstanding these reference drawings which the Contractor is free to adopt or not, or to modify in whole or in part, the Contractor shall be solely responsible for the design (including submission of ELSP) and construction of the ELSW. The provision of these reference drawings shall not prejudice the Contractor's obligations and liabilities under the Contract;

3. Where the Contractor chooses to adopt in full the said reference design of the ELSW referred to in sub-clause (3) of EAR1.D010, submit ELSP based on the said reference design of the ELSW duly signed by the RSE and / or RGE as appropriate appointed in accordance with the Preliminaries Worksection and allow at least the number of days as specified in the Project Specific Specification to obtain CM's approval for such submission before commencement of the ELSW. Notwithstanding the approval of the ELSP, the commencement of the ELSW shall be subject to the CM's written permission referred to in PRE.B4.050;

4. Where the Contractor chooses to dispense with or modify the said reference design of the ELSW referred to in sub-clause (4) of EAR1.D010, the Contractor shall submit ELSP to CM and allow at least the number of days as specified in the Project Specific Specification to obtain CM's approval for the new or modified design before commencement of the ELSW. The structural calculations and drawings submitted are prepared and signed by the RSE referred to in sub-clause (1) of EAR1.D010. The geotechnical report / supporting documentation for the ELSP shall be prepared and signed by the RGE appointed in accordance with the Preliminaries Worksection in case of having excavation depth deeper than 4.5 m and / or involving significant geotechnical elements. Allow for a further number of days as specified in the Project Specific Specification for granting of approval by the CM for each ELSP re-submission. ELSP submission is required where the excavation is one of the following types:

    a. Deeper than 2.5 m and greater than 5 m in length;

    b. Liable to affect any road, building, structure, slope steeper than 30 degrees or water main 75 mm in diameter or greater, the affected area being defined as within the 45 degree line up from the base of the excavation to the ground surface;

    c. Of substantial depth, the collapse of which would cause serious consequences to public safety as per PNAP APP-57;

    d. Any other ELSW requiring ELSP submission as specified by CM.

    Notwithstanding the approval of the ELSP, the commencement of the ELSW shall be subject to the CM's written permission referred to in PRE.B4.050.

5. The ELSP submission shall include information as specified in the Project Specific Specification;

6. For ELSW with pile walls and bulk excavation, comply with the following:

    a. Refer to the Project Specific Specification on restrictions on commencement for pile walls driving work;

    b. Comply with the requirements of the Approved ELSP;

    c. At the completion of pile walls driving works, submit record plans showing the actual penetration depth of the pile walls to CM for approval. Allow at least of 22 days for granting of approval by CM on:

        i. Certification of completion of the works using Form ICU 14;

        ii. Commencement of bulk excavation works.

    d. Allow sufficient time in the programme of Works for obtaining the said Approvals. Do not commence driving of pile walls and bulk excavations without written Approval for commencement from the CM.

7. For ELSW with bulk excavation only, comply with the following:

    a. Refer to the Project Specific Specification on restrictions on commencement on bulk excavation works;

b. Allow sufficient time in the programme of Works for obtaining the said Approvals. Do not commence ELSW without written Approval for commencement from the CM;

c. Comply with the requirements under the Approved ELSP.

EAR1.D040.9 SHORING AND EXCAVATION PROCEDURE DETAILS

1. Unless ELSP has been submitted in accordance with EAR1.D030, submit 'Shoring and Excavation Procedure Details' to CM and allow the number of days as specified in Project Specific Specification after obtaining CM's written approval of such procedure details for obtaining CM's written permission to commence such work;
2. Comply with the requirements under the submitted 'Shoring and Excavation Procedure Details'.

EAR1.D050.9 DESIGN PARAMETERS

1. Design temporary works, excavation and dewatering methods and submit proposals for review and Approval. Include in the submission of the details of the temporary earth support systems the following:
   a. Design philosophy; bearing in mind that design is such that the risk of failure is not more than that which would be adopted if the temporary works were to be permanent. Allowance may be made in the design for the shorter design life and for the risk to persons and property and the surface water and ground water conditions which are likely to occur during construction;
   b. Detailed design calculations and drawings;
   c. Specification for the works including procedures for installation and removal;
   d. Prediction of deformation of the temporary works and ground settlement and horizontal movement;
   e. Assessment of ground vibrations resulting from the temporary works that must not exceed the limits set down in EAR2.W200. In case where the temporary works involve installation of pile walls by percussive or vibratory methods, assessment of ground vibrations resulting from such works that must not exceed the limits set down in Appendix A of PNAP APP-137;
   f. Precautionary measures to safeguard the integrity of the existing drainage pipe work and retaining wall in vicinity of the temporary works.
2. Refer to EAR1.D030 on the design requirement and method of construction of the ELSW;
3. Include in the design contingency measures to be adopted should site conditions deviate from the design assumptions;
4. Ensure all calculations and drawings submitted are certified and signed by the Registered Structural Engineer referred to at EAR1.D010 and ensure all geotechnical reports and supporting documents are certified and signed by the Registered Geotechnical Engineer referred to in EAR1.D010;
5. Allow in the design for the subsequent removal of the temporary works while maintaining the stability of the excavation upon completion of the Works;
6. Make a detailed submission to the CM to provide design parameters and design ground water levels with supporting document/calculation/justification for the design and:

a. Verify the proposed design parameters and design ground water levels by carrying out necessary Approved laboratory tests and monitoring. The CM reserves the right to reject any proposed design parameters and design ground water levels that are not to the CM's satisfaction;

b. Submit details of all required tests to the CM's satisfaction. Arrange for sufficient number of laboratory tests and investigation to establish the design parameters for each major stratum with sufficient independent results for that stratum. Carry out all laboratory tests and investigation for this purpose at the expense of the Contractor and bear all the time involved.

7. Where the Contractor chooses to adopt in full the reference design of ELSW for permanent works construction referred to in sub-clause (2) of EAR1.D030:

a. Refer to EAR1.D030 on the design requirement and method of construction of the ELSW;

b. Include in the design contingency measures to be adopted should site conditions deviate from the design assumptions;

c. Submit details of all required tests to the CM's satisfaction. Arrange for sufficient number of laboratory tests and investigation to establish the design parameters for each major stratum with sufficient independent results for that stratum. Carry out all laboratory tests and investigation for this purpose at the expense of the Contractor and bear all the time involved.

8. Where the Contractor chooses to dispense with or modify the reference design of ELSW for permanent works construction referred to in sub-clause (2) of EAR1.D030:

a. Design temporary works, excavation and dewatering methods and submit proposals for review and Approval. Include in the submission of the details of the temporary earth support systems the following:

i. Design philosophy; bearing in mind that design is such that the risk of failure is not more than that which would be adopted if the temporary works were to be permanent. Allowance may be made in the design for the shorter design life and for the risk to persons and property and the surface water and ground water conditions which are likely to occur during construction;

ii. Detailed design calculations and drawings;

iii. Specification for the works including procedures for installation and removal;

iv. Prediction of deformation of the temporary works and ground settlement and horizontal movement;

v. Assessment of ground vibrations resulting from the temporary works that must not exceed the limits set down in EAR2.W200. In case where the temporary works involve installation of pile walls by percussive or vibratory methods, assessment of ground vibrations resulting from such works that must not exceed the limits set down in Appendix A of PNAP APP-137;

vi. Precautionary measures to safeguard the integrity of the existing drainage pipe work and retaining wall in vicinity of the temporary works.

b. Refer to EAR1.D030 on the design requirement and method of construction of the ELSW;

c. Include in the design contingency measures to be adopted should site conditions deviate from the design assumptions;

d. Ensure all calculations and drawings submitted are certified and signed by the Registered Structural Engineer referred to at EAR1.D010 and ensure all geotechnical reports and supporting documents are certified and signed by the Registered Geotechnical Engineer referred to in EAR1.D010;

e. Allow in the design for the subsequent removal of the temporary works while maintaining the stability of the excavation upon completion of the Works;

f. Make a detailed submission to the CM to provide design parameters and design ground water levels with supporting document/calculation/ justification for the design and:

i. Verify the proposed design parameters and design ground water levels by carrying out necessary Approved laboratory tests and monitoring. The CM reserves the right to reject any proposed design parameters and design ground water levels that are not to the CM's satisfaction;

ii. Submit details of all required tests to the CM's satisfaction. Arrange for sufficient number of laboratory tests and investigation to establish the design parameters for each major stratum with sufficient independent results for that stratum. Carry out all laboratory tests and investigation for this purpose at the expense of the Contractor and bear all the time involved.

EAR1.D060.9 EFFECT OF WORKS ON OTHERS

1. Where temporary work, ELSW and dewatering proposals could have an effect on the properties of others, the CM may require submission of the design proposals to be presented to the Geotechnical Engineering Office (GEO), Technical Services Division of Civil Engineering Development Department, Highways Department, Mass Transit Railway Corporation, Kowloon Canton Railway Corporation, Water Supplies Department and Drainage Services Department, etc. for comments and / or acceptance;
2. When Instructed abide by such requirements;
3. Where this is the case allow sufficient time in the programme for comment by various Government Departments. Incorporate all comments and requirements from various Government Departments into the ELSP prior to submission to CM in accordance with EAR1.D030;
4. Address all queries raised by the various Government Departments;
5. Do not commence construction works until formal Approval has been given.

EAR1.D070.9 INFORMATION PROVIDED BY THE AUTHORITY

1. Drillhole data, laboratory testing data, structural design criteria and any other information relevant to the Works may be viewed at the Authority's office by appointment at any time during normal office hours;
2. The following soil parameters may be taken as reference values for design of ELSW:

Soil material	Soil Parameters				
	c' (kPa)	ϕ' (deg.)	γ (kN/m^3)	E' (MPa)	ν'

Notes to table:

a. c′ = effective cohesion of soil;

b. ϕ′ = effective friction angle of soil;

c. γ = bulk unit weight of soil;

d. E′ = Young's modulus (for drained loading); and

e. ν′ = Poisson's ratio (for drained loading)

3. The above information is given in good faith for reference only and is not meant to be exhaustive or to be representative of the whole or any part of the Site or in any way limiting the obligations and liabilities of the Contractor under the Contract. No guarantee can be given nor responsibility be taken by the Employer or the CM for their accuracy, consistency or sufficiency, and no claim whatsoever will be entertained on account of any errors, discrepancies and insufficiency in relation to the information given.

EAR1.D080.9 GEOTECHNICAL STUDY AND GROUND INVESTIGATION

1. In addition to the general responsibilities provided under the Contract, carry out a geotechnical study and any necessary ground investigation so as to become fully aware of the geotechnical characteristics of the design of temporary works or the execution of the works;

2. Comply with the requirements as specified in Project Specific Specification.

EAR1.D090.9 BUILDING REGULATIONS

Carry out calculations for temporary works in accordance with the relevant Building Regulations made under the Building Ordinance, slope manual, geoguide and model specification of Geotechnical Engineering Office and the relevant British Standards. Wherever there is conflict between British Standards and Building Regulations, the latter shall take precedence.

EAR1.D100.9 DESIGN OF LOAD CARRYING ELEMENTS

Ensure all materials used as load carrying elements conform to the relevant British Standards in respect of quality, and that the design conforms with the safe working stresses laid down in those Standards.

EAR1.D110.9 TRENCH EXCAVATION

Without prejudice to other provisions in the Contract, comply with the provisions in the "Guide to Trench Excavations (Shoring Support and Drainage Measures)" published jointly by the Highways Department and the Civil Engineering and Development Department, Hong Kong Government or its updates as may be promulgated from time to time in the design of temporary support to trench excavations.

EAR1.D120.A SELF-COMPACTING BACKFILL MATERIAL (SCM)

1. Seek the CM's approval for the use of SCM as the alternative backfill material for:

   a. Backfilling utilities trenches;

   b. Filling voids in the following areas where difficulties are anticipated in achieving desirable performance of backfilling or compacting conventional backfilling material (i.e. soil) in a timely manner, and thus may cause unsatisfactory permanent reinstatement of the pavement above:

      i. Between pile caps and temporary lateral supports;

ii. Between manholes, gully pits, gully sumps, other drainage chambers and temporary lateral supports;

iii. Between underpass wall without permeable drainage and temporary lateral supports;

iv. Pits, trenches and voids in slope and retaining wall works.

2. The use of SCM as an alternative backfill material shall be subject to the fulfilment of the following conditions:

   a. Seek consent from the concerned Utility Undertaking if its existing underground installations will be embedded by SCM;

   b. Seek comments from Estate Management Division if SCM is proposed to be used;

   c. Prepare and provide as-built plan (including area, depth etc.) to Estate Management Division where the SCM is adopted.

3. Bear all associated costs and the extra time required by reason of the progress of the Works or any part thereof having been affected by the time due to any failure in obtaining approval/consent as required under sub-clauses (1) and (2) above.

MATERIALS

DEFINITIONS

EAR1.M005.9 INERT CONSTRUCTION AND DEMOLITION MATERIAL

Rock, rubble, earth, soil, concrete, asphalt, brick, tile and masonry generated from construction and demolition works.

EAR1.M010.9 EARTHWORKS MATERIAL

Soil, rock, or inert construction and demolition material on or below the Site at the commencement of the Works, or which is imported to the Site to carry out the Works.

EAR1.M020.9 OWNERSHIP OF EARTHWORKS MATERIAL

1. Ownership of the Employer - earthworks material within the Site at the commencement of the Works, except as in sub-clause (2) below;
2. Ownership of the Contractor - earthworks material which is required to be disposed of by the Contractor is the property of the Contractor when it is removed from the Site. Dispose of in tips provided by the Contractor, unless otherwise stated in the Contract.

EAR1.M030.9 SUITABLE MATERIAL

1. Naturally occurring or processed material, or inert construction and demolition material, which at the time of deposition is capable of being compacted in accordance with the specified requirements to form stable areas of fill;
2. Grade 200 Recycled Rock Fill as EAR1.M045 where specified in the Drawings or approved by CM;
3. Do not use unsuitable materials as listed in EAR1.M050.

EAR1.M040.9 PUBLIC FILL

1. Public fill shall mean the inert material arising from construction and demolition activities such as site clearance, excavation, construction, refurbishment, renovation, demolition and roadworks. Public fill comprises material including stone, rock, masonry, brick, concrete, soil and other inert material. There is no size limitation on the public fill, and a small amount of timber mixed with otherwise suitable material is permissible. The public fill may also consist of wet soil;
2. The use of public fill as fill material for earthwork may be permitted and the size limitation, transportation, stockpiling, deposit, spreading, compaction and any particular requirements of such material shall be as stated in the Contract.

EAR1.M045.9 GRADE 200 RECYCLED ROCK FILL

1. Grade 200 Recycled Rock Fill (RR 200) shall mean a type of recycled rock or inert construction and demolition material which is hard and durable, and free from cracks, veins, and other evidence of decomposition;
2. RR 200 shall be collected from the recycling facilities managed by the Fill Management Division of Civil Engineering and Development Department as specified in the Project Specific Specification;
3. In the event that RR200 is used in the Works, comply with the following:

a. Comply with the relevant ordering and collection procedures of RR 200 as specified by the CEDD;

b. Complete and submit the order form to the CM at least 10 days before the collection of RR 200 from the recycling facilities. The ordering and collection procedures together with the order form can be obtained from the CEDD web-site;

c. Make due allowance in the works programme for the time associated with ordering and collection of RR200 and bear all associated costs, and no extension of time will be allowed.

EAR1.M050.9 UNSUITABLE MATERIAL

Other than Suitable Material and Grade 200 Recycled Rock Fill, and including the following:

1. Peat, vegetation, timber, organic, soluble or perishable material, or rubbish;
2. Swelling clays or collapsible soils;
3. Dangerous or toxic material or material susceptible to combustion;
4. Material susceptible to volume change, including marine mud, materials from swamps, nullahs, stream courses and culverts, or soil with a liquid limit exceeding 65% or a plasticity index exceeding 35%; and
5. Metal, rubber, plastic or synthetic material.

EAR1.M055.9 MARINE MUD

The term "mud" shall be as defined in Table 11 of 'Geoguide 3:Guide to Rock and Soil Descriptions' GEO, which is broadly classified as marine deposits with fine soils of over 35% by mass of silts and clays of particle sizes up to 0.06 mm.

EAR1.M060.9 ROCK

1. Naturally occurring hard material which in the opinion of the CM can only be removed by:
   a. Blasting;
   b. Pneumatic tools other than clay spades;
   c. Wedges and sledge hammers;
   d. Drilling and the use of mechanical bursting;
   e. Drilling and the use of expanding agents.
2. Any isolated, solid boulder or detached piece of rock exceeding 0.2 m^3.

EAR1.M070.9 TOPSOIL

Soil capable of supporting vegetable growth.

EAR1.M080.9 EMBANKMENT

An area on the Site, other than a foreshore or sea-bed, where the ground level is to be raised by filling in layers as part of the Works.

EAR1.M090.9 TRENCH EXCAVATION

Excavation starting at ground level and not exceeding 5 m in width at the surface.

EAR1.M100.9 BULK EXCAVATION

Excavation in the open, other than trench excavation.

EAR1.M110.A SELF-COMPACTING BACKFILL MATERIAL (SCM)

1. SCM shall be backfill material using cementitious material, fine aggregate, pulverized material, water and admixtures for controlling the rheology and setting time of the in-situ material;
2. Cementitious material shall be Portland Cement (PC) to BS EN 197-1:2011 or Pulverized Fuel Ash (PFA) to BS EN 450-1:2012;
3. Fine aggregate shall be clean and hard complying with CS3:2013. Natural sand shall not be used unless with the prior agreement of the CM;
4. Pulverized material shall be clean sedimentary rock material with the following requirements:
   a. Grain size of no more than 100 μm as determined in accordance with Test Method 8.5 of Geospec 3 or equivalent;
   b. The clay content, determined by the methylene blue test in accordance with CS3:2013shall not exceed 1.50g/100g;
   c. Calcium carbonate ($CaCO_3$) content calculated from the calcium oxide content in accordance with BS EN 196-2:2013 shall be at least 75 % by mass.
5. Admixtures shall comply with the following standards: BS EN 12878:2014 for pigments, BS EN 934-2:2009 for accelerating admixtures, retarding admixtures, water-reducing admixtures and BS EN 934-2:2009 for superplasticising admixtures;
6. Water shall be clean fresh water taken from the public supply. Non-saline water from other sources may be used subject to the CM's approval, provided that it can be demonstrated that the water is neutral in PH value, free from suspended solids and liquid contaminants non-miscible with water. It shall be tested and comply with BS EN 1008. Wash water from concrete mixer washout operations (recycled water) shall not be used.

FILL MATERIALS

EAR1.M210.9 GENERAL

1. Use only suitable material as previously defined;
2. Unless otherwise specified, form areas of fill by general fill material;
3. Obtain fill material from excavation within the Site. If there is insufficient fill material of the required types within the Site, provide imported fill material from sources outside the Site subject to approval by the CM.

EAR1.M220.9 PARTICLE SIZE DISTRIBUTION AND TYPES OF FILL MATERIAL

For different types of fill material, keep particle size distribution within the following table:

Type of fill material	Percentage by mass passing					
	Size		BS Test Sieve			
	400 mm	200 mm	75 mm	20 mm	600 μm	63 μm
Fine fill	-	-	100	-	-	-

General fill	-	100	75 - 100	-	-	-
Special fill	-	-	100	-	-	0 - 45
Granular fill	-	-	100	-	0 - 5	-
Rock fill (Grade 200)	-	100	20 - 75	0 - 50	-	-
Recycled rock fill (Grade 200)	-	100	20 - 75	0 - 50	-	-
Rock fill (Grade 400)	100	20 - 75	10 - 30	0 - 25	-	-

Notes to table:

1. Special fill material is to consist of material which has a liquid limit not exceeding 45%, a plasticity index not exceeding 20% and a coefficient of uniformity exceeding 50. For those special fill material which contains less than 30% by weight of particles less than 63 μm, testing on the liquid limit and plasticity index of the material is not required;
2. Granular fill material is to consist of clean, hard, durable material including recycled aggregates, rock and concrete;
3. Rock fill material is to consist of pieces of hard and durable rock of which the maximum size shall not be greater than three times the minimum dimension of individual pieces and in the opinion of the CM not more than 30% by mass is discoloured or shows other evidence of decomposition. Crushed rock or crushed concrete may be permitted subject to approval by the CM;
4. The soluble sulphate content of fill material placed within 500 mm of concrete, cement bound material or cementitious material must not exceed 1.9 grams of sulphate, expressed as SO_3, per litre;
5. The total sulphate content, expressed as SO_3, of fill material placed within 500 mm of metalwork must not exceed 0.5% by mass;
6. Well-graded material to consist of material which has a coefficient of uniformity exceeding 10;
7. Uniform-graded material to consist of material which has a coefficient of uniformity of 10 or less.

EAR1.M230.9 FILTER MATERIAL

1. Hard, durable, inert material. When placed and compacted this material, either:
   a. Conforms with the grading limits specified; or
   b. Other limits separately designed by the Contractor to suit the type of adjacent material in accordance with filter rules acceptable to the GEO, as agreed by the CM; and
   c. Submitted to the CM at least 4 weeks prior to actual incorporation into the Works; and
   d. Graded - in accordance with Test Method 8.2 of Geospec 3: Model Specification for Soil Testing, GEO, and free from organic or other impurities.
2. Sampling - size of sample and method of sampling in accordance with BS 812-102:1989.

EAR1.M240.9 HARDCORE

To comprise either:

1. Rock fill, or;
2. Broken stone, hard brick, concrete or other comparable hard, inert material, free from dust, rubbish or deleterious foreign matter and capable of passing through a 150 mm diameter ring in every direction.

EAR1.M250.9 HYDROSEEDING

Refer to Project Specific Specification.

EAR1.M260.9 SOFT LANDSCAPING

Refer to Project Specific Specification.

WORKMANSHIP

DEFINITIONS AND SUBMISSIONS

EAR1.W010.9 AREAS OF FILL

Areas within the Site, including areas in embankments, platforms and slopes and in excavations for structures, pits and trenches, in which fill material is deposited and compacted as part of the permanent work.

EAR1.W020.9 EARTHWORKS FINAL SURFACE

The surface to which the work included in this Worksection is finished.

EAR1.W030.9 FORMATION

That part of the earthworks final surface on which a pavement, structure or utility, is constructed, or on which the blinding or bedding for a pavement, structure or utility is placed.

EAR1.W040.9 INTERMEDIATE AREAS OF FILL

Areas of fill in which fill material is deposited and compacted directly into shallow water or onto naturally occurring soft ground.

EAR1.W050.9 SUBMISSION OF PARTICULARS

Submit the following particulars of proposed methods of construction for earthworks to the CM at least 14 days before relevant work starts:

1. Details of constructional plant and haulage vehicles;
2. Methods of excavation and of deposition and compaction of fill material;
3. Use of different type of excavated material and sources of imported fill material;
4. Arrangements for stockpiling, sorting and separating excavated material, earthworks material and fill material and for reusing and disposing of such materials;
5. Methods of controlling the moisture content of fill material;
6. Methods of controlling surface water and groundwater and of protecting earthworks and earthworks material from damage due to water and from weather conditions which may affect the earthworks or earthworks material;
7. Methods of monitoring groundwater levels;
8. Methods of monitoring the ground and structures for movements;
9. Methods, with detailed design of supporting excavations adjacent to slopes, retaining walls, structures, roads, private developments or other properties;
10. Stability calculations of unsupported excavations adjacent to slopes, retaining walls, structures, roads, private developments or other properties.

EAR1.W060.A SUBMISSION OF PARTICULARS OF SELF-COMPACTING BACKFILL MATERIAL (SCM)

1. Submit the following particulars of the proposed cementitious materials, fine aggregate, pulverized material and admixture to the CM for approval at least 14 days before the SCM is placed in the backfilling area:

a. Certificates not older than 6 months for each type of cement or PFA materials showing the manufacturer's name, the date and place of manufacture, the compliance with the requirements stated in the Contract and the test results for composition;

b. Certificates / documents not older than 6 months for fine aggregate in accordance with Clause 6.2.2 (2) of CS3:2013 showing the compliance of requirements as stated in the Contract;

c. Certificates / documents not older than 6 months for pulverized material showing the compliance with the requirements stated in the Contract and the test results for the grain size, the methylene blue value and the calcium carbonate content.

2. Submit the following particulars of admixtures to the CM for approval at least 14 days before the SCM is placed in the backfilling area:

a. Manufacturers' literature, descriptions of physical state, colour and composition, recommended storage conditions and the shelf life;

b. Method of adding to the SCM mix, the recommended dosage, effect(s) of under-dosage and over-dosage;

c. A certificate not older than 6 months for each type of admixtures showing the manufacturer's name, the date and place of manufacture and the compliance with the requirements stated in the Contract.

3. Submit the following particulars of each proposed designed SCM mix to the CM for approval at least 14 days before the SCM is placed in the backfilling area:

a. Grading of fine aggregates;

b. Method of placing the SCM;

c. Source, formulation, test data for the designed SCM mix produced in the plant(s) and test reports of site trials for the designed SCM mix proposed to be used including test results required in sub-clause (2) of EAR1.T960 conducted on the site trial samples to demonstrate the compliance with the criteria specified in sub-clause (2) of EAR1.T960;

d. When SCM is used as alternative backfill material for the location listed in sub-clause 1(b)(iv) of EAR1.D120. The following item is required together with the items listed in sub-clauses 3(a), 3(b) and 3(c) of EAR1.W060.

i. Hardening time of the SCM.

4. The following particulars of the proposed production facilities shall be submitted to the CM for approval at least 14 days before the SCM is placed in the backfilling area:

a. The name of the suppliers and the location of each plant, including a back-up plant and the calibration frequency of the equipment, from which the Contractor proposes to obtain SCM;

b. Particulars of the proposed batching and mixing plant to be used on the Site, including a layout plan and the output of the plant. Method of batching and mixing SCM, including measures to maintain the quality of the SCM produced.

5. Submit the following particulars of the proposed placement methods of SCM to the CM for approval at least 14 days before the SCM is placed in the backfilling area:

a. Before SCM reaching its initial set and providing sufficient load bearing capacity in the first several hours after placement, the Contractor shall submit a plan to fence off the backfilled area properly before any subsequent application of the surfacing materials above.

USE OF BLASTING

EAR1.W110.9 USE OF BLASTING METHOD

Refer to Project Specific Specification.

SURVEYS

EAR1.W210.9 DATUM

Spot levels and contours shown on the Drawings are, unless otherwise specified, reduced to Hong Kong Principal Datum for levels and the latest edition of Hong Kong Geodetic Datum for coordinate locations.

EAR1.W220.9 COMMENCEMENT SURVEY

1. Upon possession of the Site, and before any work is carried out, carry out and record a topographical survey of the whole of the Site in the presence of the representatives of the CM;
2. Obtain Approval to the method of survey and the instrument to be used from the CM before the commencement of the survey;
3. Submit the survey drawings to the CM within 14 days after commencement of the survey for endorsement and adopt the endorsed survey drawings as the true record of the Site at commencement;
4. Use the endorsed survey drawings for measurement of earthwork quantities as applicable;
5. Do not start earthworks on any location prior to the endorsement of the survey drawings;
6. When instructed by the CM, carry out a joint survey of the Site with the previous piling contractor immediately upon award of the Contract in the presence of the CM or his representatives as specified in PRE.B3.080.

EAR1.W230.9 INTERIM AND FINAL SURVEYS

1. Carry out interim surveys at intervals requested by the CM;
2. Carry out final topographical survey upon completion of the works;
3. Follow instructions of the CM for any extra surveys required to resolve any doubts on the correctness of survey records;
4. Adopt the same process for interim, final, and extra surveys as specified in EAR1.W220;
5. When instructed by the CM, carry out a joint survey with the subsequent building contractor after completion of the Works and upon award of the subsequent building contract to record the site topography and the works to be handed over to the subsequent building contractor in the presence of the CM or his representatives as specified in PRE.B9.130.

EAR1.W240.9 SURVEY INFORMATION

All topographical surveys:

1. Must be reduced to Hong Kong Principal Datum and coordinate locations to be to the latest edition of the Hong Kong Geodetic Datum;
2. Must include plans and sections;

3. Must be reproduced on transparent film of dimensionally stable material to scale of 1:200 (or as Instructed);
4. Must be signed by the Contractor and the responsible party involved in case of a joint survey and the CM as being a true record of the Site.

TEMPORARY WORKS, SLOPES AND GROUND DRAINAGE

EAR1.W310.9 TEMPORARY DRAINAGE SYSTEM

Rapidly disperse water, whether shed on to the excavation or earthwork or arising from any other source, including flowing into the Site from elsewhere and:

1. Obtain Approval to the discharge points of the temporary drainage and pumping systems;
2. Make all arrangements with and obtain necessary approvals and inspections from the relevant authorities for discharging water to drains, watercourses or the sea;
3. Do not start the work until the Approved arrangements for disposal of the water have been implemented;
4. Take measures to prevent floatation of new and existing structures;
5. Provide temporary watercourses, ditches, catchpits, drains, pumping or other means of maintaining the excavations and earthworks free from water;
6. Discharge the water into the permanent outfall of the piped drainage system whenever possible;
7. Provide Approved means of trapping silt on temporary systems discharging into the permanent drainage systems;
8. Ensure that temporary and permanent drainage systems are adequately maintained and clear of rubbish and debris.

EAR1.W320.9 TEMPORARY SUPPORTS TO EARTHWORKS

1. Use temporary supports or other methods to maintain excavations in a stable condition and to prevent settlement of structures or utilities due to excavation or dewatering;
2. Do not operate or park construction plant or other vehicles adjacent to excavations unless this has been allowed for in the design of the temporary works for the support of the excavation. Erect barriers at a distance from excavations not less than the depth of excavations, or where space is not permitted, at a shorter distance from excavations as agreed with the CM;
3. Do not place earthworks material or other materials adjacent to excavations unless this has been allowed for in the design of the temporary works for the support of the excavation;
4. Securely support all sides of trenches, pits, excavations, slopes or stockpiles exceeding 1.2 m vertical height/depth unless formed to a safe batter substantiated by design calculation agreed with the CM.

EAR1.W330.9 GENERAL SAFETY PRECAUTIONS

1. Carry out excavations and earthworks in such a manner to prevent erosion or slips;
2. Do not stockpile material where it might cause a landslide;

3. Do not store excavated materials adjacent to the top edge of mass excavations, slopes or stockpiles exceeding 1.2 m high unless otherwise agreed;
4. When Instructed trim and seal final faces of excavations to remove all loose rocks to prevent falling which might cause injury to workmen;
5. Limit working surfaces to safe slopes and height.

EAR1.W340.9 SAFETY PRECAUTIONS FOR OPEN EXCAVATION EARTHWORKS

1. Provide open board fencing, or equivalent, and warning signs to:
   a. Excavations, slopes or stockpiles exceeding the following heights:
      i. Vertical slope face: 2 m
      ii. Battered slope face: 3 m
   b. Trenches or pits exceeding 2 m deep.
2. Provide temporary fencing or warning ribbons to excavations, slopes, stockpiles, trenches or pits less than the heights/depth given in sub-clause (1) above but exceeding 1.2 m.

GENERAL

EAR1.W410.9 EXCAVATION AND EARTHWORKS

1. Carry out excavations and earthworks in dry conditions unless otherwise permitted by the CM, except where the excavations and earthworks are required to be carried out in or with water or other fluids;
2. Suppress dust generation during excavation and earthworks operations by spraying the work area of any excavation or earth moving equipment operation with water or a dust suppression chemical immediately before, during and immediately after the operation so as to maintain the entire surface wet. Dispose cement, pulverized fuel ash or any other dusty materials collected by fabric filters or other air pollution control system or equipment in totally enclosed containers;
3. Control height from which excavated materials are dropped to a practical minimum;
4. Carry out the formation of cuttings and filling in such a manner that the surfaces have at all times a sufficient minimum crossfall and, where practicable a sufficient longitudinal gradient to enable them to shed water and prevent ponding;
5. Adopt a method of working which minimises the area of exposed soil across the Site;
6. Carry out excavation to the lines, levels, dimensions and slopes specified;
7. Carefully level the bottom of excavation and step or bench horizontally as specified.

EAR1.W420.9 PROTECTION FROM WATER AND WEATHER

1. Keep earthworks after site clearance, excavation or filling and earthworks material after excavation free of water and:
   a. Protect from damage due to water;
   b. Protect from exposure to weather conditions which may affect the earthworks or earthworks material.
2. Take measures including but not limited to the following:

a. Use temporary drainage, pumping systems or other effective measures approved by the CM. Intercept silt and debris with traps before water is discharged from the Site;

b. Obtain Approval from the CM for the discharge points of temporary drainage and pumping systems. Make all arrangement with and obtain the necessary approvals and inspections from the relevant authorities for discharging water to drains, watercourses or the sea. Do not start the relevant works until the approved arrangements for disposal of the water have been implemented;

c. Do not carry out works in weather conditions that may adversely affect the works unless protection by methods agreed by the CM is provided;

d. Maintain surfaces in a stable condition;

e. Form surfaces to falls to shed water and to prevent ponding;

f. Keep the area of exposed surfaces to a minimum;

g. Seal or cover with impermeable sheeting or protect by other Approved methods surfaces which are temporarily exposed.

EAR1.W430.9 WORK NEAR SLOPES

Do not carry out excavations on or adjacent to slopes unless measures are taken to drain the excavation and to prevent water from the excavation entering the slopes.

EAR1.W440.9 UNSUITABLE EARTHWORKS MATERIAL

1. Replace the following materials or deal with by the methods agreed by the CM:

   a. Earthworks material which has been used, or is required for use, in the permanent work and which is allowed to become unsuitable such that in the opinion of the CM it no longer complies with the specified requirements for that type of material;

   b. Earthworks material which is not specified to be excavated and which the Contractor causes or allows to deteriorate such that in the opinion of the CM the permanent work will be affected.

2. Dispose of all unsuitable material;

3. Material provided to replace earthworks material, which has been allowed to become unsuitable, or which the Contractor causes or allows to deteriorate, shall be an equivalent material approved by the CM. The replacement material shall have the same volume after compaction as the material replaced.

EAR1.W450.9 ADDITIONAL EXCAVATION AND STABILIZATION

When Instructed, carry out additional excavation to remove earthworks material which in the opinion of the CM has inadequate strength, durability or stability and treat the voids as follows:

1. Deposit and compact general fill, fine fill, or special fill material below areas of fill and below formations other than in rock;

2. Place and compact Grade 10 concrete as specified in Worksection CON1 below formations in rock;

3. Deposit granular fill material below standing water;

4. In other circumstances where the CM requires stabilisation of existing material, use rock fill material (Grade 400) deposited directly into the original material and compacted to form a stable foundation on which to construct the subsequent work.

EAR1.W460.9 HANDLING AND STORAGE OF EARTHWORKS MATERIAL

1. Do not handle or store in a manner which will result in segregation, deterioration, erosion or instability of the material;
2. Keep different types of earthworks material separate from each other. Maintain earthworks material which is suitable for use as fill material in a suitable condition and free from contamination by other materials;
3. Stockpile excavated materials away from nullahs, stream courses and covered culverts at a point convenient for direct loading onto transport in such a manner as to cause the minimum nuisance to the public;
4. Remove topsoil when required before starting excavation or filling and, unless otherwise specified, deposit on Site in temporary heaps not greater than 2 m in height for re-use. Ensure the soil is kept free from contamination and undue compaction;
5. Temporary spoil heaps will not be allowed in certain areas. Obtain CM's permission for location;
6. Level and drain properly the material handling and storage areas. Spray stockpiles of material with water or a dust suppression chemical to minimize dust generation.

EAR1.W470.9 EXISTING DRAINS AND SERVICES

During excavation and earthworks:

1. Take all precautions to prevent damage and excessive settlement to existing drains and services;
2. Notify the CM and the Authority of any damage and any settlement in excess of the limits allowed by relevant authority immediately and make good;
3. Temporarily divert ditches, land drains and other waterways found in excavation and subsequently reinstate to Approval;
4. Excavate by hand adjacent to utilities that are known, proven or suspected to exist.

EAR1.W480.9 EXCAVATION ADJACENT EXISTING STRUCTURES

Excavate by hand unless otherwise permitted by the CM.

EAR1.W490.9 TRIMMING

Neatly trim the face of excavations. Do not trim the side faces of excavation for at least 24 hours after placing any blinding concrete.

EAR1.W500.9 EXCAVATION OF TRENCHES FOR UTILITIES

1. The length of trench excavation left open at any one time shall not exceed that agreed by the CM;
2. Unless otherwise permitted by the CM, do not excavate trenches for utilities in areas of fill until the fill material has been deposited and compacted up to the earthworks final surface or formation or up to 1 m above the top of the utility, whichever is lower.

OBSTRUCTIONS

EAR1.W610.9 BURIED OBSTRUCTIONS

Notify the CM without delay of the location and nature of any unforeseen obstruction encountered during excavation.

EAR1.W620.9 DISUSED DRAINS AND MANHOLES

If required by the CM, take up disused drains encountered during the excavation, clear away and:

1. Remove any contaminated earth;
2. Disinfect as necessary and seal off ends with concrete;
3. Break up and remove disused manholes and backfill where required, properly compacted;
4. Submit details of filling materials to be used for Approval.

EAR1.W630.9 OLD UNDERGROUND STRUCTURES

1. If required by the CM, break out and remove old walls, foundations, piles and other underground structures encountered during the excavation and backfill where required, properly compacted;
2. Submit details of filling materials to be used for Approval.

EAR1.W640.9 BOULDERS

Treat boulders that intersect the earthworks final surface or formation as excavation proceeds by methods agreed by the CM. Do not leave boulders protruding unless permitted by the CM.

EAR1.W650.9 PILED FOUNDATIONS

Take necessary precautions to prevent damage to tops of piles during excavation.

CUTTINGS

EAR1.W710.9 SURFACES OF CUTTINGS

Remove the following from surfaces as required by the CM:

1. Inferior stone or soft material occurring between layers of compact rock;
2. Rock which the CM considers will not withstand weather sufficiently;
3. Rock fragments which move when prised with a crow-bar.

EAR1.W720.9 DEPTH OF REMOVAL

Comply with the CM's instructions on the depth from the face of cuttings to which material is to be removed.

EAR1.W730.9 MAKING GOOD

Build up to required profile with Grade 15/20 concrete as specified in Worksection CON1 or masonry laid with cement mortar finishing in "rock texture" similar to adjoining natural rock faces.

DISPOSAL OF EXCAVATED MATERIAL

EAR1.W810.9 UNSUITABLE AND SURPLUS MATERIAL

1. Unless otherwise stated in the Contract:
   a. Take measures to sort and separate excavated material on Site for use in the permanent works according to the Environmental Management Plan;
   b. Dispose of the excavated material, which in the opinion of the CM cannot be selected, processed or mixed in a practical manner to make it suitable for use in the permanent work;
   c. Dispose of excavated material that is surplus to the requirements of the permanent works. Take measures to sort and separate the surplus material according to the Environmental Management Plan before disposal.
2. Take possession of unsuitable material and surplus material, unless otherwise provided for in the Contract.

EAR1.W820.9 SUITABLE MATERIAL

Do not remove suitable material from Site without the permission of the CM, unless surplus to the requirements of the Contract.

EAR1.W830.9 DUMPING OF UNSUITABLE AND SURPLUS MATERIALS

Inform the CM of the proposed dumping areas and take responsibility for making arrangements for disposal of these materials. Notwithstanding the foregoing, the CM retains the right to direct the manner in which the dumping is carried out.

EAR1.W835.9 DISPOSAL OR REUSE OF MARINE MUD

Refer to Project Specific Specification.

EAR1.W840.9 ON SITE SORTING OF CONSTRUCTION AND DEMOLITION MATERIALS

1. All construction and demolition (C&D) materials arising from or in connection with the works shall be sorted on-site and be separated into different groups for disposal at landfills, public filling areas, in filling areas within the Site, in filling areas outside the Site provided by the Contractor, or recycling as appropriate. The inert portion of the C&D material is the public fill. All public fills to be disposed of at public filling areas shall be sorted and broken down according to the Dumping Licence conditions. The non-inert portion of the C&D material is the C&D waste which shall be disposed of at the landfill;
2. Unless otherwise stated in the Contract, all C&D material arising from or in connection with the works shall become the property of the Contractor when it is removed from the Site. Promptly remove all sorted and processed materials arising from or in connection with the works from the Site on a regular basis as the works proceed;
3. A method statement for the sorting, processing and disposal of C&D materials arising from or in connection with the works shall be submitted to the CM's Representative for approval 14 days before the commencement of any sections of the Works.

EAR1.W845.9 TRIP-TICKET SYSTEM

Comply with the Trip-ticket System as specified in Preliminaries Specification for the disposal of construction and demolition (C&D) materials generated from the Works.

RETAINING WALLS, SHALLOW FOUNDATIONS AND OTHER STRUCTURES

EAR1.W910.9 SIZE OF EXCAVATIONS

1. When excavating for structures, pits, and trenches keep to the minimum size necessary to construct the permanent work. Keep the sides of excavations vertical unless otherwise permitted by the CM;
2. Obtain Approval for the length of trench excavation left open at any one time and do not exceed that amount.

EAR1.W920.9 APPROVAL OF EXCAVATION BOTTOMS

Bottoms of excavations are to be Approved before any new work is laid on them. Inform the CM when the excavation is ready for inspection.

EAR1.W930.9 FOUNDING OF SHALLOW FOUNDATIONS

1. All shallow foundations (rafts or pads) of the structures specified in Project Specific Specification shall be founded on material of the type and / or bearing capacity specified and at the founding levels shown on the drawings unless otherwise instructed by the CM;
2. The founding bases of shallow foundations shall be free of unsuitable materials. If the base lies below the groundwater table and where necessary, proper means shall be provided to divert and / or lower the groundwater such that the integrity of the exposed founding material(s) and the subsequent concrete casting will be ensured;
3. Sink drillholes for carrying out Standard Penetration tests (SPT) in accordance with BS EN ISO 22476-3:2005, modified by Geoguide 2 as necessary, to the founding materials (except for foundations on rock). The SPT shall be carried out by a contractor on the Housing Authority List of Ground Investigation Contractors. The minimum number and depth of the drillholes shall be as specified in Project Specific Specification. Unless otherwise Instructed, commence the drillhole at existing ground level before excavation for the foundations and carry out the SPT at intervals as specified in Project Specific Specification. Submit to the CM the preliminary test reports within 2 days and the final test reports within 2 weeks upon completion of the SPT;
4. If Instructed, carry out Plate Load Test for shallow foundations (except for foundations on rock) in accordance with GIN.T190 and the Code of Practice for Foundations issued by the Buildings Department;
5. If Instructed, take down the excavations for founding of shallow foundations (except for foundations on rock) first to not less than 300 mm above the designed founding level and carry out dynamic probe tests or other tests. The dynamic probe tests shall be in accordance with Appendix 7.1 of the 'General Specification for Civil Engineering Works', The Government of the Hong Kong Special Administrative Region, 2006 Edition. Submit the test results within 2 days and a record plan showing all the locations and levels of the dynamic probe tests within 1 week upon completion of the tests;
6. If considered necessary after examining the actual ground exposures and / or test results, the CM may order further excavation to deepen the founding level of the foundations and / or other measures to ensure a satisfactory foundation. The bases shall be inspected and approved by the CM before concreting;

7. If considered necessary the CM may order compaction of the whole or parts of the founding bases of shallow foundations by at least 12 passes of a vibratory roller, or other accepted construction plant, with a minimum static load per 100 mm width of roll of 2kN or 4kN. In areas adjacent to structures and utilities, which are existing or constructed as part of the permanent works, compaction shall be carried out by hand-rammers or manually operated power equipment in a manner that these structures and utilities are not disturbed or damaged.

EAR1.W940.9 PROVING BEDROCK FOR FOOTINGS (RAFTS AND PADS)

1. Where footings (rafts/pads) are specified to be founded on bedrock, carry out proving of bedrock in accordance with the following sub-clauses as directed by the CM. Clear completed excavations for footings of all soils and loose materials;
2. Footings shall be founded on bedrock of minimum bearing capacity as specified in Project Specific Specification;
3. When Instructed, upon excavation reaching bedrock, take NX size cores for a depth of 5000 mm into the bedrock and provide rock core samples and records of bores for the CM's inspection; cores to be taken at the frequency as specified in Project Specific Specification;
4. When Instructed, carry out laboratory compression tests or field point load tests on recovered cores to determine rock strength;
5. Fill core holes for the full depth with 1:3 cement and sand grout with water/cement ratio of 0.6;
6. When Instructed, upon excavation reaching bedrock, proving test at the frequency as specified in the Project Specific Specification shall be conducted with a percussive air rock drill to be supplied by the Contractor, of not less than 35 kg in weight and fitted with newly sharpened 40 mm diameter steel drilling bit. The proving test shall be performed with 25 mm diameter steel drilling rods. At the completion of each 1.5 m of drilling, the drilling bit shall be replaced with a newly sharpened 40 mm diameter bit. Additional lengths of drilling rock shall be fitted at that time as appropriate. The rock drill shall be at all times free to penetrate under its own weight and in a vertical direction. Perform the proving test by drilling minimum 5.0 m below the founding level. The results of each proving test shall be recorded by the Contractor, and he shall plot the time in minutes taken to drill each 300 mm on a graph. A 20 mm diameter steel rod 5.5 m long shall be placed in each completed drillhole for the CM's inspection. Fill drill holes for the full depth with 1:3 cement and sand grout with water/cement ratio of 0.6.

REMEDIAL WORKS

EAR1.W1010.9 EXCAVATION BOTTOMS DAMAGED AFTER APPROVAL

If, due to water or other causes, the bottom of the excavation becomes unsuitable after Approval, excavate further to a new Approved level, and backfill with Grade 15/20 concrete as specified in Worksection CON1.

EAR1.W1020.9 OVER EXCAVATION

Backfill and compact in accordance with this Specification or other Approved means those areas where the Contractor's method involves excavation in excess of that specified.

EAR1.W1030.9 DAMAGED SURFACES

1. Make good surfaces after excavation which, due to exposure to weather conditions, flooding or other cause, have been allowed to deteriorate to a condition unacceptable to the CM;
2. Where this is the case carry out additional excavation and filling in accordance with this Specification, or by waiting until the condition of the exposed material is, in the opinion of the CM, fit to receive the backfill.

FILLING GENERALLY

EAR1.W1110.9 USE OF ROCK CRUSHING PLANT

Do not use rock crushing plant on the Site unless permitted by the CM to do so.

EAR1.W1115.9 USE OF GRADE 200 RECYCLED ROCK FILL

Where the use of Grade 200 Recycled Rock Fill (RR 200) is specified in the Contract, comply with the requirements stated in EAR1.W1720 to EAR1.W1750 and EAR1.W1910 to EAR1.W1930 in respect of the deposition and compaction of this material.

EAR1.W1120.9 HAULAGE OF FILL MATERIAL

Do not haul fill material to the area of fill until compaction plant operating at the area of fill is sufficient to achieve the specified requirements for relative compaction of the fill material.

EAR1.W1130.9 REMOVAL OF EARTHWORKS MATERIAL

Do not remove from the Site any earthworks material that is required for use in the permanent work as fill material without prior Approval. Notify the CM before any earthworks material is removed from the Site.

PREPARATION FOR FILLING

EAR1.W1210.9 EXISTING GROUND

Prepare the surfaces on which fill material is to be deposited after site clearance in accordance with the following requirements:

1. Remove topsoil, grass, and other organic matter;
2. Remove soft spots, boulders, and other materials, which in the opinion of the CM are unsuitable or unstable;
3. Deal with voids as stated in the Contract or Instructed.

EAR1.W1220.9 WATER-COURSES

Do not place fill material until watercourses have been diverted or under-drained.

EAR1.W1230.9 SLOPING GROUND

1. Cut benches and install sub-soil drainage system as stated in the Contract;
2. Do not place fill material on sloping ground until benches have been completed at the area receiving the fill material.

EAR1.W1240.9 AVAILABILITY OF PLANT

Commence filling works only when sufficient compaction plant is in operation at the place of deposition to ensure compliance with the requirements of this Specification and when the CM's permission has been obtained.

EAR1.W1250.9 SCARIFYING

Scarify surfaces other than rock to a depth of 200 mm and compact to the same standard as the fill material which is to be deposited.

FILLING OPERATIONS

EAR1.W1310.9 DISPOSAL OF WATER

1. Keep the fill area free of water;
2. Leave surfaces with no area that can retain water at the end of each day's work and, if necessary, cut ditches to achieve this.

EAR1.W1320.9 APPROVAL

Obtain Approval before deposition of fill material starts and before any fill layer is covered.

EAR1.W1330.9 ADVERSE WEATHER CONDITIONS

Stop work when the state of the weather is such that, in the opinion of the CM, it will adversely affect the placing and compacting of fill.

EAR1.W1340.9 APPROVAL OF REMEDIAL MEASURES

Obtain Approval for and prior to carrying out remedial measures.

EAR1.W1350.9 REMEDIAL MEASURES FOR DAMAGED FILL AREAS

Adopt one of the following procedures when material placed and compacted or awaiting compaction reaches a condition which, in the opinion of the CM does not comply with this Specification or has been damaged either by weather or in any other way:

1. Remove the material from Site, replacing it with equivalent suitable material;
2. Remove the material to stockpile until it is in a condition suitable for re-use;
3. Make good the material by mechanical or chemical means;
4. Cease work on the material until it is in a suitable physical condition for re-use.

EAR1.W1360.9 REMEDIAL MEASURES WHERE FILL OVERLAID

Remove, and adopt sub-clause (1) or (2) in EAR1.W1350 for any material not complying with this Specification that has been overlaid by more recently laid material.

EAR1.W1370.9 RESTRICTIONS ON USE OF FILL MATERIAL

1. Do not use excavated material required for use in the permanent works which is capable of being selected, processed and mixed to make it suitable for use as fill material for any other purposes unless permitted by the CM;
2. Replace any such excavated material which the CM permits to be removed from the Site or used for other purposes by an equivalent Approved material of the same volume after compaction as the material replaced.

EAR1.W1380.9 MIX PROPORTIONS, MIXING AND PLACING RECONSTITUTED SOIL

1. For reconstituted soil use 1:3:12 cement, sand, special filling material by weight;
2. Mix in a concrete mixer with sufficient water to ensure the mix is just damp enough to enable it to be properly mixed and compacted;
3. Place each batch in its final position and compact within 30 minutes of the water being added. Mixed material not placed and compacted within this time limit will be rejected;
4. Hand mixing of small quantities may be permitted by the CM.

EAR1.W1390.9 SETTLEMENT

Make good, to the satisfaction of the CM, settlement in filling and backfilling and any consequential damage that may occur up to the end of the Maintenance Period.

FILLING FOUNDATION PITS AND TRENCHES ETC

EAR1.W1410.9 ADJACENT UTILITIES OR STRUCTURES

1. Within 500 mm of a structure or utility except as stated in EAR1.W1420, deposit fill material of:
   a. Fine fill material, unless otherwise stated in the Contract;
   b. The fine fill material may contain no more than 5% by weight of fresh, slightly decomposed or moderately decomposed rock fragments of up to 200 mm maximum size provided that these rock fragments do not cause any damage to the structures or utilities and do not interfere with compaction requirements.
2. Do not deposit fill material adjacent to or above structures or utilities until the construction of the structure or utility is sufficiently advanced to accept the imposed forces without disturbance or damage;
3. Deposit evenly on all sides of structures or utilities and in such a manner that the structure or utility is not disturbed or damaged;
4. Compact the fill material in such a manner that the structure or utility is not disturbed or damaged;
5. Where sheet piling, timbering or other temporary supports to the excavations are not to be left in place, remove the sheet piling, timbering or other temporary supports as deposition of fill material proceeds, in such a manner that the stability of the adjacent ground is maintained and the compacted fill material is not disturbed.

EAR1.W1420.9 FILLING AROUND WATER, SEWERAGE AND DRAINAGE PIPES

Where these have been laid as part of the permanent works:

1. Use special filling material unless otherwise stated in the Contract;
2. Deposit the fill material in layers not exceeding 100 mm thick to a level of 300 mm above the top of the pipe;
3. Deposit the fill material in such a manner that the layer on one side of the pipe is not more than 100 mm higher than the layer on the other side;
4. Compact the fill material by hand rammers or manually operated power equipment;
5. Compact the fill material within 300 mm above the top of sewage and drainage pipes to obtain a relative compaction of at least 85% throughout.

EAR1.W1430.9 BACKFILLING TO FOUNDATIONS

Backfill to top of foundations with general filling materials.

EAR1.W1440.9 BACKFILLING TO TRENCHES FOR AUTOMATED REFUSE COLLECTION SYSTEM (ARCS)

Backfill to top of trenches with excavated or Approved general filling materials. Cover to ARCS conveyance pipe to be minimum 600 mm generally and 800 mm in vehicle circulation areas.

FILLING EXISTING WATERCOURSES

EAR1.W1510.9 PREPARATION

Divert existing watercourses and channels as required and clear the same of all vegetation growth and unsuitable material.

EAR1.W1520.9 FILLING

Filling materials and method of construction to be used are specified in Project Specific Specification.

BACKFILLING BEHIND RETAINING WALLS

EAR1.W1610.9 PLACING FILTER MATERIAL

1. Carefully place filter material to avoid contamination and damage;
2. Bed in layers simultaneously with the filling material and compact.

EAR1.W1620.9 FILLING

Unless otherwise specified place special filling material as backfilling and compact by the Performance Specification method of compaction: EAR1.W1810 - EAR1.W1860. Compaction plant is to be of such a size as to ensure that no undue stress is placed on the wall during compaction.

FORMING EMBANKMENTS AND PLATFORMS

EAR1.W1710.9 MATERIAL SELECTION

Form embankments with special fill material unless otherwise specified.

EAR1.W1720.9 DEPOSITION OF FILL MATERIAL

1. Deposit fill material obtained from excavation within the Site in its final location as soon as practicable after it has been excavated;
2. Build up embankments evenly over the full width;
3. Control the construction method to ensure that any compaction of the fill material resulting from the passage of construction plant or haulage vehicles is uniform;

4. In areas of fill formed of fill material other than rock fill material, form earthworks final surfaces sloping at a gradient exceeding 1 to 3 (vertical to horizontal) by over-filling and cutting back after compaction. Extend the over-filling beyond the earthworks final surface by a horizontal distance of 500 mm or three times the thickness of the compacted layer, whichever is greater;
5. Deposit fill material in layers of a thickness appropriate to the compaction method to be used. In deposition of fill material, ensure that a good bonding is achieved between layers of fill, and unless otherwise directed by the CM, do not place fill material on previously compacted layers unless the surface has been scarified or otherwise broken up and, if necessary, watered.;
6. Unless otherwise permitted by the CM, construct layers of fill material horizontally, except for any gradient required for drainage, and keep the thickness of each layer uniform over the area to be filled. Bring up the fill material from the bottom in uniform horizontal layers, with the top of each layer graded to enable surface water to drain readily;
7. If the difference in level between adjacent areas to be filled exceeds 1 m, bench the edge of the higher area before fill material is placed against it;
8. Except for intermediate fill area, do not deposit fill material by end-tipping, by pushing loose material down slope faces or by other methods which may result in segregation or inadequate compaction of the fill material;
9. Make good damage to compacted layers caused by construction traffic.

EAR1.W1730.9 COMPACTION

1. Compact filling material, other than rock fill and material as stated in EAR1.W1940 in accordance with the Compaction by Performance Specification: EAR1.W1810 - EAR1.W1860 unless otherwise specified;
2. Compact rock fill material in accordance with the Compaction by Method Specification: EAR1.W1910 - EAR1.W1930;
3. Compact general fill material with a large portion of coarse material in accordance with EAR1.W1940.

EAR1.W1740.9 ROCK FILL EMBANKMENTS AND PLATFORMS

1. Place rock fill material so that the final compacted thickness of each layer exceeds 1.5 times and does not exceed twice the nominal Grade size of the rock fill material;
2. Spread and level the fill material by a crawler tractor weighing not less than 15 tonnes and compact the fill material in accordance with the Compaction by Method Specification: EAR1.W1910 - EAR1.W1930;
3. Ensure each layer consists of reasonably graded rock and fill the surface voids with fragments of rock before the next layer is deposited.

EAR1.W1750.9 BLINDING ROCK FILL EMBANKMENTS AND PLATFORM

1. Blind the top surface and side slopes with fine fill material to seal the surface;
2. Top soil may be used to blind side slopes and verges.

EAR1.W1760.9 ISOLATED BOULDERS

At the discretion of the CM isolated boulders, each within the range 0.015 m^3 to 0.1 m^3 in volume, may be incorporated into embankments not of rock fill, provided that the specified compaction requirements are met. Any boulders exceeding 0.015 m^3 must be placed at a minimum of 2 m below formation level of carriageways or hard shoulders.

EAR1.W1770.9 CULVERTS AND DRAINS ETC

Form embankments equally on both sides of culverts or drain pipes and the like.

EAR1.W1780.9 SURFACES USED BY CONSTRUCTION TRAFFIC

1. Where surfaces of embankments are required for use by construction traffic, build up and maintain at a minimum of 300 mm above formation level, the area between extremities of carriageways, including any central reserve and hard shoulders before subsequently trimming to formation level;
2. Make good surface damage;
3. Ensure that no construction traffic uses the area once trimming to final formation level has commenced, with the exception of constructional plant necessary for such trimming and ensure that no damage is caused to the surface by such constructional plant.

REUSE OF MARINE MUD FOR BACKFILLING

EAR1.W1785.9 REUSE OF MARINE MUD FOR BACKFILLING

Where specified to reuse marine mud for backfilling, at least 28 days before commencement of excavation works, obtain CM's approval for backfilling with cement-stabilized marine mud, which shall have undergone an approved cement-stabilization process to avoid undue ground settlement in future, and comply with the following requirements:

1. Submit a detailed method statement of the proposed cement-stabilization and backfilling processes, which shall include but not be limited to the method and procedure of the proposed cement-stabilization process, the sorting and temporary storage of the materials to prevent cross-contamination with other materials, the mix proportion with cement, granular soil, water and other approved additives, the methods of mixing, backfilling, compacting, curing, sampling and testing of the cement-stabilized materials to achieve 7-day cube test of 100 kN/m² minimum in accordance with CS1;
2. Prepare sufficient test samples on Site and test the cement-stabilized materials at 7-day in accordance with CS1 for determination of the 7-day cube strength to demonstrate the suitability of the proposed mix proportion and method of construction. Appoint a HOKLAS accredited testing laboratory approved by the CM to carry out the test;
3. Carry out trials on Site and all necessary testing to demonstrate the suitability of the proposed cement-stabilization and backfilling processes for the Works to the satisfaction of the CM;
4. Backfill with and compact the cement-stabilized materials in accordance with the approved method statement and in layers of not greater than 300 mm thick to achieve a standard of compaction as stipulated in EAR1.W1850 and EAR1.W1860, unless otherwise approved by the CM;
5. All areas backfilled with cement-stabilized marine mud should be covered on top by suitable materials all in accordance with Worksection EAR1 and/or other specified materials for a minimum thickness of 500 mm;
6. For piling works, do not backfill the fill areas between future ground level and 1.5 m below the future ground level with cement-stabilized marine mud unless otherwise approved by the CM;

7. Do not backfill the fill areas between top of pile caps and underside of ground slabs of domestic blocks with cement-stabilized marine mud without CM's prior approval. Restrictions on backfilling of cement-stabilized marine mud for external areas are as follow:

Pipes/ducts	Range in level at carriageway where ducts/pipes are located with which no backfilling of Cement–Stabilized Marine Mud is allowed	Range in level at locations other than carriageway where ducts/pipes are located with which no backfilling of Cement–Stabilized Marine Mud is allowed	Drainage for Cable /valve pit required
Water Pipes	From FGL to -1400 mm below FGL	From FGL to -1000 mm below FGL	Yes
Gas Pipe	From FGL to -1300 mm below FGL	From FGL to -1000 mm below FGL	Yes
Power Cable Duct	NA	NA	Yes
Telecom Cable Duct	NA	NA	No.

(FGL = Finished Ground Level)

Backfilling by cement-stabilized marine mud directly underneath the cable pits or valve pits is not allowed for proper drainage of water from the pits. Water pipes and gas pipes are not allowed to be directly surrounded by backfilled cement-stabilized marine mud for ease of maintenance. Cable ducts are allowed to be surrounded by cement-stabilized marine mud subject to proper coordination of works sequence with utility undertakings and sub-contractors;

8. Sink drillholes for carrying out Standard Penetration Tests (SPT) in accordance with BS1377:Part 9:1990 (Test 3.3), modified by Geoguide 2 at 1.5 m intervals to below the backfilled material to demonstrate that the relative strength of the stabilized material is achieved. Appoint a contractor on the Housing Authority List of Ground Investigation Contractors to carry out the SPT 7 days after backfilling. The minimum number of the drillholes shall be one drillhole for 100 m^3 of the backfilling or part thereof in each foundation base on each operation day, and to a depth and location as directed by the CM;

9. Submit to the CM preliminary test reports within 1 day and final test reports within 1 week upon completion of the SPT;

10. In any situation, a SPT N-value of less than 10 shall render the backfilling unsuccessful. In this situation, submit a remedial proposal, which shall include but not be limited to excavation of the backfilled material, adjustment of the mix proportion and method of construction, and re-execution of the Works, to the CM for approval. Bear all costs and no extension of time is allowed for the remedial works and all associated consequences;

11. Obtain EPD's permit for disposal of all surplus cement-stabilized materials to a suitable dumping facility and dispose the materials accordingly after the backfilling. Make reference to ETWB Technical Circular (Works) No. 34/2002 and 19/2005 and other relevant regulations and guidelines for obtaining the permit;

12. Refer to the drawing in Appendix APC to this Specification for the profile of backfilling around foundations.

13. Provide adequate personal protective equipments to the workers to protect them against direct contact with contaminated marine mud.

USE OF SELF-COMPACTING BACKFILL MATERIAL

EAR1.W1790.A USE OF SELF-COMPACTING BACKFILL MATERIAL (SCM)

1. Batching and mixing
    a. Measuring and weighing equipment for batching SCM shall be maintained in a clean and serviceable condition. The equipment shall be zeroed daily and calibrated at a frequency provided in the submission under sub-clause (4) of EAR1.W060. The accuracy of the measuring equipment shall be within 3% of the quantity of cementitious materials, total aggregates or water being measured and within 5% of the quantity of admixtures being measured;
    b. The quantities of cementitious materials, fine aggregate and pulverized material shall be measured by mass. The mass of aggregates shall be adjusted to allow for the free moisture content of the aggregates;
    c. Separate weighing equipment shall be used for cementitious material;
    d. The quantity of water shall be adjusted for the free moisture content of the aggregates and shall be measured by mass or volume;
    e. Liquid admixtures shall be measured by mass or volume and powdered admixtures shall be measured by mass;
    f. The quantities of SCM mixed and the speed of operation of a mixer shall comply with the supplier's recommendations;
    g. A mixer shall not be loaded in excess of its rated capacity and shall be emptied before being re-charged. A mixer that has been out of use for more than 30 minutes shall be cleaned before fresh SCM is mixed in it;
    h. If a mixer has been used to mix concrete, it shall be thoroughly cleaned before mixing fresh SCM in it.
    i. Mixing times or the number and rate of revolutions of mixer drums shall not be less than those recommended by the supplier unless it is demonstrated in the production of SCM that a shorter time or fewer or slower revolutions are adequate. Constituents shall be thoroughly mixed and admixtures shall be uniformly distributed throughout the SCM;
    j. Water shall be added to truck mixed SCM at the batching plant and shall not be added in transit or at the Site.
2. Transportation of SCM
    a. SCM shall not be transported in a manner that will result in contamination, segregation or loss of constituents;
    b. SCM batched off the Site shall be transported to the Site in purpose-made agitators operating continuously or in truck mixers;
    c. Truck mixers transporting SCM shall be thoroughly cleaned before loading and transporting fresh SCM.
3. Records of SCM
    a. Delivery notes shall be provided for each delivery of SCM to the Site. The delivery notes shall be kept on the Site and available for inspection by the CM at all times. Delivery notes shall contain the following details:
        i. Serial number of the delivery note;

ii. Date;

iii. Name and location of the batching and mixing plant;

iv. Registration number of the delivery vehicle;

v. Name of the purchaser;

vi. Name and location of the Site;

vii. Designation of SCM mix;

viii. Sources of cementitious materials and fine aggregate;

ix. Quantity of SCM;

x. Time of introduction of water to SCM;

xi. Source, formulation and proprietor of the SCM mix.

b. Records of backfilling operations shall be kept by the Contractor on the Site and available for inspection by the CM at all times. Records shall contain the following details:

i. Date;

ii. Designation of SCM mix;

iii. Total quantity of each SCM mix produced that day;

iv. Serial number of the delivery note;

v. Arrival time of the delivery vehicle;

vi. Time of completion of the discharge;

c. When SCM is used as alternative backfill material for the locations listed in sub clauses 1(a), 1(b)(i), 1(b)(ii) and 1(b)(iii) of EAR1.D120. The following items are required together with the items listed in sub-clauses 3(b)(i), 3(b)(ii), 3(b)(iii), 3(b)(iv), 3(b)(v) and 3(b)(vi) of EAR1.W1790:

i. Location where SCM is placed;

ii. Results of flowability tests;

iii. Details of test cubes made for compressive strength tests;

iv. Details of test samples made for hardening time tests;

v. Details of testing locations for initial strength tests and thermal conductivity tests;

d. When SCM is used as alternative backfill material for the locations listed in sub-clause 1(b)(iv) of EAR1.D120. The following items are required together with the items listed in sub-clauses 3(b)(i), 3(b)(ii), 3(b)(iii), 3(b)(iv), 3(b)(v) and 3(b)(vi) of EAR1.W1790:

i. Location(s) and position(s) where SCM is placed;

ii. Results of density tests and flowability tests;

iii. Details of test cylinders made for compressive strength tests.

4. Placing of SCM

a. Prior to placement of the SCM, consent from existing underground installations owners should be available if their existing underground installations will be embedded by the SCM;

b. Permission from the CM shall be obtained before SCM is placed in any part of the permanent work. If placing of SCM is not started within 24 hours of the permission having been given, permission shall be obtained from the CM again. The Contractor shall inform the CM before backfilling starts and allow sufficient time for the CM or his representatives to inspect the work to be backfilled;

c. Fresh SCM shall be placed in its final position within 2½ hours of the introduction of water to the SCM mix;

d. Additional protective sheets shall be used around the discharging area to avoid any splashing of SCM. In addition, trunking or chutes shall be used to place SCM which will fall more than 2.7 m to further control the splashing unless otherwise permitted by the CM. Trunkings or chutes, where being used, shall be clean and used in such a way to avoid segregation and loss of constituents of the SCM;

e. SCM shall be placed in horizontal layers in a manner that non-permanent components of lateral support can be removed after placement;

f. SCM can be placed with concrete pumps, which shall be operated and maintained in accordance with the supplier's recommendations. The pumps and pipelines shall be maintained in a clean condition. Joints in pipelines shall be tightly fixed to ensure no grout loss;

g. When SCM is used as alternative backfill material for the locations listed in sub-clause 1(b)(iv) of EAR1.D120. The following item is required together with the items listed in sub-clauses 4(a), 4(b), 4(c), 4(e) and 4(f) of EAR1.W1790:

   i. SCM shall not be placed under submerged conditions.

COMPACTION BY PERFORMANCE SPECIFICATION

EAR1.W1810.A PROCEDURE

1. Compact fill material in areas of fill in uniform layers to a stable condition as soon as practicable after deposition and in a manner appropriate to the location and to the material to be compacted;
2. Obtain the permission of the CM before the next layer is deposited on each layer of compact fill material;
3. Agree with the CM the thickness of each layer which is to be compatible with the compaction plant used. Carry out carefully controlled tests to determine the optimum placing thickness for the particular fill and the number of passes to achieve the required density with the compaction plant provided;
4. Do not place any permanent fill until such tests have been agreed with the CM. Earthmoving plant will not be accepted as compaction equipment;
5. Except as stated in EAR1.W1420, EAR1.W1850, EAR1.W1940, EAR1.W2020 and EAR1.W2120, fill material shall be compacted to obtain a relative compaction of at least 95% throughout unless otherwise stated in the Contract. The moisture content of the fill material shall be adjusted by wetting or drying on site to achieve the required relative compaction.

EAR1.W1820.9 TESTING

Test each class of material to be compacted in accordance with the compaction tests specified in the Testing section of this Worksection.

EAR1.W1830.X DELETED

EAR1.W1840.9 FIELD DENSITY

After compaction carry out insitu field density tests in accordance with the compaction tests specified in the Testing section of this Worksection. Test each layer and obtain Approval before placing of the next layer.

EAR1.W1850.9 STANDARD OF COMPACTION

Unless specified otherwise, compact fill material to obtain a relative compaction of at least 95% of the maximum dry density in general and at least 98% for fill within 200 mm of any formation level or slope profile.

EAR1.W1860.9 STANDARD OF COMPACTION BETWEEN PILE CAPS AND SUSPENDED SLABS AND AROUND PILE CAPS

The relative compaction of compacted material in the fill areas between top of pile cap and underside of suspended slab to be minimum 90% of the maximum dry density. Compact fill material around pile caps to achieve a relative compaction of at least 95%.

COMPACTION BY METHOD SPECIFICATION

EAR1.W1910.9 ADOPTION

Use for rock fill material and in exceptional circumstances for other suitable material when Approved.

EAR1.W1920.9 ROLLERS

Use vibratory rollers having a static load of at least 2 kN per 100 mm width of roll for layers with a compacted thickness not exceeding 500 mm, and at least 4 kN for layers with a compacted thickness exceeding 500 mm.

EAR1.W1930.9 COMPACTION METHOD

1. Compact each layer of rock fill material by at least eight passes of a vibrating roller, or by other Approved equivalent compaction method;
2. Compact the final surface of rock fill material by at least two additional passes of a vibrating roller or by other Approved equivalent method;
3. Fill voids as compaction proceeds.

EAR1.W1940.9 COMPACTION OF GENERAL FILL MATERIAL WITH A LARGE PORTION OF COARSE MATERIAL

1. For general fill material of which less than 90% passes a 20 mm BS test sieve, it will be difficult to permit determination of the moisture content and maximum dry density according to EAR1.T350, EAR1.T420 and EAR1.T540. This type of material shall be compacted to the requirements of sub-clauses (2), (3) and (4);

2. Spread and level each horizontal layer of general fill material with a thickness not less than 1.5 times of the maximum size of the general fill material and not exceeding the maximum depth of compacted layer in accordance with the following Table. If this criterion is not met due to the presence of over-sized coarse material in the general fill, remove and break down the over-sized coarse material to sizes acceptable to the CM. Compact each layer systematically by a vibratory roller with the stipulated minimum number of passes corresponding to the minimum static load per 100 mm width of the roller;

Compaction requirement for general fill material with a large portion of coarse material				
Force per 100 mm width	Well-graded material		Uniform-graded material	
(kN)	Maximum depth of compacted layer (mm)	Minimum no. of passes	Maximum depth of compacted layer (mm)	Minimum no. of passes
0.25-0.45			150	16
0.46-0.70			150	12
0.71-1.25	125	12	150	10
1.26-1.75	150	8	200	10
1.76-2.30	150	4	225	10
2.31-2.80	175	4	250	10
2.81-3.50	200	4	275	8
3.51-4.20	225	4	300	8
4.21-4.90	250	4	300	8

3. Count only the number of passes of the roller when the roller is travelled on the material to be compacted at a speed of not more than 2 km per hour with full vibration. Disregard plant other than vibratory roller carrying out material spreading or providing some preliminary compaction, to assist the use of heavier plant in counting the number of passes;

4. Variation from the method or the use of plant different from that specified in sub-clause (2) will be permitted only if the Contractor demonstrates at site trials that equivalent compaction is achieved by the alternative method or plant. Agree with CM and obtain CM's approval on the procedure to be adopted for these site trials;

5. Without prejudice to the provision of the Conditions of Contract and in order that the CM may take proper provision for the supervision of compaction in the permanent work, apply in writing to the CM for permission to carry out compaction not less than 24 hours before the compaction process;

6. When materials of widely divergent grading are used in embankments and fill areas, spread and compact the materials in separate clearly defined areas;

7. If more than one class of material is being used in such a way that in the opinion of the CM, it is not practicable to define the areas in which each class occurs, operate the compaction plant as if only the material which requires the greatest compaction effort is being compacted.

INTERMEDIATE AREAS OF FILL

EAR1.W2010.9 DEPOSITING

Fill material may be deposited in intermediate areas of fill by end-tipping or by pushing into position until, in the opinion of the CM, it is sufficient to form a stable foundation on which to construct the subsequent work.

EAR1.W2020.9 COMPACTION

Except in areas of fill formed of rock fill material or fill material as stated in EAR1.W1940, compact fill material in intermediate areas of fill to a degree which in the opinion of the CM is practicable. Compact fill material above the level stated in clause EAR1.W2010 to obtain a relative compaction of at least:

1. 90% throughout;
2. 95% within 1500 mm of earthworks final surfaces and formations; and
3. 98% within 200 mm of formations.

COMPLETION OF GENERAL EARTHWORKS SURFACES

EAR1.W2110.9 GENERAL

1. Complete earthworks final surfaces to a stable condition as soon as practicable after excavation or after deposition and compaction of fill material has been completed;
2. Carry out the subsequent permanent work or surface protection as soon as practicable after the earthworks final surface has been completed;
3. Properly treat exposed earth by compaction, turfing, hydroseeding, vegetable planting or sealing with latex, vinyl, bitumen, shotcrete or other suitable surface stabilizer within six months after the last construction activity on the exposed earth;
4. Complete earthworks final surfaces to smooth alignments without abrupt irregularities unless otherwise stated in the Contract;
5. Complete formations above structures or utilities after construction of the structure or utility.

EAR1.W2120.9 COMPACTION

Compact formations to obtain a relative compaction of at least 98% to a depth of 200 mm below the formation.

EAR1.W2130.9 PROOF ROLLING

1. Unless otherwise agreed by the CM, carry out proof rolling on formations;
2. Roll the formation in the presence of the CM by at least two passes of a non-vibrating rubber tyred roller;
3. The roller must have a static load per 100 mm width of roll of at least 4 kN and travel at a speed not exceeding 2 km/h.

EAR1.W2140.9 MAKING GOOD DEFECTS

Make good to Approval any defect in the formation which is revealed during proof rolling by deformation of the formation which in the opinion of the CM is excessive.

EAR1.W2150.9 PAVEMENT FORMATIONS

After all other formation work and testing have been completed and damage caused by testing reinstated, roll any pavement formation with one pass of a smooth steel-wheeled non-vibrating roller. The roller must have a load per 100 mm width of roll of at least 2 kN.

EAR1.W2160.9 PROTECTION OF FORMATIONS

Carry out the following procedures:

1. Unless otherwise permitted by the CM, protect formation surfaces which will not be immediately covered by the subsequent permanent work by methods agreed by the CM;
2. Maintain earthworks final surfaces and formations in a stable condition and protect from damage due to water or other causes and from exposure to conditions which may adversely affect the surface;
3. Do not allow formations to be used by construction plant or vehicles other than those which, in the opinion of the CM, are essential to construct the subsequent work.

EAR1.W2170.9 HYDROSEEDING

Refer to Project Specific Specification.

ADDITIONAL REQUIREMENTS FOR SOFT LANDSCAPING

EAR1.W2210.9 GENERAL

Refer to Project Specific Specification.

ADDITIONAL REQUIREMENTS FOR SURFACE PREPARATION OF ROAD FORMATIONS

EAR1.W2310.9 SEQUENCE

Carry out preparation and surface treatment of the road formation after completion of any specified sub-grade drainage and, unless otherwise agreed by the CM, immediately prior to laying the sub-base or the road-base where no sub-base is required.

EAR1.W2320.9 FORMATIONS OTHER THAN ROCK FILL

Carry out the following sequence of operations:

1. Remove all mud and slurry from surfaces below carriageways, lay-bys, cycle tracks, footpaths and hard shoulders after general reinstatement of any soft areas;
2. Unless otherwise permitted by the CM to carry out proof rolling on the road formation. Roll in the presence of the CM by at least 2 passes of a non-vibrating roller with rubber tyres. Roller to have a static load per 100 mm width of at least 4 kN and travel at speeds not exceeding 2 km/h;
3. Make good any defect in the formation during proof rolling where required by the CM;
4. Trim the formation after testing and when any damaged reinstatement has been carried out;

5. Roll the trimmed formation by one pass of a smooth steel-wheeled non-vibrating roller having a minimum load per 100 mm of 2 kN.

EAR1.W2330.9 ROCK FILL FORMATIONS

Carry out the following sequence of operations:

1. Trim and blind the formation as EAR1.W1740 and EAR1.W1750;
2. Roll the trimmed formation as EAR1.W2320 (5);
3. Make good with Grade 15/20 concrete as specified in Worksection CON1 any surface irregularities under the formation which remain after trimming the rock excavation.

ADDITIONAL REQUIREMENTS FOR FILL SLOPES

EAR1.W2410.9 GENERAL

1. Comply with the following sub-clauses for the fill slopes as specified in the Drawings and submit to the CM the date of commencement of the filling works for these slopes;
2. Notwithstanding the requirements on filling works as specified in other clauses of this Worksection, comply with the "Standards for Filling Works" specified in Appendix A of PNAP APP-15;
3. During construction, submit monthly reports to the CM giving records of tests on compaction of fill slopes together with a covering assessment on the adequacy of compaction. Submit the format of the report to the CM for prior approval. The reports shall be prepared and signed by the TCP Grade T4 and the AS of RSC(SF) (provided in accordance with the Preliminaries Worksection);
4. Incorporate in the report all the test results determined in accordance with this clause and the Testing section of this Worksection, including those tests carried out by the Direct Testing Contractor(s). Keep records on drawings the soil type, plan location and elevation reference to Principal Datum of each test. Graphs of dry density vs. moisture content, laboratory test record sheets, field sheets, calculation sheets and a complete soil description are to be kept in a companion folder;
5. Carry out all tests under the supervision of the TCP Grade T4 as mentioned in sub-clause (3);
6. Include in the contents of the covering assessment:
    a. A summary of the results of insitu density tests and laboratory compaction tests of the fill, highlighting areas of non-compliance with the specified compaction standards;
    b. Details of any corrective measures taken to rectify areas of inadequate compaction; and
    c. An overall assessment to all the filling works completed at the time of assessment.
7. Keep records of compaction tests also on site for inspection by the CM, ICU and the officers of Geotechnical Engineering Office (GEO). The costs of providing the monthly reports are deemed to be included in the Contract rates of the filling works;

8. Where there is reason to believe that the placed fill may be loose, or if the CM from time to time directs, carry out field checks under the CM's direction, initially by dynamic probe tests (supplemented by observations of fill materials in trial pits if an appreciable cobble and boulder content in the fill is suspected). Provide the necessary equipment, apparatus and labourers for the dynamic probe tests and trial pit excavation. Carry out dynamic probe tests in accordance with Appendix 7.1 of the 'General Specification for Civil Engineering Works', The Government of the Hong Kong Special Administrative Region, 2006;
9. If loose fill is detected, arrange for the Approved Laboratory to carry out insitu density tests of the loose layer in accordance with the Testing section of this Worksection in the presence of the CM or his representatives. Carry out the tests within seven days after the detection of the loose fill. If the test results fail to comply with the Contract requirements, rectify the filling works to the satisfaction of the CM as a matter of urgency. Where extensive loose fill is found which could pose a significant threat if not rectified, the CM may issue an order to suspend the progress of the Works in accordance with GCC Clause 9.2;
10. If the filling work has been done after compliance with the requirements of GCC Clause 7.3, and is found to be executed in accordance with the Contract, the expense of investigation, testing, reinstating and making good the same shall be valued at the relevant Contract rates but in any other case the expense shall be borne by the Contractor;
11. Upon completion of the filling work, submit to the CM:
    a. "As-built" plans and sections of the work showing its relationship to existing and proposed structures; and
    b. Records of insitu density tests and laboratory compaction tests of the fill.

    The costs of providing as-built records are deemed to be included in the Contract rates of the filling works;
12. Bear all associated costs and make due allowance in the programme of the Works for the provisions as stated in the above sub-clauses. No claim for extension of time will be entertained in connection therewith.

REMOVAL OF TEMPORARY WORKS

EAR1.W2510.9 DISMANTLING AND REMOVAL

Dismantle and remove temporary works after completion of the permanent works unless otherwise agreed by the CM.

TOLERANCES

EAR1.W2610.9 GENERAL

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

TESTING

FILL MATERIAL - GENERAL REQUIREMENTS

EAR1.T020.9 BATCH

A batch of fill material is any quantity of fill material of the same type and which, in the opinion of the CM, has similar properties throughout. For the purpose of testing for moisture content and relative compaction, a batch is also any fill material which is deposited in a single layer in any area of fill presented by the Contractor for testing on one occasion.

EAR1.T030.9 SAMPLES

Each sample of fill material must consist of at least four increments taken from different parts of the batch. Combine the increments and thoroughly mix and divide by quartering or by using a riffle box to obtain specimens of an appropriate size to carry out the individual tests.

EAR1.T040.9 SAMPLE SIZE

Take the size of samples of fill material, other than rock fill, in accordance with Clauses 2.5.1, 4.2 and Table 2.1 of 'Geospec 3: Model Specification for Soil Testing', GEO, 2001. Each sample of rock fill material of grade size not exceeding 200 is to have a mass of at least 250 kg and each sample of rock fill material of grade size exceeding 200 must have a mass of at least 1000 kg.

SITE TESTS FOR SOIL AND GROUNDWATER

EAR1.T110.9 GENERAL

1. Arrange for an independent laboratory to carry out the tests described in 'Geospec 3: Model Specification for Soil Testing', GEO, 2001;
2. Select the laboratory from one of those listed on the Development Bureau's List of Approved Suppliers of Materials and Specialist Contractors for Public Works: Soil and Rock Testing and Approved. In addition, the laboratory must be accredited by HOKLAS for the said tests.

EAR1.T115.9 COMPACTION TEST FOR FILL SLOPES

1. Arrange for independent laboratories as stated in EAR1.T110 on a roster system to carry out compaction tests stated in EAR1.T510 to EAR1.T550 for all fill slopes specified in the Drawings. No independent laboratories shall carry out compaction tests for a cumulative period longer than 3 months within any twelve-month period;
2. Instruct the independent laboratories to deliver directly to the CM in a sealed envelope or by other means agreed by the CM, without routing through the Contractor, a copy of all test reports including preliminary testing results compiled by the independent laboratories, not later than the copy sent to the Contractor;
3. In addition, where considered necessary, the CM will order Direct Testing Contractor(s) (DTC) to carry out the same tests as mentioned in sub-clause (1) above;

4. Provide attendance on the DTC and render all necessary assistance to the DTC including:
   a. Provision of all facilities for the DTC in the taking of samples;
   b. Provision of information for the preparation of the report, all as required by the DTC; and
   c. Reinstatement and making good of the sampled areas to its original condition where Instructed.
5. Carry out additional tests for relative compaction in accordance with EAR1.T550 if the result of any test for relative compaction of fill material does not comply with the specified requirements;
6. Investigate and report findings on any non-compliance or irregularities identified by the compaction tests and carry out rectification as necessary to the satisfaction of the CM before proceeding to the next stage of the filling works;
7. Bear all associated costs and allow sufficient time in the programming of the filling works for the compliance with this clause. No claim whatsoever will be entertained for the interruption, if any, due to the DTC's works.

FILL MATERIAL - PARTICLE SIZE DISTRIBUTION, LIQUID LIMIT, PLASTICITY INDEX, COEFFICIENT OF UNIFORMITY AND SULPHATE CONTENT

EAR1.T210.9 GENERAL

The size of sample and method of sampling to be in accordance with "Geospec 3: Model Specification for Soil Testing published by GEO". Where required test samples of fill material for particle size distribution, liquid limit, plasticity index coefficient of uniformity and sulphate content and deliver results at least 14 days, or such shorter period agreed by the CM, before deposition of the fill material starts. Provide samples from each batch as stated in the following table:

Description	Size of Batch	No. of samples per Batch
Special fill material	0 - 3,000 m³	3
	Exceeding 3,000 m³	1 for each 1,000 m³ or part thereof
Fill material other than special fill material	0 - 15,000 m³	3
	Exceeding 15,000 m³	1 for each 5,000 m³ or part thereof

EAR1.T220.9 TESTING CRITERIA

For samples of fill material in the table to EAR1.T210:

1. Particle size distribution: test as EAR1.T230 (1);
2. Special fill material: test for the coefficient of uniformity as EAR1.T230 (2);
3. Liquid limit: test all samples other than rock fill material (unless otherwise agreed by the CM) as EAR1.T230 (3);
4. Plasticity index: as sub-clause (3) above and EAR1.T230 (4);
5. Soluble sulphate: test each sample of fill that will be deposited within 500 mm of concrete, cement bound, or cementitious material, or metalwork as EAR1.T230 (5).

EAR1.T230.9 TEST METHODS

Test in accordance with 'Geospec 3: Model Specification for Soil Testing', GEO, 2001 as follows:

1. Particle size: test as Test Method 8.1 or 8.2 whichever is Instructed for particles passing a 75 mm BS Test Sieve. Take the size of particles of fill material which do not pass a 75 mm BS test Sieve as the largest dimension measured in any plane;
2. Coefficient of uniformity: calculate the coefficient of uniformity (Cu) from the equation:

   $Cu = D_{60}/D_{10}$

   where:

   D_{60} and D_{10} are the equivalent sieve sizes in millimetres, interpolated from the particle size distribution curve, through which 60% and 10% of the fill material would pass respectively;
3. Liquid limit: test in accordance with Test Method 6.1 for that proportion of fill passing a 425 micron BS Test Sieve;
4. Plasticity index: test in accordance with Test Method 6.1 for that proportion of fill passing a 425 micron BS Test Sieve;
5. Soluble sulphate: test as Test Method 9.3;
6. Total sulphate: test as Test Method 9.3.

EAR1.T240.9 NON-COMPLIANCE WITH TESTS

Where the tests show non-compliance, adopt the following procedures:

1. Soluble sulphate content: test each sample to determine the total sulphate content as in Test Method 9.3 of 'Geospec 3: Model Specification for Soil Testing', GEO, 2001;
2. Particle size distribution, liquid limit, plasticity index, coefficient of uniformity or total sulphate content: provide additional samples, in numbers as stated in the table to EAR1.T210, from same batch and retest as before.

FILL MATERIAL - OPTIMUM MOISTURE CONTENT AND MAXIMUM DRY DENSITY

EAR1.T310.9 GENERAL

Where required, test samples of fill material for optimum moisture content and maximum dry density and deliver results at least 72 hours, or such shorter period agreed by the CM, before deposition of the fill material starts. Provide samples from each batch as specified in the table to EAR1.T210.

EAR1.T320.9 LOCATION

Inform the CM of the exact location in which the fill material from which each sample is taken is to be deposited.

EAR1.T330.9 ADDITIONAL SAMPLES

Take additional samples to test for optimum moisture content and maximum dry density after the fill material has been deposited in its final position, at intervals of not more than 28 days.

EAR1.T340.9 MATERIALS NOT FOR SAMPLING

Do not take samples from the following material:

1. Fill material including rock fill material which contains an insufficient proportion of particles passing a 20 mm BS Test Sieve to permit determination of the moisture content and maximum dry density; and
2. Fill material which is to be deposited as intermediate areas of fill, as specified under EAR1.W2010.

EAR1.T350.9 TESTING METHODS

1. Test each sample for:
   a. Optimum moisture content, as Test Method 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7 or 10.8 of 'Geospec 3: Model Specification for Soil Testing', GEO, whichever is Instructed;
   b. Maximum dry density, as for sub-clause (1)(a) above and whichever is Instructed.
2. If agreed by the CM, use the Hilf method as specified in EAR1.T860 to EAR1.T900 instead of the methods stipulated in sub-clause (1) above to determine the optimum moisture content and maximum dry density;
3. If in the opinion of the CM that there is any undue discrepancy between the results of tests for optimum moisture content of fill material using methods as stipulated in sub-clause (1)(a) above and the results of tests using the Hilf method, adopt only the results of tests using methods stipulated in sub-clause (1)(a) above.

EAR1.T370.9 INCONSISTENT MATERIALS

Where tests for optimum moisture content or maximum dry density indicate inconsistencies in the fill material and are likely, in the opinion of the CM, to affect subsequent relative compaction tests:

1. Divide the batch into smaller batches of material with similar properties throughout;
2. Provide additional samples from each of the smaller batches, the number of samples being as in accordance with the table to EAR1.T210;
3. Carry out additional tests for optimum moisture content and maximum dry density, of each sample.

FILL MATERIAL - MOISTURE CONTENT

EAR1.T410.X DELETED

EAR1.T420.A TESTING METHODS

Test each sample to determine moisture content by Method 1, or by Method 2 or 3 if agreed by the CM, as follows:

1. Method 1: Test Method 5.1 or 5.2 of 'Geospec 3: Model Specification for Soil Testing', GEO, whichever is Instructed;
2. Method 2: Microwave oven drying method as specified in EAR1.T810 to EAR1.T850;
3. Method 3: Infrared oven drying method as specified in EAR1.T1010 to EAR1.T1050.

EAR1.T430.X DELETED

EAR1.T440.A NUMBER OF TESTS FOR RELATIVE COMPACTION

Number of tests for relative compaction			
Description	Size of area of fill in batch	No. of tests per batch = (a) + (b)	
		(a)	(b)
Areas of fill in excavations for structures pits and trenches and on formation	0 - 100 m²	3	-
	Exceeding 100 - 500 m²	1	2 for each 100 m² or part thereof
	Exceeding 500 m²	6	1 for each 100 m² or part thereof
Other areas of fill	0 - 1 ha	-	4 for each 1000 m² or part thereof
	Exceeding 1 - 10 ha	10	3 for each 1000 m² or part thereof
	Exceeding 10 ha	110	2 for each 1000 m² or part thereof

FILL MATERIAL - RELATIVE COMPACTION

EAR1.T510.9 REQUIREMENT FOR TESTING

1. Unless otherwise agreed by the CM, test each batch of fill material to determine relative compaction;
2. Carry out each test after the fill material has been deposited and compacted in its final position;
3. The number of tests will be in accordance with the requirements of the table to EAR1.T440;
4. Do not test the following:
   a. Fill material including rock fill materials which contain an insufficient proportion of particles passing a 20 mm BS test sieve to permit determination of the relative compaction; and
   b. Fill material which has been deposited as intermediate areas of fill as EAR1.W2010.

EAR1.T520.9 LOCATION OF TESTS

Carry out tests at positions which, in the opinion of the CM, are representative of the batch of compacted fill material as a whole.

EAR1.T530.9 METHODS

1. Adopt Method 1, or adopt Method 2 if agreed by the CM, to determine the relative compaction of fill material as follows:
   a. Method 1: Test Method 11.4, Geospec 3, GEO

      Determine the relative compaction (RC) of fill material from the equation:

      RC = IDD/MDD x 100%

      where:

IDD is the in-situ dry density determined as EAR1.T540;

MDD is the maximum dry density determined as EAR1.T350 (1)(b);

b. Method 2: The relative compaction (RC) shall be calculated from the equation:

RC = IBulkD/MCBulkD x 100%

where:

IBulkD is the in-situ bulk density determined as EAR1.T540;

MCBulkD is the maximum converted bulk density determined by Hilf method as EAR1.T350 (2). If the amount of material retained on a 20 mm BS test sieve is more than 5% of the mass of the sample, adjust the maximum converted bulk density (MCBulkD) of fill material in accordance with EAR1.T910 to EAR1.T950.

2. If in the opinion of the CM that there is any undue discrepancy between the results of tests for relative compaction of fill using Method 1 stipulated in sub-clause (1)(a) above and the results of tests using Method 2 stipulated in sub-clause (1)(b), adopt only the results of tests using the Method 1.

EAR1.T540.9 IN-SITU BULK DENSITY AND IN-SITU DRY DENSITY

Adopt Method 1, or adopt Method 2 if agreed by the CM, to determine in-situ bulk density and in-situ dry density as follows:

1. Method 1: Test Method 11.1 or 11.2 of 'Geospec 3: Model Specification for Soil Testing', GEO, as appropriate to the grain size of the fill material;
2. Method 2: Nuclear densometer method in accordance with Test Method 11.3 of 'Geospec 3: Model Specification for Soil Testing', GEO.

EAR1.T550.9 NON-COMPLIANCE OF RELATIVE COMPACTION TEST

If the result of any test for relative compaction of fill material does not comply with the specified requirements for relative compaction, carry out additional tests for relative compaction on the same batch. The number of additional tests are stated in the table to EAR1.T440.

TEST METHODS FOR FILL MATERIALS

EAR1.T710.9 GENERAL

The definitions, terms, abbreviations symbols, and grouping of materials stated in the relevant parts of 'Geospec 3: Model Specification for Soil Testing', GEO, apply except as stated in EAR1.T720 and EAR1.T730.

EAR1.T720.9 ABBREVIATIONS AND SYMBOLS

Terms used in this Worksection and in the relevant parts of 'Geospec 3: Model Specification for Soil Testing', GEO, are identified by the following abbreviations and symbols:

Abbreviation/Symbol	Term
BulkD	Bulk density
CBulkD	Converted bulk density
DD	Dry density
IBulkD	In-situ bulk density

IDD	In-situ dry density
MDD	Maximum dry density
MCBulkD	Maximum converted bulk density
RC	Relative compaction
w	Moisture content
w_i	In-situ moisture content
w_o	Optimum moisture content

EAR1.T730.9 GROUPING OF MATERIALS

1. Fine grained material is material of which at least 90% passes a 2 mm BS Test Sieve;
2. Medium grained material is material of which at least 90% passes a 20 mm BS Test Sieve and more than 10% is retained on a 2 mm BS Test Sieve.

DETERMINATION OF THE MOISTURE CONTENT OF FINE GRAINED AND MEDIUM GRAINED MATERIAL BY THE MICROWAVE OVEN DRYING METHOD

EAR1.T810.9 SCOPE

This method covers the determination of the moisture content of fine grained and medium grained material as a percentage of the mass of the dry material.

EAR1.T820.9 APPARATUS

Use the following apparatus:

1. A microwave oven with a timer and an adjustable power setting;
2. An airtight container of microwave safe and non-reflective material;
3. A balance readable and accurate to 0.01 g;
4. A desiccator containing anhydrous silica gel.

EAR1.T830.9 PROCEDURE

Adopt the following procedure:

1. The container must be clean, dry and weighed to the nearest 0.01 g (m_1);
2. Crumble a specimen and place loosely in the container and replace the lid. Ensure each specimen of fine grained material is at least 30 g and each specimen of medium grained material at least 300 g. Specimens of medium grained material may be tested in several parts each less than 300 g and the results aggregated;
3. Weigh the container and contents to the nearest 0.01 g (m_2);
4. Remove the lid of the specimen container and place the container with its lid and content in the microwave oven and dry. Consider the specimen to be dry when, after an initial drying period, successive weighing at intervals of 1 minute produce results which are the same to the nearest 0.01 g. Alternatively, the oven may be set to an appropriate time and power setting to dry the specimen as determined by calibration of the oven on soil of a similar type;

5. After drying, remove the container and contents from the microwave oven and place in the desiccator to cool;
6. Replace the lid and weigh the container and contents to the nearest 0.01 g (m_3).

EAR1.T840.9 CALCULATION

Calculate the moisture content of the material (w) as a percentage of the dry mass of the material from the equation:

$w = (m_2 - m_3)/(m_3 - m_1) \times 100\%$

where:

- m_1 is the mass of the container (g)
- m_2 is the mass of the container and contents before drying (g)
- m_3 is the mass of the container and contents after drying (g).

EAR1.T850.9 REPORTING

Report on the following:

1. Source and identification of the soil;
2. The moisture content of the material to the nearest 0.1%;
3. That the test method used was in accordance with this Specification.

DETERMINATION OF THE MAXIMUM CONVERTED BULK DENSITY BY THE HILF METHOD

EAR1.T860.9 SCOPE

This method covers the determination of the maximum converted bulk density and the difference between the optimum moisture content and the in-situ moisture content of a material by relating the converted bulk density and the moisture content added.

EAR1.T870.A APPARATUS

Use the following apparatus:

1. Apparatus in accordance with Geospec 3, Test Methods 10.1, 10.2, 10.5 or 10.6, whichever as Instructed by the CM;
2. Apparatus for determination of the moisture content in accordance with either Geospec 3, Test Method 5.1 or 5.2 or EAR1.T820, whichever as Instructed by the CM;
3. Apparatus to extract specimen from the mould;
4. Apparatus, such as a warm air blower, for rapid drying of the material.

EAR1.T880.A PROCEDURE

Adopt the following procedures:

1. Take a sample of material immediately after completing the in-situ bulk density test at the same location as the test. The sample shall be obtained by digging to the same depth as that of the in-situ bulk density test, keeping the sides of the excavation vertical and bottom lat and level. The size of the sample shall be sufficient to yield a maximum of 13 kg after screening over a 20 mm BS test sieve. For material which is susceptible to crushing, the following minimum mass of material shall be collected:
    a. Minimum 15 kg for material with percentage by mass of the sample retained on 20 mm BS test sieve less than 5%;
    b. Minimum 20 kg for material with percentage by mass of the sample retained on 20 mm BS test sieve between 5% and 20%;
    c. Minimum 40 kg for material with percentage by mass of the sample retained on 20 mm BS test sieve exceeding 20%.
2. Weigh the sample to the nearest 0.01 g;
3. Screen the sample over a 20 mm BS test sieve, ensuring that moisture loss is kept to a minimum and that any free moisture appearing in the container is worked back into the sample;
4. Weigh the amount retained on the sieve to the nearest 0.01 g and express as a percentage of the mass of the sample. If the percentage exceeds 5%, adjust for coarse material in accordance with EAR1.T910 to EAR1.T950. If the percentage does not exceed 5%, no adjustment is required;
5. Mix the material to be tested thoroughly and divide by quartering or by using a riffle box to obtain a maximum of five specimens of at least 2,500 g each, ensuring that the moisture loss is kept to a minimum. Alternatively, if it has previously been ascertained that the material is not susceptible to crushing, use a single specimen of at least 2,500 g for repeating the testing;
6. Weigh each specimen to the nearest 0.01 g and take the result as the mass of the specimen at the in-situ moisture content;
7. Place and seal each specimen and any remaining material in separate moisture- tight containers;
8. Plot the converted bulk density of at least three specimens against the amount of water added or removed as a percentage of the mass of the specimen at the in-situ moisture content (z) on a graph where the ordinate shows the converted bulk density and the abscissa shows the amount of water added / removed as a percentage of the mass of the specimen (see Civil Engineering and Development Department Standard Drawing No. C2006/1) in accordance with the procedures as stated in sub-clauses (9) to (15) below;
9. Obtain the first point on the graph as follows:
    a. Compact a specimen at its in-situ moisture content in accordance with Geospec 3, Test Method 10.1, Clause 10.1.5, Test Method 10.2, Clause 10.2.5, Test Method 10.5, Clause 10.5.5 or Test Method 10.6, Clause 10.6.5 whichever is Instructed by the CM;
    b. Cut a diametrical slice of approximately 400 g to 500 g from the specimen along its entire length. Determine the in-situ moisture content of the slice (w) in accordance with either Geospec 3, Test Method 5.1 or 5.2 or EAR1.T810 to EAR1.T850 or EAR1.T1010 to EAR1.T1050, whichever as Instructed by the CM;
    c. Calculate the bulk density ($BulkD_1$) as stated in EAR1.T890 (1) and plot on the 0% ordinate of the graph as the converted bulk density ($CBulkD_1$).

10. Obtain the second point on the graph as follows:
    a. Examine a second specimen and, if the in-situ moisture content obviously exceeds the optimum moisture content, follow the procedure stated in sub-clause (11) below;
    b. Increase the moisture content of the specimen by adding an amount of water equal to approximately 2% of the mass of the specimen. Mix the specimen thoroughly and compact in accordance with the method stipulated in sub-clause (9) above;
    c. Calculate the bulk density ($BulkD_2$) as stated in EAR1.T890 (1), adjust to converted bulk density ($CBulkD_2$) as stated in EAR1.T890 (2) and plot on the +2% ordinate of the graph.
11. If the in-situ moisture content of the second specimen obviously exceeds the optimum moisture content, dry and cool the specimen until the amount of water removed is approximately 2% of the mass of the specimen. Mix the specimen thoroughly and compact in accordance with the method stipulated in sub-clause (9) above. Determine the amount of water removed. Calculate the bulk density ($BulkD_2$) as stated in EAR1.T890 (1), adjust to converted bulk density ($CBulkD_2$) as stated in EAR1.T890 (2) and plot on the negative ordinate of the graph at a point which corresponds to the amount of water removed;
12. Obtain the third point on the graph as follows:
    a. If the plotted value of $CBulkD_2$ is equal to or greater than the plotted value of $CBulkD_1$, increase the moisture content of the third specimen by adding an amount of water equal to approximately 4% of the mass of the specimen. Alternatively, if the procedure of sub-clause (11) above has been followed, dry and cool the specimen until the amount of water removed is approximately 4% of the specimen after cooling;
    b. If the plotted value of the $CBulkD_2$ is less than the plotted value of $CBulkD_1$, dry and cool the third specimen until the amount of water removed is approximately 2% of the specimen after cooling. Alternatively, if the procedure of sub-clause (11) above has been followed, increase the moisture content by adding an amount of water equal to approximately 2% of the mass of the specimen;
    c. Mix the specimen thoroughly and compact in accordance with the method stipulated in sub-clause (9) above. Determine the amount of water removed if applicable;
    d. Calculate the bulk density ($BulkD_3$) as stated in EAR1.T890 (1), adjust to converted bulk density ($CBulkD_3$) as stated in EAR1.T890 (2) and plot on the graph at a point corresponds to the amount of water added or removed.
13. If the centre point of the three points plotted is lower than one of the other two points, or is higher than one point and equal to the other, obtain an additional point or points by proceeding in 2% increments or decrements as appropriate;
14. If it is apparent that the moisture condition of the material is such that a total five points will not result in the determination of the optimum moisture content, adopt increments or decrements of 3% moisture content for the entire procedure;
15. Draw a smooth parabolic curve to the plotted points. The peak value of the curve, as the maximum converted bulk density (MCBulkD), shall be determined as the maximum converted bulk density (MCBulkD);
16. Calculate the amount of water added of removed as a percentage of the mass of the specimen at the in-situ moisture content corresponding to the maximum converted bulk density (z_m);

17. The moisture content adjustment value (z_c) shall be determined according to Civil Engineering and Development Department Standard Drawing No. C2006/2.

EAR1.T890.A CALCULATION

1. Calculate the bulk density (BulkD) from the equation:

   $BulkD = (m_2 - m_1)/V$ Mg/m^3

   where:

   m_1 is the mass of the mould and base (g)

   m_2 is the mass of the mould and base and wet material (g)

   V is the mass of the volume of the mould (mL).

2. Calculate the converted bulk density (CBulkD) from the equation:

   $CBulkD = BulkD/(1 + z/100)$ Mg/m^3

   where:

   z is the amount of water added or removed as a percentage of mass of the specimen at the in-situ moisture content (%)

   z is negative for values below the in-situ moisture content.

3. Calculate the difference between the optimum moisture content (w_o) and the in-situ moisture content (w_i) of the material from the equation:

   $w_o - w_i = z_m + z_c$ %

   where:

   z_m is the amount of water added or removed as a percentage of mass of the specimen at the in-situ moisture content corresponding to the maximum converted bulk density (%)

   z_c is the moisture content adjustment value (%).

4. Calculate the maximum dray density (MDD) from the equation:

   $MDD = MCBulkD/(1 + w_i/100)$ Mg/m^3

   where:

   w_i is the in-situ moisture content of the material (%).

   MCBulkD is the maximum converted bulk density of the material (Mg/m^3).

5. Calculate the relative compaction (RC), if required, from the equation:

   RC = IBulkD/MCBulkD x 100%

   where:

   IBulkD is the in-situ bulk density of the material determined in accordance with Geospec 3, Test Method 11.1 or 11.2 as appropriate to the grain size of the material.

EAR1.T900.A REPORTING

Report on the following:

1. Source and identification of the soil;
2. The graph showing the plotted points and the parabolic curve passing through them;
3. The maximum converted bulk density to the nearest 0.01 Mg/m^3;
4. The optimum moisture content to the nearest 0.1%;

5. The maximum dry density to the nearest 0.01 Mg/m³;
6. The relative compaction to the nearest 0.1 %, if determined;
7. The difference between optimum moisture content and the in-situ moisture content to the nearest 0.1%, if determined;
8. The percentage retained on the 20 mm BS test sieve and the percentage retained on the 37.5 mm BS test sieve to the nearest 1%;
9. Whether the test was carried out using individual specimens or repeat testing of a single specimen;
10. Whether a manual or an automatic compaction rammer was used;
11. That the test method used was in accordance with this Specification.

ADJUSTMENT OF THE MAXIMUM CONVERTED BULK DENSITY FOR DETERMINATION OF RELATIVE COMPACTION

EAR1.T910.9 SCOPE

This method covers the adjustment of the maximum converted bulk density determined in accordance with EAR1.T860 to EAR1.T900 for the determination of relative compaction of a material containing more than 5% of the mass of the material at the in-situ moisture content retained on a 20 mm BS test sieve.

EAR1.T920.9 APPARATUS

Use the following apparatus:

1. Apparatus in accordance with EAR1.T870;
2. A 20 mm and a 37.5 mm BS test sieve;
3. A mould with collar as used for determination of the California Bearing Ratio (CBR mould);
4. An extrusion device as used for determination of the California Bearing Ratio.

EAR1.T930.A PROCEDURE

Adopt the following procedures:

1. If the amount of material retained on the 20 mm BS test sieve exceeds 5% and does not exceeds 20%, compact the material passing the sieve in accordance with EAR1.T860 to EAR1.T900. Determine and adjust the maximum converted bulk density (MCBulkD) as stated in EAR1.T940;
2. If the amount of material retained on the 20 mm BS test sieve exceeds 20%, screen the retained material over the 37.5 mm BS test sieve. Follow the procedure stated in either sub-clause (3) or (4) below as appropriate;
3. If the amount of material retained on the 37.5 mm BS test sieve does not exceed 5%, follow the procedure stated in sub-clause (5);
4. If the amount of material retained on the 37.5 mm BS test sieve exceeds 5% and does not exceed 20%, replace the retained material with an equal mass of material which is of similar nature and which is retained on a 20 mm BS test sieve but passes a 37.5 mm BS test sieve. Follow the procedure stated in sub-clause (5) below;

5. Follow the procedure in EAR1.T860 to EAR1.T900 except that the material shall be compacted into the CBR mould and each layer shall be subject to 62 blows of the rammer. The material to be tested shall be thoroughly mixed and divided by quartering or by using a riffle box to obtain a minimum of five specimens of at least 6,000g each, ensuring that moisture loss is kept to a minimum. Alternatively, if it has previously been ascertained that the material is not susceptible to crushing, a single specimen of at least 6,000g may be used for repeat testing.

EAR1.T940.A CALCULATION

Calculate the maximum converted bulk density (MCBulkD) from the equation:

$MCBulkD = MCBulkD_{20}[1 + m(1 – MCBulkD_{20}/G_s)/(1 + z/100)]$ Mg/m^3

where:

$MCBulkD_{20}$ is the maximum converted bulk density of the material passing the 20 mm BS test sieve (Mg/m^3).

m is the weight of particles retained on the 20 mm BS test sieve expressed as a fraction of the fill wet weight.

G_s is the specific gravity of the particles retained on the 20 mm BS test sieve.

EAR1.T950.9 REPORTING

Report on the following:

1. Source and identification of the soil;
2. The results in accordance with EAR1.T900;
3. The mass of the original material not passing the 20 mm BS test sieve and 37.5 mm BS test sieve as a percentage of the mass of the material at the in-situ moisture content to the nearest 0.1%;
4. The type of mould used;
5. The number of blows per layer;
6. Whether the specific gravity was measured or assumed and, if measured, the method used;
7. That the test method used and the results adjusted were in accordance with this Specification.

SELF-COMPACTING BACKFILL MATERIAL

EAR1.T960.A TESTING

1. Testing and sampling
    a. The sampling of fresh SCM shall be done according to CSl:2010 Section 1 where samples are collected from the first batch and from subsequent batches after discharge of every or less than 25 cubic meters. Samples are collected from the first vehicle delivering SCM in the above batches. The number of tests for flowability, density of fresh SCM, compressive strength of SCM may be reduced if, in the opinion of the CM, the standard of quality control is satisfactory;
    b. The density of fresh SCM shall be tested according to CS1 Section 5 where two samples are collected from a batch;

c. The flowability of SCM shall be tested according to ASTM D6103 or equivalent, where two samples are collected from a batch. The flowability shall be tested from every batch before placement of SCM;

d. When SCM is used as alternative backfill material for the location listed in sub-clauses 1(a), 1(b)(i), 1(b)(ii) and 1(b)(iii) of EAR1.D120. The following items are required together with the items listed in sub-clauses 1(a), 1(b) and 1(c) of EAR1.T960:

i. Two samples are collected from a batch for determination of the compressive strength after 28 days, where a pair of testing cubes shall be made from each sample. The size of the test cube shall be 100 mm and the method of making test cubes shall be in accordance with CS1. The method of testing shall be in accordance with CS1;

ii. The load placement capability of the SCM surface shall be tested according to ASTM D6024 or equivalent prior to further backfilling or other works are to be carried out over the SCM backfilled area. The CM shall appoint a representative testing location, where the load placement capability test shall be conducted in five consecutive times for every 20 m^2 of the in-place SCM or part thereof;

iii. The thermal conductivity of SCM shall be carried out when backfilling utility trench with power cables and tested according to ASTM D5334 or equivalent. The CM shall appoint no less than five locations, where the thermal conductivity test shall be conducted, for every 20 m^2 of the in-place SCM or part thereof.

e. When SCM is used as alternative backfill material for the locations listed in sub-clause 1(b)(iv) of EAR1.D120. The following item is required together with the items listed in sub-clauses 1(a), 1(b) and 1(c) of EAR1.T960:

i. Two samples are collected from a batch for determination of the compressive strength at 28 days, where a pair of testing cylinders shall be made each sample by pouring the SCM into a non-reusable rigid clear Acrylonitrile Butadiene Styrene plastic mold. The diameter of the cylindrical specimens shall be within 63 mm to 100 mm where the minimum length to diameter ratio is 2 to 1. The method of testing shall be in accordance with Appendix B of the "Interim Guidelines on Testing of Unconfined Compressive Strength of Cement Stabilised Soil Cores in Hong Kong" published by Geotechnical Division of The Hong Kong Institution of Engineers in October 2017. Two additional samples shall be provided from the same batch. The CM may order additional tests for reviewing the quality of the SCM.

2. Compliance criteria

a. When SCM is used as alternative backfill material for the locations listed in sub-clauses 1(a), 1(b)(i), 1(b)(ii) and 1(b)(iii) of EAR1.D120. The following items are required:

i. The compressive strength of SCM at 28 days shall be not less than 0.3 MPa and not more than 1 MPa (for utility trench backfilling) or 2 MPa (for other void backfilling);

ii. The density of fresh SCM shall be in range of 1900-2100 kg/m^3;

iii. The flowability of the SCM shall be no less than 200 mm without segregation according to ASTM D6103;

iv. The indentation diameter of five measurements under the load placement capability test shall be no more than 75 mm and is considered ready for placement of subsequent layers and open to traffic;

v. Five measurements under the thermal conductivity test shall be greater than 1.1 W/mK when moisture content >10%.

b. When SCM is used as alternative backfill material for the locations listed in sub-clause 1(b)(iv) of EAR1.D120. The following items are required:

i. The compressive strength of SCM at 28 days shall be not less than 0.2 MPa;

ii. The density of fresh SCM shall be in range of 1900-2300 kg/m^3;

iii. The flowability of the SCM shall be no less than 200 mm without segregation according to ASTM D6103-17.

3. Non-compliance

a. If the result of either the flowability test or the density test carried out on a sample taken from the first vehicle of the batch does not comply with the requirements in sub-clause (2)(b) or (2)(c) above, the SCM in that vehicle shall not be placed in the backfill area. Sample(s) from the subsequent vehicle(s) of the same batch shall be collected for testing the flowability or the density until compliance with such requirements;

b. When SCM is used as alternative backfill material for the locations listed in sub-clauses 1(a), 1(b)(i), 1(b)(ii) and 1(b)(iii) of EAR1.D120. The following items are required together with the items listed in sub-clause 3(a) of EAR1.T960:

i. If the compressive strength of the proposed SCM at 28 days does not comply with the requirements in sub-clause (2)(a) above, the Contractor shall be required to propose rectification measures and carry out rectification measures such as manual excavation of spare SCM bulk sample prepared from the same batch of SCM used in the backfilling works to demonstrate that the hardened non-compliant SCM can still be excavated with hand tools without sharp edges to the satisfaction of the CM and Utility Undertakings if their existing installations are embedded by the non-compliant SCM such that hardened non-compliant SCM is not necessary to be removed. The proposed rectification measures and arrangement shall be included under consent requirement in sub-clause (4)(a) of EAR1.W1790. The Contractor shall bear all associated costs and the extra time required for the remedial works in case of non-compliance of the requirements in sub-clause (2)(a) above;

ii. If indentation diameter after the five measurements under the load placement capability test does not meet the requirement in sub-clause (2)(d) above, an additional load placement capability test in the vicinity of the non-compliant testing location shall be conducted at appropriate intervals, such as hourly until such requirement is met such that works over the backfilled area can be resumed;

iii. If any of the five measurements under the thermal conductivity test does not comply with the requirements in sub-clause (2)(e) above, the Contractor shall remove the hardened non-compliant SCM, backfill the trench and reinstate pavement above with an appropriate method as agreed with the CM. The Contractor shall bear all associated costs and the extra time required for the remedial works in case of non-compliance of the requirements in sub-clause (2)(e) above.

c. When SCM is used as alternative backfill material for the locations listed in sub-clause 1(b)(iv) of EAR1.D120. The following item is required together with the items listed in sub-clause 3(a) of EAR1.T960:

i. If the compressive strength at 28 days of the SCM does not comply with the specified requirements, the Contractor shall be required to propose rectification measures to the satisfaction of the CM.

EAR1.T1010.N SCOPE

This method covers the determination of the moisture content of soil by infrared oven drying with convection heating at 105 ± 5 °C. The method is not suitable for soil containing gypsm, calcareous material or organic matters.

EAR1.T1020.N APPARATUS

Use the following apparatus:

1. An infrared oven with convection heating and with a suitable power control device and ventilation, capable of maintain oven temperature at 105 ± 5 °C and meets the following performance requirements:
   (a) the difference of mass of the test specimens(l) taken in 3 hours and 3½ hours after drying in the infrared oven shall be less than 0.1% of the original wet mass of the test specimens;
   (b) the temperature of test specimens does not exceed 110 °C;
   (c) the difference between the moisture content values of the test specimens by infrared oven drying and further convection oven drying at 105 ± 5 °C for 24 hours shall be less than 0.4%.

Note: (i) Test specifications used for verifying the performance of the infrared oven should have a minimum moisture content of optimum moisture content plus 3%.

2. Suitable corrosion-resistant containers with lids;
3. A balance, readable to 0.01g and accurate to 0.05g for fine-grained soils;
4. A balance, readable to 0.1g and accurate to 0.3g for medium-grained soils;
5. A balance, readable to 1g and accurate to 3g for coarse-grained soils.

EAR1.T1030.N PROCEDURE

Adopt the following procedures:

1. The container and its lid shall be cleaned, dried and weighed to the nearest 0.01g, 0.1g or 1g for fine-grained, medium-grained or coarse-grained soils respectively (m1);
2. A test specimen shall be crumbled and placed loosely in the container. The mass of soil required for the preparation of a test specimen shall follow Clause 5.1.4 of Test Method 5.1 of Geospec 3;
3. The container and contents together with its lid on shall be weighed to the nearest 0.01g, 0.1g or 1g for fine-grained, medium-grained or coarse-grained soils respectively (m2);
4. The lid of the container shall be removed and the container with its contents shall be placed in the infrared oven and dried;
5. After an initial drying period of 3 hours, the lid shall be replaced and the container and contents shall be weighed to the nearest 0.01g, 0.1g or 1g for fine-grained, medium-grained or coarse-grained soils respectively;
6. The lid of the container shall be removed and the container with its contents shall be placed back in the infrared oven for successive drying of half an hour;

7. The lid shall be replaced and the container and contents shall be weighed to the nearest 0.01g, 0.1g or 1g for fine-grained, medium-grained or coarse-grained soils respectively;

8. The test specimen shall be considered to be dry when the difference between the mass readings taken 3 hours and 3½ hours after drying is less than 0.1% of the original wet mass of the test specimen. In case the drying criterion is not satisfied, the test specimen shall be returned to the infrared oven for successive drying until the drying criterion is satisfied. In this case, the test specimen shall be successively weighed at half-hourly intervals and the specimen shall be considered to be dry when the difference between two consecutive mass readings is less than 0.1 % of the original wet mass.

   (a) The final mass of the container, its lid and contents shall be weighed to the nearest 0.01g, 0.1g or 1g for fine-grained, medium-grained or coarse-grained soils respectively (m^3) when the test specimen is dried.

EAR1.T1040.N CALCULATION

The moisture content of the test specimen (w) shall be calculated as a percentage of the dry soil mass to the nearest 0.1% from the equation:

$w = [(m_2 – m_3)/(m_3 – m_1)] \times 100\%$

where:

m_1 is the mass of container (in g).

m_2 is the mass of container and wet soil (in g).

m_3 is the mass of container and dry soil (in g).

EAR1.T1050.N REPORTING

Report on the following:

1. The source and identification of the test specimen;
2. The moisture content of the test specimen to two significant figures for values up to 10% or to the nearest whole number for values above 10%;
3. The duration of all drying activities to the nearest half hour;
4. A statement stating that the test method used was in accordance with this Specification.

EAR2 BLASTING

MATERIALS

EXPLOSIVES

EAR2.M010.9 NITRO-GLYCERINE BASED EXPLOSIVES

Do not use.

EAR2.M020.9 PRE-SPLIT BLASTING EXPLOSIVES

Only use explosives for pre-split blasting that are specifically recommended by the explosives manufacturer for pre-splitting.

WORKMANSHIP

GENERALLY

EAR2.W010.9 STATUTORY REQUIREMENTS

1. Comply with conditions and restrictions imposed by the Commissioner of Mines for:
   a. Blasting operations;
   b. Supply, transportation, storage, use and disposal of explosives.
2. Make all arrangements with and obtain all licences and permits from the Commissioner of Mines in connection with blasting operations;
3. Ensure that the Mines and Quarries Division, Civil Engineering Development Department is given adequate notice to arrange visits to the site to consider blasting conditions, and thereafter comply promptly and fully with any instruction issued by the Commissioner of Mines, or his representative, in connection with blasting;
4. Allow access to the Site by the staff of the Mines and Quarries Division at all times;
5. Employ at least one registered shotfirer who holds a valid Hong Kong Mine Blasting Certificate and is approved by the Mines and Quarries Division and the CM.

EAR2.W020.9 TRAFFIC CONTROL

Liaise with the Hong Kong Police Force in respect of traffic control on adjacent roads during blasting operations.

EAR2.W030.9 RESTRICTIONS ON TIMING

Do not carry out blasting at the following times:

1. General holidays;
2. Before 8:30 am or after 5:30 pm on any day;
3. When a Hong Kong Observatory thunderstorm warning is in force (unless permitted by the Commissioner of Mines);
4. When strong wind signal or tropical cyclone warning No. 3 or higher is hoisted (unless permitted by the Commissioner of Mines).

EAR2.W040.9 PARTICULARS OF BLASTING

Submit the following particulars to the CM at least 48 hours before blasting starts:

1. Any conditions or restrictions imposed by the Commissioner of Mines, including copies of applications, licences, permits and correspondence;
2. Names, qualifications and experience of the persons responsible for the design and supervision of blasting operations;
3. Location, diameter, inclination and depth of holes to be charged with explosive;
4. Type and total mass of explosive to be used and its mass and distribution in each hole;
5. Dimensions of stemming and decking;
6. Initiation sequence, delay periods and mass of explosive per delay;

7. Burden and bench height;
8. Ratio of diameter of explosive to diameter of hole;
9. Arrangements for and methods of instrumentation and monitoring the effects of blasting;
10. Details of velocity seismographs, including manufacturer's literature;
11. Method of controlled blasting;
12. Details of blasting trials; and
13. Protective measures.

EAR2.W050.9 PARTICULARS OF PRE-SPLIT BLASTING

In addition to the data required by clause EAR2.W040 submit to the CM the following information at least 48 hours before pre-split blasting starts:

1. Plan showing proposed method of working;
2. Pre-split burden;
3. No of pre-split holes to be fired at each delay;
4. Distance from the pre-split face to the nearest primary blast drillholes;
5. Decoupling ratio;
6. Delay arrangements between pre-split and primary blasts.

EAR2.W060.9 BLASTING ASSESSMENT

Prior to carrying out blasting works, submit to the Geotechnical Engineering Office a Blasting Assessment containing the following information:

1. Assessment of site geology and the condition of existing structures, slopes, retaining walls and services;
2. Assessment of the stability of existing structures, slopes and retaining walls under the effects of blasting;
3. Proposals for preventive and precautionary measures to be implemented to ensure stability and integrity of the affected structures, slopes, retaining walls and services both during blasting and in the long term;
4. Outline blast design to demonstrate the practicability of satisfying any constraints imposed under sub-clause (3) above;
5. Proposals for instrumentation and monitoring of the effects of blasting;
6. Details of site supervision to ensure professional input during the blasting work by the Blasting Control Engineer; and
7. Curriculum vitae of the Blasting Control Engineer who prepared the Blasting Assessment.

EAR2.W070.9 GEOTECHNICAL ENGINEERING OFFICE (GEO) REQUIREMENTS

Comply with all requirements, comments and conditions imposed on the blasting works by the GEO in respect of the submitted Blasting Assessment.

SAFETY PRECAUTIONS, RESTRICTIONS AND BLASTING PROCEDURES

EAR2.W110.9 SAFETY PRECAUTIONS AND RESTRICTIONS

1. The CM may regulate, restrict or prohibit blasting if, in his opinion, it is necessary to do so for the safety of persons or property, to limit noise or to safeguard the Works. Notify the CM, by not later than noon of the previous day, any intention to bring any Explosives to the Site or to carry out any blasting;
2. Store, transport and use explosives at all times in accordance with the Dangerous Goods Ordinance (Cap 295) and such other Statutory Regulations concerned with the possession and use of explosives which may be in force. Do not store explosives and detonators on the Site overnight unless permitted by the Commissioner of Mines;
3. Safeguard, and relocate if necessary, any structures or services within the Site;
4. Consult Power Companies when blasting near high voltage underground or overhead cables and observe restrictions imposed by these Companies; make good any damage caused by, or consequential to, blasting operations;
5. Provide a system approved by the CM for warning and preparing the general public and all site personnel of an impending blast, both by audible and visual means, and ensure that the blasting area is cleared of all personnel immediately prior to blasting. This warning system is to comply with all statutory requirements;
6. Take all necessary precautions to prevent accident, injury or loss to persons and damage to works or property, within and outside the Site, resulting from the use or handling of explosives. Obtain agreement from the CM of such precautions and the method of handling and using explosives;
7. Blasting will be allowed only within the area outlined on the site plan attached to the Commissioner of Mines permit;
8. Do not use ANFO or emulsion, that is not in cartridged form, for blasting within 5 m from an excavation free face;
9. Dispose of unused explosives and detonators at the end of each day as stipulated by the Commissioner of Mines.

EAR2.W120.9 GENERAL PROCEDURES

1. Wet areas within 30 m from the blasting area with water prior to blasting;
2. Clear all loose materials to expose the final rock face as soon as practicable after the blast and scale all final rock faces to remove loose rock fragments;
3. Do not blast to form drainage channel, cascade, catchpit and the like, on the final rock face;
4. Utilise uncharged guide holes to form any corner in the final slope profile. When the final profile design includes the provision of berms between slopes, exercise extreme care to ensure no drilling below berm level and in the selection of toe charging details to produce the required profile.

EAR2.W130.9 SURFACE PREPARATION

Before assessments of blasting safety precautions are made, remove all vegetation, overburden, and soft or loose materials, and expose the rock that is to be blasted.

EAR2.W140.9 PROTECTIVE SCREENS

Unless otherwise permitted by the Commissioner of Mines, erect screens and other protective covers to prevent the projection of flying fragments of material resulting from blasting. Construct screens using wire mesh securely supported on steel frames; use wire of nominal diameter at least 3.5 mm and wire mesh size not exceeding 25 mm.

EAR2.W150.9 PLASTER BLASTING

Do not use plaster blasting unless permitted by the Commissioner of Mines.

EAR2.W160.9 BLAST HOLES

Unless otherwise permitted by the Commissioner of Mines provide blast holes stemmed and decked using free-flowing granular materials. Cover charges with thick gunny sacking and 2 m by 2 m square of steel fabric reinforcement weighted down with filled sandbags. Except on slopes cover surface detonating cords, knots, detonating relay conductors and initiating detonators with a 300 mm thickness of sand or soil.

EAR2.W170.9 DETONATORS

Do not use electrical detonators within 60 m of overhead power lines unless permitted by the Commissioner of Mines. When using electrical detonators in the vicinity of static or mobile radios transmitters comply with BS 6657:1991.

EAR2.W180.9 DELAY BLASTING

Use delay-blasting at all times with millisecond delays unless otherwise permitted by the Commissioner of Mines, or as specified under pre-splitting.

EAR2.W190.9 PROXIMITY TO CERTAIN STRUCTURES

Unless permitted by the CM, do not carry out blasting within a distance of:

1. 60 m from water retaining structure or water tunnels; and
2. 6 m from water mains or other water supply structures or installations.

EAR2.W200.9 VIBRATIONS TO INSTALLATIONS OR STRUCTURES

Unless permitted by the CM the vibrations at structures and installations due to blasting, measured in terms of peak particle velocity and vibrational amplitude, must not exceed the values stated in the following table:

Type of structure or installation	Peak particle velocity (mm/s)	Vibrational amplitude (mm)
Water retaining structures. Water tunnels. Under any reinforced concrete structure that has been cast less than 24 hours previously.	13	0.1
Water mains. Other structures and pipes.	25	0.2

EAR2.W210.9 VIBRATIONS TO ADJOINING LAND

Unless otherwise permitted by the CM, the vibration at adjoining slopes and land due to blasting measured in terms of peak particle acceleration and peak particle velocity must not exceed the values stated in the Contract.

EAR2.W220.9 RECORDING VIBRATIONS

1. Take measurements of vibrations due to blasting at locations stated in the Contract, or instructed by the CM, at all times when blasting is carried out. Keep records of vibrations on the Site and provide a copy for the CM. Make any arrangements for installing instruments and taking measurements both inside and outside the Site;
2. Measure vibrations due to blasting in terms of peak particle velocity, peak particle acceleration and vibration amplitude. Take peak values as the maximum resultant calculated by vector summation of the three components of velocity and amplitude respectively, measured as instantaneously as the resolution of the recording instrument permits;
3. Take measurements with velocity seismographs, which have operating instructions in English of a type agreed by the CM. Seismographs must be capable of:
   a. Recording vibrations in terms of peak particle velocity and vibration amplitude over a frequency of 0 - 200 Hz in three mutually perpendicular directions; and
   b. Producing a permanent record of vibrations by tracing an ultra-violet light beam on sensitised paper, or by other methods agreed by the CM;
4. Check the accuracy of seismographs at regular intervals agreed with the CM.

PRE-SPLIT BLASTING

EAR2.W310.9 FORMING FINAL SURFACES

1. Form earthworks final surfaces and formations, which are to be formed by blasting, and which slope at a gradient exceeding 2 vertical to 1 horizontal and exceed 3 m in height by pre-splitting. Do not use other methods of controlled blasting unless permitted by the CM;
2. Ensure that:
   a. Other blast holes are located at a sufficient distance from the earthwork final surface to avoid damaging the surface; and
   b. The row of blast holes nearest to that surface is inclined parallel to the slope face.

EAR2.W320.9 METHODOLOGY

1. Carry out pre-splitting and other methods of controlled blasting in such a manner that the rock mass is cleanly split on the required plane and that rock outside the earthworks final surface is not shattered or loosened;
2. Faces formed by pre-splitting or other methods of controlled blasting must not exceed 15 m in height in any one blasting operation unless permitted by the CM.

EAR2.W330.9 HOLES FOR PRE-SPLITTING

1. Drill a single row of holes at the appropriate inclination along the line of the earthworks final surface. Load holes with explosives not exceeding half the diameter of the hole. Detonate the explosives simultaneously or with the minimum amount of delay necessary to reduce ground vibrations;
2. Drill holes for pre-splitting at least 50 mm in diameter with the ratio of the distance between the centre of the holes and the diameter of the hole not exceeding 10;
3. Form the holes so that they are within a distance of 0.015 times the length of the hole from their designed position;

4. Do not drill holes for pre-splitting into the sub-grade below berm levels. Remove rock which remains in position on berms after blasting by method other than blasting.

TRIAL BLASTS

EAR2.W410.9 REASON FOR TRIAL BLASTS

Carry out trial blasts to demonstrate that:

1. The procedure is safe;
2. The resulting ground vibrations at locations stated in the Contract or instructed by the CM can be satisfactorily predicted, recorded and are within acceptable limits, do not adversely affect the safety and stability of adjoining structures, installations, slopes and land.

EAR2.W420.9 PARTICULARS OF TRIAL BLASTING

Submit to the CM details of blasting trials in accordance with EAR2.W040 at least 14 days in advance of blasting.

EAR2.W430.9 PRE-SPLIT BLASTING TRIALS

Carry out the blasting trials for pre-splitting and other methods of controlled blasting to form a face at least 6 m wide by 6 m high, on rock which has similar properties to that of the earthwork final surface and which is at least 6 m away from the earthwork final surface.

EAR2.W440.9 RESULTS OF BLAST TRIALS

If in the opinion of the CM any aspect of the proposed blasting procedures as demonstrated by blasting trials is unsatisfactory, submit details of proposed changes in the procedure to the CM. Carry out further blasting trials until the procedure is satisfactory.

EAR2.W450.9 CHANGES IN PROCEDURE

Do not vary the satisfactorily Approved blasting procedure. Demonstrate any proposed changes in procedure by further blast trials, unless otherwise permitted by the CM.

EAR2.W460.9 COMPLETION OF TRIAL BLASTS

1. Complete all trials at least 7 days before the related blasting is due to start;
2. Carry out blasting trials in accordance with the trial procedure submitted to and agreed by the CM. The location and size of blasting trials shall be as agreed by the CM.

EAR2.W470.9 COMMENCEMENT OF BLASTING

Do not proceed with blasting until in the opinion of the CM the procedure as demonstrated by the relevant blasting trials is satisfactory.

TOLERANCES

EAR2.W510.9 GENERAL

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

STR STRUCTURAL STEELWORK

STR1 STRUCTURAL STEEL 6

GENERAL 6

STANDARDS 6

STR1.G010.9 CODE OF PRACTICE AND STANDARDS 6
STR1.G020.9 STATUS OF THE SPECIFICATION 6
STR1.G030.9 RESPONSIBLE ENGINEER 6
STR1.G040.9 MINOR STEEL STRUCTURES 6

DESIGN 7

GENERAL 7

STR1.D010.9 STRUCTURAL STEEL DESIGN 7
STR1.D020.9 DESIGN STANDARDS 7
STR1.D030.A WIND LOADING 7
STR1.D040.9 SEISMIC LOADING 7
STR1.D050.9 ALTERNATIVE DESIGN 7
STR1.D060.9 DESIGN SUBMISSION FOR MINOR STEEL STRUCTURE 7

FABRICATION AND ERECTION DOCUMENTS 7

STR1.D110.9 FABRICATION DOCUMENTS 7
STR1.D120.9 ERECTION DOCUMENTS 8
STR1.D150.9 WELDING SYMBOLS 8
STR1.D160.9 DRAWINGS RESPONSIBILITY 8
STR1.D170.9 RECORD DRAWINGS 8

DESIGN OF SPACE FRAMES 8

STR1.D210.9 GENERAL 8
STR1.D220.9 DESIGN RESPONSIBILITY 8
STR1.D230.9 SCOPE OF WORKS 8
STR1.D240.9 DESCRIPTION OF WORKS 9
STR1.D250.9 SPACE FRAME SYSTEM 9
STR1.D260.9 TENDER INFORMATION 9
STR1.D270.9 DESIGN 9
STR1.D280.9 ERECTION INFORMATION 9

MATERIALS FOR AND FABRICATION OF SPACE FRAMES 10

STR1.D310.9 MATERIALS STANDARDS 10
STR1.D320.9 ROOF FALLS 10
STR1.D330.9 SIZE OF MEMBERS 10
STR1.D340.9 FABRICATION 10
STR1.D350.9 CUTTING AND FITTING 10
STR1.D360.9 FASTENERS 10
STR1.D370.9 LIGHT FITTINGS 11
STR1.D380.9 ACCESS CATWALKS 11
STR1.D390.9 SECURITY GATE 11
STR1.D400.9 ELECTRICAL CONNECTIONS 11

TREATMENTS AND FINISHES TO SPACE FRAMES 11

STR1.D510.9 ELECTROPLATING 11
STR1.D520.9 HOT DIP GALVANIZING 11
STR1.D530.9 POWDER COATINGS 11

ERECTION OF SPACE FRAMES 11

STR1.D610.9 ERECTION SUBMISSION 11
STR1.D620.9 TEMPORARY SUPPORTS 12
STR1.D630.9 FIXINGS 12
STR1.D640.9 PROTECTION 12
STR1.D650.9 CONTRACTOR'S SUPERVISION 12

DESIGN OF PEDESTRIAN FOOTBRIDGES 12
STR1.D710.9 GENERAL 12
STR1.D720.9 DRAWINGS AND DETAILS 12
STR1.D730.9 FABRICATION APPROVALS 12
STR1.D740.9 APPROVED FIRMS 12
STR1.D750.9 ERECTION APPROVALS 13
STR1.D760.A ERECTION PROPOSALS 13
STR1.D770.9 ERECTION PROCEDURE 13
STR1.D780.9 BRIDGE BEARINGS 14

MATERIALS 15
GENERAL 15
STR1.M020.9 MATERIALS AND WORKMANSHIP 15
STR1.M030.9 APPROVALS 15
STR1.M040.9 SAFETY 15
STR1.M050.9 METHOD OF MANUFACTURE 15
STR1.M060.9 STEEL GRADES 15
STR1.M070.9 HOT ROLLED SECTIONS 15
STR1.M080.9 COLD ROLLED SECTIONS 16
STR1.M090.9 COLD ROLLED HOLLOW SECTIONS 16
STR1.M100.9 PLATES, FLATS AND BARS 16
STR1.M110.9 SURFACE QUALITY 16
STR1.M120.9 SURFACE DEFECTS AND REPAIR 16
STR1.M130.9 SURFACE RUSTING 16
STR1.M140.9 MAXIMUM CARBON EQUIVALENT 16
STR1.M150.9 MARKING STEELWORK 17
STR1.M160.9 NON-AVAILABLE MATERIALS 17
STR1.M170.9 MANUFACTURERS CERTIFICATES 17
STR1.M180.9 CLASS OF STEEL 17
BOLTS, ACCESSORIES, CONNECTIONS AND FITTINGS 17
STR1.M210.9 STEEL GRADE FOR CONNECTIONS AND FITTINGS 17
STR1.M220.9 HIGH STRENGTH BOLTS AND NUTS 17
STR1.M230.9 BS 4190 HOLDING DOWN BOLTS AND NUTS 18
STR1.M240.9 BS 3692 HOLDING DOWN BOLTS AND NUTS 18
STR1.M250.9 BLACK BOLTS AND NUTS 18
STR1.M260.9 DRIVE SCREWS 18
STR1.M270.9 PLAIN WASHERS FOR BLACK BOLTS 18
STR1.M280.9 SPRING WASHERS FOR BLACK BOLTS 18
STR1.M290.9 TAPERED WASHERS 18
STR1.M300.9 BOLT LENGTHS 18
STR1.M310.9 HIGH STRENGTH FRICTION GRIP BOLTS 18
STR1.M320.9 RIVETS 18
STR1.M330.9 TURNBUCKLES OR SIMILAR 18
STR1.M340.9 MARKING BOLTS AND ACCESSORIES 19
WELDING CONSUMABLES 19
STR1.M410.9 QUALITY OF ELECTRODES, RODS AND WIRES 19
STR1.M420.9 CONSUMABLES FOR WELDING STEELS TO BS EN 10025 19
STR1.M430.9 ELECTRODES FOR WELDING GRADE S355 AND S450 STEELS 19
STR1.M440.9 COVERED ELECTRODES FOR MANUAL METAL ARC WELDING 19
STR1.M450.9 FILLER WIRES FOR GAS-SHIELDED WELDING 19
STR1.M460.9 CORED ELECTRODES 19
STR1.M470.9 FILLER WIRES AND FLUXES FOR SUBMERGED ARC WELDING 19
STR1.M480.9 CONTINUOUS COVERED ELECTRODES 19
STR1.M490.9 MANUFACTURER'S TEST CERTIFICATES 19

STR1.M500.9 STORAGE OF ELECTRODES 19

WORKMANSHIP 20

TRANSPORTATION AND STORAGE 20

STR1.W010.9 GENERAL 20
STR1.W020.9 HANDLING 20
STR1.W030.9 SPECIAL HANDLING 20
STR1.W040.9 BOLTS, NUTS, WASHERS, AND SCREWS 20
STR1.W050.9 EXPOSURE TO POLLUTANTS 20
STR1.W060.9 ROAD TRANSPORT 21
STR1.W070.9 SEA TRANSPORT 21
STR1.W080.9 REPAIR OF DAMAGE INCURRED IN TRANSPORT 21

FABRICATION 21

STR1.W110.9 ACCESS 21
STR1.W120.9 GEOMETRIC FORM 21
STR1.W130.9 IDENTIFICATION 22
STR1.W140.9 SURFACE PREPARATION 22
STR1.W150.9 POST CLEANING 22
STR1.W160.9 EXECUTION 22
STR1.W170.9 SETTING OUT 22
STR1.W180.9 TEMPORARY ATTACHMENTS 22
STR1.W190.9 END PLATES 22
STR1.W200.9 JIGS 23
STR1.W210.9 MEASUREMENT AND SETTING OUT MARKS 23
STR1.W220.9 CONTINUOUS STRUCTURES 23
STR1.W230.9 STRAIGHTENING BENDING AND CAMBERING OF STEEL SECTIONS 23
STR1.W240.9 POST FABRICATION MAKING GOOD 23
STR1.W250.9 CUTTING STEEL 23
STR1.W260.9 CUT EDGES 23
STR1.W270.9 MACHINING GENERALLY 23
STR1.W280.9 FLAME CUTTING 24
STR1.W290.9 FORMING HOLES FOR BOLTS AND RIVETS 24
STR1.W300.9 BUILT-UP SECTIONS 24
STR1.W310.9 REMOVING BURRS 25
STR1.W320.9 HOLES FOR BLACK BOLTS 25
STR1.W330.9 HOLES FOR HIGH STRENGTH FRICTION GRIP BOLTS 25
STR1.W340.9 FITTED BOLTS, PINS OR RIVETS 25
STR1.W350.9 SLOTTED HOLES 25
STR1.W360.9 PREVENT MOISTURE INGRESS 25

MECHANICAL JOINTING 26

STR1.W410.9 SURFACE PREPARATION 26
STR1.W420.9 USE OF HIGH STRENGTH FRICTION GRIP BOLTS 26
STR1.W430.9 WRENCH CALIBRATION 26
STR1.W440.9 CALIBRATION OF BOLT LOAD METER 26
STR1.W450.9 BLACK OR PRECISION BOLTED CONNECTIONS 27
STR1.W460.9 ALIGNMENT, TEMPORARY CONNECTIONS AND PERMANENT FIXINGS 27
STR1.W470.9 BOLTED CONNECTIONS WITH PROVISION FOR SLIDING 27

WELDING 27

STR1.W510.9 GENERAL 27
STR1.W520.9 USE OF WELDING EQUIPMENT AND ACCESSORIES 27
STR1.W530.9 PREPARATION FOR WELDING 28
STR1.W540.9 ADDITIONAL REQUIREMENTS FOR SITE WELDING 28

STR1.W550.9 METHOD OF WELDING....28
STR1.W560.9 REMOVAL OF SLAG....29
STR1.W570.9 TACK WELDS....29
STR1.W580.9 WELD DEFECTS....29
STR1.W590.9 FILLET WELDS....29
STR1.W600.9 BUTT WELDS....29
STR1.W610.9 STUD SHEAR CONNECTORS....29

ERECTION OF STEELWORK....29
STR1.W710.9 ERECTION....29
STR1.W720.9 ERECTORS....30
STR1.W730.9 SAFETY....30
STR1.W740.9 STABILITY....30
STR1.W750.9 SEQUENCE OF OPERATIONS....30
STR1.W760.9 PLANT AND EQUIPMENT....30
STR1.W770.9 PREVENTION OF DISTORTION....30
STR1.W780.9 APPROVED SEQUENCE....30
STR1.W790.A FALSEWORK....30
STR1.W800.9 SETTING OUT, LEVELLING AND LOCATION....31
STR1.W810.9 ERECTION OF STEELWORK....31
STR1.W820.9 STEELWORK BY SUB-CONTRACTOR....31

CLEANING, SURFACE PREPARATION AND PROTECTION (POST FABRICATION) ..31
STR1.W910.9 CLEANING AND COATING IN THE SUPPLIERS WORKSHOP....31
STR1.W920.9 CLEANING SURFACES OF BARE METAL....32
STR1.W930.9 CONTAMINATED SURFACES....32
STR1.W940.9 PAINTED AND OTHER COATED SURFACES....32
STR1.W950.9 ATMOSPHERIC CORROSION....32
STR1.W960.9 BLAST CLEANING....32
STR1.W970.9 MECHANICAL CLEANING....33
STR1.W980.9 PICKLING....33
STR1.W990.9 FLAME CLEANING....33
STR1.W1000.9 NEW GALVANIZED SURFACES....33
STR1.W1010.9 PREVIOUSLY PAINTED GALVANIZED SURFACES....33
STR1.W1020.9 CLEANED OR COATED MEMBERS....33

APPLICATION OF METAL COATINGS....34
STR1.W1110.9 HOT DIP GALVANIZING....34
STR1.W1120.9 SPRAYED METAL COATING....34
STR1.W1130.9 ELECTROPLATING....34
STR1.W1140.9 CHROMIUM PLATING....34
STR1.W1150.9 METAL COATING ON PART ONLY OF ASSEMBLED SECTION....34
STR1.W1160.9 PROTECTION OF HSFG BOLTED JOINTS....35
STR1.W1170.9 PROTECTION OF OTHER BOLTED JOINTS....35
STR1.W1180.9 PROTECTION OF NON-BOLTED JOINTS....35
STR1.W1190.9 SURFACES ADJACENT TO TREATED JOINTS....35
STR1.W1200.9 PAINTING AND SEALING OF JOINTS....35
STR1.W1210.9 APPLICATION OF PAINT....36
STR1.W1220.9 PAINTING STEELWORK....36
STR1.W1230.9 PAINT FOR STEELWORK PROTECTION SYSTEMS....37

ACCURACY AND TOLERANCES....37
STR1.W1310.9 GENERAL....37

OFF-SITE FABRICATION....38
STR1.W1410.A SUBMISSIONS....38
STR1.W1415.9 SUBMISSIONS FOR MINOR STEEL STRUCTURES FABRICATED OFF-SITE....38

STR1.W1420.A QUALITY ASSURANCE (QA) SCHEME....38
STR1.W1430.9 REGISTERED STRUCTURAL ENGINEER....39
STR1.W1440.N QUALIFIED SUPERVISION....39

TESTING....40

GENERAL REQUIREMENTS....40

STR1.T010.9 GENERAL....40
STR1.T020.9 TESTING BY MANUFACTURER....40
STR1.T030.9 TESTING OF BOLTS, NUTS AND WASHERS....40
STR1.T040.9 TEST CERTIFICATES....40
STR1.T050.9 TESTING OF SECTIONS....40
STR1.T060.9 FAILURE OF TESTS....40
STR1.T070.9 ULTRASONIC TESTING....41
STR1.T080.9 ABILITY OF WELDERS....41
STR1.T090.9 PARTICULARS OF INSPECTING AUTHORITY....41
STR1.T093.9 BATCH OF WELDING CONSUMABLE....41
STR1.T094.9 TESTING OF WELDING CONSUMABLES....42
STR1.T095.9 ACCEPTANCE CRITERIA - WELDING CONSUMABLES....42
STR1.T096.9 FAILURE OF TESTS....42
STR1.T097.9 STANDARD FOR REJECTION....43
STR1.T100.9 STANDARD OF WELD PROCEDURE TESTING....43
STR1.T110.9 ADDITIONAL DESTRUCTIVE WELD TESTS AS SELECTED BY THE CM....43
STR1.T120.A ADDITIONAL NON-DESTRUCTIVE TESTING OF STEEL, STAINLESS STEEL AND ALUMINIUM....43
STR1.T130.9 ACCEPTANCE CRITERIA....44
STR1.T140.9 WELD REPAIR....44
STR1.T150.9 ENGAGEMENT OF SPECIALIST TESTING CONTRACTOR (FOR FABRICATION ON SITE)....44

TESTING OF PAINTS....44

STR1.T210.9 SAMPLING AND TESTING....44
STR1.T220.9 PAINT SAMPLES....44
STR1.T230.9 TESTING PAINTS....45
STR1.T240.9 TESTING LABORATORY....45
STR1.T250.9 GLOSS FINISH....45

SPACE FRAMES - WARRANTIES AND TESTING....45

STR1.T310.9 SUITABILITY WARRANTY....45
STR1.T340.9 TESTING OF SECTIONS....45
STR1.T350.9 WELDING TESTS....45
STR1.T360.9 PROOF LOAD TESTING....46
STR1.T370.9 NODAL JOINTS OF SPACE FRAMES....46
STR1.T380.9 ACCEPTANCE CRITERIA FOR NODAL JOINT TESTS....46
STR1.T390.9 FAILURE AND RE-TESTING OF NODAL JOINTS....46
STR1.T400.9 LOADING TESTS....47

OFF-SITE FABRICATION....47

STR1.T510.9 TESTING AND SURVEILLANCE VISITS AT FABRICATION YARD....47
STR1.T520.9 ENGAGEMENT OF SPECIALIST TESTING CONTRACTOR (FOR OFF-SITE FABRICATION)....47

APPENDIX STR1/I....48

STR1.APPEND1.9 CALCULATION OF NUMBER OF FURTHER INSPECTIONS / TESTS....48

STR1 STRUCTURAL STEEL

GENERAL

STANDARDS

STR1.G010.9 CODE OF PRACTICE AND STANDARDS

1. Comply with the Code of Practice for the Structural Use of Steel 2011 issued by the Buildings Department;
2. Unless otherwise approved, comply with the British Standards stated in this Specification. Where the Contractor proposes to substitute any other standard or code of practice either in its entirety or in part, for any of those specified, submit details of such together with two complete copies for Approval. Generally, Approval will only be given where the CM considers the proposals to give at least an equivalent standard of the finished work;
3. In the case of any conflict, ambiguity or contradiction between the Code of Practice for the Structural Use of Steel 2011 and the British Standards or other Approved Standards, unless expressly stated otherwise in this Specification, the conditions of the Code of Practice for the Structural Use of Steel 2011 shall prevail.

STR1.G020.9 STATUS OF THE SPECIFICATION

Where this Specification includes provisions additional to, or more stringent than those of the aforementioned Code of Practice for the Structural Use of Steel 2011 and the British Standards, the provisions of this Specification shall prevail overall.

STR1.G030.9 RESPONSIBLE ENGINEER

Employ a Registered Structural Engineer as specified in PRE.B6.060 to take up the role of Responsible Engineer stated in the Code of Practice for the Structural Use of Steel 2011. The Responsible Engineer shall take responsibility for the design, erection and construction of all permanent and/or temporary works and falsework for the construction of major structural steelwork. No consent or dissent of the CM will relieve the Contractor of his sole responsibility for the design, construction and obtaining Approval.

STR1.G040.9 MINOR STEEL STRUCTURES

1. The list of minor steel structures is given in the Project Specific Specification;
2. Specification clauses not applicable to the minor steel structures are listed in the Project Specific Specification.

DESIGN

GENERAL

STR1.D010.9 STRUCTURAL STEEL DESIGN

Comply with the information given on the Drawings and the following information. In general member sizes on the Drawings will be given as serial sizes and loads will be indicated under dead and superimposed live loads only. Wind loading, seismic loading and thermal loading will not generally be shown.

STR1.D020.9 DESIGN STANDARDS

Ensure compliance of the design with the requirements of Code of Practice for the Structural Use of Steel 2011 for all building works. For steel bridges the design must also comply with BS 5400 and the Structure Design Manual for Highways and Railways issued by the Highways Department.

STR1.D030.A WIND LOADING

Calculate the wind loads in accordance with the Code of Practice on Wind Effects in Hong Kong 2019 issued by the Buildings Department.

STR1.D040.9 SEISMIC LOADING

Ensure that seismic loading, (where this needs to be considered) is in compliance with the appropriate national standard for the design of structures in relation to earthquakes.

STR1.D050.9 ALTERNATIVE DESIGN

Loading tests in accordance with Chapter 16 of the Code of Practice for the Structural Use of Steel 2011 may be used to verify alternative design or construction that is not entirely in accordance with the design requirements of the same Code.

STR1.D060.9 DESIGN SUBMISSION FOR MINOR STEEL STRUCTURE

1. Notwithstanding the submission requirements stated in PRE.B6.085, submit for CM's approval calculation and drawings, which have been certified by a Registered Structural Engineer, to demonstrate that the design of minor steel structure, including the details of the materials of the structure, shown on the manufacturer's drawings, manuals or catalogues complied with the Specification and the Code of Practice for Structural Use of Steel 2011;
2. Agree with CM the programme for submission.

FABRICATION AND ERECTION DOCUMENTS

STR1.D110.9 FABRICATION DOCUMENTS

1. Prepare and submit to the CM at least six weeks before starting fabrication, complete details of fabrication to include the following:
    a. All connections including relevant calculations;
    b. Methods of fabrication;
    c. Welding process and procedure, see STR1.T090 and STR1.T100;

d. Temporary guys and bracing for use during the erection;

e. Details of holding down bolts and fittings to be built into the concrete or masonry.

2. Do not commence fabrication or deviate from the Drawings prior to receiving Approval.

STR1.D120.9 ERECTION DOCUMENTS

1. Prepare and submit to the CM at least six weeks before starting to erect steelwork, details of the following:

   a. Method of erection;

   b. Type of craneage;

   c. Calculations of erection stresses;

   d. Temporary guys and bracing for use during the erection.

2. Do not commence erection or deviate from the Drawings prior to receiving Approval.

STR1.D150.9 WELDING SYMBOLS

Show welding on the drawings using welding symbols to the Code of Practice for the Structural Use of Steel 2011.

STR1.D160.9 DRAWINGS RESPONSIBILITY

Accept responsibility for any errors in fabrication drawings subsequently found whether or not Approval to the drawings has been obtained.

STR1.D170.9 RECORD DRAWINGS

On completion of the erection, revise or redraw fabrication drawings to show any agreed modifications made during the course of the Contract. Submit one copy negative or velograph of each drawing to the CM for record purposes.

DESIGN OF SPACE FRAMES

STR1.D210.9 GENERAL

This Specification and the Drawings show the works for the purpose of defining the design intent and performance requirements. Details show the preferred arrangements to other building elements and do not provide solutions to structural and thermal movements, fixings and anchorages etc.

STR1.D220.9 DESIGN RESPONSIBILITY

Accept responsibility for the complete suitability of the design. Approval to the design does not relieve the Contractor from this responsibility.

STR1.D230.9 SCOPE OF WORKS

The space frame works comprise the design, supply and erection of the whole of the space frame structure in accordance with this Specification including delivery to the site, all testing as required by this Specification, assembling, erecting in position and painting.

STR1.D240.9 DESCRIPTION OF WORKS

Design the space structure with dimensions as indicated in the Project Specific Specification. General Layout, structural supports and all other relevant information pertaining to the space frame are depicted in Project Specific Specification.

STR1.D250.9 SPACE FRAME SYSTEM

1. Propose a specialist supplier/contractor on the Hong Kong Special Administrative Region Development Bureau's 'List of Approved Suppliers of Materials and Specialist Contractors for Public Works' in the category of Space Frame System for the CM's approval and obtain the space frame from the Approved specialist supplier/contractor;
2. Design the space frame which shall be a proprietary system complying with the details as specified in the Project Specific Specification.

STR1.D260.9 TENDER INFORMATION

Provide the following information with return of Tender:

1. The manufacturer's certificate of origin, certificates of chemical composition and physical tests;
2. A complete design calculation of the space frame structure certified by a Registered Structural Engineer;
3. The approximate total weight, loads on each supports, anchorages/anchor bolts required for the fixing of the space frame structure;
4. Method of erection.

STR1.D270.9 DESIGN

Design proprietary space frame system:

1. To comply with the Code of Practice for the Structural Use of Steel 2011 for steel or BS 8118 for aluminium, as appropriate;
2. To be capable of withstanding thermal movement and induced stresses under a temperature variation ranging from 0ºC to 40ºC and other loads as shown on Drawings.

STR1.D280.9 ERECTION INFORMATION

1. Submit for the CM's consent at least one month before the proposed erection of the space frame:
    a. Organization chart and details of the erection supervisory staff;
    b. Detail programme for erection;
    c. Method and procedure of erection with the system employed complete with sketches, drawings, or photographs;
    d. Details including capacities of all lifting equipment to be used;
    e. A quality control & assurance system for the verification of the compliance of specification in all materials and workmanship;
    f. A copy of full set of design calculations including those for the erection stage, certified by the Responsible Engineer;
    g. Four copies of a full set of shop drawings of the space frame structure and the supporting parts complete with bearings, required for the proper execution of works, certified by the same Responsible Engineer; and

h. Manufacturer's certificates of origin and chemical composition of, and certificates of results of physical tests for, structural elements showing compliance with the specification.

2. The CM undertakes to reply to the Contractor's submissions and re-submissions within 42 days.

MATERIALS FOR AND FABRICATION OF SPACE FRAMES

STR1.D310.9 MATERIALS STANDARDS

Design with materials of standard hollow section complying with Code of Practice for the Structural Use of Steel 2011 for steel, and BS 1471:1972 or BS EN 755 part 1-2:1997, Part 3-6:1996, part 7-8:1998, Part 9:2001 as appropriate for aluminium. Use members of circular section connected by spherical nodes of the same material. Make the configuration of the nodes such that all resultant forces from members coincide with the centroid of nodes. Where a proprietary space frame is proposed based on other recognized international standards, submit the relevant material specification for Approval.

STR1.D320.9 ROOF FALLS

Design the finished roof with a minimum fall as specified in the Project Specific Specification. Fall to be effected by the space frame structure and/or the purlin systems, after being loaded with all roofing materials.

STR1.D330.9 SIZE OF MEMBERS

Give consideration to providing an aesthetic proportion and balance between members when selecting member sizes.

STR1.D340.9 FABRICATION

Ensure all members are free from twist, true to profile and dead straight or truly curved as shown on the Drawings. Materials damaged whilst being straightened or curved to be rectified or rejected as the CM directs.

STR1.D350.9 CUTTING AND FITTING

Cut to exact lengths the ends of members and other parts abutting against or upon other parts, true and square, so as to provide a good bed or joints as the case may be. Proper cover plates must be provided where necessary.

STR1.D360.9 FASTENERS

1. Provide and fit all bolts with washers, splayed if necessary, to give a level and even bearing on the nuts;
2. Washers to be minimum of 2.4 mm thick;
3. When required by the CM, provide tapered washers for connections with a difference in slope of 3 degrees or greater. Tapered washers are to be used with bolts through flanges. As far as possible, fix the bolt heads to the upper side of the connections.

STR1.D370.9 LIGHT FITTINGS

Provide supports for all light fittings and as shown on drawings and as specified in the Project Specific Specification. Derive support from nodal joints and not from chords, unless otherwise Approved.

STR1.D380.9 ACCESS CATWALKS

Provide internal catwalks together with catladders to the layout shown on the Drawings. Number of catladders required are as specified in the Project Specific Specification. Design catwalks to fit within the depth of the space frame structure and be minimum 600 mm wide unless otherwise stated. Catwalks to be maximum 400 mm from each light fitting. The position of each light fitting may be adjusted from the position shown on the Drawings by up to maximum of 200 mm in any direction to accommodate the design and construction method of the space frame structure and the catwalks.

STR1.D390.9 SECURITY GATE

Allow for provision of a 600 mm wide hinged, opening inward, lockable gate at location as shown on Drawings and specified in the Project Specific Specification.

STR1.D400.9 ELECTRICAL CONNECTIONS

Allow for provision of screw holes or other suitable connection points for the purpose of connection, by the Nominated Sub-contractor for electrical installation and of equipotential bonding conductors as required by the IEE Wiring Regulations.

TREATMENTS AND FINISHES TO SPACE FRAMES

STR1.D510.9 ELECTROPLATING

Electroplate spherical nodes with zinc layer 25 microns minimum.

STR1.D520.9 HOT DIP GALVANIZING

Hot dip galvanize all other components (both inside and outside of tube members) to BS EN ISO 1461:2009 with minimum mean coating thickness of 45 microns to 85 microns depending on thickness of tube walls as stipulated in Table 3 of BS EN ISO 1461:2009, unless otherwise specified.

STR1.D530.9 POWDER COATINGS

Apply finishing coat to space frame members of factory applied polyester powder. Coat of minimum dry film thickness of 80 microns. Colour to be selected from Standard colour chart.

ERECTION OF SPACE FRAMES

STR1.D610.9 ERECTION SUBMISSION

Submit for the CM's consent the proposed method and procedure of erection of the space frame prior to installation. Ensure compatibility with the requirements of the proposed construction programme and the site conditions. Demonstrate to the satisfaction of the CM that the effects of the forces and stresses imposed in the structure during erection of the space frame shall not exceed the originally allowed for in the design of the structure.

STR1.D620.9 TEMPORARY SUPPORTS

Allow for the provision and the CM's consent of all necessary temporary bracing and supports prior to final fixing.

STR1.D630.9 FIXINGS

Provide installation details of all anchorages/anchor bolts, that must avoid conflicting with the reinforcement of supporting elements.

STR1.D640.9 PROTECTION

Allow for taking necessary precautions to prevent damage to the existing structure and finishes thereof if applicable, during erection. Protect floors when cranes or other plant are to be used internally for erection.

STR1.D650.9 CONTRACTOR'S SUPERVISION

Provide a suitable experienced engineer full time on Site to supervise the erection of the space frame structure until physical completion of the works. The engineer must have previous experience in space frame construction. Submit for Approval the name and qualifications of the engineer who may be the employee of the Specialist Sub-contractor.

DESIGN OF PEDESTRIAN FOOTBRIDGES

STR1.D710.9 GENERAL

Design steel footbridges using structural steelwork to Code of Practice for the Structural Use of Steel 2011, BS 5400 and the Structure Design Manual for Highways and Railways issued by the Highways Department unless otherwise particularly specified.

STR1.D720.9 DRAWINGS AND DETAILS

Submit to the CM, at least 42 days before fabrication, two copies of all detailed working drawings and calculations for the erection and for temporary works and, where applicable, the following information:

1. Specification of materials used in the temporary works;
2. Locations, sizes, lengths and form of joint, angle between fusion faces, gap between parts of all welds. Symbols conforming to Code of Practice for the Structural Use of Steel 2011 should be used for standard weld forms, but full details must be given of any non-standard welds;
3. Where welds are to be made in the shop or elsewhere;
4. Details of stress relieving;
5. Details of testing and inspection methods.

STR1.D730.9 FABRICATION APPROVALS

Do not commence fabrication until Approval to the proposals has been received. Such Approval does not relieve the Contractor of any obligation under the Contract.

STR1.D740.9 APPROVED FIRMS

1. Select a specialist contractor from the Development Bureau's "List of Approved Suppliers of Materials and Specialist Contractors for Public Works" in the category of Structural Steelwork for CM's approval;

2. Employ the Approved specialist contractor and accept all normal obligations under the Contract including responsibility for works carried out by the specialist contractor.

STR1.D750.9 ERECTION APPROVALS

Before commencing erection of footbridges:

1. Obtain approvals from Highways Department, Commissioner of Police, and Commissioner for Transport for proposed method of erection of footbridges;
2. Comply with all requirements of the Highways Department and the Commissioners at Contractor's own expense and without any claim for extension of time.

STR1.D760.A ERECTION PROPOSALS

1. Prepare and submit the erection proposal at an appropriate time having regard to the programme of work and the time taken for checking by the CM, obtaining replies and approvals from the Highways Department and the Commissioners, and making any necessary amendments as required by the Highways Department, the Commissioners and the CM. Details of the erection proposal submitted must include:
   a. A method statement including the type of plant and equipment to be used;
   b. Drawings and calculations of any proposed temporary falsework system;
   c. All drawings properly numbered, fully detailed and dimensioned. All calculations and drawings submitted certified and signed by a Registered Structural Engineer, stating that the design is adequately safe;
   d. Refer to PRE.B10.010 sub-clause (8) for the certification requirement of RSE.
2. Amend details as necessary to meet the CM's requirements and then submit through the Authority, to the aforesaid authorities for obtaining their approvals;
3. The giving of consent by the CM to the proposal does not relieve the Contractor of any of his duties or responsibilities under the Contract including his responsibility to obtain the necessary approvals from the aforesaid authorities. Allow a minimum of four weeks for comments from various Government departments on the erection proposal.

STR1.D770.9 ERECTION PROCEDURE

1. Ensure that all falsework used does not interfere with normal traffic flow, and not reduce the width of the traffic lanes. Comply with the minimum clearance restriction imposed by relevant authorities for falsework spanning across carriageways and footways;
2. Assemble, fit and temporarily bolt or tack weld members to Approval prior to final riveting or welding;
3. Submit records of inspection of the completed formwork and falsework to the CM for information before carrying out any further works that may affect the stability of the formwork and falsework. Such records are to be certified by a contractor's superintendent holding qualification equivalent to TCP Grade T4 in civil or structural engineering discipline;
4. Monitor falsework levels and make any necessary adjustments for settlement, or other deflection or movements.

STR1.D780.9 BRIDGE BEARINGS

1. Prepare bearing surfaces for bridge bearings by removing all oil and grease by use of a suitable solvent all mill scale, rust and dirt removed by shot blasting;
2. Protect the proposed surface by covering with tape or similar material. The surfaces must not be primed or painted at any time prior to application of the bonding agent.

MATERIALS

GENERAL

STR1.M020.9 MATERIALS AND WORKMANSHIP

Ensure that all structural steelwork is in accordance with the Code of Practice for the Structural Use of Steel 2011 for building and general work and in accordance with BS 5400 and the Structure Design Manual for Highways and Railways issued by the Highways Department for bridge works except where specified otherwise.

STR1.M030.9 APPROVALS

Prior to commencing construction, submit for Approval any details required of the welding plant, techniques and procedures, jigs, workshop facilities and construction devices e.g. cranes, scaffolding etc, which the Contractor proposes using for the fabrication and erection of the steelwork. The information must be in sufficient detail to enable the CM to approve or otherwise.

STR1.M040.9 SAFETY

Comply with safety recommendation contained in BS EN 1011-1:2009 and with the Factories and Industrial Undertakings Ordinance throughout the fabrication, transport, handling and erection of structural steelwork.

STR1.M050.9 METHOD OF MANUFACTURE

Do not use the following method of steel manufacture:

1. Steel made by the Bessemer process;
2. Rimming steel.

STR1.M060.9 STEEL GRADES

Structural steelwork to comprise weldable structural steel in accordance with the following standards as appropriate:

1. Hot rolled sections (excluding hollow sections) and plates:

   BS EN 10025 Part 1-6:2004 Grade S275, S275JR, S355JR, S355J0, S450J0;

2. Hot finished hollow sections:

   BS EN 10210-1:2006, Grade S275J0H, S355J0H, S450J0;

3. Cold formed hollow sections:

   BS EN 10219-1:2006: Grade S275J0H, S355J0H;

4. Cold rolled galvanized sections:

   either BS 2989:1992 Grade Z35, coating type G600, surface finish N, or Hot dipped coated steel sheets to BS EN 10147:1992 Grade FE E3509, coating type G600, surface finish N.

STR1.M070.9 HOT ROLLED SECTIONS

Dimensions, mass, tolerances and rolling margins for:

1. Universal beams, columns, joists, tees and channels to BS 4:Part 1:2005;

2. Hollow sections to BS EN 10210-2:2006;
3. Angles to BS EN 10056-1:1999 and BS EN 10056-2:1993.

STR1.M080.9 COLD ROLLED SECTIONS

1. Dimension, mass and tolerances of cold rolled sections to BS 2994:1976 (1987);
2. Do not use cold rolled sections without Approval.

STR1.M090.9 COLD ROLLED HOLLOW SECTIONS

1. Dimension, mass and tolerances of cold rolled hollow sections to BS EN 10219-2:2006;
2. Do not use as substitute for hot finished hollow sections.

STR1.M100.9 PLATES, FLATS AND BARS

1. Comply with the standards as follows:
   a. For plates dimensions and mass tolerances to BS EN 10029:2010;
   b. For wide flats dimensions and mass tolerances to Euronorm 91 Class II thicknesses tolerances;
   c. For bars dimensions and mass tolerances to Euronorm 59 - Square bars, Euronorm 60 - Round bars, Euronorm 61 - Hexagonal bars.
2. Ensure tolerances on thickness are wholly over that shown on the drawings unless otherwise specified.

STR1.M110.9 SURFACE QUALITY

Surface quality of steel to be in accordance with the following:

1. Sections: BS EN 10163 Part 3:2004 Class C;
2. Plates and wide flats: BS EN 10163 Part 2:2004 Class A.

STR1.M120.9 SURFACE DEFECTS AND REPAIR

1. Steel with surface defects within the limits of the following may be repaired and used:
   a. Sections: BS EN 10163 Part 3:2004 Class C;
   b. Plates and wide flats: BS EN 10163 Part 2:2004 Class A.
2. Obtain Approval to carry out surface defect repairs by welding.

STR1.M130.9 SURFACE RUSTING

Use only steel with Grade A, B or C surface rusting in accordance with BS 7079: Part A1:1989 (1994).

STR1.M140.9 MAXIMUM CARBON EQUIVALENT

Steel used in built-up welded assemblies or at welded connections must have a carbon equivalent value not exceeding that appropriate to the grade of steel given in Annex D1.1 of the Code of Practice for the Structural Use of Steel 2011 where this may be required for the avoidance of hydrogen cracking in welds unless the Contractor's proposed welding procedures are such to make this requirement unnecessary.

STR1.M150.9 MARKING STEELWORK

Clearly mark all steelwork for identification and erection purposes as follows:

1. Identification: ensure that all steel elements are identified in accordance with BS EN 10025:2004, indicating grade, cast number and manufacturer's identification mark. Where indicated on the Drawings as being unmarked, tag steelwork and leave free of all other marking or hard stamping;
2. Grade S355 and S450 steel: in addition to marking in accordance with BS EN 10025:2004 mark steel with a continuous pale blue water paint line. Mark immediately, with light blue water painting any part cut from S355 and S450 steel which does not have a light blue marking;
3. Cold work steel: mark cold worked areas of member with orange water paint;
4. Marking for erection purposes: tag, hard stamp or pencil weld each member with an individual identification mark, which can not be obliterated by surface coatings. Prepare a marking drawing identifying markings and indicating position of member in structure;
5. Permanent identification: supply and fix to structure after erection, a brass identification plate. Plate to indicate with lettering not less than 15 mm high, etched or punched to a depth not less than 1.5 mm, the following:
    a. Steelwork Contractor's name;
    b. Grade of steel in structure;
    c. Date of fabrication.

STR1.M160.9 NON-AVAILABLE MATERIALS

Obtain Approval for any equivalent alternative required when the specified material is not available.

STR1.M170.9 MANUFACTURERS CERTIFICATES

Provide the manufacturer's certificates for all steel sections, rivets, bolts, screws, nuts and washers delivered to Site.

STR1.M180.9 CLASS OF STEEL

Use only the Class of steel as stated in the Project Specific Specification, unless otherwise shown on the Drawings and/or Approved.

BOLTS, ACCESSORIES, CONNECTIONS AND FITTINGS

STR1.M210.9 STEEL GRADE FOR CONNECTIONS AND FITTINGS

Use Grade S275 steel as a minimum, subject to design suitability, unless otherwise specified.

STR1.M220.9 HIGH STRENGTH BOLTS AND NUTS

1. To BS 3692:2001:Grade 8.8;
2. To the strength of BS 3692:2001:Grade 8.8 and the tolerances of BS 4190:2001;
3. To BS EN 14399:2005 used as ordinary high strength bolts in accordance with BS 4604:Part 1:1970, without the hardened steel washers.

STR1.M230.9 BS 4190 HOLDING DOWN BOLTS AND NUTS

Holding down bolts and nuts to BS 4190:2001:Grade 4.6. Unless otherwise agreed by the CM, holding down bolts shall be encased in concrete or grout and with either one of the following:

1. Normal bolt head at the exposed end;
2. Screwed ends with two nuts at the exposed end.

STR1.M240.9 BS 3692 HOLDING DOWN BOLTS AND NUTS

Holding down bolts and nuts to BS 3692:2001:Grade 8.8. Unless otherwise agreed by the CM, holding down bolts shall be encased in concrete or grout and with either one of the following:

1. Normal bolt head at the exposed end;
2. Screwed ends with two nuts at the exposed end.

STR1.M250.9 BLACK BOLTS AND NUTS

To BS 4190:2001:Grade 4.6.

STR1.M260.9 DRIVE SCREWS

Use self-tapping metallic drive screws to BS 4174:1972.

STR1.M270.9 PLAIN WASHERS FOR BLACK BOLTS

Round washers to be to BS 4320:1968, Form A made from cold rolled strip in the hardened condition to BS 1449:Part 1:1991:Section 1.15, Grade CS4 chamfered on one outside edge.

STR1.M280.9 SPRING WASHERS FOR BLACK BOLTS

Washers to be single coil square or rectangular steel spring washers to BS 4464:1969 (1990).

STR1.M290.9 TAPERED WASHERS

Made from cold formed strip in the hard condition to BS 1449:Part 1:1991:Section 1.15, Grade CS4 to similar dimensions and tolerances as shown in BS EN 14399:2005.

STR1.M300.9 BOLT LENGTHS

Ensure threaded portion of each bolt projects through the nut by at least one thread.

STR1.M310.9 HIGH STRENGTH FRICTION GRIP BOLTS

Use bolts and associated nuts and washers to BS EN 14399:2005 unless otherwise specified.

STR1.M320.9 RIVETS

Use mild steel rivets for general engineering purposes to BS 4620:1970 (1988).

STR1.M330.9 TURNBUCKLES OR SIMILAR

Obtain Approval for specially made elements and components such as turnbuckles.

STR1.M340.9 MARKING BOLTS AND ACCESSORIES

Clearly mark all bolts, screws, nuts and washers by either embossed or indented markings identifying the relevant British Standard. (See also STR1.W040).

WELDING CONSUMABLES

STR1.M410.9 QUALITY OF ELECTRODES, RODS AND WIRES

Select to give weld metal properties not less than the minimum specified for the grade of steel being welded.

STR1.M420.9 CONSUMABLES FOR WELDING STEELS TO BS EN 10025

To BS EN 1011-1:2009.

STR1.M430.9 ELECTRODES FOR WELDING GRADE S355 AND S450 STEELS

To be capable of depositing no more than 15 ml of diffusible hydrogen per 100 g of deposited weld metal, as defined in BS EN ISO 2560:2009.

STR1.M440.9 COVERED ELECTRODES FOR MANUAL METAL ARC WELDING

To BS EN ISO 2560:2009.

STR1.M450.9 FILLER WIRES FOR GAS-SHIELDED WELDING

To BS EN ISO 14341:2011.

STR1.M460.9 CORED ELECTRODES

To BS EN ISO 17632:2015.

STR1.M470.9 FILLER WIRES AND FLUXES FOR SUBMERGED ARC WELDING

To BS EN ISO 14171:2010.

STR1.M480.9 CONTINUOUS COVERED ELECTRODES

Of an Approved manufacture.

STR1.M490.9 MANUFACTURER'S TEST CERTIFICATES

Provide CM with relevant manufacturer's certificates for each batch of electrodes/rods/coils of wire.

STR1.M500.9 STORAGE OF ELECTRODES

Keep electrodes in unbroken packets in accordance with BS EN 1011-1:2009. Any drying or baking of consumables before issue shall be carried out in accordance with the manufacturers recommendations.

WORKMANSHIP

TRANSPORTATION AND STORAGE

STR1.W010.9 GENERAL

Make all necessary arrangements for transport of steel from the fabrication yard to the site.

STR1.W020.9 HANDLING

Carefully load, stack, and unload to avoid damage of any description. Replace damaged items at Contractor's own expense unless the CM permits rectification of damage.

STR1.W030.9 SPECIAL HANDLING

1. Where necessary; use, special slings or lifting points or both for handling, loading and unloading in fabrication shops, during transit and on Site;
2. Provide special supports, packings and lashings on vehicles, trucks and on ship (if appropriate) to prevent chafing;
3. Ensure small components receive special handling and stacking;
4. Ensure unpainted components, e.g. high strength friction grip bolts and associated nuts and washers are adequately protected against corrosion.

STR1.W040.9 BOLTS, NUTS, WASHERS, AND SCREWS

1. Transport and store in sealed or wire clipped bags labelled to identify:
    a. Contents;
    b. Number;
    c. Grade;
    d. Standard;
    e. Manufacturer;
    f. Batch or cast number.
2. Store in a dry area dedicated to the purpose;
3. Do not mix contents of opened bags.

STR1.W050.9 EXPOSURE TO POLLUTANTS

1. Take precautions to minimise exposure of steelwork to atmospheric or chemical pollution before and after fabrication;
2. Store and stack steel members in such a manner that markings are clearly visible;
3. Either one of the following:
    a. For superstructure works:
        i. Store steelwork awaiting erection clear of a levelled, well-drained and maintained hard-standing ground and keep different members separate. Lay or stack to avoid accumulation of water or dirt on or against any of the surfaces. Provide suitable packings between layers of stacked steelwork. Ventilate covered steelwork sufficiently to preclude condensation.

b. For works other than that in sub-clause (3)(a):

i. Store steelwork awaiting erection clear of the ground and keep different members separate. Lay or stack to avoid accumulation of water or dirt on or against any of the surfaces. Provide suitable packings between layers of stacked steelwork. Ventilate covered steelwork sufficiently to preclude condensation.

STR1.W060.9 ROAD TRANSPORT

1. Use vehicles long enough to carry components with permitted overhang at either end;
2. Provide intermediate supports to which a component can be tied with strops to prevent oscillation;
3. Sit components on softwood supports covered with soft clean pads;
4. Ensure buckles to strops do not touch components.

STR1.W070.9 SEA TRANSPORT

1. Containerise steelwork destined to be shipped overseas;
2. Do not ship steelwork as deck cargo unless in containers;
3. Ensure containers can be handled at ports of exist and entry if vehicle cannot be ferried;
4. Pack containers so that no components touch. Use softwood with soft padding and man-made fibre ropes and strops to prevent movement and contract;
5. Bag fasteners and accessories;
6. Bundle small components and prevent contact;
7. Chromate dip galvanized steel, which is not to be overcoated, when it is to be containerised for longer than three weeks or when going to go through the tropics.

STR1.W080.9 REPAIR OF DAMAGE INCURRED IN TRANSPORT

1. Inspect steelwork after transportation;
2. Set aside components with damage to steel or coatings;
3. Report damaged steel to the CM;
4. If damaged component is not rejected by the CM repair by agreed method;
5. Repair coatings as specified immediately.

FABRICATION

STR1.W110.9 ACCESS

Provide access for the CM at all reasonable times to all places where work is being carried out, with all necessary facilities for inspection during fabrication and off-site assembly.

STR1.W120.9 GEOMETRIC FORM

Keep all material, before and after fabrication, straight unless required to be of curvilinear form. Keep free from twists. Avoid excessive stack-up of sections to prevent damage and distortion.

STR1.W130.9 IDENTIFICATION

Identify at all stages of fabrication, structural steel as described in STR1.M150.

STR1.W140.9 SURFACE PREPARATION

Before fabrication remove all oil and grease by use of a suitable solvent from all bare surfaces and remove all mill scale, rust and dirt by either:

1. Shot blasting to surface finish designation Sa 2 to BS 7079:Part A1:1989 (1994);
2. Mechanical wire brushing to surface finish designation St 2 to BS 7079:Part A1:1989 (1994).

STR1.W150.9 POST CLEANING

After cleaning adopt one of the following methods:

1. Apply a coat of blast primer, not greater than 20 microns DFT. Where subsequent welding is to be carried out ensure that a weld through blast primer is used which will not give off noxious fumes during welding. Ensure compatibility with final protective system; or
2. Fabricate steelwork within four hours of cleaning and apply protective system primer (See STR1.W1220); or
3. Reclean steel after fabrication by shot blasting or mechanical wire brushing to standard required for protective coating and apply protective system primer (See STR1.W1220).

STR1.W160.9 EXECUTION

1. Carry out all fabrication to:
    a. The Code of Practice for the Structural Use of Steel 2011 for hot rolled sections and cold formed sections in building;
    b. BS 5400:Part 6:1980 for plates and sections in bridgework.
2. Conform with the requirements for accuracy of construction with respect to levels, dimensions, alignment and fabrication tolerances of members and joints given in the above Code of Practice and British Standard.

STR1.W170.9 SETTING OUT

Set out all holes and cuts along the length of a member from one datum line perpendicular to its longitudinal axis. Mark centres of all holes at standard back marks/cross centre unless otherwise shown on the Drawings.

STR1.W180.9 TEMPORARY ATTACHMENTS

Design and fabricate all temporary attachments for use as assembly/erection aids to ensure their use will not damage the structure of its surface protection.

STR1.W190.9 END PLATES

1. For flexible end plate connections:
    a. To be not less than 12 mm thick;
    b. To extend across, but not be connected to the top flange;
2. For sealing hollow sections;
    a. Suspend suitable desiccant (Silica-gel) in bags in each void prior to sealing up;

b. Weld sealing plate over end.

STR1.W200.9 JIGS

Use jigs for repetitive, interchangeable or complicated work.

STR1.W210.9 MEASUREMENT AND SETTING OUT MARKS

Make all measurements by steel tape or bands calibrated at 20°C and used at the correct tension.

STR1.W220.9 CONTINUOUS STRUCTURES

Make allowance in setting out continuous structures for dimensional variations due to temperature variations.

STR1.W230.9 STRAIGHTENING BENDING AND CAMBERING OF STEEL SECTIONS

Submit proposals to the CM where steel sections are required to be straightened, bent to a specified radius or precambered and methods to be adopted to perform these operations, for his approval in each case. Ensure that the adopted method does not weaken or deface the member.

STR1.W240.9 POST FABRICATION MAKING GOOD

Clean and prepare all mechanical damage, weld burns and welded surfaces as follows:

1. By shot blasting; or
2. Mechanical or hand wire brushing;
3. All bare and welded surfaces must also be made good and primed in accordance with STR1.W150;
4. Plates over 25 mm that are to be connected by high strength friction grip bolts and found to be bowed or rippled must be machined flat before the steel leaves the fabrication works.

STR1.W250.9 CUTTING STEEL

1. Cut by sawing, shearing, cropping, nibbling, laser or machine flame cutting, unless otherwise Instructed. Do not use manual gas cutting without Approval;
2. Shearing must not distort steelwork;
3. Saw cut slightly oversize to allow for machining and/or grinding;
4. Flame cut oversize where necessary to allow for removal of notches by machining.

STR1.W260.9 CUT EDGES

1. Remove burrs, sharp arrises and slag from edges of all cut members;
2. Dress machine sheared or cropped edges to a neat finish, free from distortion.

STR1.W270.9 MACHINING GENERALLY

1. Grind stiffeners, plates and the like to fit the profile of the parent member with diagonal cuts to clear the root radius;
2. Machine stanchion splices and butt joints of compression members true and square;

3. Splay cut projecting corners of cleats, plates, etc and machine the edges and ends of all flanges and end plates of girders or other members except where Universal beams or flats with reasonably square edges are used;
4. Machine the edges of all web and flange plates of welded girders square unless specified otherwise. Where plates are specified to be planed, cut to sufficient size to permit 3 mm to be planed off all edges. The edges of floor plates, gutter plates, and trough flooring may be sheared;
5. Machine square all butt ends of compression members and those in close contact throughout so that applied loads are evenly transmitted over the entire area of the section.

STR1.W280.9 FLAME CUTTING

Grind off heat affected metal or notches where gas cutting is used. Where gas cutting is applied to Grade S275 steel over 25 mm thick or to Grade S355 & S450 steel of all thicknesses, machine any gas cut edge which is to be subject to fluctuating stresses along its length but not subsequently incorporated in a weld so as to remove not less than 3 mm of the flame cut profile.

STR1.W290.9 FORMING HOLES FOR BOLTS AND RIVETS

1. Form holes by any of the following methods:
   a. Drilling full size;
   b. For plate less than 15 mm thick: punching 2 mm less in diameter than the required size and subsequently reaming out to the required diameter;
   c. Punching full size and meeting the following conditions:
      i. The punching operations must not in the opinion of the CM unduly distort the material;
      ii. The holes must be free from burrs which would prevent solid seating of the parts when tightened;
      iii. The thickness of the material through which the hole is punched must not exceed the diameter of the hole;
      iv. The thickness of the material must not be greater than 12 mm unless Approved;
      v. In spliced connections the holes in the mating surfaces must be punched from the same direction.
   d. Holes must not to be punched full size in any of the following conditions:
      i. In tension flanges at locations where plastic hinges have been assumed in the design analysis;
      ii. In elements of rigid connections in which local yield lines have been assumed;
      iii. Where repetition of loading makes fatigue critical in the member design.
2. Comply with clause 14.2.5 of the Code of Practice for the Structural Use of Steel 2011.

STR1.W300.9 BUILT-UP SECTIONS

1. Drill after the members have been assembled and tightly clamped together;

2. Where not practicable, drill the holes to a diameter at least 2 mm less than the required size and ream after assembly to the full diameter.

STR1.W310.9 REMOVING BURRS

Remove all burrs from holes from assembly. Parts which have been drilled to receive black bolts need not be separated to remove burrs. Parts drilled to receive HSFG bolts to be separated and the surfaces cleaned of all burrs and drilling fluid to ensure the coefficient of friction is not compromised.

STR1.W320.9 HOLES FOR BLACK BOLTS

Finished holes for black bolts must not be more than 2 mm in diameter larger than the diameter of the bolt passing through them for bolt diameters up to 24 mm, and not more than 3 mm larger than the diameter of the bolts for bolt diameters over 24 mm, unless otherwise specified or required by the design.

STR1.W330.9 HOLES FOR HIGH STRENGTH FRICTION GRIP BOLTS

Use hole sizes specified in STR1.W320 where the number of plies in the grip does not exceed three, if the number of plies exceed three, form the holes in the two outer plies as before and the diameter of the hole in the inner plies not more than 3 mm larger than that of the bolt.

STR1.W340.9 FITTED BOLTS, PINS OR RIVETS

1. Holes for rivets:
    a. All matching holes for rivets to register with each other so that a gauge 2 mm less in diameter than the diameter of hole will pass freely through the assembled members in a direction at right angles to such members;
    b. Finished holes to be more than 2 mm in diameter larger than the diameter of the rivet passing through them, for rivet diameters up to 24 mm, and not more than 3 mm greater than the diameter of the rivet for rivet diameters over 24 mm, unless otherwise specified;
    c. Holes for rivets must not be formed by a gas cutting process.
2. Holes for fitted bolts:
    a. Drill holes for fitted bolts to a diameter equal to the nominal diameter of the shank subject to a tolerance of +0.15 mm and -0 mm;
    b. Use tacking bolts or cramps on parts connected together with fitted bolts. Drill through all the thicknesses at one operation and ream to size;
    c. All holes not drilled through a thicknesses at one operation are to be drilled to a smaller size and reamed out after assembly. Where this is not practicable, drill and ream the parts separately through hard bushed steel jigs.

STR1.W350.9 SLOTTED HOLES

Drill first then ream out smooth to required size.

STR1.W360.9 PREVENT MOISTURE INGRESS

Make provision to prevent moisture ingress to sealed hollow members where these are holed for bolts.

MECHANICAL JOINTING

STR1.W410.9 SURFACE PREPARATION

Prepare and prime the contact surfaces at riveted, bolted and screwed joints. If the contact surfaces are specified to be coated or otherwise treated, e.g. machined surface finish, obtain Approval to the joint before assembly.

STR1.W420.9 USE OF HIGH STRENGTH FRICTION GRIP BOLTS

1. Clean the interface of members jointed with high strength friction grip bolts to the specified surface preparation and leave unpainted;
2. Use high strength friction grip bolts in accordance with BS 4604:Part 1:1970. Tighten the bolts and nuts by the torque-control method using a calibrated power-operated or a hand-operated torque wrench to achieve the proof loads set out below:

Nominal size	Proof Load, kN (minimum shank tension)
M12	49.4
M16	92.1
M20	144
M22	177
M24	207
M27	234
M30	286

3. Use tapered washers on surfaces with a slope >3°.

STR1.W430.9 WRENCH CALIBRATION

1. Maintain the wrench in a proper working condition in accordance with the manufacturer's recommendations. Calibrate the wrench regularly using a calibrated bolt load meter and using a bolt from the batch of bolts to be used in the works as follows:
   a. At the commencement of each new working day or shift;
   b. With each change of bolt diameter;
   c. With each change of bolt grip length in excess of 1/5th of the length used in the calibration of the wrench in accordance with BS 4604:Part 1:1970.
2. Re-apply the wrench to bolts previously tightened in a multi-bolt connection to ensure all bolts have the correct torque;
3. Ensure that the bolt used in the calibration is, as far as is practicable, representative of bolts to be used in the works. No additional lubrication should be applied unless it is to be applied to bolts incorporated in the permanent works.

STR1.W440.9 CALIBRATION OF BOLT LOAD METER

The bolt load meter for measuring bolt shank tension must be calibrated by an Approved laboratory before tightening of bolts and nuts commences and at regular intervals agreed by the CM. During re-calibration, a replacement calibrated bolt load meter must be provided on the Site. Submit calibration results to the CM at least one week before the bolt load meter is used.

STR1.W450.9 BLACK OR PRECISION BOLTED CONNECTIONS

1. Keep all bolts, nuts and washers free from rust and dip in linseed oil immediately before connections;
2. Provide each bolt with at least one steel washer placed under the nut or bolt head, whichever element is to be rotated during the tightening operation;
3. Tighten all bolt heads and nuts against surfaces normal to the bolt axes. Use tapered washers as necessary to meet this requirement. Where bolted connections are subject to vibration provide the nuts with lock nuts or castle nuts and split pins.

STR1.W460.9 ALIGNMENT, TEMPORARY CONNECTIONS AND PERMANENT FIXINGS

1. Do not distort holes or members during alignment;
2. Do not enlarge holes without prior Approval;
3. Drifts used during the fabrication or erection of the steelwork must be of such shape and dimensions as to locate the work accurately. Drifts must not cause any damage to or deformation of the component parts, nor alter in any way the sizes of the holes provided for the permanent bolts;
4. Temporary bolts used for the initial or trial assembly of any part of the steelwork must have the same hole clearances as the permanent bolts;
5. Tighten all bolts securely in the finished work so that the length of each bolt after tightening projects at least one thread beyond the other face of the secured nut.

STR1.W470.9 BOLTED CONNECTIONS WITH PROVISION FOR SLIDING

Provide slotted hole through one member and a round hole in the other. Connect with shouldered bolts, spring washers, flat washers, castle nuts and splits pins. Form round holes with a diameter less than the width of the slot and place the shoulder of the bolt against the faying surface of the unslotted member enabling the bolt to be tightened on this member. Locate the spring washer under the head of the bolt and the flat washer under the castle nut.

WELDING

STR1.W510.9 GENERAL

1. Prior to fabrication of bridgework carry out welding and flame cutting trials using representative samples of materials to be used in the work in accordance with BS 5400:Part 6:1980;
2. Provide an experienced and competent operative to supervise welding. Submit evidence that all welders are capable in accordance with STR1.T080;
3. When directed by the CM, keep a site record that identifies the welders responsible for major welds.

STR1.W520.9 USE OF WELDING EQUIPMENT AND ACCESSORIES

1. Use welding plant, equipment and accessories that comply with the requirements of BS 638;
2. Use individual transformers or motor generator that are fitted with a current density control and situated close to the welder so that he may adjust the current;
3. Store and use welding consumables in accordance with BS EN 1011-1:2009, BS EN ISO 2560:2009 and the manufacturers recommendations;

4. Store electrodes in dry conditions and where necessary keep in heated quivers while in use;
5. Use covered electrodes to BS EN ISO 2560:2009;
6. Regularly calibrate, using an ammeter, the transformers or motor generators to ensure that current is kept within the range specified by the manufacturers for electrodes;
7. Do not open packets except for sampling or when electrodes are to be used;
8. Reject electrodes with broken, damp or damaged coatings.

STR1.W530.9 PREPARATION FOR WELDING

1. Submit in writing, for Approval, details of proposed welding procedure for each type of welded connection in accordance with STR1.T100;
2. Keep the surfaces to be welded free from all scale, grease, paint, rust and other matter. Prepare all parts to be welded in a manner that ensures a close fit;
3. Prepare fusion surfaces to BS EN 1011-1:2009. Dry surfaces and warm as necessary, to remove any condensation.

STR1.W540.9 ADDITIONAL REQUIREMENTS FOR SITE WELDING

1. Surfaces to be welded must be clean, free from paint, grease, contaminants dry and free from condensation. Where the steel is damp or the temperature is low then warming with a low temperature flame may be used. Thermal indicating crayons may be used to determine the plate temperature and the area pre-heated;
2. Protection from the weather: provide adequate protection to shield the welding from the weather. Tent type structures made from fireproof and waterproof material may be used to shield the weldment from the wind and rain. Such temporary structures to be mounted on stable scaffolding supports, and a stable platform to be provided for the welder. Where welding to hollow sections is required ensure draughts are prevented from blowing through the section;
3. Electrodes: bake on site at a temperature between 100°C and 150°C and where necessary store in heated quivers for use at the welders convenience;
4. Power supply: may be from a transformer or generator to provide a three phase power supply of the required voltage. Locate the generator or transformer as close as possible to the welder to prevent a drop in voltage along the cables length. Ensure all the cables are as short as possible, routed away from the path of construction vehicles, and adequately protected;
5. Earth run: adequately earth all electrical plant. Ensure the welding return from the weldment is adequate in cross section and correctly connected and earthed;
6. Weld detail: ensure the welded joint is of the correct profile and fit up. As a general guide do not carry out welding where the gap is less than 1 mm or more than 3 mm unless a backing strip is provided. Where a backing strip is provided the weld gap is not to exceed the greater of 5 mm or the thickness of the material being welded. Adequately support all welded joints with props or restraints that ensure relative movement of the fusion faces is prevented;
7. Work in confined spaces: provide adequate ventilation and formulate plans of evacuation and escape before the work commences.

STR1.W550.9 METHOD OF WELDING

1. Carry out welding in accordance with the requirements of BS EN 1011-1:2009. Manual metal-arc weld unless otherwise specified;

2. Execute welding in a flat or horizontal position wherever possible. Do not weld overhead without Approval;
3. Ensure electrodes used in conjunction with fluxes give a weld deposit having mechanical properties at least equal to the minimum specified for the parent metal. Use electrodes and fluxes strictly in accordance with the manufacturer's recommendations.

STR1.W560.9 REMOVAL OF SLAG

Remove welding slag by chipping before depositing subsequent runs, and thoroughly wire brush the surfaces.

STR1.W570.9 TACK WELDS

Do not use tack welding unless Approved. Tack welds to be minimum 50 mm long. Form location welds, where Approved, of the same quality and size as the first run of the main weld which when completed, fuse completely with the ends of the location welds and form a reasonably regular finished profile. Do not weld temporary attachments to principle joints. Obtain Approval of the position of welds for temporary attachments.

STR1.W580.9 WELD DEFECTS

1. Welds will be rejected if they do not meet the acceptance criteria of welds stipulated in clause 14.3.6.7 of the Code of Practice for the Structural Use of Steel 2011;
2. Take particular care when welding hollow sections, plates and angles to avoid distortion by using correct sequences and speeds.

STR1.W590.9 FILLET WELDS

Deposit fillet welds to the required length, throat thicknesses and with partial or full penetration as specified.

STR1.W600.9 BUTT WELDS

1. Form butt welds as full penetration welds between prepared fusion faces, unless otherwise directed;
2. Carry out back chipping, grinding or gouging of the deposited weld as required to obviate imperfections in the root run such that the root edges or root faces are not out of alignment by more that 1/8 of the thickness of the thinner material for material up to 12 mm thick or by more than 1.5 mm for thicker material;
3. Grind butt welds flush without loss of parent metal;
4. In the fabrication of built-up assemblies ensure, all butt welds in each component are completed, wherever possible, before the final assembly.

STR1.W610.9 STUD SHEAR CONNECTORS

Weld stud shear connectors by automatic stud welding gun strictly in accordance with the manufacturer's recommendations unless specified otherwise.

ERECTION OF STEELWORK

STR1.W710.9 ERECTION

1. Carry out all erection to:

a. The Code of Practice for the Structural Use of Steel 2011 for hot rolled sections and cold formed sections in building;

b. BS 5400:Part 6:1980 for plates and sections in bridgework.

2. Conform with the requirements for accuracy of construction in respect of levels, dimensions and alignment given in the above Code of Practice and British Standard and those contained in the "Schedule of Tolerances" in Appendix H to this Specification.

STR1.W720.9 ERECTORS

Carry out all work employing trained and experienced erectors. Provide evidence of the erector's competence when directed by the CM.

STR1.W730.9 SAFETY

Comply with the relevant regulations on safety including the 'Factories and Industrial Undertakings Ordinance', the recommendations of BS 5531:1988 as applicable and:

1. Use only recently tested equipment for lifting and remove from site any damaged equipment;

2. Do not carry out complex operations at a height except from safe platforms large enough to take operators and equipment. Maintain platforms and safe access until work has been accepted and any added protection completed.

STR1.W740.9 STABILITY

Ensure stability of structure at all stages of construction.

STR1.W750.9 SEQUENCE OF OPERATIONS

Prepare and submit details of the proposed method of erection for the CM's consent. Details submitted must include type of plant and equipment to be used and if necessary drawings and calculations of any temporary work. The giving of consent by the CM will not in any way relieve the Contractor of his responsibility for safe erection of permanent work or the safe erection and subsequent dismantling of temporary work.

STR1.W760.9 PLANT AND EQUIPMENT

Do not employ any plant or equipment which is, or in the CM's opinion likely to be, unsuitable, unsafe, or likely to cause damage to the structure during erection or damage to existing buildings etc.

STR1.W770.9 PREVENTION OF DISTORTION

Do not distort steelwork or exceed the stresses specified in the Code of Practice for the Structural Use of Steel 2011 or BS 5400:Part 3:1982 for bridgework during erection.

STR1.W780.9 APPROVED SEQUENCE

Erect structural steel according to the sequence agreed with the CM.

STR1.W790.A FALSEWORK

When specified, design, construct and dismantle falsework to BS 5975:1982. Supply all staging and all labour, tools, erection plant, lifts, services, nuts and washers and other necessary materials. Provide temporary bracings and guys to ensure adequate resistance to wind and stability against collapse during construction.

1. Submit records of inspection of the completed formwork and falsework to the CM for information before carrying cut any further works that may affect the stability of the formwork and falsework. Such records are to be certified by a contractor's superintendent holding qualification equivalent to TCP Grade T4 in civil or structural engineering discipline;
2. Monitor falsework levels and make any necessary adjustments for settlement, or other deflection or movements;
3. Refer to PRE.B10.010 sub-clauses (6) and (7) and PRE.B10.065 for the certification requirement of QE.

STR1.W800.9 SETTING OUT, LEVELLING AND LOCATION

Set out, level and position:

1. Using steel tapes or bands for setting out that are calibrated at 20°C and used at the correct tension;
2. To a level that is levelled to a datum point and aligned to a base line during erection. Agree both datum point and setting out lines before commencement;
3. That ensures all steelwork is accurately and securely located to the correct profile and camber, if any, before assembly;
4. That ensures the structural steelwork is not subjected to stresses in excess of those for which it was designed.

STR1.W810.9 ERECTION OF STEELWORK

1. Do not erect fabricated steelwork until all welded joints and specified protective coatings have been inspected, tested where required, and Approved;
2. Align structural members accurately to the specified tolerances and obtain Approval before any permanent welding or tightening of bolts is carried out;
3. Do not bed stanchion bases or grout anchor bolts until the steelwork has been plumbed, levelled, aligned and Approved.

STR1.W820.9 STEELWORK BY SUB-CONTRACTOR

1. Take responsibility for checking all the work prepared by others that may be incorporated into the work or the dimensions of any structure affecting steel erection. As a result of the check report any discrepancies or shortfalls to the CM immediately;
2. Ensure that the Sub-contractor supplies any items required to be cast into concrete. Cast in such items using templates provided by the Sub-contractor where these are necessary.

CLEANING, SURFACE PREPARATION AND PROTECTION (POST FABRICATION)

STR1.W910.9 CLEANING AND COATING IN THE SUPPLIERS WORKSHOP

Ensure that the supplier provides sufficient covered and enclosed workshop space to enable blast cleaning, priming coat and undercoat painting to be carried out in close sequence. The blast cleaning section of the workshop must be fitted with extractors and filters to prevent and deposition of dust on metal surfaces to be painted.

STR1.W920.9 CLEANING SURFACES OF BARE METAL

Thoroughly clean down to remove all dirt, grease and the like, using a suitable solvent and thoroughly chip, scrape, wire-brush flame clean or grit blast to remove all loose scale back to clean metal.

STR1.W930.9 CONTAMINATED SURFACES

1. Weld spatter: clean of all surfaces, keep paint films free of embedded foreign metallic particles;
2. Concrete deposits etc: wash or clean off immediately they occur and if necessary make the surfaces good to the satisfaction of the CM;
3. Oil or grease: clean with white spirit.

STR1.W940.9 PAINTED AND OTHER COATED SURFACES

Unless otherwise directed by the CM clean the final workshop applied coating to the external surfaces on site by:

1. Washing with a solution of an Approved liquid detergent followed by rinsing with clean fresh water and allowed to dry thoroughly before overcoating;
2. Thoroughly cleaning rivet heads, bolts heads and the surfaces surrounding them;
3. Removing all loose particles, dust and debris immediately prior to application of paint.

STR1.W950.9 ATMOSPHERIC CORROSION

Do not apply protective coating to surfaces bearing atmospheric corrosion products or other chemicals which may be harmful to the coating or succeeding coating. Clean off these contaminants, which may include any remaining after surface preparation as specified in this Worksection and any produced by welding, to an Approved extent that is compatible with the specified protective system.

STR1.W960.9 BLAST CLEANING

1. Carry out blast cleaning in accordance with BS 7079:Part A1:1989 (1994) and that produces surface qualities as follows:
   a. For surfaces to be galvanized to 140 microns: Sa 2 (prior to pickling).

      Note: Surfaces to be galvanized to 85 microns do not require blast cleaning;

   b. For surfaces to be metal sprayed: as specified in BS EN ISO 2063:2005;
   c. For surfaces to be painted: Sa 2½.
2. Non-metallic abrasive should be free from contamination and recovered material is to be cleaned to the satisfaction of the CM before re-use;
3. Do not exceed a maximum amplitude (peak to trough) of the blast-cleaned surface of 0.1 mm;
4. Clean blasted surfaces by brush or vacuum. Do not touch by hand. Do not contaminate in any other way;
5. Apply protective coating within 4 hours of blast cleaning;
6. Before commencing any follow on operations submit, for Approval, a sample blast cleaned steel panel measuring not less than 150 mm x 150 mm x 6 mm thick adequately protected by sealed clean polythene wrapping. The Approved sample will be retained by the CM for comparison with the prepared steelwork.

STR1.W970.9 MECHANICAL CLEANING

Carry out mechanical cleaning to surface quality designation St 2 of BS 7079:Part A1:1989 (1994) by power driven tools, such as carborundum grinding discs, chipping hammers and needle guns, followed by steel-wire brushing and dusting to remove all loosened material. Avoid excessive brushing of the metal through prolonged application to rotary wire brushes. Protect surfaces within 48 hours of mechanical cleaning.

STR1.W980.9 PICKLING

Carry out pickling of steel by the "Footner" process as specified in BS 5493:1977. Apply the first priming coat of paint as soon as the steel has dried and is still warm.

STR1.W990.9 FLAME CLEANING

Plan and control the sequence of operations for flame cleaning steelwork to avoid the risk of distortion and buckling. Clean the flame cleaned surfaces of all loosened material. Apply priming coat while the steel is still warm. Control the heat input so that no harmful distortion of the steelwork occurs.

STR1.W1000.9 NEW GALVANIZED SURFACES

Thoroughly clean to remove all dirt, oil and grease and pre-treat with either an etching primer or Approved etching compound.

STR1.W1010.9 PREVIOUSLY PAINTED GALVANIZED SURFACES

Thoroughly degrease previously painted galvanized surfaces. Where corrosion has spread under the paint film, remove old paint with an organic solvent type paint remover.

STR1.W1020.9 CLEANED OR COATED MEMBERS

1. Ensure that, unless specified otherwise, exposure times for blast cleaned, wire brushed or coated surfaces (other than at joints) are not longer than those given in the following table:

Surface	Enclosed Workshop	Outside
a. Blast cleaned	4 hours	Nil
b. Metal Sprayed	4 hours	Nil
c. Mechanically Cleaned	48 hours	Nil
d. Blast Primer on 'a'	Maximum exposure of 8 weeks with up to 2 weeks of this time outside	
e. Etch primer on 'b'	24 hours	Nil
f. Primer on 'c'	48 hours	Nil
g. 1st Undercoat on 'd', 'e' or 'f'	48 hours	Nil
h. Subsequent Undercoats	As agreed by the CM	

Note: 'Outside' refers to any area outside a fully enclosed workshop.

2. The tabulated exposure times refer to any part of the surface being blast or mechanically cleaned, metal sprayed or painted;
3. For surface condition 'd' where blast primed steelwork is exposed outside, the minimum dry paint film thickness over the peaks of the blast cleaned steel must not be less than 13 microns;

4. Zinc rich coated steelwork may only be exposed outside for the minimum period to allow movement at the fabricator's works. Such movement to be under the supervision of the CM or his representatives and unless the weather conditions are favourable the sections are to be covered;
5. Where it is necessary to overcoat two pack paints of the epoxide or polyurethane type, re-coat within 48 hours of application. Where it is not possible to overcoat within this time the paint film to be abraded to produce a roughened surface, given a flash coat of suitable primer, and allowed to dry for at least 4 hours before application of the next coat of the system;
6. No steelwork to be loaded for transport until the paint system has been Approved as being sufficiently dry for handling;
7. Keep steelwork to be site painted clean and dry. Where necessary provide temporary shelters to simulate, as far as is practicable, workshops conditions.

APPLICATION OF METAL COATINGS

STR1.W1110.9 HOT DIP GALVANIZING

1. To BS EN ISO 1461:2009: minimum mean coating thickness of 45 microns to 85 microns depending on thickness of steel sections as stipulated in Table 3 of BS EN ISO 1461:2009, unless otherwise specified;
2. Apply metal coatings to BS EN ISO 1461:2009 only to components of a tensile strength up to and including that of general grade high strength friction grip bolts unless otherwise specified;
3. Make good small areas of galvanized coating damaged by welding, cutting or by rough treatment during transit or erection either by the use of low melting point zinc alloy repair rods, powders made specifically for this purpose, or by the use of at least two coats of zinc rich paint to BS 4652:1995. Apply sufficient material to provide a zinc coating at least equal in thickness to the galvanized coating.

STR1.W1120.9 SPRAYED METAL COATING

To BS EN ISO 2063:2005. The nominal thickness of coating to be 100 microns. Apply one flood coat of polyurethane (or similar approved) sealer immediately after spraying.

STR1.W1130.9 ELECTROPLATING

1. To BS 3382:Parts 1 and 2:1961;
2. Coating thickness: 5 microns minimum.

STR1.W1140.9 CHROMIUM PLATING

To BS 4641:1986 (1996). Ensure that the protection offered is at least the same as that provided for the adjacent main structural steel element.

STR1.W1150.9 METAL COATING ON PART ONLY OF ASSEMBLED SECTION

Apply the metal coating before the remainder receives its priming coat.

STR1.W1160.9 PROTECTION OF HSFG BOLTED JOINTS

1. Zinc or aluminium sprayed steelwork: where the metal spray is carried over the interfaces of the HSFG bolted joints, take the etch primer on the parent metal between 10 mm and 20 mm inside the perimeter of the joint area. The outer surfaces and edges of the joint material may also be given a coat of the same primer in order to reduce surface preparation required after the joint has been made;
2. Painted steelwork: where metal spray is specified only at the interfaces of HSFG bolted joints, carry the metal spray between 10 mm and 20 mm outside the perimeter of the joint area and the blast primer taken between 10 mm and 20 mm inside the perimeter. If the outer surfaces and edges of the joint materials are metal sprayed, these may be given a coat of etch primer in order to reduce subsequent surface preparation;
3. Painted steelwork: where the interfaces of HSFG bolted joints are bare steel, take the blast primer between 10 mm and 20 mm inside the perimeter of the joint area. The outer edges and surfaces of the joint material may also be given a coat of blast primer in order to reduce subsequent surfaces preparation.

STR1.W1170.9 PROTECTION OF OTHER BOLTED JOINTS

1. Shop joints: apply metal spray plus etch primer or blast primer alone to parent and joint material. Assemble the joint immediately after the first undercoat of the parent system has been applied to the contact surfaces;
2. Site joints: apply to all surfaces, excepting those of fasteners, the same painting system in the shop as is to be applied to the parent metal surfaces, unless otherwise specified.

STR1.W1180.9 PROTECTION OF NON-BOLTED JOINTS

1. Riveted joints: shop and site joints: apply metal spray plus etch primer or blast primer alone, to parent and joint material. Assemble the joint immediately after the first undercoat of the parent system has been applied to the contact surfaces;
2. Welded joints: unless otherwise specified, treat welds and surfaces which have been affected by welding with the protective system which is applied to the parent surfaces.

STR1.W1190.9 SURFACES ADJACENT TO TREATED JOINTS

1. Keep metal spray at least 15 mm clear of areas to be welded and mask off these areas during spraying;
2. Where paints other than blast primers are to be applied to the parent surfaces before the making of a joint they must be stepped back at 30 mm intervals commencing at 80 mm from welded joints and at 10 mm from the perimeter of all other joints.

STR1.W1200.9 PAINTING AND SEALING OF JOINTS

1. As soon as possible after joints have been Approved, paint the parent and joint material, exposed parts of bolts, nuts and washers, weld and affected areas to bring them up to the same state of preparation and painting as the adjoining surfaces;
2. Seal all bolted joints against the ingress of water. Before painting commences and, subject to Approval, plug gaps at joints with an Approved filler. Seal the perimeter of all joints with subsequent coats of paint.

STR1.W1210.9 APPLICATION OF PAINT

1. Types of paint and painting generally to be as specified at STR1.W1220 and STR1.W1230 as appropriate for application to steelwork;
2. Only apply to surfaces which have been prepared and cleaned in accordance with this Worksection;
3. Do not apply in the following conditions:
   a. When the ambient temperature falls below 4°C or the relative humidity rises above 90%;
   b. For external works: during period of inclement weather, e.g. rain, fog or mist or when condensation has occurred or is likely to occur on steel;
   c. When the surface temperature of the metal to be painted is less than 3°C above the dew point of the ambient air;
   d. When, in the opinion of the CM, the amount of dust in the atmosphere and/or on the surface of the material is such that the application of the paint would be unsatisfactory;
   e. For two pack paints of the epoxide resin type: when the temperate is below 5°C or as recommended by the paint manufacturer, nor when the temperature is likely to fall below the specified minimum during the curing period.

STR1.W1220.9 PAINTING STEELWORK

Apply the appropriate paint system as detailed in the following table at the locations as specified in the Project Specific Specification.

System A:	- primer : - undercoat : - finish : - minimum total DFT :	1 coat of high build zinc phosphate paint; 2 coats of oil based with micaceous iron oxide phenolic paint; 1 coat of alkyd resin paint; 250 microns
System B:	- primer : - undercoat : - finish : - minimum total DFT :	1 coat of epoxy resin with aluminium mastic paint; 1 coat of epoxy resin paint; 1 coat of epoxy resin paint; 280 microns
System C:	- primer : - undercoat : - finish : - minimum total DFT :	1 coat of inorganic zinc silicate paint, DFT 75 microns; 2 coats of high build micaceous iron oxide epoxy paint; 1 coat of high build amine adduct cure epoxy paint; 320 microns
System D:	- primer : - undercoat : - finish :	1 coat of two pack wash primer, DFT 5 microns; 1 coat of epoxy resin paint; 1 coat of epoxy resin paint or 2 coats of polyurethane paint;

	- minimum total DFT :	180 microns
System E:	- Inhibitor :	'Rustoleum' or other rust inhibitor paint approved by the CM;
	- primer :	Zinc phosphate or, for hot-dip galvanized or GI surface, 'T' wash as specified in BS 5493:1977, Section 2, Clause 11.3.2;
	- undercoat :	2 coats of micaceous iron oxide paint;
	- finish :	1 coat of oil based paint or 1 coat of micaceous iron oxide paint;
	- DFT of each coat :	as recommended by the manufacturer.

Notes:

1. The different types of paints within each painting system to be compatible with each other and manufactured by the same manufacturer. Successive coats in a painting system, including stripe coats, to be in contrasting colours to aid identification;
2. DFT is the dry film thickness.

STR1.W1230.9 PAINT FOR STEELWORK PROTECTION SYSTEMS

1. In accordance with BS 5493:1977, Section 2, Table 4 unless specified otherwise. Organic zinc-rich paint to comply with BS 4652:1995. Do not use lead-based paint for finishing coats;
2. To be supplied in sealed containers of not more than 5 litres capacity. Each container shall show the following information:
   a. The name of the manufacturer;
   b. The paint manufacturer's reference number;
   c. Intended purposes, type of pigment and binder;
   d. Batch number, date of manufacture, expiry date and pot life; and
   e. Colour, gloss, drying times and flash point.
3. To be in compliance with the prescribed limits of VOC content as set out in the Air Pollution Control (Volatile Organic Compounds) Regulation;
4. Submit written confirmation from paints suppliers and manufacturers for the following:
   a. The VOC contents of the proposed paints are complied with the Air Pollution Control (Volatile Organic Compounds) Regulation;
   b. The types of regulated paints that the proposed paints belong; and
   c. The VOC contents of the proposed paints.

ACCURACY AND TOLERANCES

STR1.W1310.9 GENERAL

Refer to Chapter 15 of the Code of Practice for the Structural Use of Steel 2011 and Appendix H, "Schedule of Tolerances" to this Specification.

OFF-SITE FABRICATION

STR1.W1410.A SUBMISSIONS

Where structural steelwork is to be fabricated off-site, submit the following items for Approval within a period from the notified date for commencement of Works as specified in the Project Specific Specification:

1. The name, fabrication yard address with street maps and job reference of the fabricator and the following:
   a. A quality assurance (QA) scheme and testing regime on fabrication of the structural steelwork with the items as stipulated in STR1.W1420;
   b. A fabrication and delivery schedule.
2. An RSE appointed by the Contractor / fabrication yard who shall carry out the duties as stipulated in STR1.W1430;
3. A Quality Control Coordinator (QCC) appointed by the Contractor who shall carry out the duties as stipulated in STR1.W1440;
4. A laboratory for carrying out the tests and issuing test certificates in the QA scheme (except for those tests specified in STR1.T520 (2)), which shall be accredited either by Hong Kong Accreditation Scheme (HKAS) under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS.

STR1.W1415.9 SUBMISSIONS FOR MINOR STEEL STRUCTURES FABRICATED OFF-SITE

1. Prior to fabrication, submit for Approval proposal of a laboratory for carrying out tests and issuing test certificates for minor steel structures excepting the following tests:
   a. Tests specified in STR1.T520 (2);
   b. Tests concerned are not applicable to minor steel structure as stated in STR1.G040 (2).
2. The laboratory proposed in sub-clause (1) above shall be accredited either by Hong Kong Accreditation Service (HKAS) under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HKAS.

STR1.W1420.A QUALITY ASSURANCE (QA) SCHEME

Ensure that the steelwork is fabricated under a quality assurance scheme which covers the following items and is certified under ISO 9001:

1. Organisation chart of the fabrication yard with the qualification and experience of key technical personnel clearly stated;
2. Responsibility of the management in respect of the fabrication process;
3. Material purchasing and delivery procedures;
4. Material / product identification, traceability process and control;
5. Fabrication and inspection process;
6. Designated welders who shall be tested to and comply with the requirements of this Specification;

7. Quality control testing regime including welding procedural test and chemical analysis for welding consumables used for temporary or permanent structural steelworks on Site of steel grade as stated in STR1.M060 and shown in the structural working drawings;
8. Control on non-compliant materials and works;
9. Transportation and storage process;
10. Provision of attendances, who shall not be the Quality Control Coordinator (QCC) under the Registered Contractor's stream in the CoPSS, at the fabrication yard to assist the CM in supervising off-site fabrication of structural steel elements by videotelephony (i.e., two-way simultaneous communication with both audio and video in real time through telephone or computer network connections) as required by the CM. Responsibilities include, but are not limited to, the following:
    a. Assist in the selection and examination of samples;
    b. Handle and manoeuvre of samples;
    c. Provide videotelephony system, calibrated measuring equipment and any other equipment as required;
    d. Record video in colour with resolution of not less than 1080p on a non-rewritable DVD-ROM for ICU's inspection and checking by the CM or his representatives as and when necessary.

STR1.W1430.9 REGISTERED STRUCTURAL ENGINEER

1. Appoint an Registered Structural Engineer (RSE) registered under Buildings Department for ensuring and certifying the fabrication works are in compliance with the drawings and Specification;
2. The duties and roles of the RSE include but not limited to:
    a. Pay regular site visits for proper control of the works and submit reports after each visit;
    b. Carry out inspection on all activities which, in his professional judgement, are critical and require close supervision;
3. The frequency of RSE's visits shall be a minimum of two visits per month.

STR1.W1440.N QUALIFIED SUPERVISION

1. Assign a Quality Control Coordinator (QCC), with a minimum qualification and experience of a Grade T1 TCP under the Registered Contractor's stream in the CoPSS, to provide full-time inspection of the off-site fabrication works;
2. Submit the details of the QCC for Approval;
3. The Authorized Signatory as stipulated in PRE.B6.060 is to devise the inspection check lists.

TESTING

GENERAL REQUIREMENTS

STR1.T010.9 GENERAL

Allow sufficient time in the Works programme for the testing specified below. Do not incorporate materials until relevant tests have been carried out and Approval obtained.

STR1.T020.9 TESTING BY MANUFACTURER

Carry out inspection and testing on BS EN 10025:2004 products by cast and documentation supplied in accordance with Euronorm 21. Specific testing and documentation to include chemical analysis; tensile tests and impact tests.

STR1.T030.9 TESTING OF BOLTS, NUTS AND WASHERS

1. Testing arrangement:

   Provide test specimens and carry out testing of bolts and associated nuts and washers in accordance with the relevant BS in an Approved Laboratory employed and paid for directly by the Contractor, when so directed by the CM;

2. Testing samples:

   Rate of sampling to be one bolt per identifiable batch or 1% whichever is the lesser unless otherwise specified.

STR1.T040.9 TEST CERTIFICATES

Submission requirements:

1. Submit a manufacturer's certificate of tests in accordance with the appropriate standard for each steel batch relating to steel to be used in the works. Documentation to include chemical analysis impact test and tensile test.

STR1.T050.9 TESTING OF SECTIONS

Testing samples:

1. Provide specimens for testing which shall be in accordance with the requirements stipulated in the Code of Practice for the Structural Use of Steel 2011. In addition, provide further specimens for testing when otherwise stated in the Project Specific Specification or as Instructed. For minor steel structures, further test specimens for Class 1 Steel are not required. Test specimens to be taken from sections selected at random on Site by the CM;
2. Prepare the test specimens to BS EN 10025:2004 or BS EN 10210:2006 as directed and appropriately mark and deliver them to a Direct Testing Contractor employed and paid direct by the Authority for testing. Testing and documentation to include tensile tests and impact tests;
3. For steel sections used for construction of hoardings and associated covered walkways and gantries, the frequency of sampling stated in the sub-clauses (1) above may be reduced at the discretion of the CM.

STR1.T060.9 FAILURE OF TESTS

Non-compliance:

1. If any test specimens do not comply with the relevant BS, the CM may require further tests at the Contractor's expense or reject the whole or part of the particular consignment, which must be removed from Site forthwith.

STR1.T070.9 ULTRASONIC TESTING

When plates are subjected to through thickness tension by virtue of the type of connection, test quality grade steel plates and flats which may, as a result of welding be subject to lamellar tearing, using ultrasonic testing using equipment as described in Section 2 of BS 5996:1993 and, unless otherwise specified or agreed, be of quality LC3 as defined in Section 3 of that document.

STR1.T080.9 ABILITY OF WELDERS

1. All welders must be capable of passing the training tests to BS 1295:1987;
2. Where specified, carry out approval testing of welders by either one of the following:
    a. For welds where welding procedure approval is required to BS EN ISO 15614-1:2004: carry out approval testing of welders to BS EN 287: Part 1:2004 for steel and stainless steel and to BS EN 287:Part 2:1992 for aluminium as appropriate;
    b. For welds where welding procedure approval is not required: carry out approval testing of welders to BS 4872:Part 1:1982 for steel and stainless steel and to BS 4872:Part 2:1976 (1995) for aluminium as appropriate.
3. Submit evidence to show that all welders satisfy the requirements as stated in sub-clause (1) above.

STR1.T090.9 PARTICULARS OF INSPECTING AUTHORITY

Submit to the CM the name of the proposed inspecting authority endorsing welder certificates and records of approval tests for welding procedures. The proposed inspecting authority must be accredited by the Hong Kong Accreditation Service (HKAS) under the Hong Kong Inspection Body Accreditation Scheme (HKIAS) for welding inspection or by other accreditation bodies which have reached mutual recognition agreement for inspection body accreditation with HKAS. The name to be submitted at least 3 weeks before approval tests start or, if approval tests are not required, at the same time as the welder certificates are submitted.

STR1.T093.9 BATCH OF WELDING CONSUMABLE

In this Specification, a batch of welding consumables is the quantity of welding consumables of the same type and size, which may include one or multiple standard lot(s) as defined in the manufacturer’s quality assurance programme, delivered to the Site, or the off-site fabrication yard as one consignment that is covered by the manufacturer’s certificate(s) and under one delivery order, and shall not exceed five tonnes and twenty tonnes respectively.

STR1.T094.9 TESTING OF WELDING CONSUMABLES

For each batch of welding consumables used for temporary or permanent structural steelworks on Site of steel grade as stated in STR1.M060 and shown in the structural working drawings, prepare 2 test specimens for each standard lot and carry out the chemical analysis in accordance with BS EN ISO 2560:2009 or BS EN ISO 14341:2011 or BS EN ISO 14171:2010 or BS EN ISO 17632:2015 as appropriate, except for the standard lot(s) where complying chemical analysis results have been attained from the first chemical analysis under which circumstance no further chemical analysis is required for the same standard lot(s) in subsequent batches of welding consumables. The chemical analysis shall be carried out by an Approved laboratory, accredited either by the Hong Kong Accreditation Service (HKAS) under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or an equivalent organization which has signed a mutual recognition agreement with HKAS and is employed and paid for directly by the Contractor. Allow sufficient time for testing of welding consumables in the programme.

STR1.T095.9 ACCEPTANCE CRITERIA - WELDING CONSUMABLES

A standard lot in a batch of welding consumables is deemed to comply with the requirements of the Specification if the test results meet the requirements of BS EN ISO 2560:2009 or BS EN ISO 14341:2011 or BS EN ISO 14171:2010 or BS EN ISO 17632:2015 as appropriate. If the test results of the first chemical analysis of a standard lot complied with the requirements of the Specification, further chemical analysis on the same standard lot in all subsequent batches of welding consumables delivered to the same Site or the same off-site fabrication yard is not required.

STR1.T096.9 FAILURE OF TESTS

Non-compliance:

If any test specimen of the welding consumables does not comply with BS EN ISO 2560:2009 or BS EN ISO 14341:2011 or BS EN ISO 14171:2010 or BS EN ISO 17632:2015, the Contractor may choose to carry out further test(s) and take further test samples from the same lot of welding consumables at the Contractor's expense or remove the whole lot of the particular batch from Site and / or the fabrication yard for off-site fabrication if appropriate. If further test(s) is chosen, the number of further test(s) is to be calculated by the application of the formula given below and no extension of time will be allowed for the said further test(s). Bear the cost of such further test(s).

$$\text{number of further test(s)} = \left(n^2 - 2n + 3\right)$$

where n = total number of unsuccessful inspection(s) / test(s) progressively until all inspection(s) / test(s) is / are successful.

Typical example of calculating the number of further inspections / tests is given in Appendix I to this Worksection, for illustration purposes only.

Acceptance criteria and further actions arising from the further test(s) shall be in accordance with STR1.T095.

For a standard lot with any non-compliant chemical analysis results, chemical analysis shall be carried out for the standard lot of welding consumables, as defined in the manufacturer's quality assurance programme, subsequently delivered to the same Site or the same off-site fabrication yard regardless of the results of the further test(s).

STR1.T097.9 STANDARD FOR REJECTION

If the result of any test or any further test does not comply with the specified requirements in the Specification for any particular property, the standard lot in a batch of welding consumables is deemed failing to comply with the specified requirements for that property. Then:

1. The non-compliant standard lot in a batch of welding consumables shall be removed from Site;
2. The non-compliant standard lot in a batch of welding consumables shall be removed from the off-site fabrication yard if appropriate.

STR1.T100.9 STANDARD OF WELD PROCEDURE TESTING

Testing arrangement:

1. Unless acceptable documentation relating to the welding of similar connections is available, carry out approval testing of each welding procedure in accordance with BS EN ISO 15614-1:2004 for steel and BS EN ISO 15614-2:2005 for aluminium.

STR1.T110.9 ADDITIONAL DESTRUCTIVE WELD TESTS AS SELECTED BY THE CM

Testing arrangement:

1. Prepare specimen welds and subject to one or more of the following tests as required:
    a. Butt welds:
        i. Transverse tensile test to BS EN 895:1995;
        ii. Transverse bend tests to BS EN 910:1996 or BS 709:1983 as appropriate with the root of the weld in tension and compression respectively;
        iii. Side bend tests to BS EN 910:1996 or BS 709:1983 as appropriate;
        iv. Macro-examinations to BS 709:1983 or BS EN 1321:1997 as appropriate.
    b. Fillet welds:
        i. Fracture tests to BS 709:1983;
        ii. Macro-examinations to BS 709:1983 or BS EN 1321:1997 as appropriate.
    c. For destructive weld test, comply with the same hold time as stipulated in clause 14.3.6.4 of the Code of Practice for the Structural Use of Steel 2011;
    d. If any test specimens do not comply with the relevant BS, the CM may require further tests at the Contractor's expense or reject the whole or part of the particular consignment, which must be removed from Site forthwith.
2. Strictly follow the procedures of welding established in the successful Approval test for the Works. Carry out further Approval tests if either the material or procedure changes.

STR1.T120.A ADDITIONAL NON-DESTRUCTIVE TESTING OF STEEL, STAINLESS STEEL AND ALUMINIUM

1. Testing arrangement:
    a. Arrange for a percentage of each welder work including each welder work of temporary works stated in PRE.B10.015 to be selected by the CM and subjected to non-destructive testing as follows:
        i. Visual inspection in accordance with BS EN 970:1997;

ii. Ultrasonic in accordance with BS EN 1714:1998; or magnetic particle inspection in accordance with BS EN 1290:1998. (Not for stainless steel and aluminium);

iii. The scope and frequency of test shall be in accordance with clause 14.3.6.1 of the Code of Practice for the Structural Use of Steel 2011;

iv. For welds on steelworks of temporary works stated in PRE.B10.015, hoardings and associated covered walkways and gantries, the percentages of tests stated in the sub-clause (1)(a)(iii) above may be reduced at the discretion of the CM.

b. Comply with clause 14.3.6.4 of the Code of Practice for the Structural Use of Steel 2011 for hold time before final non-destructive testing.

2. Non-compliance:

Where any weld is judged to be unsatisfactory by the CM, a further 10% of that welder's work is to be tested. If further defects are found, then all weld in the group should be tested by the same method.

STR1.T130.9 ACCEPTANCE CRITERIA

Non-compliance:

1. Welds on steel will be rejected if they do not meet the acceptance criteria for welds stipulated in clause 14.3.6.7 of the Code of Practice for the Structural Use of Steel 2011;
2. Welds on aluminium will be rejected if they do not meet the acceptance level for welds stated in BS 8118:Part 2:1991.

STR1.T140.9 WELD REPAIR

Cut out and repair all defective welds in accordance with the Code of Practice for the Structural Use of Steel 2011 for steel or BS 8118 :Part 2:1991 for aluminium.

STR1.T150.9 ENGAGEMENT OF SPECIALIST TESTING CONTRACTOR (FOR FABRICATION ON SITE)

1. Carry out tests required to satisfy the requirements of BS 4872, BS EN 287-1:2004 and BS EN ISO 15614-1:2004 by an Approved Laboratory employed and paid for directly by the Contractor;
2. Provide samples required by the CM (STR1.T050, STR1.T110, STR1.T120 and STR1.T140) for tests by a Direct Testing Contractor employed and paid for directly by the Authority.

TESTING OF PAINTS

STR1.T210.9 SAMPLING AND TESTING

Permit authorized sampling of materials on site. Set aside unopened sealed containers of materials for testing when directed by the CM.

STR1.T220.9 PAINT SAMPLES

Testing samples:

1. Sample each batch of paints in accordance with BS 3900:Part A1:1992.

STR1.T230.9 TESTING PAINTS

Testing method:

1. Carry out the following tests on each sample as directed by the CM in STR1.T240:

BS 3900: Part C2:1994:	Surface drying test;
BS 3900: Part C3:1990:	Through dry test;
BS 3900: Part E1:1970:	Bend test;
BS 3900: Part E2:1992:	Scratch test;
BS 3900: Part E7:1974 (1992):	Resistance;
BS 3900: Part F3:1971 (1986):	Resistance to artificial weathering;
BS 3900: Part F4:1968 (1991):	Resistance to continuous salt spray;
BS 3900: Part F8:1993:	Resistance to humid atmospheres containing sulphur dioxides.

STR1.T240.9 TESTING LABORATORY

Submission requirements and testing arrangement:

1. Test certificates to be submitted to the CM before painting starts;
2. Where manufacturer's test certificates are available these may be accepted in lieu of a retest at the CM's discretion;
3. Tests for paints in STR1.T230 to be carried out by an Approved Laboratory employed and paid for directly by the Contractor.

STR1.T250.9 GLOSS FINISH

Prepare a sample panel to indicate the standard of gloss finish and obtain Approval. Ensure application matches agreed sample.

SPACE FRAMES - WARRANTIES AND TESTING

STR1.T310.9 SUITABILITY WARRANTY

If required, submit a warranty as specified in the Project Specific Specification.

STR1.T340.9 TESTING OF SECTIONS

Testing arrangement:

1. Undertake testing of steel and aluminium sections as clauses STR1.T010, STR1.T030, STR1.T050 and STR1.T060 except as specified at sub-clause (2) below;
2. Provide at least two full length samples for every aluminium section of same thickness to be used in the Works for testing to BS EN 10002-1:2001, as appropriate.

STR1.T350.9 WELDING TESTS

1. Testing of welds for steel and aluminium will be required;
2. Clauses STR1.T080 to STR1.T140 apply equally to welding of aluminium.

STR1.T360.9 PROOF LOAD TESTING

1. If in the opinion of the CM the relevant British Standards are not appropriate for the welding configuration proposed, the CM may order not more than 10% of the welded components for proof load tests at the Contractor's expense;
2. Provide suitable equipment to carry out proof load tests on welded components. Apply a tensile load uniaxially in opposite directions of a magnitude equal to the resultant of the worst combination of factored design loads multiplied by a factor of 1.3. and on removal of the test load, the deflection shall be reduced by at least 20%;
3. The weld shall be deemed to comply the requirements of this Specification when under the proof load test the weld shall exhibit no sign of crack. If any one test of a group of welded components fails to meet this Specification, then 2 additional welded components for the same group are to be subject to load proof tests. If any of these two further welded components continue to fail the test, then each welded component of the group is to be subject to proof load tests. Any cracks identified in any stage of the test are to be repaired and retested until they all satisfy the requirements;
4. A group of welded components is defined as the welds done by the particular welder within a specified period of time as decided by the CM.

STR1.T370.9 NODAL JOINTS OF SPACE FRAMES

Testing samples:

1. Provide one test specimen for every 100 or part thereof of each type of nodal joint for tensile test. The test load shall be a tensile load applied uniaxially in opposite directions of a magnitude equal to the resultant of the worst combination of factored design loads of the possible heaviest connecting member multiplied by a factor of safety of 1.3 acting on the nodal joints.

STR1.T380.9 ACCEPTANCE CRITERIA FOR NODAL JOINT TESTS

The test specimen in STR1.T370 is deemed to comply with the requirement of this Specification under the test loading if there is no sign of crack, no deformation at thread, buckling or rupture of any part of the nodal joint. On removal of the test load the deflection should reduce by at least 20%.

STR1.T390.9 FAILURE AND RE-TESTING OF NODAL JOINTS

Non-compliance:

1. The CM will reject any test specimens which do not comply with the requirements. In addition, the CM may require further tests at the Contractor's expense or reject the whole or part of the particular consignment, which must be removed from Site forthwith;
2. Carry out further tests if directed, provided the results of these further tests fulfil the test requirements, all the nodal joints represented by these tests are deemed to comply with this Specification;
3. If the result of any of these additional tests fail to fulfil the test requirements, the part of the particular consignment represented by these nodal joints must be removed from Site forthwith.

STR1.T400.9 LOADING TESTS

If in the opinion of the CM that loading tests on parts of the space frame are necessary, the CM may order proof tests in accordance with the Code of Practice for the Structural Use of Steel 2011, by an Approved Laboratory employed and paid for directly by the Contractor.

OFF-SITE FABRICATION

STR1.T510.9 TESTING AND SURVEILLANCE VISITS AT FABRICATION YARD

For off-site fabrication in Guangdong province of China, comply with the following:

1. Provide all necessary facilities and attendance required by the CM and Consultant employed for inspection and surveillance visits and the Direct Testing Contractors for carrying out the tests as stated in STR1.T520 (2) at the fabrication yard;
2. Make all necessary arrangement including providing transportation to the CM and Consultant employed for inspection and surveillance visits to the fabrication yards. Take the staff of each of the Direct Testing Contractors to the locations of the testing and / or parallel testing works for the first visit to the fabrication yards, and the Direct Testing Contractors shall arrange their own transportation for subsequent visits to the same locations of the fabrication yard.

STR1.T520.9 ENGAGEMENT OF SPECIALIST TESTING CONTRACTOR (FOR OFF-SITE FABRICATION)

For off-site fabrication, testing arrangement shall comply with the Approved quality assurance scheme and testing regime submitted in accordance with STR1.W1410. The engagement of specialist testing contractor shall comply with the following requirements:

1. Except for the testing arrangement as stated in sub-clause (2) below, all testing shall be carried out by the Approved laboratory proposed in STR1.W1410 (3), employed and paid for directly by the Contractor;
2. For off-site fabrication carried out in Guangdong province of China, comply with the following:
    a. The following tests shall be carried out by the Direct Testing Contractor employed and paid for directly by the Authority:
        i. Tensile tests and impact tests of steel sections;
        ii. Visual inspection of welds;
        iii. Ultrasonic inspection of welds;
        iv. Magnetic particle inspection of welds.
    b. Provide specimens for testing as specified in 2(a)(i) above, which shall be selected from sections at random either in the fabrication yard by the Direct Testing Contractor or on the Site by the CM or his representatives. The preparation and delivery of the test specimens from the fabrication yard or the Site to the laboratory for testing shall be carried out by the Direct Testing Contractor;
    c. Welds for testing shall be selected and tested by the Direct Testing Contractors in the fabrication yard.

APPENDIX STR1/I

STR1.APPEND1.9 CALCULATION OF NUMBER OF FURTHER INSPECTIONS / TESTS

Typical Examples for Illustrative Purposes Only

1. Chemical analysis shows 2 samples failing to meet the requirements in the Specification.

2. The Contractor can either remove the standard lot of the particular batch of welding consumables from the Site and / or the fabrication yard for off-site fabrication or at his own expense, carry out further test(s) in accordance with the formula of:

   $\left(n^2 - 2n + 3\right) = 2^2 - 2 \times 2 + 3$

   = 3 further tests

3. If one of the above 3 further tests fails, the Contractor may order further tests to be carried out at the Contractor's own expense by re-applying the formula and taking into account the total number of failed samples. Altogether and based on the formula, the number of total retesting required:

   $= 3^2 - 2 \times 3 + 3$

   $= 6$

   As 3 tests have already been carried out by the Contractor, the Contractor shall carry out:

   6 - 3 = 3 further tests

4. If the next 3 further tests show further failed samples, the formula will be re-applied as before until all the tests results are satisfactory.

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APE APPENDIX E - MODIFICATION TO DESIGN OF DOMESTIC BLOCKS

APE1 SCOPE OF APPENDIX 3
APE1.A010.9 APPLICATION 3
APE1.A020.9 TERMS AND REQUIREMENTS ON PERMITTED MODIFICATIONS PROPOSED IN TENDER STAGE 3
APE1.A030.9 TERMS AND REQUIREMENTS ON PROPOSALS FOR MODIFICATIONS IN POST-CONTRACT STAGE 3
APE1.A040.9 ACCEPTANCE CRITERIA FOR PROPOSED MODIFICATIONS 3

APE2 TERMS AND REQUIREMENTS ON PERMITTED MODIFICATIONS PROPOSED IN TENDER STAGE 4
GENERALLY 4
APE2.A010.9 APPLICATION 4
SCOPE OF MODIFICATIONS 4
APE2.A020.9 LIMITATIONS 4
APE2.A030.9 LARGE PANEL FORMWORK SYSTEM 4
APE2.A040.9 NON-MANDATORY PRECAST EXTERNAL FACADES 4
APE2.A050.9 NON-MANDATORY SEMI-PRECAST SLABS 4
APE2.A060.9 NON-MANDATORY PRECAST STAIRS 4
APE2.A070.9 MECHANISED CONSTRUCTION METHODS 4
SUBMISSIONS 5
APE2.A110.9 SUBMISSIONS - GENERALLY 5
APE2.A120.9 CONFLICT WITH SPECIFICATION 5
APE2.A130.9 MECHANISED CONSTRUCTION METHODS 5
APE2.A140.9 PROPOSED STRUCTURAL MODIFICATIONS 5
APE2.A150.9 PROGRAMME FOR FURTHER SUBMISSIONS IN POST CONTRACT STAGE 5
DESIGN RESPONSIBILITY 5
APE2.A210.9 DESIGN RESPONSIBILITY 5
BILLS OF QUANTITIES 6
APE2.A310.9 AMENDMENTS 6
APE2.A320.9 PREPARATORY WORKS FOR FINISHES 6
PRELIMINARIES ITEMS 6
APE2.A410.9 ON-SITE PLANT AND EQUIPMENT 6
INFORMATION TO TENDERERS FOR NOMINATED SUB-CONTACT AND SPECIALIST WORKS 7
APE2.A510.9 INFORMATION TO TENDERERS FOR NOMINATED SUB-CONTRACT AND SPECIALIST WORKS 7

APE3 TERMS AND REQUIREMENTS ON PROPOSALS FOR MODIFICATIONS IN POST-CONTRACT STAGE 8
GENERALLY 8
APE3.A010.9 APPLICATION 8
APE3.A020.9 TERMS AND CONDITIONS 8
SUBMISSIONS 8
APE3.A110.9 SUBMISSIONS - GENERALLY 8

APE4 ACCEPTANCE CRITERIA FOR PROPOSED MODIFICATIONS TO DESIGN AND/OR SPECIFICATION FOR DOMESTIC BLOCKS 9
DESIGN AND/OR SPECIFICATION 9
APE4.A010.9 COMPLIANCE WITH REGULATIONS 9

CONSTRUCTION 9
APE4.A110.9 INSPECTION OF WORK 9
APE4.A120.9 OPENINGS THROUGH STRUCTURAL MEMBERS 9
APE4.A130.9 INSTALLATION OF CONCEALED SERVICES 9
ACCEPTABILITY OF STRUCTURAL MODIFICATIONS 10
APE4.A210.9 CONDITIONS OF ACCEPTABILITY 10
APE4.A220.9 REDESIGN OF FOUNDATIONS 10
APE4.A230.9 STRUCTURAL MEMBER SIZES 10
APE4.A240.9 CONCRETE DESIGN 10
APE4.A250.9 REINFORCEMENT DESIGN 10
APE4.A260.9 USE OF FABRIC REINFORCEMENT 10
APE4.A270.9 PRECAST CONCRETE STAIRS 10
APE4.A280.9 NON-STRUCTURAL CONCRETE ELEMENTS 10
ACCEPTABILITY OF ARCHITECTURAL MODIFICATIONS 10
APE4.A310.9 CONDITIONS OF ACCEPTABILITY 10
APE4.A320.9 FLOOR LAYOUTS AND ELEVATIONS 11
APE4.A330.9 MODIFICATIONS TO BUILDING STRUCTURE 11
APE4.A340.9 UTILITY SERVICE ROOMS 11
APE4.A350.9 RENDER COAT TO WALLS 11
APE4.A360.9 CONCEALMENT OF ELECTRICAL WIRING 11
APE4.A370.9 EXTERNAL BUILDING FEATURES 11
APE4.A380.9 DIMENSIONS OF OPENINGS 11
APE4.A390.9 MONOLITHIC SLAB AND SCREED FINISH 11

APE1 SCOPE OF APPENDIX

APE1.A010.9 APPLICATION

1. All terms and requirements set out in this Appendix shall only be applicable to contracts with the construction of superstructure of domestic blocks.
2. All terms and requirements set out in this Appendix shall be applicable to permitted modifications or proposals for modifications to design and/or Specification for the domestic blocks.
3. Where any terms and requirements in Worksection APE4 of this Appendix are at variance with those in Worksections APE2 and APE3 of this Appendix, the terms and requirements of Worksection APE4 shall prevail.

APE1.A020.9 TERMS AND REQUIREMENTS ON PERMITTED MODIFICATIONS PROPOSED IN TENDER STAGE

Terms and requirements applicable to permitted modifications to design and/or Specification for the domestic blocks proposed by the Contractor in tender stage are specified in Worksection APE2 of this Appendix.

APE1.A030.9 TERMS AND REQUIREMENTS ON PROPOSALS FOR MODIFICATIONS IN POST-CONTRACT STAGE

Terms and requirements applicable to modifications to design and/or Specification for the domestic blocks proposed by the Contractor in post-contract stage after the notified date for commencement of the Works are specified in Worksection APE3 of this Appendix.

APE1.A040.9 ACCEPTANCE CRITERIA FOR PROPOSED MODIFICATIONS

The acceptance criteria for permitted modifications to design and/or Specification proposed by the Contractor in tender stage and for modifications to design and/or Specification for domestic blocks proposed by the Contractor in post-contract stage after the notified date for commencement of the Works are specified in Worksection APE4 of this Appendix.

APE2 TERMS AND REQUIREMENTS ON PERMITTED MODIFICATIONS PROPOSED IN TENDER STAGE

GENERALLY

APE2.A010.9 APPLICATION

All terms and requirements included in Worksection APE2 hereunder apply to permitted modifications to design and/or Specification for domestic blocks proposed by the Contractor in tender stage.

SCOPE OF MODIFICATIONS

APE2.A020.9 LIMITATIONS

1. Only modifications to design and/or Specification for domestic blocks arising as a result of complying with Items APE2.A030 to APE2.A070 inclusive are permitted in tender stage.
2. Permitted modifications proposed and submitted by the Contractor with the tender shall be in accordance with the Special Conditions of Tender and shall comply with all the requirements as specified in Worksections APE2 and APE4 of this Appendix.

APE2.A030.9 LARGE PANEL FORMWORK SYSTEM

The further use of large panel formwork system for constructing the structural walls (see CON2.D310 to CON2.D450).

APE2.A040.9 NON-MANDATORY PRECAST EXTERNAL FACADES

The use of precasting method for constructing the external facades of the domestic flat units (see Worksection CON5).

APE2.A050.9 NON-MANDATORY SEMI-PRECAST SLABS

The use of semi-precasting method for constructing the slabs to areas other than domestic flat units (see Worksection CON7).

APE2.A060.9 NON-MANDATORY PRECAST STAIRS

The use of precasting method for constructing the stairs of the domestic blocks (see Worksection CON7).

APE2.A070.9 MECHANISED CONSTRUCTION METHODS

The use of any Approved mechanised method of construction.

SUBMISSIONS

APE2.A110.9 SUBMISSIONS - GENERALLY

Submit a schedule listing any permitted modifications to the design and/or Specification for domestic blocks proposed by the Contractor in a letter attached to the Form of Tender.

APE2.A120.9 CONFLICT WITH SPECIFICATION

Submit with the tender a list of all items contained in the Specification which may conflict with the tenderer's design, and full details of proposals for any amendments or additions to the Specification.

APE2.A130.9 MECHANISED CONSTRUCTION METHODS

Submit with the tender details of any mechanised method of construction that it is intended to use.

APE2.A140.9 PROPOSED STRUCTURAL MODIFICATIONS

Submit details with the tender showing:

1. The principles of any incidental structural design modifications proposed which shall be prepared by a Registered Structural Engineer registered with the Buildings Department; and
2. Proposals for supervision of all aspects of the concrete work by Contractor's own staff and the CM.

APE2.A150.9 PROGRAMME FOR FURTHER SUBMISSIONS IN POST CONTRACT STAGE

Agree programme for submission of design calculations, framing plans, reinforcement details, etc. with the CM prior to the notified date for commencement of the Works. No change to the design principles submitted with the tender documents will be permitted.

DESIGN RESPONSIBILITY

APE2.A210.9 DESIGN RESPONSIBILITY

Notwithstanding Clause 5.15 of the General Conditions of Contract, the Contractor shall, with respect to the Contractor’s proposed modification to the design and / or Specification, be responsible for the satisfactory performance of the Works as modified by the Contractor’s proposed modifications to the design and / or Specification and shall guarantee the same to the Employer. The Contractor shall indemnify and keep indemnified the Employer, his agents and employees against any liability, claims, demands, proceedings, damage, costs, charges and expenses whatsoever in respect thereof or in relation thereto, and shall compensate the Employer for any loss or expense arising therefrom.

BILLS OF QUANTITIES

APE2.A310.9 AMENDMENTS

1. Subject to compliance with sub-clause (2) of this clause, the Contractor may, at time of tender, insert, delete or revise the description and / or quantity of the measured items within the Bills of Quantities to suit any modifications to design and / or Specification for domestic blocks proposed by him. Such insertion, deletion or revision shall be made in accordance with the Method of Measurement stated in the Preliminaries to the Bills of Quantities. The Contractor shall include a schedule in his tender showing all such revisions to the Bills of Quantities;

2.

   a. No insertion, deletion or revision shall be made to the Preliminaries to the Bills of Quantities;

   b. No insertion, deletion or revision to any provisional quantities contained in the Bills of Quantities shall be allowed to be made, although the work or works to which the provisional quantities refer may be modified by the Contractor in accordance with Worksection APE2 of this Appendix.

APE2.A320.9 PREPARATORY WORKS FOR FINISHES

Where items, such as plastering, rendering and screeding, have been deleted from the Bills of Quantities as a result of the operation of sub-clause (1) of Item APE2.A310, the cost of all preparatory work, including keying, or the use of special bonding agent, etc., as required by the CM, to receive any subsequent finish is deemed to have been included in the tender.

PRELIMINARIES ITEMS

APE2.A410.9 ON-SITE PLANT AND EQUIPMENT

1. For domestic blocks, where the precast concrete facade system involves early capital cost of major and necessary items of on-Site plant and equipment which are used intimately in association with the precast facade construction, the Contractor may make a request for special terms of payment in respect of these items and is advised to make known to the Employer at time of tender, by submitting proposals in a separate letter with his tender.

2. In this connection, the Contractor is to note that any special terms of payment proposal must be restricted to only the on-Site items of plant and equipment as described in Clause SCT10 of the Special Conditions of Tender and the amounts of these items must have been tendered in Bill No 1 - Preliminaries. The acceptance of any special terms of payment proposals shall be at the discretion of the Employer.

3. All other Preliminaries items not related to the special terms of payment proposal shall be paid in accordance with the provisions set out in Bill No 1 Preliminaries.

INFORMATION TO TENDERERS FOR NOMINATED SUB-CONTACT AND SPECIALIST WORKS

APE2.A510.9 INFORMATION TO TENDERERS FOR NOMINATED SUB-CONTRACT AND SPECIALIST WORKS

1. The Contractor shall give full information and assistance to tenderers tendering for any Nominated Sub-contract or Specialist Works on any permitted modifications to design and/or Specification for domestic blocks which may affect the submission of a tender for any such Nominated Sub-contract or Specialist Works.

2. The Contractor shall be responsible for any additional costs, claims or expenses whatsoever and howsoever arising on Nominated Sub-contracts or Specialist Works as a result of any permitted modification to design and/or Specification for domestic blocks and the Final Contract Sum shall not be adjusted in respect of any such claims.

APE3 TERMS AND REQUIREMENTS ON PROPOSALS FOR MODIFICATIONS IN POST-CONTRACT STAGE

GENERALLY

APE3.A010.9 APPLICATION

All terms and requirements included in Worksection APE3 hereunder apply to modifications to design and/or Specification for domestic blocks proposed by the Contractor in post-contract stage after the notified date for commencement of the Works.

APE3.A020.9 TERMS AND CONDITIONS

1. Any modifications proposed by the Contractor in post-contract stage after the notified date for commencement of the Works shall be submitted to the CM in accordance with Clause 11.8 of the General Conditions of Contract. Such proposals shall be treated as Requested Variation Proposals and subject to the CM's agreement under Clause 11.8 of the General Conditions of Contract.
2. The proposed modifications shall comply with all the requirements as specified in Worksections APE3 and APE4 of this Appendix.

SUBMISSIONS

APE3.A110.9 SUBMISSIONS - GENERALLY

Any modifications proposed by the Contractor shall be submitted in accordance with Clause 11.8(2) of the General Conditions of Contract. Submit with the proposal a report identifying the principles of any proposed structural modifications which shall be prepared by a Registered Structural Engineer registered with the Buildings Department.

APE4 ACCEPTANCE CRITERIA FOR PROPOSED MODIFICATIONS TO DESIGN AND/OR SPECIFICATION FOR DOMESTIC BLOCKS

DESIGN AND/OR SPECIFICATION

APE4.A010.9 COMPLIANCE WITH REGULATIONS

1. Any permitted modifications to design and/or Specification for domestic blocks including any incidental structural design modifications proposed by the Contractor in tender stage, and any modifications to design and/or Specification for domestic blocks proposed by the Contractor in post-contract stage after the notified date for commencement of the Works shall comply with the Hong Kong Buildings Ordinance and its subsidiary Regulations.
2. The structural design of any modifications to domestic blocks shall comply with the Building (Construction) Regulations, Codes of Practices, Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (PNAPs), and the Hong Kong Housing Authority Specification Library, currently in use.
3. In the event that any element of the design of modifications is not covered by the requirements in the Ordinance, Regulations and documents specified in sub-clauses (1) and (2) above or any British Standards, when instructed by the CM, the Contractor shall demonstrate by design calculation or experiment at his own expense the suitability of any such element to comply with any other proposed standard.

CONSTRUCTION

APE4.A110.9 INSPECTION OF WORK

Any proposal that may require the CM or his representative to carry out inspection of any work outside normal office hours will not be considered.

APE4.A120.9 OPENINGS THROUGH STRUCTURAL MEMBERS

Ensure that all proposed modifications allow for all openings, sleeves, etc., through structural members as shown in the Contract drawings or where necessary.

APE4.A130.9 INSTALLATION OF CONCEALED SERVICES

Ensure that all proposed modifications allow for installation of all concealed building services provisions in concrete, brickwork and blockwork where required under the Contract.

ACCEPTABILITY OF STRUCTURAL MODIFICATIONS

APE4.A210.9 CONDITIONS OF ACCEPTABILITY

The following clauses in this sub-section are subject to all the conditions stated elsewhere in the Appendix.

APE4.A220.9 REDESIGN OF FOUNDATIONS

Redesign of the foundation is not permitted.

APE4.A230.9 STRUCTURAL MEMBER SIZES

Reduction to structural member sizes is not permitted. Increase to structural member sizes shall be subject to Approval.

APE4.A240.9 CONCRETE DESIGN

Change to lower concrete grades and/or smaller concrete covers to reinforcing bars are not permitted.

APE4.A250.9 REINFORCEMENT DESIGN

Modification to reinforcement design, except to suit any permitted modification to structural concrete design, is not permitted.

APE4.A260.9 USE OF FABRIC REINFORCEMENT

Fabric reinforcement may be substituted for bar reinforcement providing that the fabric reinforcement complies with all requirements of the Specification. In the event that a change to design is required to suit a proprietary mesh, the cross sectional area of the reinforcement in the fabric shall not, in any location, be less than the designed area of steel/m² for bar reinforcement for that location.

APE4.A270.9 PRECAST CONCRETE STAIRS

Where a staircase flight is required to be constructed as precast concrete, a redesign of the staircase flight to insitu concrete is not permitted. However, modifications to the joints between the precast concrete flight and the insitu concrete landing may be made but such modifications will be subject to Approval.

APE4.A280.9 NON-STRUCTURAL CONCRETE ELEMENTS

In accordance with CON4.M010 to CON4.M030, non-structural concrete elements which are not shown on the Structural Framing Plans may be substituted with precast concrete providing that such precast concrete complies with all requirements of the Specification.

ACCEPTABILITY OF ARCHITECTURAL MODIFICATIONS

APE4.A310.9 CONDITIONS OF ACCEPTABILITY

The following clauses in this sub-section are subject to all the conditions stated elsewhere in this Appendix.

APE4.A320.9 FLOOR LAYOUTS AND ELEVATIONS

Unless otherwise specified in the Contract, modification to floor layouts and elevations is not permitted.

APE4.A330.9 MODIFICATIONS TO BUILDING STRUCTURE

Internal non-structural walls may be constructed as a later separate operation, and may be constructed of precast concrete, or solid concrete blocks plastered both sides. For any proposed design changes to internal non-structural walls provide at least the same performance standards as the walls shown on the tender drawings.

APE4.A340.9 UTILITY SERVICE ROOMS

Notwithstanding the provisions of Item APE4.A330 above, no modification or change to utility service rooms will be permitted.

APE4.A350.9 RENDER COAT TO WALLS

For domestic blocks, all walls receiving a tile or paint finish include a 10 mm render coat unless otherwise specified. Under no circumstances is this render coat to be omitted. Pay special attention to spatterdash in accordance with the Specification to ensure adequate key for this render coat.

APE4.A360.9 CONCEALMENT OF ELECTRICAL WIRING

For domestic blocks, electrical wiring is all by concealed conduit in walls and slabs and shall comply with the requirements of the Code of Practice for the Electricity (Wiring) Regulations published by the Electrical and Mechanical Services Department. No modifications to the layout will be permitted without prior Approval.

APE4.A370.9 EXTERNAL BUILDING FEATURES

Do not omit any external building features. Any non-structural external elements may be constructed later as a separate operation.

APE4.A380.9 DIMENSIONS OF OPENINGS

Do not vary the dimensions shown on the tender drawings for all doors, windows and other openings.

APE4.A390.9 MONOLITHIC SLAB AND SCREED FINISH

Monolithic slab and screed finish is acceptable subject to the following conditions:

1. Floor level and falls being maintained as shown on the tender drawings;
2. The removal of any stains, marks, scratches or foreign matter left on the cast floors and making good to the satisfaction of the CM. Should there be any floors which, in the opinion of the CM, were not properly prepared or which were left with a bowed floor surface with a surface which is excessively marked, cut back the entire floor surface by 25 mm and lay a 25 mm cement sand screeding at no extra cost; and
3. Permission to use a monolithic floor finish will be withdrawn should the CM consider, at any time, that the general standard of floor finish is unacceptable. No monetary claims whatsoever will be entertained or extensions of time granted in the event of such a withdrawal of permission.

APH APPENDIX H - SCHEDULE OF TOLERANCES

APH APPENDIX H - SCHEDULE OF TOLERANCES 9

INTRODUCTION 9
TOL.INTRO1.9 INTRODUCTION 9

TOL.BRI - BRIDGE WORKS 10
TOL.BRI.010.9 BRIDGE BEARINGS 10
TOL.BRI.020.9 VEHICULAR PARAPETS 10
TOL.BRI.030.9 FABRICATED MOVEMENT JOINTS 10

TOL.BSW - WORK FOR ELECTRICAL AND MECHANICAL INSTALLATIONS 11
TOL.BSW.010.9 FLOORS OF SWITCHGEAR ROOMS 11
TOL.BSW.020.9 LAMP STANDARDS 11

TOL.COM1 - STAINLESS STEEL WINDOWS, DOORS AND LOUVRES 12
TOL.COM1.010.9 DESIGN CLEARANCE 12
TOL.COM1.020.9 VERTICALITY 12

TOL.COM2 - ALUMINIUM WINDOWS AND LOUVRES 13
TOL.COM2.010.9 DIMENSION 13
TOL.COM2.020.9 VERTICALITY 13

TOL.COM5 - TIMBER DOORSETS 14
DOORSETS 14
TOL.COM5.010.9 WORKSIZES 14
DOOR LEAVES 14
TOL.COM5.110.9 HEIGHT 14
TOL.COM5.120.9 WIDTH 14
TOL.COM5.130.9 THICKNESS 14
TOL.COM5.140.9 DOORSTOP WIDTH 14
TOL.COM5.150.9 REBATE DEPTH 14
TOL.COM5.160.9 CLEARANCES 14
TOL.COM5.170.9 SQUARENESS 15
TOL.COM5.180.9 FLATNESS 15
TOL.COM5.190.9 SMOOTHNESS 15
DOOR FRAMES 15
TOL.COM5.210.9 BOW 15
TOL.COM5.220.9 SPRING 15
INSTALLATION OF FRAMES AND SUB-FRAMES 16
TOL.COM5.230.9 PD FROM LEVEL OR VERTICALITY 16

TOL.COM6 - METAL DOORS 17
TOL.COM6.010.9 DESIGN CLEARANCE 17
TOL.COM6.020.9 VERTICALITY 17

TOL.COM7 - GATESETS 18
GATE AND FRAME 18
TOL.COM7.010.9 VERTICALITY AND SQUARENESS 18

TOL.COM9 - COOKING BENCH / SINK UNITS 19
PRODUCT ACCURACY 19
TOL.COM9.010.9 CROSS SECTION AND LINEAR DIMENSIONS 19
TOL.COM9.020.9 STRAIGHTNESS OR BOW DIMENSIONS 19
TOL.COM9.030.9 TWIST 19
TOL.COM9.040.9 SQUARENESS OF CORNER 19
TOL.COM9.050.9 FLATNESS 19

ERECTION ACCURACY 19
TOL.COM9.110.9 LINES AND LEVEL 19

TOL.CON1 - INSITU CONCRETE 20

UNREINFORCED/REINFORCED CONCRETE FOUNDATION (INCLUDING RAFTS, GROUND BEAMS, COLUMN BASES, PILE CAPS AND STRIP FOUNDATIONS) 20
TOL.CON1.010.9 POSITION ON PLAN 20
TOL.CON1.020.9 DIMENSION ON PLAN 20
TOL.CON1.030.9 UPPER SURFACE LEVEL 20
TOL.CON1.040.9 CAST-IN FOUNDATION BOLTS 20

ELEMENTS OR COMPONENTS ABOVE FOUNDATIONS (EXCEPT LIFTWELLS AND STAIRS) 20
TOL.CON1.110.9 POSITION ON PLAN 20
TOL.CON1.120.9 SIZE AND SHAPE OF ELEMENT 20
TOL.CON1.130.9 VERTICALITY OF WALL AND COLUMNS 21
TOL.CON1.140.9 SURFACE PROFILE OF WALLS AND SLAB SOFFITS 21
TOL.CON1.150.9 GRADUAL IRREGULARITIES 21
TOL.CON1.160.9 ABRUPT IRREGULARITIES 21
TOL.CON1.170.9 TWIST 21
TOL.CON1.180.9 SQUARENESS OF CORNERS 22
TOL.CON1.200.9 LEVEL 22
TOL.CON1.210.9 ITEMS CAST IN 22

LIFTWELLS 22
TOL.CON1.310.9 POSITION ON PLAN 22
TOL.CON1.320.9 STRUCTURAL LIMITS OF WELL ACCURACY AT ANY LEVEL 22
TOL.CON1.330.9 LANDING DOOR OPENINGS 23
TOL.CON1.340.9 ABRUPT IRREGULARITIES OF WALLS 23

INSITU STAIRS (FLIGHT FROM LANDING TO LANDING) 23
TOL.CON1.410.9 POSITION ON PLAN 23
TOL.CON1.420.9 LENGTH 23
TOL.CON1.430.9 WIDTH OF FLIGHT 23
TOL.CON1.440.9 HEIGHT 23
TOL.CON1.450.9 WAIST THICKNESS 23
TOL.CON1.460.9 RISE 23
TOL.CON1.470.9 GOING 24
TOL.CON1.480.9 TREAD LEVEL 24

OPENINGS (EXCLUDING LIFT OPENINGS) - ALL BLOCK TYPES 24
TOL.CON1.510.9 POSITION ON ELEVATION 24
TOL.CON1.520.9 POSITION ON PLAN 24

OPENINGS (EXCLUDING LIFT OPENINGS) - HARMONY BLOCKS ONLY 24
TOL.CON1.610.9 FAIRFACED CONCRETE WALL OPENING IN FLAT A AND D 24
TOL.CON1.620.9 DOOR, WINDOW AND OTHER OPENINGS 24

OPENINGS (EXCLUDING LIFT OPENINGS) - BLOCK TYPES EXCEPT HARMONY 25
TOL.CON1.710.9 DOOR, WINDOW AND OTHER OPENINGS 25
TOL.CON1.720.9 PLUMBNESS OF JAMBS 25
TOL.CON1.730.9 LEVEL OF SILL OR SOFFIT 25

OVERALL DIMENSIONS OF A CONCRETE FRAMED BUILDING 25
TOL.CON1.810.9 LENGTH AND WIDTH 25
TOL.CON1.820.9 HEIGHT 25

TOL.CON2 - FORMWORK 26

FORMWORK TO FOUNDATIONS (INCLUDING RAFTS, GROUND BEAMS, COLUMN BASES, PILE CAPS AND STRIP FOUNDATIONS) 26
TOL.CON2.010.9 DIMENSION ON PLAN 26

FORMWORK TO ELEMENTS OR COMPONENTS ABOVE FOUNDATIONS 26
TOL.CON2.110.9 SIZE AND SHAPE OF ELEMENTS 26
TOL.CON2.120.9 ABRUPT IRREGULARITIES 26
TOL.CON2.130.9 TWIST 27
TOL.CON2.140.9 SQUARENESS OF CORNER 27

TOL.CON3 - REINFORCEMENT 28
TOL.CON3.020.9 TOLERANCES TO CONCRETE COVER - GENERALLY 28
TOL.CON3.030.9 TOLERANCES TO CONCRETE COVER - STARTER BARS 28
TOL.CON3.040.9 SPACING 28
TOL.CON3.050.9 ANCHORAGE, LAP LENGTH AND CURTAILMENT 28
TOL.CON3.060.9 CUTTING AND BENDING 28

TOL.CON4 - PRECAST CONCRETE 29
TOL.CON4.010.9 ALL ELEMENTS (UNLESS OTHERWISE SPECIFIED) 29

STAIRS TO STANDARD DOMESTIC (FLIGHT FROM LANDING TO LANDING) 29
TOL.CON4.110.9 POSITION ON PLAN 29
TOL.CON4.120.9 LENGTH 29
TOL.CON4.130.9 WIDTH OF FLIGHT 29
TOL.CON4.140.9 HEIGHT 29
TOL.CON4.150.9 WAIST THICKNESS 29
TOL.CON4.160.9 RISE 29
TOL.CON4.170.9 GOING 29
TOL.CON4.180.9 TREAD LEVEL 29

TOL.CON5 - PRECAST FACADE UNITS 30

CASTING FACADE UNITS 30
TOL.CON5.010.9 DEVIATIONS FROM DESIGN DIMENSIONS 30
TOL.CON5.020.9 SQUARENESS 30
TOL.CON5.030.9 TWIST 30
TOL.CON5.040.9 POSITION OF CAST-IN WINDOW FRAMES 31

INSTALLING FACADE UNITS 31
TOL.CON5.110.9 ERECTION TOLERANCES 31

TOL.CON7 - PRECAST CONCRETE COMPONENTS 32

CASTING FACADE AND PRECAST CONCRETE WALL UNITS 32
TOL.CON7.010.9 DEVIATIONS FROM DESIGN DIMENSIONS 32
TOL.CON7.020.9 SQUARENESS 32
TOL.CON7.030.9 TWIST 33
TOL.CON7.040.9 POSITION OF CAST-IN WINDOW FRAMES 33

INSTALLING FACADE AND PRECAST CONCRETE WALL UNITS 33
TOL.CON7.110.9 ERECTION TOLERANCES 33

STAIRS TO STANDARD DOMESTIC (FLIGHT FROM LANDING TO LANDING) 33
TOL.CON7.210.9 POSITION ON PLAN 33
TOL.CON7.220.9 LENGTH 33
TOL.CON7.230.9 WIDTH OF FLIGHT 34
TOL.CON7.240.9 HEIGHT 34
TOL.CON7.250.9 WAIST THICKNESS 34
TOL.CON7.260.9 RISE 34
TOL.CON7.270.9 GOING 34
TOL.CON7.280.9 TREAD LEVEL 34

TOL.CON8 - VOLUMETRIC PRECAST CONCRETE COMPONENTS FOR DOMESTIC BLOCKS 35

OVERALL TOLERANCES - GENERAL 35
TOL.CON8.010.9 POSITION ON PLAN 35
TOL.CON8.020.9 LENGTH AND WIDTH 35
TOL.CON8.030.9 HEIGHT 35
TOL.CON8.040.9 VERTICALITY OF WALL AND COLUMNS 35
TOL.CON8.050.9 SURFACE PROFILE OF WALLS AND SLAB SOFFITS 35
TOL.CON8.060.9 TWIST 36
TOL.CON8.070.9 SQUARENESS OF CORNERS 36
TOL.CON8.080.9 LEVEL 36
OVERALL TOLERANCES - LIFTWELLS 36
TOL.CON8.110.9 POSITION ON PLAN 36
TOL.CON8.120.9 STRUCTURAL LIMITS OF WELL ACCURACY AT ANY LEVEL 36
TOL.CON8.130.9 LANDING DOOR OPENINGS 37
TOL.DRA1 - DRAINAGE ABOVE GROUND 38
TOL.DRA1.010.9 VERTICALITY 38
TOL.DRA2 - DRAINAGE BELOW GROUND 39
PIPELINES (EXCLUDING TERMINATION PIPES) 39
TOL.DRA2.010.9 GRAVITY PIPELINES 39
TOL.DRA2.020.9 PRESSURE PIPELINES 39
TERMINATION PIPES 39
TOL.DRA2.110.9 TERMINATION PIPES 39
MANHOLES 39
TOL.DRA2.210.9 MANHOLE COVERS 39
TOL.EAR1 - EXCAVATION AND FILLING 40
EARTHWORKS FINAL SURFACE TOLERANCES 40
TOL.EAR1.010.9 GENERAL 40
TOL.EAR1.020.9 SETTING OUT 40
TOL.EAR1.030.9 BULK EXCAVATION/FILLING 40
TOL.EAR1.040.9 FOUNDATION PITS AND TRENCHES 41
TOL.EAR2 - BLASTING 42
PRE-SPLIT BLASTING 42
TOL.EAR2.010.9 FINAL SURFACE TOLERANCES 42
TOL.EXT1 - SUB-BASES, BITUMINOUS ROADWAYS AND RELATED FOOTPATHS 43
TOL.EXT1.010.9 ALIGNMENT 43
TOL.EXT1.020.9 MEASUREMENT OF LEVELS 43
TOL.EXT1.030.9 TOLERANCES IN LEVELS FOR EACH TYPE OF LAYER 43
TOL.EXT1.040.9 SURFACE LEVELS AT JOINTS 43
TOL.EXT1.050.9 COMBINATION OF TOLERANCES 43
TOL.EXT1.060.9 LEVELS OF GULLY GRATINGS 43
TOL.EXT1.070.9 LEVELS OF COVERS, FRAMES AND OTHER HARDWARE 43
TOL.EXT1.080.9 SURFACE REGULARITY 44
TOL.EXT2 - CONCRETE CARRIAGEWAYS 45
TOL.EXT2.010.9 STRAIGHT ALIGNMENT 45
TOL.EXT2.020.9 CURVED ALIGNMENT 45
TOL.EXT2.030.9 ALIGNMENT OF JOINTS 45
TOL.EXT2.040.9 LEVEL OF SUB-BASE 45
TOL.EXT2.050.9 FORMWORK 45
TOL.EXT2.060.9 COVER TO REINFORCEMENT 45
TOL.EXT2.070.9 DOWEL BARS 45

TOL.EXT2.080.9 GROOVE DEPTH 46
TOL.EXT2.090.9 LEVELS 46
TOL.EXT2.100.9 SLAB THICKNESS 46
TOL.EXT2.110.9 LEVEL OF COVERS, FRAMES AND OTHER HARDWARE 46

TOL.EXT3 - PATHS AND PAVED AREAS 47

MATERIALS 47
TOL.EXT3.010.9 INTERLOCKING CONCRETE BLOCKS 47
TOL.EXT3.020.9 PRECAST CONCRETE PAVING SLABS 47
TOL.EXT3.030.9 CLAY PAVERS 47

WORKMANSHIP 47
TOL.EXT3.110.9 INTERLOCKING CONCRETE BLOCKS, PRECAST CONCRETE PAVING SLABS AND CLAY PAVERS 47
TOL.EXT3.120.9 INSITU CONCRETE SURFACE FINISH 48

TOL.EXT5 - KERBS, EDGINGS AND QUADRANTS 49
TOL.EXT5.010.9 LINE 49
TOL.EXT5.020.9 TOP LEVEL 49
TOL.EXT5.030.9 IN SITU SURFACE FINISH 49
TOL.EXT5.040.9 ACCURACY OF PRECAST UNITS 49

TOL.EXT6 - CONCRETE PROFILE BARRIERS 50
TOL.EXT6.010.9 HORIZONTAL DIMENSIONS OF CROSS SECTIONS 50
TOL.EXT6.020.9 VERTICAL DIMENSIONS OF CROSS SECTIONS 50
TOL.EXT6.030.9 HORIZONTAL ALIGNMENT 50
TOL.EXT6.040.9 FORMATION LEVEL 50
TOL.EXT6.050.9 BARRIER TOP LEVEL 50
TOL.EXT6.060.9 ABRUPT IRREGULARITIES 50

TOL.EXT7 - UNTENSIONED BEAM BARRIERS 51

MATERIALS 51
TOL.EXT7.010.9 BASE METAL THICKNESS 51
TOL.EXT7.020.9 STRIP WIDTH 51
TOL.EXT7.030.9 CAMBER 51
TOL.EXT7.040.9 DISTORTION 51
TOL.EXT7.050.9 ANGLES AT BENDS 51
TOL.EXT7.060.9 STEEL POSTS 51
TOL.EXT7.070.9 CLEAT AND STRUTS 51

WORKMANSHIP 51
TOL.EXT7.110.9 INSTALLATION 51

TOL.EXT8 - ROAD MARKING 52

THICKNESSES AND TOLERANCES 52
TOL.EXT8.010.9 SCREED MARKINGS 52
TOL.EXT8.020.9 WIDTH AND LENGTH 52

TOL.EXT9 - FENCING, GATES AND GUARD RAILS 53

FENCING 53
TOL.EXT9.010.9 MATERIALS 53
TOL.EXT9.020.9 WORKMANSHIP 53

PEDESTRIAN GUARD RAILS 53
TOL.EXT9.110.9 ALIGNMENT 53

TOL.FEN - FENCING 54
TOL.FEN.010.9 GENERAL 54

TOL.FIN1 - PLASTERED AND RENDERED FINISHES 55

INTERNAL AND EXTERNAL WALL FINISHES 55
TOL.FIN1.010.9 EVENNESS AND PLUMB 55
CEILING FINISHES 55
TOL.FIN1.110.9 LINE AND LEVEL 55
TOL.FIN2 - PLASTERBOARD 56
TOL.FIN2.010.9 BRITISH STANDARD 56
TOL.FIN3 - SCREEDS 57
TOL.FIN3.010.9 LEVEL 57
TOL.FIN4 - INSITU WALL AND FLOOR FINISHES 58
TOL.FIN4.010.9 LEVEL 58
TOL.FIN5 - FLOOR AND WALL TILES AND SLABS 59
FLOOR TILES AND SLABS 59
TOL.FIN5.010.9 LEVEL 59
TOL.FIN5.020.9 LEVEL OF ADJACENT TILES 59
TOL.FIN5.030.9 ALIGNMENT OF JOINTS 59
WALL TILES 59
TOL.FIN5.110.9 PLANE 59
TOL.FIN5.120.9 PLANE OF ADJACENT TILES 59
TOL.FIN5.130.9 ALIGNMENT OF JOINTS 59
MOSAIC TILES 59
TOL.FIN5.210.9 PLANE 59
TOL.FIN5.220.9 PLANE OF ADJACENT TILES 59
TOL.FIN5.230.9 ALIGNMENT OF JOINTS 60
TOL.FIN6 - FLEXIBLE SHEET AND TILE FINISHES 61
TOL.FIN6.010.9 LEVEL 61
TOL.FIN8 - PROPRIETARY SUSPENDED CEILINGS 62
INSTALLED CEILING SYSTEM 62
TOL.FIN8.010.9 LINE AND LEVEL 62
TOL.FIN8.020.9 ALIGNMENT OF JOINTS 62
TOL.FIN8.030.9 DEFLECTION OF MAIN MEMBERS 62
CEILING COMPONENTS 62
TOL.FIN8.110.9 STRUCTURAL MEMBERS AND GRIDS 62
TOL.FIN8.120.9 INFILL UNITS 62
TOL.GIN - GROUND INVESTIGATION, INSTRUMENTATION AND SOIL TESTING 63
TOL.GIN.010.9 DEPTHS OF EXPLORATION 63
TOL.GIN.020.9 VERTICAL TOLERANCE 63
TOL.GWD - GROUND WATER DRAINAGE AND CONTROL 64
TOL.GWD.010.9 DRILLING 64
TOL.MAR - MARINE WORKS 65
TOL.MAR.010.9 DREDGING 65
TOL.MAR.020.9 DEPOSITION OF FILL MATERIAL 65
TOL.MAR.030.9 PRECAST CONCRETE SEAWALL BLOCKS AND COPINGS 65
TOL.MAR.040.9 TIMBER FENDERING SYSTEMS 65
TOL.MAR.050.9 RUBBER FENDERS 65
TOL.MAR.060.9 SUBMARINE OUTFALLS 66
TOL.MAS1 - BRICKWORK, BLOCKWORK AND PANEL PARTITIONS 67

BRICKWORK **67**
TOL.MAS1.010.9 GENERALLY 67
BRICKWORK AND PANEL PARTITIONS **67**
TOL.MAS1.110.9 POSITION ON PLAN 67
TOL.MAS1.120.9 LENGTH 67
TOL.MAS1.130.9 HEIGHT 67
TOL.MAS1.140.9 LEVEL OF BED JOINTS 67
TOL.MAS1.150.9 THICKNESS OF BED JOINTS 67
TOL.MAS1.160.9 STRAIGHTNESS 67
TOL.MAS1.170.9 VERTICALITY 67
TOL.MAS1.180.9 SETTING-OUT OF PRE-INSTALLED JUNCTION/BS 4662 BOXES ON WALLS 68
OPENINGS IN BRICKWORK, BLOCKWORK AND PANEL PARTITIONS **68**
TOL.MAS1.210.9 OPENINGS FOR DOORS, WINDOWS ETC. 68
MANUFACTURING OF PANEL WALL PARTITIONS **68**
TOL.MAS1.310.9 MANUFACTURING OF PANEL WALL PARTITIONS 68
TOL.MAS2 - STONEWORK **69**
RUBBLE STONE WALLING **69**
TOL.MAS2.010.9 POSITION ON PLAN 69
TOL.MAS2.020.9 LENGTH 69
TOL.MAS2.030.9 HEIGHT 69
TOL.MAS2.040.9 LEVEL OF BED JOINTS 69
TOL.MAS2.050.9 STRAIGHTNESS 69
TOL.MAS2.060.9 VERTICALITY 69
ASHLAR STONE WALLING **69**
TOL.MAS2.110.9 POSITION ON PLAN 69
TOL.MAS2.120.9 LENGTH 69
TOL.MAS2.130.9 OVERALL HEIGHT 69
TOL.MAS2.140.9 LEVEL OF BED JOINTS 69
TOL.MAS2.150.9 STRAIGHTNESS 69
TOL.MAS2.160.9 VERTICALITY 69
TOL.MAS2.170.9 WINDOW AND DOOR OPENINGS 70
NATURAL STONE CLADDING - WORKMANSHIP IN PRODUCTION **70**
TOL.MAS2.210.9 FACE DIMENSIONS 70
TOL.MAS2.220.9 THICKNESSES 70
TOL.MAS2.230.9 BOW OR TWIST 70
NATURAL STONE CLADDING - ERECTION **70**
TOL.MAS2.310.9 POSITION ON PLAN 70
TOL.MAS2.320.9 LENGTH 70
TOL.MAS2.330.9 OVERALL HEIGHT 70
TOL.MAS2.340.9 LEVEL OF BED JOINTS 70
TOL.MAS2.350.9 STRAIGHTNESS 70
TOL.MAS2.360.9 VERTICALITY 70
TOL.MAS2.370.9 WINDOW AND DOOR OPENINGS 71
TOL.MEW - METALWORK **72**
TOL.MEW.010.9 GENERAL 72
TOL.MRY - MASONRY WALLING **73**
TOL.MRY.010.9 GENERAL 73
TOL.PIL1 - PILING AND FOOTINGS **74**
ALL PILE TYPES **74**
TOL.PIL1.010.9 POSITION ON PLAN 74

TOL.PIL1.020.9 VERTICALITY 74
TOL.PIL1.030.9 OUT OF EXACT INCLINATION 74
TOL.PIL1.040.9 CUT-OFF LEVELS 74
TOL.PIL1.050.9 DIAMETER OF CAST INSITU PILES 74

PILE TYPES 1A AND 1B 74
TOL.PIL1.110.9 DIMENSIONAL ACCURACY FOR SOLID NON-CIRCULAR SECTION 74
TOL.PIL1.120.9 DIMENSIONAL ACCURACY FOR HOLLOW CYLINDRICAL SECTION 74
TOL.PIL1.130.9 STRAIGHTNESS 74
TOL.PIL1.140.9 SUPERFICIAL CRACKS 75

PILE TYPE 3 75
TOL.PIL1.160.9 DIAMETER OF PERMANENT LINERS 75

PILE TYPE 4 75
TOL.PIL1.210.9 STRAIGHTNESS OF COMPLETE PILE 75

PILE TYPE 5 75
TOL.PIL1.310.9 BORING 75
TOL.PIL1.305.9 POSITION ON PLAN 75
TOL.PIL1.330.9 VERTICALITY 75

TOL.PLU2 - SANITARY APPLIANCES 76
TOL.PLU2.010.9 HORIZONTALITY OF INSTALLATION 76

TOL.PSC - PRESTRESSING CONCRETE 77
TOL.PSC.010.9 TOLERANCES 77

TOL.SLO - SLOPE TREATMENT WORKS 78

SOIL-CEMENT FILLING 78
TOL.SLO.010.9 COMPACTION 78

SOIL NAILING 78
TOL.SLO.110.9 GENERAL 78

TOL.STR1 - STRUCTURAL STEEL 79

FABRICATION OF STEELWORK 79
TOL.STR1.010.9 CRITICAL DIMENSIONS AFFECTING REPETITION OR INTERCHANGEABILITY OF UNITS 79
TOL.STR1.020.9 DETAILED DIMENSIONS 79

ERECTION OF STEELWORK 79
TOL.STR1.110.9 CAST-IN FOUNDATION BOLTS 79
TOL.STR1.120.9 ERECTION TOLERANCES 79

TOL.STW - STEELWORK 81
TOL.STW.010.9 FABRICATION TOLERANCES GENERALLY 81
TOL.STW.020.9 FABRICATION TOLERANCES FOR BRIDGEWORKS 81
TOL.STW.030.9 FOUNDATION BOLTS 81
TOL.STW.040.9 ERECTION TOLERANCES 81

TOL.WSP - WATER SUPPLY PIPEWORK 82
TOL.WSP.010.9 LINE AND LEVEL 82

APH APPENDIX H - SCHEDULE OF TOLERANCES

INTRODUCTION

TOL.INTRO1.9 INTRODUCTION

1. FORMAT: This Schedule is prepared as an Appendix so that it is in a convenient form to use as a reference document by those concerned with site quality control during the construction stage of HKHA projects. However the Schedule is divided into the same Worksections as those used in the main body of the Specification; this facilitates easy division and attachment to Specification Worksections by main contractors for sub-contract tendering purposes;
2. PRECEDENCE: This Schedule shall not take precedence over any conflicting or variation tolerances given in other parts of this Specification or shown on the Drawings;
3. DEFINITIONS: The following are definitions of terms used in this Schedule of Tolerances:
    a. MASTER BENCH MARK (MBM): The level datum from which all levels on site are derived;
    b. TRANSFERRED BENCH MARK (TBM): Subsidiary level datum derived from the master bench mark;
    c. BOW: Curvature of the length or width of the component expressed as a deviation from a straight line connecting the extremities;
    d. DEVIATION: Difference between a size or position (actual, limit etc) and a specified size or position;
    e. PERMISSIBLE DEVIATION (PD): Specified limit(s) of deviation;
    f. TOLERANCE: Difference between the limits within which a size or position must lie. The tolerance is an absolute value without sign but the dimension or axis is to which it applies must be stated.

TOL.BRI - BRIDGE WORKS

TOL.BRI.010.9 BRIDGE BEARINGS

1. The centreline of bridge bearings shall be within 3 mm of the specified position;
2. The level of bridge bearings shall be within 0.0001 times the adjacent span or the lesser of the adjacent spans or with 5 mm of the specified level, whichever is less;
3. The inclination of bridge bearings shall be within 1 in 200 of the specified inclination;
4. The horizontal axis of bridge bearings shall be within 0.005 radian of the specified alignment;
5. Departure from the common plane between twin or multiple bridge bearings shall be within the tolerances stated on the Drawings.

TOL.BRI.020.9 VEHICULAR PARAPETS

Vehicular parapets shall be within 10 mm of the specified position and height.

TOL.BRI.030.9 FABRICATED MOVEMENT JOINTS

The surface of fabricated movement joints shall be at least 1 mm, and not more than 3 mm, below the surrounding road surface.

TOL.BSW - WORK FOR ELECTRICAL AND MECHANICAL INSTALLATIONS

TOL.BSW.010.9 FLOORS OF SWITCHGEAR ROOMS

The tolerance in floor levels for switchgear rooms shall be as follows:

1. ±2 mm in 1000 mm for high voltage switchgear rooms;
2. ±4 mm in 1000 mm for medium voltage switchgear rooms.

TOL.BSW.020.9 LAMP STANDARDS

Lamp standards shall be within 0.1 degrees of the vertical.

TOL.COM1 - STAINLESS STEEL WINDOWS, DOORS AND LOUVRES

		TOLERANCE
TOL.COM1.010.9	**DESIGN CLEARANCE**	
	PD of the clearance between the frame and the structure opening at the:	
	1. Jamb	+5 mm : -10 mm
	2. Head	+8 mm : -10 mm
	3. Sill	+2 mm : -3 mm
TOL.COM1.020.9	**VERTICALITY**	
	PD of frame from plumb in any 1.2 m length	±3 mm

TOL.COM2 - ALUMINIUM WINDOWS AND LOUVRES

		TOLERANCE
TOL.COM2.010.9	**DIMENSION**	
1.	PD for peripheral dimensions:	
a.	Length <2 m:	±1.0 mm
b.	Ditto ≥2 m <3.5 m:	±1.5 mm
c.	Ditto ≥3.5 m <5 m:	±2.0 mm
d.	Ditto ≥5 m:	±3.0 mm
2.	PD for step joint:	+0.5 mm : 0 mm
3.	PD for diagonal dimensions:	
a.	Length <2 m:	±1.5 mm
b.	Ditto ≥2 m <3.5 m:	±2.5 mm
c.	Ditto ≥3.5 m:	±3.5 mm
4.	Aluminum wall thickness:	
a.	Structural members:	+0.16 mm : 0 mm
b.	Non-structural members:	+0.16 mm : 0 mm
c.	Glazing bead	±0.1 mm
TOL.COM2.020.9	**VERTICALITY**	
	PD from plumb in any 1.2 m length	±3 mm

TOL.COM5 - TIMBER DOORSETS

NOTE: 1. Read the tolerances given in this section in conjunction with the dimensional requirements specified in BS 4787:Part 1:1980 unless otherwise specified on the Drawings. Dimension references given in brackets relate to these used in this BS;

2. Where smoke seals are to be used, other clearance sizes and related permissible deviations between door leaf and jamb, head, transom and sill may be specified.

DOORSETS

		TOLERANCE
TOL.COM5.010.9	**WORKSIZES**	
	PD from doorset worksizes specified in BS 4787:Part 1:1980:	
	1. Height (A2 and G2)	+2.5 mm : -2.5 mm
	2. Width (B2)	+2.5 mm : -2.5 mm

DOOR LEAVES

		TOLERANCE
TOL.COM5.110.9	**HEIGHT**	
	PD for leaves in all doorsets (d3)	+2.5 mm : -2.5 mm
TOL.COM5.120.9	**WIDTH**	
	PD for leaves in single or double equal leaf doorsets (e3)	+2.5 mm : -2.5 mm
TOL.COM5.130.9	**THICKNESS**	
	PD for all leaf thicknesses (f3):	
	1. Internal doorsets	+1.0 mm : -2.0 mm
	2. External doorsets	+1.5 mm : -1.5 mm
TOL.COM5.140.9	**DOORSTOP WIDTH**	
	1. Internal doorsets	+2.0 mm : -2.0 mm
	2. External doorsets	+2.0 mm : -0 mm
TOL.COM5.150.9	**REBATE DEPTH**	
	PD (f2)	+1.0 mm : -1.0 mm
TOL.COM5.160.9	**CLEARANCES**	
	PD from clearances specified in BS 4787:Part 1:1980 or shown on drawings for:	
	1. Non fire resisting doors	+2.0 mm : -1.0 mm
	2. Fire resisting doors without smoke seals	+1.0 mm : -0.5 mm
	3. Fire resisting door with smoke seals	See Note 2 Above

TOL.COM5.170.9 SQUARENESS

PD when measured in accordance with BS 5278:1976 at a point 500 mm from any corner ..... 2.0 mm

TOL.COM5.180.9 FLATNESS

PD when measured in accordance with BS 5278:1976, due to:

1. Bending:
   a. Measured horizontally ..... 2.0 mm
   b. Measured vertically ..... 4.0 mm
2. Twisting of any corner in relation to the other three:
   a. Doors of type '2' construction ..... 6.0 mm
   b. Doors of types '1' and '3' construction ..... 3.0 mm

TOL.COM5.190.9 SMOOTHNESS

For any door type:

1. PD in any position:
   a. When measured with a 50 mm bridge ..... 0.2 mm
   b. When measured with a 200 mm bridge ..... 1.0 mm
2. PD for doors of type '2' construction, when measured with a 200 mm bridge, at not more than 3 points along the 4 horizontal lines and 3 points along the 2 vertical lines of each face ..... 0.5 mm
3. PD for doors of type '1' and '3' construction, when measured with a 200 mm bridge, at not more than 4 points along the 2 vertical lines and 4 points along the 4 horizontal lines of each face ..... 0.5 mm

DOOR FRAMES

TOLERANCE

TOL.COM5.210.9 BOW

PD in the thickness of hardwood framing members in any 2 m length:

1. Member thickness ≤50 mm ..... 2.0 mm
2. Member thickness >50 mm ..... 6.0 mm

TOL.COM5.220.9 SPRING

PD in the width of hardwood framing members in any 2 m length:

1. Member thickness ≤100 mm ..... 4.0 mm
2. Member thickness >100 mm ..... 6.0 mm

INSTALLATION OF FRAMES AND SUB-FRAMES

TOLERANCE

TOL.COM5.230.9 PD FROM LEVEL OR VERTICALITY

In any 1.2 m length ..... 3.0 mm

TOL.COM6 - METAL DOORS

		TOLERANCE
TOL.COM6.010.9	**DESIGN CLEARANCE**	
	PD of clearance between the frame and the structural openings at head, sill and jambs.....	+5 mm : -10 mm
TOL.COM6.020.9	**VERTICALITY**	
	PD of frame from plumb in any 1.2 m length	±3 mm

TOL.COM7 - GATESETS

GATE AND FRAME

		TOLERANCE
TOL.COM7.010.9	**VERTICALITY AND SQUARENESS**	
	PD from plumb or level in any 1.2 m length	±3 mm

TOL.COM9 - COOKING BENCH / SINK UNITS

PRODUCT ACCURACY

		TOLERANCE
TOL.COM9.010.9	**CROSS SECTION AND LINEAR DIMENSIONS**	
	PD	±3 mm
TOL.COM9.020.9	**STRAIGHTNESS OR BOW DIMENSIONS**	
	PD	±3 mm
TOL.COM9.030.9	**TWIST**	
	PD in the distance of any one corner from the plane containing the other three corners	±3 mm
TOL.COM9.040.9	**SQUARENESS OF CORNER**	
	Taking the larger of two adjacent sides as the base line, the shorter side must not vary in its distance from a perpendicular to the base line by more than	±3 mm
TOL.COM9.050.9	**FLATNESS**	
	PD of a nominally plane surface when measured with a 1.5 m straight edge	±3 mm

ERECTION ACCURACY

		TOLERANCE
TOL.COM9.110.9	**LINES AND LEVEL**	
	PD from horizontal plane of unit in any 1.2 m length	±3 mm

TOL.CON1 - INSITU CONCRETE

Note: Tolerances given in this section should be read in conjunction with additional tolerances given in TOL.CON2.

UNREINFORCED/REINFORCED CONCRETE FOUNDATION (INCLUDING RAFTS, GROUND BEAMS, COLUMN BASES, PILE CAPS AND STRIP FOUNDATIONS)

		TOLERANCE
TOL.CON1.010.9	**POSITION ON PLAN**	
	PD in plan of any point measured from the nearest building grid line, for elements of dimensions	
	1. ≤1500 mm	±35 mm
	2. >1500 mm	±50 mm
TOL.CON1.020.9	**DIMENSION ON PLAN**	
	1. PD per 300 mm:	± 10 mm
	2. Maximum PD:	+50 mm : -35 mm
TOL.CON1.030.9	**UPPER SURFACE LEVEL**	
	PD in level of upper surface with reference to the nearest TBM	±20 mm
TOL.CON1.040.9	**CAST-IN FOUNDATION BOLTS**	
	PD from specified position	±25 mm

ELEMENTS OR COMPONENTS ABOVE FOUNDATIONS (EXCEPT LIFTWELLS AND STAIRS)

		TOLERANCE
TOL.CON1.110.9	**POSITION ON PLAN**	
	PD in plan of any point measured from the nearest building grid line:	±15 mm
TOL.CON1.120.9	**SIZE AND SHAPE OF ELEMENT**	
	PD for elements of dimensions:	
	1. ≤500 mm:	±10 mm
	2. >500 ≤3000 mm:	±20 mm
	3. >3000 mm:	±30 mm

TOL.CON1.130.9 VERTICALITY OF WALL AND COLUMNS

1. Plumbness in height ≤500 mm:	±10 mm
2. Ditto >500 mm ≤3000 mm:	±15 mm
3. Ditto >3000 mm ≤30 m:	±20 mm
4. >30 m: Pro-rata on ±20 mm per 30 m to the nearest 5 mm.	

Note: When separated by another plane or member use the thickness of the plane or member for checking verticality.

TOL.CON1.140.9 SURFACE PROFILE OF WALLS AND SLAB SOFFITS

PD from mean of surface profile across the whole element (from extremities):

1. Surface profile ≤3000 mm:	±10 mm
2. Ditto >3000 mm ≤15 m:	±15 mm
3. Ditto >15 m:	±20 mm

Notes: Measure deviations in two directions.

TOL.CON1.150.9 GRADUAL IRREGULARITIES

PD from 3000 mm straight edge:

1. Formwork type A: Rough board	±10 mm
2. Formwork type B: Fairfaced	±10 mm

TOL.CON1.160.9 ABRUPT IRREGULARITIES

Abrupt changes of a continuous finished concrete surface:

1. Formwork type A:	±4 mm
2. Formwork type B:	±3 mm

Note: This also applies to displacement of successive lifts for columns and walls within one storey height.

TOL.CON1.170.9 TWIST

The distance of any one corner from the plane containing the other three corners, i.e. a variation from the target plane:

1. For diagonal ≤3000 mm:	
a. Formwork type A:	10 mm
b. Formwork type B:	5 mm
2. For diagonal >3000 mm ≤15 m:	
a. Formwork type A:	20 mm
b. Formwork type B:	10 mm
3. For each further 10 m of diagonal:	
a. Formwork type A:	10 mm
b. Formwork type B:	5 mm

TOL.CON1.180.9 SQUARENESS OF CORNERS

Where the longer of two adjacent sides is taken as the base line and the PD of the shorter side, from a perpendicular to the base line, is related to the length of the shorter side:

1. Short side ≤250 mm: ..... ±10 mm
2. Ditto >250 mm ≤500 mm: ..... ±10 mm
3. Ditto >500 mm ≤3000 mm: ..... ±20 mm
4. Ditto for every additional 2500 mm (to nearest 5 mm): ..... ±20 mm x L/3

TOL.CON1.200.9 LEVEL

PD from designed level with reference to the nearest TBM of the upper or lower surface, as may be specified of any slab or other element or component:

1. Length ≤8 m: ..... ±10 mm
2. Length >8 m ≤15 m: ..... ±15 mm
3. Length >15 m ≤30 m: ..... ±20 mm

TOL.CON1.210.9 ITEMS CAST IN

The position of, or provision for, components fixings and holes cast in: PD from its designed position of centre line of component, fixing or hole: ..... ±15 mm

LIFTWELLS

TOLERANCE

TOL.CON1.310.9 POSITION ON PLAN

Position on plan at bottom of well of any point of each wall. PD of internal face from the designed position in relation to the nearest parallel reference line at the same level (distance between the two points being not more than 15 m): ..... ±10 mm

TOL.CON1.320.9 STRUCTURAL LIMITS OF WELL ACCURACY AT ANY LEVEL

Comply with Section 3 of BS 5655:Part 6:1990 including Table 1 which is extended as follows:

TABLE 1
Limits of accuracy of well plumb dimensions

Well height (m)		Limits of accuracy (mm)	
		+	-
1.	≤30	25	0
2.	>30 ≤60	35	0
3.	>60 ≤90	50	0

4.	>90	65	0

Read Table 1 in conjunction with figure 1 of Section 3 of BS 5655.

TOL.CON1.330.9 LANDING DOOR OPENINGS

1. Position of landing door openings in relation to design position: ..... ±15 mm

Note: It is important that landing doors come one above another PD of actual centre line of structural opening (to receive lift doors) from the design position.

2. Plumbness of jamb: PD from the vertical:

   a. For every 1000 mm of height: ..... ±5 mm

   b. Up to a maximum of: ..... ±15 mm

TOL.CON1.340.9 ABRUPT IRREGULARITIES OF WALLS

Abrupt changes of inner surfaces of walls: ..... Not to exceed 5 mm

INSITU STAIRS (FLIGHT FROM LANDING TO LANDING)

TOLERANCE

TOL.CON1.410.9 POSITION ON PLAN

PD on plan of any point in relation to the nearest reference point at the same level, the distance between the points being no more than 15 m: ..... ±15 mm

TOL.CON1.420.9 LENGTH

Length on plan of clear span (excluding landings): ..... ±15 mm

TOL.CON1.430.9 WIDTH OF FLIGHT

..... ±10 mm

TOL.CON1.440.9 HEIGHT

Vertical height measured between either top surfaces or soffit surfaces of any flight of stairs: ..... ±15 mm

TOL.CON1.450.9 WAIST THICKNESS

Thickness of waist measured at right angles to the slope of the flight: ..... ±10 mm

TOL.CON1.460.9 RISE

Difference in the rise of two consecutive steps: ..... ±5 mm

TOL.CON1.470.9 GOING

Difference in width of tread of two consecutive steps:	±10 mm

TOL.CON1.480.9 TREAD LEVEL

Difference in level of tread:

1. Across the going:	±4 mm
2. Across width of stairs per 1000 mm width (measured between extremities of tread):	±5 mm
3. Other widths: Pro-rata with a maximum of:	±10 mm

OPENINGS (EXCLUDING LIFT OPENINGS) - ALL BLOCK TYPES

TOLERANCE

TOL.CON1.510.9 POSITION ON ELEVATION

PD on elevation from its designed position of centre line with reference to the nearest building grid line:	±15 m

TOL.CON1.520.9 POSITION ON PLAN

PD on plan of any point measured from the nearest building grid line:	±15 mm

OPENINGS (EXCLUDING LIFT OPENINGS) - HARMONY BLOCKS ONLY

TOLERANCE

TOL.CON1.610.9 FAIRFACED CONCRETE WALL OPENING IN FLAT A AND D

1. Height:	±6 mm
2. Width:	±6 mm
3. Plumb:	±3 mm/1.2 m
4. Level:	±3 mm/1.2 m

TOL.CON1.620.9 DOOR, WINDOW AND OTHER OPENINGS

Width and height:

1. ≤500 mm:	±15 mm
2. >500 mm ≤3000 mm:	±20 mm

OPENINGS (EXCLUDING LIFT OPENINGS) - BLOCK TYPES EXCEPT HARMONY

TOLERANCE

TOL.CON1.710.9 DOOR, WINDOW AND OTHER OPENINGS

Width and height:

1. ≤500 mm: ..... ±15 mm
2. >500 mm ≤3000 mm: ..... ±20 mm

TOL.CON1.720.9 PLUMBNESS OF JAMBS

PD from the vertical:

1. For every 1000 mm of height: ..... ±5 mm
2. With a maximum of: ..... ±15 mm

TOL.CON1.730.9 LEVEL OF SILL OR SOFFIT

PD:

1. For every 1000 mm of length: ..... ±5 mm
2. With a maximum of: ..... ±15 mm

OVERALL DIMENSIONS OF A CONCRETE FRAMED BUILDING

TOLERANCE

TOL.CON1.810.9 LENGTH AND WIDTH

1. ≤15 m: ..... ±25 mm
2. >15 m ≤30 m: ..... ±50 mm
3. Each subsequent 30 m: ..... ±20 mm

Note: Measure dimensions at lowest floor level or, if not practicable, as otherwise specified or agreed.

TOL.CON1.820.9 HEIGHT

To structural roof level with reference to the TBM:

1. ≤30 m: ..... ±40 mm
2. Each subsequent 30 m: ..... ±15 mm

TOL.CON2 - FORMWORK

Note: Tolerances given in this section should be read in conjunction with those given in TOL.CON1.

FORMWORK TO FOUNDATIONS (INCLUDING RAFTS, GROUND BEAMS, COLUMN BASES, PILE CAPS AND STRIP FOUNDATIONS)

TOLERANCE

TOL.CON2.010.9 DIMENSION ON PLAN

1. PD per 300 mm: ..... ±10 mm
2. Maximum PD: ..... +50 mm : -35 mm

FORMWORK TO ELEMENTS OR COMPONENTS ABOVE FOUNDATIONS

TOLERANCE

TOL.CON2.110.9 SIZE AND SHAPE OF ELEMENTS

PD for elements of dimensions:

1. ≤500 mm: ..... ±10 mm
2. >500 mm ≤3000 mm: ..... ±20 mm
3. > 3000 mm: ..... ±30 mm

TOL.CON2.120.9 ABRUPT IRREGULARITIES

Misalignment of joints:

1. Formwork Type A: ..... ±4 mm
2. Formwork Type B:
   a. Small panel metal formwork: ..... ±2 mm
   b. Others: ..... ±3 mm

TOL.CON2.130.9 TWIST

The distance of any one corner from the plane containing the other three corners, i.e. a variation from the target plane:

1. For diagonal ≤3000 mm:	
a. Formwork type A:	10 mm
b. Formwork type B:	5 mm
2. For diagonal >3000 m ≤15 m:	
a. Formwork type A:	20 mm
b. Formwork type B:	10 mm
3. For each further 10 m of diagonal:	
a. Formwork type A:	10 mm
b. Formwork type B:	5 mm

TOL.CON2.140.9 SQUARENESS OF CORNER

Where the longer of two adjacent sides is taken as the base line and the PD of the shorter side, from a perpendicular to the base line, is related to the length of the shorter side:

1. Short side ≤250 mm:	±10 mm
2. Ditto >250 mm ≤500 mm:	±10 mm
3. Ditto >500 mm ≤3000 mm:	±20 mm
4. Ditto for every additional 2500 mm: (to nearest 5 mm)	±20 mm x L/3

TOL.CON3 - REINFORCEMENT

TOLERANCE

TOL.CON3.020.9 TOLERANCES TO CONCRETE COVER - GENERALLY

PD from nominal cover: ..... ±5 mm

TOL.CON3.030.9 TOLERANCES TO CONCRETE COVER - STARTER BARS

Starters in walls and column spots of horizontal lift: ..... +5 mm + Φ, -5 mm

Φ = diameter of starter bar

TOL.CON3.040.9 SPACING

The lesser of: ..... +50 mm or 20% of specified spacing

TOL.CON3.050.9 ANCHORAGE, LAP LENGTH AND CURTAILMENT

PD from specified length: ..... -25 mm

TOL.CON3.060.9 CUTTING AND BENDING

Comply with the cutting and/or bending tolerances defined in Table 4 of BS 8666 : 2000 as follows:

1. Cutting of straight lengths (including reinforcement for subsequent bending): ..... ±25 mm
2. Bent bars:
   a. Dimension of bent bars ≤1000 mm: ..... ±5 mm
   b. Ditto >1000 mm to ≤2000 mm: ..... +5 mm : -10 mm
   c. Ditto >2000 mm: ..... +5 mm : -25 mm
3. Length of wires in fabric: ..... ±25 mm or 0.5 % of the length (whichever is greater)

TOL.CON4 - PRECAST CONCRETE

TOLERANCE

TOL.CON4.010.9 ALL ELEMENTS (UNLESS OTHERWISE SPECIFIED)

1. Length up to 2000 mm: ..... ±6 mm
2. Width or height up to 250 mm: ..... ±4 mm
3. Thickness or depth up to 500 mm: ..... ±6 mm

STAIRS TO STANDARD DOMESTIC (FLIGHT FROM LANDING TO LANDING)

TOLERANCE

TOL.CON4.110.9 POSITION ON PLAN

PD on plan of any point in relation to the nearest reference point at the same level, the distance between the points being not more than 15 m: ... . ±10 mm

TOL.CON4.120.9 LENGTH

Length on plan of clear span (excluding landings): ..... ±12 mm

TOL.CON4.130.9 WIDTH OF FLIGHT

..... ±6 mm

TOL.CON4.140.9 HEIGHT

Vertical height measured between either top surfaces or soffit surfaces of any flight of stairs: ..... ±10 mm

TOL.CON4.150.9 WAIST THICKNESS

Thickness of waist measured at right angles to the slope of the flight: ..... +6 mm : -3 mm

TOL.CON4.160.9 RISE

Difference in the rise of two consecutive steps: ..... ±5 mm

TOL.CON4.170.9 GOING

Difference in width of tread of two consecutive steps: ..... ±8 mm

TOL.CON4.180.9 TREAD LEVEL

Difference in level of tread:

1. Across the going: ..... ±4 mm
2. Across width of stair: ..... ±5 mm

TOL.CON5 - PRECAST FACADE UNITS

CASTING FACADE UNITS

TOLERANCE

TOL.CON5.010.9 DEVIATIONS FROM DESIGN DIMENSIONS

Manufacture the facade units within the dimensional tolerances set out below:

1. Length and height:
   a. Up to 2 m: ..... +0 : -3 mm
   b. 2 m to 3 m: ..... +0 : -6 mm
   c. 3 m to 4.5 m: ..... +0 : -9 mm
   d. 4.5 m to 6 m or more: ..... +0 : -12 mm
2. Thickness:
   a. Up to 500 mm: ..... +6 mm : -3 mm
   b. 500 mm to 750 mm: ..... +8 mm : -5 mm
3. Straightness or bow (deviation from intended line):
   a. Up to 3 m: ..... 6 mm
   b. 3 m to 6 m: ..... 9 mm
   c. 6 m to 12 m: ..... 12 mm

TOL.CON5.020.9 SQUARENESS

When assessing the squareness of a corner:

1. Take the longer of the two adjacent sides being checked as the base-line;
2. Ensure that the shorter side does not vary in its distance from a perpendicular so that the difference between the greatest and shortest dimensions exceeds:

   Length of shorter sides:

   a. Up to and including 1000 mm: ..... 3 mm
   b. Over 1000 mm to 2000 mm: ..... 5 mm
   c. Over 2000 mm: ..... 6 mm

TOL.CON5.030.9 TWIST

Ensure that no corner is more than the dimension stated from the plane containing the other three corners:

1. Up to and including 3 m: ..... 6 mm
2. Over 3 m to 6 m: ..... 9 mm
3. Over 6 m to 12 m: ..... 12 mm

TOL.CON5.040.9 POSITION OF CAST-IN WINDOW FRAMES

PD from design dimensions on plan: ..... ±6 mm

INSTALLING FACADE UNITS

TOLERANCE

TOL.CON5.110.9 ERECTION TOLERANCES

1. Install the facade units within the erection tolerances set out below:
   a. Horizontal position: In x and y directions: ..... ±5 mm
   b. Plumb: per element: ..... ±6 mm
   c. Width of joint: On a nominal joint of 20 m: ..... ±5 mm
2. In addition, respect the prescribed dimensions for height, width and length, of the completed building to within 0.1%;
3. Respect the theoretical line, both horizontal and vertical, with the same tolerance of 0.1%, for each storey when seen from the front. Deviations in profile must not exceed ±10 mm.

TOL.CON7 - PRECAST CONCRETE COMPONENTS

CASTING FACADE AND PRECAST CONCRETE WALL UNITS

TOLERANCE

TOL.CON7.010.9 DEVIATIONS FROM DESIGN DIMENSIONS

Manufacture the facade and precast concrete wall units within the dimensional tolerances set out below:

1. Length and height:
   - a. Up to 2 m: ..... +3 mm : -3 mm
   - b. 2 m to 3 m: ..... +6 mm : -6 mm
   - c. 3 m to 4.5 m: ..... +9 mm : -9 mm
   - d. 4.5 m to 6 m or ore: ..... +10 mm : -12 mm
2. Thickness:
   - a. Up to 500 mm: ..... +6 mm : -3 mm
   - b. 500 mm to 750 mm: ..... +8 mm : -5 mm
3. Straightness or bow (deviation from intended line):
   - a. Up to 3 m: ..... 6 mm
   - b. 3 m to 6 m: ..... 9 mm
   - c. 6 m to 12 m: ..... 12 mm

TOL.CON7.020.9 SQUARENESS

When assessing the squareness of a corner:

1. Take the longer of the two adjacent sides being checked as the base-line;
2. Ensure that the shorter side does not vary in its distance from a perpendicular so that the difference between the greatest and shortest dimensions exceeds:

   Length of shorter sides:
   - a. Up to and including 1000 mm: ..... 3 mm
   - b. Over 1000 mm to 2000 mm: ..... 5 mm
   - c. Over 200 mm: ..... 6 mm

TOL.CON7.030.9 TWIST

Ensure that no corner is more than the dimension stated from the plane containing the other three corners:

1. Up to and including 3: ..... 6 mm
2. Over 3 to 6: ..... 9 mm
3. Over 6 to 12: ..... 12 mm

TOL.CON7.040.9 POSITION OF CAST-IN WINDOW FRAMES

PD from design dimensions on plan: ..... ±6 mm

INSTALLING FACADE AND PRECAST CONCRETE WALL UNITS

TOLERANCE

TOL.CON7.110.9 ERECTION TOLERANCES

1. Install the facade and precast concrete wall units within the erection tolerances set out below:
   a. Horizontal position: In x and y directions: ..... ±5 mm
   b. Plumb: per element: ..... ±6 mm
   c. Width of joint: On a nominal joint of 20 mm: ..... ±5 mm
2. In addition, respect the prescribed dimensions for height, width and length, of the completed building to within 0.1%;
3. Respect the theoretical line, both horizontal and vertical, with the same tolerance of 0.1%, for each storey when seen from the front. Deviations in profile must not exceed ±10 mm.

STAIRS TO STANDARD DOMESTIC (FLIGHT FROM LANDING TO LANDING)

TOLERANCE

TOL.CON7.210.9 POSITION ON PLAN

PD on plan of any point in relation to the nearest reference point at the same level, the distance between the points being not more than 15: ..... ±10 mm

TOL.CON7.220.9 LENGTH

Length on plan of clear span (excluding landings): ..... ±12 mm

TOL.CON7.230.9 WIDTH OF FLIGHT

..... ±6 mm

TOL.CON7.240.9 HEIGHT

Vertical height measured between either top surfaces or soffit surfaces of any flight of stairs: ..... ±10 mm

TOL.CON7.250.9 WAIST THICKNESS

Thickness of waist measured at right angles to the slope of the light: ..... +6 mm : -3 mm

TOL.CON7.260.9 RISE

Difference in the rise of two consecutive steps: ..... ±5 mm

TOL.CON7.270.9 GOING

Difference in width of tread of two consecutive steps: ..... ±8 mm

TOL.CON7.280.9 TREAD LEVEL

Difference in level of tread:

1. Across the going: ..... ±4 mm
2. Across width of stair: ..... ±5 mm

TOL.CON8 - VOLUMETRIC PRECAST CONCRETE COMPONENTS FOR DOMESTIC BLOCKS

OVERALL TOLERANCES - GENERAL

		TOLERANCE
TOL.CON8.010.9	**POSITION ON PLAN**	
	Permissible Deviation (PD) in plan of any point measured from the nearest building grid line:	±15 mm
TOL.CON8.020.9	**LENGTH AND WIDTH**	
	1. ≤15 m:	±25 mm
	2. >15 m ≤30 m:	±50 mm
	3. Each subsequent 30 m:	±20 mm
	Note: Measure dimensions at lowest floor level or, if not practicable, as otherwise specified or agreed.	
TOL.CON8.030.9	**HEIGHT**	
	To structural roof level with reference to the Transferred Bench Mark (TBM):	
	1. ≤30 m:	±40 mm
	2. Each subsequent 30 m:	±15 mm
TOL.CON8.040.9	**VERTICALITY OF WALL AND COLUMNS**	
	1. Plumbness in height ≤500 mm:	±10 mm
	2. Ditto >500 mm ≤3000 mm:	±15 mm
	3. Ditto >3000 mm ≤30 m:	±20 mm
	4. >30 m:	Pro-rata on ±20 mm per 30 m to the nearest 5 mm
	Note: When separated by another plane or member use the thickness of the plane or member for checking verticality.	
TOL.CON8.050.9	**SURFACE PROFILE OF WALLS AND SLAB SOFFITS**	
	Permissible Deviation (PD) from mean of surface profile across the whole element (from extremities):	
	1. Surface profile ≤3000 mm:	±10 mm
	2. Ditto >3000 mm ≤15 m:	±15 mm
	3. Ditto >15 m:	±20 mm
	Note: Measure deviations in two directions.	

TOL.CON8.060.9 TWIST

The distance of any one corner from the plane containing the other three corners, i.e., a variation from the target plane:

1. For diagonal ≤15 m: ..... 20 mm
2. For each further 10 m of diagonal: ..... 10 mm

TOL.CON8.070.9 SQUARENESS OF CORNERS

Where the longer of two adjacent sides is taken as the base line and the Permissible Deviation (PD) of the shorter side, from a perpendicular to the base line, is related to the length of the shorter side:

1. Short side ≤3000 mm: ..... ±20 mm
2. Short side for every additional 2500 mm (to nearest 5 mm): ..... ±20 mm x L/3

TOL.CON8.080.9 LEVEL

Permissible Deviation (PD) from designed level with reference to the nearest Transferred Bench Mark (TBM) of the upper or lower surface, as may be specified of any slab or other element or component:

Length ≤8 m: ..... ±10 mm

Length >8 m ≤15 m: ..... ±15 mm

Length >15 m ≤30 m: ..... ±20 mm

OVERALL TOLERANCES - LIFTWELLS

TOLERANCE

TOL.CON8.110.9 POSITION ON PLAN

Position on plan at bottom of well of any point of each wall. Permissible Deviation (PD) of internal face from the designed position in relation to the nearest parallel reference line at the same level (distance between the two points being not more than 15 m): ..... ±10 mm

TOL.CON8.120.9 STRUCTURAL LIMITS OF WELL ACCURACY AT ANY LEVEL

Comply with Section 3 of BS 5655:Part 6:1990 including Table 1 which is extended as follows:

TABLE 1
Limits of accuracy of well plumb dimensions

Well height (m)		Limits of accuracy (mm)	
		+	-
1.	≤30	25	0
2.	>30 ≤60	35	0

3.	>60 ≤90	50	0
4.	>90	65	0

Read Table 1 in conjunction with figure 1 of Section 3 of BS 5655.

TOL.CON8.130.9 LANDING DOOR OPENINGS

1. Position of landing door openings in relation to design position: ..... ±15 mm

Note: It is important that landing doors come one above another Permissible Deviation (PD) of actual centre line of structural opening (to receive lift doors) from the design position.

2. Plumbness of jamb: Permissible Deviation (PD) from the vertical:

   a. For every 1000 mm of height: ..... ±5 mm

   b. Up to a maximum of: ..... ±15 mm

TOL.DRA1 - DRAINAGE ABOVE GROUND

		TOLERANCE
TOL.DRA1.010.9	**VERTICALITY**	
	PD of pipes from plumb when measured with a 1.2 m straight edge	±3 mm

TOL.DRA2 - DRAINAGE BELOW GROUND

PIPELINES (EXCLUDING TERMINATION PIPES)

		TOLERANCE
TOL.DRA2.010.9	**GRAVITY PIPELINES**	
	PD from lines and levels shown on the Drawings:	
	1. Line	±20 mm
	2. Invert level (providing there is no backfall at any point)	+6 mm : -6 mm
TOL.DRA2.020.9	**PRESSURE PIPELINES**	
	PD from lines and levels shown on the Drawings:	
	1. Line	±50 mm
	2. Invert level	±20 mm

TERMINATION PIPES

		TOLERANCE
TOL.DRA2.110.9	**TERMINATION PIPES**	
	PD for termination pipes which are designed to connect to pipes and fittings laid by others from the positions, gradients and levels shown on the Drawings:	
	1. Position of the centre of the termination face in the longitudinal direction	±10 mm
	2. Position of the centre of the termination face in the lateral direction	±3 mm
	3. Gradient	±0.5°
	4. Invert level of the termination face	±3 mm

MANHOLES

		TOLERANCE
TOL.DRA2.210.9	**MANHOLE COVERS**	
	PD from specified level unless a more accurate level is defined for adjacent surfaces in this schedule:	
	1. Concrete road	+10 mm : -0 mm
	2. Bituminous paving	+5 mm : -0 mm
	3. Paving blocks, tiles or granolithic finish on soft base	+10 mm : -0 mm
	4. Paving blocks, tiles or granolithic finish on hard base	+5 mm : -0 mm

TOL.EAR1 - EXCAVATION AND FILLING

EARTHWORKS FINAL SURFACE TOLERANCES

TOL.EAR1.010.9 GENERAL

1. Keep earthworks final surfaces and formations within the tolerances of the specified lines and levels tabulated in TOL.EAR1.020, TOL.EAR1.030 and TOL.EAR1.040 below;
2. The tolerances for formations do not apply to pipes or preformed structures which require to be supported over their complete length or area;
3. Excavation: A positive (+) tolerance refers to insufficient excavation and a negative (-) tolerance refers to excess excavation;
4. Filling: A positive (+) tolerance refers to excess fill material and a negative (-) tolerance refers to insufficient fill material.

TOL.EAR1.020.9 SETTING OUT

Requirement	Tolerance (mm)	
	+	-
PD in plan of any point measured from the nearest building grid line	35	35

TOL.EAR1.030.9 BULK EXCAVATION/FILLING

Types of surface		Method of forming surface		Tolerance (mm)	
				+	-
1.	Formations for structures and utilities	a.	Excavation except in rock	0	25
		b.	Excavation in rock	0	150
		c.	Deposition and compaction of fill material	0	25
2.	Formations for pavements, including carriageways, footways, cycletracks, paved areas, aircraft pavements and railway trackbeds	a.	Excavation except in rock	0	50
		b.	Excavation in rock	0	150
		c.	Deposition and compaction of fill material	0	50
3.	Earthworks final surfaces, other than	a.	Excavation except in rock	0	100
		b.	Excavation in rock	0	200

	formations, with a gradient not exceeding 1 vertical to 10 horizontal	c.	Deposition and compaction of fill material	0	100
4.	Other earthworks final surfaces	a.	Excavation except in rock	100	100
		b.	Excavation in rock	100	200
		c.	Deposition and compaction of fill material	100	100

TOL.EAR1.040.9 FOUNDATION PITS AND TRENCHES

Types of surface		Method of forming surface		Tolerance (mm)	
				+	-
1.	Formations to receive blinding or structural concrete	a.	Excavation except in rock	0	25
		b.	Excavation in rock	0	150
2.	Width of excavation	a.	Excavation except in rock	0	100
		b.	Excavation in rock	0	200

TOL.EAR2 - BLASTING

PRE-SPLIT BLASTING

TOL.EAR2.010.9 FINAL SURFACE TOLERANCES

A tolerance of + 100 - 200 mm from the design profile.

Notes:

1. Redrill any pre-split hole which, before firing, is found to be outside this tolerance;
2. A positive (+) tolerance refers to insufficient blasted material and a negative (-) tolerance refers to excess blasted material.

TOL.EXT1 - SUB-BASES, BITUMINOUS ROADWAYS AND RELATED FOOTPATHS

TOLERANCE

TOL.EXT1.010.9 ALIGNMENT

PD of edgelines from the dimensions indicated on the Drawings:

1. Generally ..... +25 mm : -25 mm
2. Adjacent edges of structure ..... +6 mm : -6 mm

TOL.EXT1.020.9 MEASUREMENT OF LEVELS

Determine the levels of the surface of each layer of sub-base, roadbase, base course, wearing and friction courses on a grid at 10 m centres in the longitudinal direction and at 2 m centres in the transverse direction.

TOL.EXT1.030.9 TOLERANCES IN LEVELS FOR EACH TYPE OF LAYER

PD from the level of the surface of each layer of sub-base, roadbase base course, wearing and friction courses:

1. Sub-base ..... +10 mm : -20 mm
2. Road-base course ..... +8 mm : -15 mm
3. Base course ..... +6 mm : -6 mm
4. Wearing course ..... +6 mm : -6 mm
5. Friction course ..... +6 mm : -6 mm

TOL.EXT1.040.9 SURFACE LEVELS AT JOINTS

PD in level of the surface of wearing course and friction course across joints ..... 3 mm

TOL.EXT1.050.9 COMBINATION OF TOLERANCES

Maximum reduction in thickness from specified thickness:

1. Pavement (excluding sub-base) ..... 15 mm
2. Bituminous wearing course ..... 5 mm

TOL.EXT1.060.9 LEVELS OF GULLY GRATINGS

PD of gully frame from level of adjacent finished surface ..... +0 mm : -5 mm

TOL.EXT1.070.9 LEVELS OF COVERS, FRAMES AND OTHER HARDWARE

PD of hardware from level of adjacent finished surface ..... +5 mm : -0 mm

TOL.EXT1.080.9 SURFACE REGULARITY

Limits of irregularity as specified in EXT1.T610 and EXT1.T620	- : -

TOL.EXT2 - CONCRETE CARRIAGEWAYS

		TOLERANCE
TOL.EXT2.010.9	**STRAIGHT ALIGNMENT**	
	1. PD of best fit straight line of straight joints and of straight edges from that shown on the Drawings	+25 mm : -25 mm
	2. PD of line of straight joints and straight edges from the best fit straight line	+10 mm : -10 mm
TOL.EXT2.020.9	**CURVED ALIGNMENT**	
	1. PD of the best fit curved line of curved joints and of curved edges from that Approved and shown on the Drawings	+25 mm : -25 mm
	2. PD of line of curved joints and curved edges from the best fit curved line	+10 mm : -10 mm
TOL.EXT2.030.9	**ALIGNMENT OF JOINTS**	
	PD of joint continuity across intersections of joints from the best fit straight lines or best fit curved line of each joint	+5 mm : -5 mm
TOL.EXT2.040.9	**LEVEL OF SUB-BASE**	
	PD from level shown on Drawings	+10 mm : -20 mm
TOL.EXT2.050.9	**FORMWORK**	
	1. PD of line of formwork from that shown on Drawings	+10 mm : -10 mm
	2. PD of level of formwork from that shown on Drawings	+3 mm : -3 mm
	3. PD of abrupt irregularities in line and level of formwork	3 mm
TOL.EXT2.060.9	**COVER TO REINFORCEMENT**	
	PD from cover specified or shown on Drawings	+10 mm : -10 mm
TOL.EXT2.070.9	**DOWEL BARS**	
	1. PD of dowel bars at joints from mid-depth of slab	+20 mm : -20 mm
	2. PD of half the length of dowel bars from parallel to:	
	a. The longitudinal joint or axis of the carriageway where there is no longitudinal joint	3 mm
	b. The top surface of the slab	3 mm
	c. Adjacent dowel bars	3 mm

TOL.EXT2.080.9 GROOVE DEPTH

PD of groove depth from that shown on the Drawings unless otherwise recommended by the sealant manufacturer	+3 mm : -3 mm

TOL.EXT2.090.9 LEVELS

When the levels of the concrete carriageway are determined 200 mm from the edges of each bay, at 10 m centres in the longitudinal direction and 2 m centres in the transverse direction:

1. PD of surface fall from that shown on Drawings ..... (Providing that falls shall always be in the specified direction without backfall).	+6 mm : -6 mm
2. Maximum difference in level across joint	3 mm

TOL.EXT2.100.9 SLAB THICKNESS

PD from specified thickness	- : -10 mm

TOL.EXT2.110.9 LEVEL OF COVERS, FRAMES AND OTHER HARDWARE

PD from surface of adjacent carriageway	+0 mm : -3 mm

Surface regularity: The tolerances specified in this section should be read in conjunction with the compliance criteria for surface regularity specified in EXT2 TESTING.

TOL.EXT3 - PATHS AND PAVED AREAS

MATERIALS

		TOLERANCE
TOL.EXT3.010.9	**INTERLOCKING CONCRETE BLOCKS**	
	PD on size	+3 mm : -3 mm
TOL.EXT3.020.9	**PRECAST CONCRETE PAVING SLABS**	
	PD as defined at 11.2.1 of BS 7263:Part 1:1994 measured in accordance with Annex A to this BS:	
	1. Thickness	+3 mm : -3 mm
	2. Length and width	+2 mm : -2 mm
	3. Squareness on plan (difference between diagonals) according to flag type defined in BS:	
	a. Flag types A, B, C and D;	6 mm
	b. Flag types E, F and G.	3 mm
	4. Flatness, winding and bowing:	
	a. Measured over 550 mm to 850 mm;	+2 mm : -2 mm
	b. Measured over 250 mm to 400 mm.	+1 mm : -1 mm
TOL.EXT3.030.9	**CLAY PAVERS**	
	Limits of overall measurement defined in Table 2 of BS 6677:Part 1:1986.	- : -

WORKMANSHIP

		TOLERANCE
TOL.EXT3.110.9	**INTERLOCKING CONCRETE BLOCKS, PRECAST CONCRETE PAVING SLABS AND CLAY PAVERS**	
	1. PD from surface level specified	+3 mm : -3 mm
	2. PD between adjacent slabs	2 mm
	3. PD of drainage channels and gratings from level of adjacent finished surface	+0 mm : -5 mm
	4. PD of covers, frames and other hardware from level of adjacent finished surface	+5 mm : -0 mm

TOL.EXT3.120.9 INSITU CONCRETE SURFACE FINISH

1. Abrupt irregularities: Maximum	3 mm
2. Gradual irregularities: Maximum in any 2 m length	10 mm
3. PD of drainage channels and gratings from level of adjacent finished surface	+0 mm : -5 mm
4. PD of covers, frames and other hardware from level of adjacent finished surface	+5 mm : -0 mm

TOL.EXT5 - KERBS, EDGINGS AND QUADRANTS

		TOLERANCE
TOL.EXT5.010.9	**LINE**	
	PD from line specified	+3 mm : -3 mm
TOL.EXT5.020.9	**TOP LEVEL**	
	PD from level specified	+3 mm : -3 mm
TOL.EXT5.030.9	**IN SITU SURFACE FINISH**	
	1. Abrupt irregularities: Maximum	3 mm
	2. Gradual irregularities: Maximum in any 2 m length	10 mm
TOL.EXT5.040.9	**ACCURACY OF PRECAST UNITS**	
	PD's when measured in accordance with Annex A of BS 7263:Part 1:1994:	
	1. Length, width or height	+3 mm : -3 mm
	2. Straightness and winding:	
	a. Measured over 550 to 850 mm	+2 mm : -2 mm
	b. Measured over 250 to 400 mm	+1 mm : -1 mm
	3. Squareness	2 mm clearance

TOL.EXT6 - CONCRETE PROFILE BARRIERS

		TOLERANCE
TOL.EXT6.010.9	**HORIZONTAL DIMENSIONS OF CROSS SECTIONS**	
	PD from specified dimensions	+5 mm : -5 mm
TOL.EXT6.020.9	**VERTICAL DIMENSIONS OF CROSS SECTIONS**	
	PD from specified dimensions	+10 mm : -10 mm
TOL.EXT6.030.9	**HORIZONTAL ALIGNMENT**	
	PD from specified centre line	+10 mm : -10 mm
TOL.EXT6.040.9	**FORMATION LEVEL**	
	PD from specified level	+10 mm : -10 mm
TOL.EXT6.050.9	**BARRIER TOP LEVEL**	
	PD from specified level	+10 mm : -10 mm
TOL.EXT6.060.9	**ABRUPT IRREGULARITIES**	
	Abrupt changes of a continuous finished concrete surface	+3 mm : -3 mm

TOL.EXT7 - UNTENSIONED BEAM BARRIERS

MATERIALS

		TOLERANCE
TOL.EXT7.010.9	**BASE METAL THICKNESS**	
	PD from thickness shown on the Drawings	+0.2 mm : -0.2 mm
TOL.EXT7.020.9	**STRIP WIDTH**	
	PD from width shown on the Drawings	+2.5 mm : -0 mm
TOL.EXT7.030.9	**CAMBER**	
	PD from camber shown on the Drawings	+8 mm : -8 mm
TOL.EXT7.040.9	**DISTORTION**	
	PD within a 1.5 m length	1.5 mm
TOL.EXT7.050.9	**ANGLES AT BENDS**	
	PD from angle shown on the Drawings	2 degrees
TOL.EXT7.060.9	**STEEL POSTS**	
	Within those specified in BS 4 : 1980	-
TOL.EXT7.070.9	**CLEAT AND STRUTS**	
	Within those specified in BS 4 : 1980	-

WORKMANSHIP

		TOLERANCE
TOL.EXT7.110.9	**INSTALLATION**	
	PD from specified position and height	+10 mm : -10 mm

TOL.EXT8 - ROAD MARKING

THICKNESSES AND TOLERANCES

		TOLERANCES
TOL.EXT8.010.9	**SCREED MARKINGS**	
	PD from specified thickness	+1.0 mm : -1.0 mm
TOL.EXT8.020.9	**WIDTH AND LENGTH**	
	PD from specified dimension	+10% : -5%

TOL.EXT9 - FENCING, GATES AND GUARD RAILS

FENCING

		TOLERANCE
TOL.EXT9.010.9	**MATERIALS**	
	PDs for components as defined in Section 2 of BS 1722 : Part 1 : 1986	- : -
TOL.EXT9.020.9	**WORKMANSHIP**	
	1. Position of posts: PD from specified position	75 mm
	2. Level of top of posts: PD from specified level	+25 mm : -25 mm
	3. Verticality of posts: PD in the height of the post rom plumb	5 mm

PEDESTRIAN GUARD RAILS

		TOLERANCE
TOL.EXT9.110.9	**ALIGNMENT**	
	PD of line, position and height from that indicated on Drawings	+10 mm : -10 mm

TOL.FEN - FENCING

TOL.FEN.010.9 GENERAL

Fencing shall comply with the following requirements:

1. The position of posts shall be within 75 mm of the position shown on the Drawings;
2. The level of the top of the posts shall be within 25 mm of the level shown on the Drawings;
3. Posts shall be vertical to within 5 mm in the height of the post.

TOL.FIN1 - PLASTERED AND RENDERED FINISHES

INTERNAL AND EXTERNAL WALL FINISHES

		TOLERANCE
TOL.FIN1.010.9	**EVENNESS AND PLUMB**	
	PD when measured in any direction with a 1.2 m straight edge for:	
	1. Plaster or render to receive mosaic or paint	3 mm
	2. Render to receive glazed wall tiles	6 mm

CEILING FINISHES

		TOLERANCE
TOL.FIN1.110.9	**LINE AND LEVEL**	
	PD from true plane when measured in any direction with a 1.2 m straight edge	3 mm

TOL.FIN2 - PLASTERBOARD

		TOLERANCE
TOL.FIN2.010.9	**BRITISH STANDARD**	
	PD to fall within the tolerances defined in BS 8000:Part 8:1989.	As stated

TOL.FIN3 - SCREEDS

TOLERANCE

TOL.FIN3.010.9 LEVEL

PD when measured with a 1.2 m straight edge:

1. From specified level measured in any direction ..... 3 mm
2. From specified fall measured in the direction of fall provided that, in any situation, there is no backfall ..... 3 mm

TOL.FIN4 - INSITU WALL AND FLOOR FINISHES

TOLERANCE

TOL.FIN4.010.9 LEVEL

PD when measured with an 1.2 m straight edge:

1. From specified level measured in any direction .. .. 3 mm
2. From specified fall measured along the fall provided that in any situation there is no backfall ..... 3 mm

TOL.FIN5 - FLOOR AND WALL TILES AND SLABS

FLOOR TILES AND SLABS

		TOLERANCE
TOL.FIN5.010.9	**LEVEL**	
	PD from specified fall when measured with a 1.2 m straight edge in the direction of fall provided that, in any situation, there is no backfall	3 mm
TOL.FIN5.020.9	**LEVEL OF ADJACENT TILES**	
	PD in level of adjacent tiles	1.25 mm
TOL.FIN5.030.9	**ALIGNMENT OF JOINTS**	
	1. PD of any tile from general line of joints	1.25 mm
	2. With a maximum non-alignment of adjacent tiles of	20% of joint width

WALL TILES

		TOLERANCE
TOL.FIN5.110.9	**PLANE**	
	PD when measured with a 1.2 m straight edge in any direction	3 mm
TOL.FIN5.120.9	**PLANE OF ADJACENT TILES**	
	PD in plane of adjacent tiles	1.25 mm
TOL.FIN5.130.9	**ALIGNMENT OF JOINTS**	
	1. PD of any tile from general line of joints	1.25 mm
	2. With a maximum non-alignment of adjacent tiles of	20% of joint width

MOSAIC TILES

		TOLERANCE
TOL.FIN5.210.9	**PLANE**	
	PD when measured with a 1.2 m straight edge in any direction	3 mm
TOL.FIN5.220.9	**PLANE OF ADJACENT TILES**	
	PD in plane of adjacent tiles	1.25 mm

TOL.FIN5.230.9 ALIGNMENT OF JOINTS

1. PD of any tile from general line of joints	1.00 mm
2. With a maximum non-alignment of adjacent tiles of	1.00 mm

TOL.FIN6 - FLEXIBLE SHEET AND TILE FINISHES

		TOLERANCE
TOL.FIN6.010.9	**LEVEL**	
	PD when measured with a 1.2 m straight edge	3 mm

TOL.FIN8 - PROPRIETARY SUSPENDED CEILINGS

INSTALLED CEILING SYSTEM

		TOLERANCE
TOL.FIN8.010.9	**LINE AND LEVEL**	
	PD from true plane when measured with a 1.2 m straight edge in any direction	±3 mm
TOL.FIN8.020.9	**ALIGNMENT OF JOINTS**	
	PD in width of joints between panels or strips	±3 mm
TOL.FIN8.030.9	**DEFLECTION OF MAIN MEMBERS**	
	Maximum deflection between points of suspension:	
	1. Spans up to 1200 mm	Span x 1/400
	2. Spans from 1200 mm to 1800 mm	Span x 1/500
	3. Spans over 1800 mm	Span x 1/600

CEILING COMPONENTS

		TOLERANCE
TOL.FIN8.110.9	**STRUCTURAL MEMBERS AND GRIDS**	
	Tolerances not to exceed these specified in Section 2.5 of BS 8290:Part 2:1991 with particular reference to Table 1 for Steel Sections	As stated
TOL.FIN8.120.9	**INFILL UNITS**	
	PD from manufacturers stated dimensions as specified in BS 8290:Part 2:1991:	
	1. Generally: As Table 3	As stated
	2. Mineral fibre: As Table 4	As stated
	3. Steel tiles and panels formed by means other than pressing: As Table 5	As stated
	4. Steel and aluminium linear strip: As Table 6	As stated

TOL.GIN - GROUND INVESTIGATION, INSTRUMENTATION AND SOIL TESTING

TOL.GIN.010.9 DEPTHS OF EXPLORATION

1. A tolerance of ±100 mm in length will be permitted on the drilled length of a drill hole;

TOL.GIN.020.9 VERTICAL TOLERANCE

1. No nominally vertical hole shall deviate from the vertical direction by more than 1% of the vertical depth below ground level except that in underwater boreholes or underwater drillholes the tolerance shall be 5%;
2. For inclined drillhole, the inclination shall not deviate from the instructed inclination by more than 2^{o} throughout the length of the hole;
3. Where required by the CM, the verticality and inclination of any hole shall be measured by an approved method.

TOL.GWD - GROUND WATER DRAINAGE AND CONTROL

TOL.GWD.010.9 DRILLING

1. The drillhole entry point shall be positioned within a tolerance of ±75 mm. Deviation in alignment shall not exceed 1 in 20. Deviation from straight shall not exceed 20 mm in any 3 m length of drillhole.

TOL.MAR - MARINE WORKS

TOL.MAR.010.9 DREDGING

The final surface of dredging shall be within 300 mm of the specified surface.

TOL.MAR.020.9 DEPOSITION OF FILL MATERIAL

1. The final surface of deposition and compaction of fill material, measured perpendicular to the specified surface, shall comply with the following requirements:
    a. Top surfaces to receive levelling stones shall not be more than 75 mm above, and not more than 250 mm below, the level shown on the Drawings;
    b. Top surfaces of levelling stones shall be within 25 mm of the specified surface for foundations of structures and shall be within 50 mm of the level shown on the Drawings for submarine outfalls;
    c. Other top surfaces shall be within 250 mm of the level shown on the Drawings;
2. There shall be no abrupt change in level of the finished surface of reclamation and levelling stones.

TOL.MAR.030.9 PRECAST CONCRETE SEAWALL BLOCKS AND COPINGS

Precast concrete seawall blocks and copings shall be within 25 mm of the position shown on the Drawings. The gaps between adjacent blocks and between successive layers of blocks shall not exceed 20 mm.

TOL.MAR.040.9 TIMBER FENDERING SYSTEMS

1. The dimensions of members of timber fendering systems shall be within 5 mm of the dimensions shown on the Drawings;
2. The levels and positions of timber fendering systems shall comply with the following requirements:
    a. The top level of blocks for landings and steps shall be within 5 mm of the level shown on the Drawings;
    b. The top level of other members shall be within 10 mm of the level shown on the Drawings;
    c. The horizontal position perpendicular to the berthing face of the fendering system shall be within 10 mm of the position shown on the Drawings;
    d. The horizontal position parallel to the berthing face of the fendering system shall be within 25 mm of the position shown on the Drawings.

TOL.MAR.050.9 RUBBER FENDERS

1. The dimensions of rubber fenders and bolt holes shall comply with the following requirements:
    a. The bolt hole diameter shall be within 2 mm of the diameter shown on the Drawings;
    b. The bolt pitch shall be within 4 mm of the pitch shown on the Drawings;
    c. The height, length and width of rubber fenders shall be within +4% and -2% of the dimensions shown on the Drawings;

d. The thickness of fender sections shall be within +8% and -5% of the thickness shown on the Drawings;

2. The positions of rubber fenders shall comply with the following requirements:

   a. The centrelines shall be within 25 mm of the positions on the face of the supporting structures shown on the Drawings;

   b. The inclination shall not deviate by more than 1 in 50 from the inclination shown on the Drawings.

TOL.MAR.060.9 SUBMARINE OUTFALLS

1. The horizontal alignment of submarine pipelines shall be within 250 mm of the alignment shown on the Drawings;
2. The invert level of submarine outfalls shall be within 50 mm of the level shown on the Drawings;
3. There shall be no abrupt change in alignment or level of the submarine outfall.

TOL.MAS1 - BRICKWORK, BLOCKWORK AND PANEL PARTITIONS

BRICKWORK

TOL.MAS1.010.9 GENERALLY

Comply with Table 2 Section 3 of BS 8000:Part 3:1989.

BRICKWORK AND PANEL PARTITIONS

		TOLERANCE
TOL.MAS1.110.9	**POSITION ON PLAN**	
	PD	±15 mm
TOL.MAS1.120.9	**LENGTH**	
	PD for:	
	1. Up to 5 m	±15 mm
	2. 5 m to 10 m	±20 mm
	3. 10 m to 20 m	±25 mm
	4. Over 20 m	±30 mm
TOL.MAS1.130.9	**HEIGHT**	
	PD for:	
	1. Up to 3 m	±15 mm
	2. 3 m to 6 m	±20 mm
	3. Over 6 m.....	±25 mm
TOL.MAS1.140.9	**LEVEL OF BED JOINTS**	
	PD in any 5 m for:	
	1. Up to 5 m	±10 mm
	2. 5 m to 10 m	±15 mm
	3. Over 10 m	±25 mm
TOL.MAS1.150.9	**THICKNESS OF BED JOINTS**	
	PD	±6 mm
TOL.MAS1.160.9	**STRAIGHTNESS**	
	1. PD in any 1.2 m	±6 mm
TOL.MAS1.170.9	**VERTICALITY**	
	1. PD in any 1.2 m	±6 mm

TOL.MAS1.180.9 SETTING-OUT OF PRE-INSTALLED JUNCTION/BS 4662 BOXES ON WALLS

The deviation of the installed position of pre-installed junction/BS 4662 boxes from the specified position as shown on the Drawings with the following considerations:

1. In general, the sockets outlets and lighting switches etc. shall be at the same level in the same room. PD for vertical levels of boxes designed at the same level on the same panel wall: ..... ±3 mm
2. The installed position of boxes after taking the above tolerance into consideration shall not contravene the requirements of the position of switches/sockets as stipulated in the Design Manual - Barrier Free Access 1997; nor have conflict with other installations such as skirting, door frame, etc.;
3. Deviations exceeding the tolerance under special site condition shall be subject to the approval of the CM.

OPENINGS IN BRICKWORK, BLOCKWORK AND PANEL PARTITIONS

TOLERANCE

TOL.MAS1.210.9 OPENINGS FOR DOORS, WINDOWS ETC.

PD in height and width ..... ±10 mm

MANUFACTURING OF PANEL WALL PARTITIONS

TOLERANCE

TOL.MAS1.310.9 MANUFACTURING OF PANEL WALL PARTITIONS

PD in:

1. Length ..... ±5 mm
2. Thickness ..... ±1.5 mm
3. Flatness ..... ±3 mm
4. Width ..... ±2 mm

TOL.MAS2 - STONEWORK

RUBBLE STONE WALLING

		TOLERANCE
TOL.MAS2.010.9	**POSITION ON PLAN**	
	PD	±25 mm
TOL.MAS2.020.9	**LENGTH**	
	PD	±25 mm
TOL.MAS2.030.9	**HEIGHT**	
	PD	±25 mm
TOL.MAS2.040.9	**LEVEL OF BED JOINTS**	
	PD in any 5 m	±25 mm
TOL.MAS2.050.9	**STRAIGHTNESS**	
	PD in any horizontal 5 m	±25 mm
TOL.MAS2.060.9	**VERTICALITY**	
	PD up to 3 m	±20 mm

ASHLAR STONE WALLING

		TOLERANCE
TOL.MAS2.110.9	**POSITION ON PLAN**	
	PD	±15 mm
TOL.MAS2.120.9	**LENGTH**	
	PD in any 6 m	±15 mm
TOL.MAS2.130.9	**OVERALL HEIGHT**	
	PD up to 3 m	±15 mm
TOL.MAS2.140.9	**LEVEL OF BED JOINTS**	
	PD in any 5 m	±10 mm
TOL.MAS2.150.9	**STRAIGHTNESS**	
	PD in any horizontal 5 m	±15 mm
TOL.MAS2.160.9	**VERTICALITY**	
	1. PD up to 3 m	±15 mm
	2. PD up to 7 m	±20 mm

TOL.MAS2.170.9 WINDOW AND DOOR OPENINGS

1. Width along wall: PD up to 3 m ..... ±10 mm
2. Height: PD up to 3 m ..... ±10 mm

NATURAL STONE CLADDING - WORKMANSHIP IN PRODUCTION

TOLERANCE

TOL.MAS2.210.9 FACE DIMENSIONS

PD from length and height:

1. Units 50 mm thick or less ..... ±2 mm
2. Units over 50 mm thick: In any 900 mm .... ±3 mm

TOL.MAS2.220.9 THICKNESSES

PD from specified thickness (minimum 19 mm) .... ±3 mm

TOL.MAS2.230.9 BOW OR TWIST

1. Natural riven faces: PD in 1.2 m length ..... ±10 mm
2. Other face finishes: PD in 1.2 m length ..... ±1.5 mm

NATURAL STONE CLADDING - ERECTION

TOLERANCE

TOL.MAS2.310.9 POSITION ON PLAN

PD ..... ±10 mm

TOL.MAS2.320.9 LENGTH

PD in any 6 m ..... ±10 mm

TOL.MAS2.330.9 OVERALL HEIGHT

PD up to 3 m ..... ±10 mm

TOL.MAS2.340.9 LEVEL OF BED JOINTS

PD in any 5 m ..... ±6 mm

TOL.MAS2.350.9 STRAIGHTNESS

PD in any horizontal 2 m ..... ±3 mm

TOL.MAS2.360.9 VERTICALITY

PD in any 1.2 m ..... ±3 mm

Note: The tolerance on the verticality is measured in relation to the true vertical from the base of the wall and is not cumulative.

TOL.MAS2.370.9 WINDOW AND DOOR OPENINGS

1. Width along wall: PD up to 3 m	±6 mm
2. Height: PD up to 3 m	±6 mm

TOL.MEW - METALWORK

TOL.MEW.010.9 GENERAL

Handrailing, ladders, stairs and flooring shall comply with the following requirements:

1. The position and height of handrailing shall be within 10 mm of the specified position and height;
2. The level of the top rung of ladders and the top tread of stairs shall be within 75 mm of the specified level;
3. The level of flooring and curbs shall be within 3 mm of the specified level.

TOL.MRY - MASONRY WALLING

TOL.MRY.010.9 GENERAL

1. Rubble stone walling shall comply with the following requirements:
   a. The position on plan shall be within 25 mm of the specified position;
   b. The length shall be within 25 mm of the specified length;
   c. The height shall be within 25 mm of the specified height;
   d. The level of bed joints shall be within 25 mm of the specified level in any 5 m length;
   e. The walling shall be straight to within 25 mm in any 5 m length;
   f. The walling shall be vertical to within 20 mm in any 3 m height.
2. Ashlar stone walling shall comply with the following requirements:
   a. The position on plan shall be within 15 mm of the specified position;
   b. The length shall be within 15 mm of the specified length;
   c. The height shall be within 10 mm of the specified height;
   d. The level of bed joints shall be within 10 mm of the specified level in any 5 m length;
   e. The walling shall be straight to within 15 mm in any 5 m length;
   f. The walling shall be vertical to within 15 mm in any 3 m height.

TOL.PIL1 - PILING AND FOOTINGS

ALL PILE TYPES

		TOLERANCE
TOL.PIL1.010.9	**POSITION ON PLAN**	
	Except Type 5 Piles, PD in plan of piles from their designed positions measured at the working level of the piling rig:	75 mm
TOL.PIL1.020.9	**VERTICALITY**	
	Except Type 5 Piles, PD from the vertical axis of the pile through the centroid of the cross-sections at the cut-off level to any level of the finished pile:	1 in 75
TOL.PIL1.030.9	**OUT OF EXACT INCLINATION**	
	PD from exact inclination, where specified, measured from the centre of pile:	2º
TOL.PIL1.040.9	**CUT-OFF LEVELS**	
	PD from specified top level of pile heads:	+20 mm : -20 mm
TOL.PIL1.050.9	**DIAMETER OF CAST INSITU PILES**	
	Minimum proportion of specified diameter:	97%

PILE TYPES 1A AND 1B

		TOLERANCE
TOL.PIL1.110.9	**DIMENSIONAL ACCURACY FOR SOLID NON-CIRCULAR SECTION**	
	PD:	+6 mm : -6 mm
TOL.PIL1.120.9	**DIMENSIONAL ACCURACY FOR HOLLOW CYLINDRICAL SECTION**	
	1. External diameter:	+10 mm : -6 mm
	2. Internal diameter:	- : -6 mm
	3. Thickness:	+25 mm : -6 mm
TOL.PIL1.130.9	**STRAIGHTNESS**	
	PD:	1 in 500

TOL.PIL1.140.9 SUPERFICIAL CRACKS

Limits which may be tolerated at the discretion of the CM provided that the Contractor can prove that the cracks will not develop further:	
1. Crack depth: Not deeper than:	1 mm
2. Crack width: Not wider than:	0.2 mm

PILE TYPE 3

TOLERANCE

TOL.PIL1.160.9 DIAMETER OF PERMANENT LINERS

Minimum proportion of specified diameter:	99%

PILE TYPE 4

TOLERANCE

TOL.PIL1.210.9 STRAIGHTNESS OF COMPLETE PILE

PD from straightness of the complete pile:	
1. Along a 3 m straight edge:	3 mm
2. Overall limit:	1 in 1000

PILE TYPE 5

TOLERANCE

TOL.PIL1.310.9 BORING

Do not drill holes oversize by more than:	20 mm

TOL.PIL1.305.9 POSITION ON PLAN

PD in plan of piles from their designed positions measured at the working level of the piling rig:	15 mm
Subject to justification and Approval, the value may be increased to a value not exceeding 75 mm.	

TOL.PIL1.330.9 VERTICALITY

PD from the vertical axis of the pile through the centroid of the cross-section at the cut-off level to any level of the finished pile:	1 in 100

TOL.PLU2 - SANITARY APPLIANCES

		TOLERANCE
TOL.PLU2.010.9	**HORIZONTALITY OF INSTALLATION**	
	PD from horizontal plane measured across width of appliance	±3 mm

TOL.PSC - PRESTRESSING CONCRETE

TOL.PSC.010.9 TOLERANCES

The lines of prestressing sheaths shall be within 5 mm of the specified line.

TOL.SLO - SLOPE TREATMENT WORKS

SOIL-CEMENT FILLING

TOL.SLO.010.9 COMPACTION

1. The tolerance on the optimum moisture content percentage shall be ±3.

SOIL NAILING

TOL.SLO.110.9 GENERAL

The installation of soil nails shall comply with the following dimensional tolerances:

1. The permitted deviation of drillholes shall be within ±2º to the specified vertical and horizontal alignments;
2. The nominal diameter of the centralizers shall not differ from the specified diameter of the drillhole by more than 10mm.

TOL.STR1 - STRUCTURAL STEEL

FABRICATION OF STEELWORK

TOL.STR1.010.9 CRITICAL DIMENSIONS AFFECTING REPETITION OR INTERCHANGEABILITY OF UNITS

Carry out fabrication so that the critical dimensions, when measured by a tape calibrated at 20°C, comply with the tolerances given in the Table below:

Dimension Measured	Tolerance for Single Element	Tolerance on overall dimension of assembled system of more than one
Not exceeding 5 m	±3 mm	±3 mm
Exceeding 5 m but not exceeding 10 m	±5 mm	±6 mm
Exceeding 10 m but not exceeding 15 m	±5 mm	±10 mm
Exceeding 15 m	±10 mm	±10 mm

TOL.STR1.020.9 DETAILED DIMENSIONS

Comply with the fabrication tolerances in the following British Standard and Code of Practice:

1. BS 5400:Part 6:1980 for plates and sections in bridgework;
2. The Code of Practice for the Structural Use of Steel 2011 for hot rolled sections and cold rolled sections in building.

ERECTION OF STEELWORK

TOLERANCE

TOL.STR1.110.9 CAST-IN FOUNDATION BOLTS

Tilt of bolts to be not more than 1 in 40 from specified line.

TOL.STR1.120.9 ERECTION TOLERANCES

After lining, levelling, plumbing and making the permanent connections:

1. Level of the top of base plates and level of the lower end of vertical or raking components in a pocket: PD from specified levels: ..... ±10 mm
2. PD from line of vertical or raking components other than portal frames:

   a. ..... 1 in 600

   or

   b. From specified line in every direction: ..... 10 mm

3. PD from line of vertical or raking components in portal frames:	
a.	1 in 600
or	
b. From specified line normal to the plane of the frame:	±10 mm
4. The position and level of components connected with other components: PD from the specified position and level at point of connect:	5 mm
5. The difference in level between adjacent sloping or horizontal components connected by a deck slab: PD from specified difference in level:	±10 mm

TOL.STW - STEELWORK

TOL.STW.010.9 FABRICATION TOLERANCES GENERALLY

Fabrication tolerances for steelwork shall comply with BS 5950:Part 2:1992, Sub-section 7.2 as appropriate.

TOL.STW.020.9 FABRICATION TOLERANCES FOR BRIDGEWORKS

Fabrication tolerances shall comply with BS 5400:Part 6:1980, Clause 4.2.

TOL.STW.030.9 FOUNDATION BOLTS

The position of cast-in foundation bolts at the top of base plates shall be within 3 mm of the specified position. The position of foundation bolts in bolt pockets at the top of base plates shall be within 5 mm of the specified position. The line of bolts shall not be tilted from the specified line by more than 1 in 40.

TOL.STW.040.9 ERECTION TOLERANCES

After lining, levelling, plumbing and making the permanent connections, steelwork shall be erected to within the following tolerances:

1. The position in plan of vertical components at the base shall be within 10 mm of the specified position;
2. The level of the top of base plates and the level of the lower end of vertical or raking components in a pocket based shall be within 10 mm of the specified level;
3. The thickness of bedding shall be within one-third of the nominal thickness or 10 mm, whichever is less, of the specified nominal thickness;
4. The line of vertical or raking components other than in portal frames shall be within 1 in 600 and within 10 mm of the specified line in every direction;
5. The line of vertical or raking components in portal frames shall be with 1 in 600 and within 10 mm of the specified line normal to the plane of the frame;
6. The position and level of components connected with other components shall be within 5 mm of the specified position and level relative to the other components at the point of connection;
7. The position of components supported on a bearing shall be within 5 mm of the specified position relative to the bearing along both principal axes of the bearing;
8. The difference in level between adjacent slopping or horizontal components connected by a deck slab shall be within 10 mm of the specified difference in level.

TOL.WSP - WATER SUPPLY PIPEWORK

TOL.WSP.010.9 LINE AND LEVEL

The line and level of pipelines for water supply pipeworks shall be within 25 mm of the specified line and level.

HONG KONG HOUSING AUTHORITY

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DemolitionWorks Specification

DEM DEMOLITION

DEM1 DEMOLISHING STRUCTURES 5

GENERAL 5

DEMOLITION SUB-CONTRACTOR 5

DEM1.G010.9 INFORMATION ON DEMOLITION SUB-CONTRACT 5
DEM1.G020.9 CONDITIONS ON DEMOLITION SUB-CONTRACT 5

DESIGN 6

GENERAL 6

DEM1.D010.9 EXISTING INFORMATION 6
DEM1.D020.9 CONTRACTOR'S RESPONSIBILITY 6
DEM1.D030.9 STANDARDS AND STATUTORY REQUIREMENTS 6
DEM1.D040.9 NON-COMPLIANCE 6
DEM1.D050.9 REGISTERED STRUCTURAL ENGINEER & REGISTERED GEOTECHNICAL ENGINEER 6

SURVEY AND PREPARATORY WORK 7

DEM1.D110.9 SURVEY 7
DEM1.D120.9 EXISTING SERVICES 7
DEM1.D130.9 SURVEY ON MATERIALS WITH POTENTIAL DANGER 7
DEM1.D140.9 SURVEY ON MATERIALS TO BE COLLECTED/RECYCLED 7

SUBMISSIONS 8

DEM1.D210.9 SUBMISSIONS PRIOR TO CONSENT APPLICATION 8
DEM1.D220.9 METHOD STATEMENTS 8
DEM1.D230.9 CONSENT TO COMMENCE DEMOLITION WORKS 8
DEM1.D240.9 COMMENCEMENT OF DEMOLITION WORKS 8
DEM1.D250.9 COMPLETION OF DEMOLITION WORKS 8

MATERIALS 10

MATERIALS ARISING FROM THE DEMOLITION WORKS 10

DEM1.M010.9 MATERIALS NOT REQUIRED FOR RE-USE 10
DEM1.M020.9 MATERIALS REQUIRED BY THE AUTHORITY 10
DEM1.M025.9 MATERIAL TO BE COLLECTED/RECYCLED 10
DEM1.M030.9 HARDCORE 10
DEM1.M040.9 EXCAVATED MATERIALS SUITABLE FOR FILLING 10

WORKMANSHIP 11

GENERAL 11

DEM1.W010.9 SEQUENCE 11
DEM1.W020.9 METHODS OF DEMOLITION 11

SUPERVISION 11

DEM1.W110.9 SUPERVISION PLAN 11
DEM1.W120.9 TECHNICALLY COMPETENT PERSONS 12
DEM1.W130.9 FLAGMAN 12
DEM1.W140.9 SITE VIDEO RECORDING SYSTEM 12

SAFETY AND PROTECTION 13

DEM1.W210.9 PRECAUTIONARY MEASURES 13
DEM1.W220.9 SHORING AND STRUTTING 13
DEM1.W230.9 PROTECTION OF ADJOINING AREAS 13
DEM1.W240.9 CATCHFAN 15
DEM1.W250.9 SUPPORTING EXISTING STRUCTURES 15
DEM1.W260.9 PARTLY DEMOLISHED STRUCTURES 15
DEM1.W270.9 WEATHERPROOFING RETAINED AREAS OF PARTIALLY DEMOLISHED BUILDINGS 15

DEM1.W280.9 PREVENTION OF OVERLOADING....16
DEM1.W290.9 OVERHEAD WIRES....16
DEM1.W300.9 RISK OF FIRE OR EXPLOSION....16
DEM1.W310.9 DAILY SITE INSPECTION IN THE MORNING....16
DEM1.W320.9 INDUCTION TRAINING....16
DEM1.W330.9 CLEAR EMERGENCY ACCESS....17
DEM1.W340.9 ROUTINE DAILY SITE INSPECTION BY CM....17

DEMOLITION WORKS....17
DEM1.W410.9 SORTING PROCESSING AND REMOVAL OF DEMOLITION MATERIAL....17
DEM1.W420.9 DISMANTLING AND STORAGE OF MATERIALS REQUIRED BY THE AUTHORITY....17
DEM1.W430.9 UNDERGROUND FEATURES....17
DEM1.W440.9 DISUSED DRAIN AND MANHOLES....17
DEM1.W450.9 SORTING AND REMOVAL OF EXCAVATED MATERIAL....17
DEM1.W460.9 FILLING VOIDS....18
DEM1.W470.9 LEVELLING....18
DEM1.W480.9 REQUIREMENT FOR STUDIES DURING CONTRACT PERIOD....18
DEM1.W490.9 STRUCTURE SUPPORTING GROUND....18
DEM1.W500.9 OPERATION OF POWERED MECHANICAL PLANT OR EQUIPMENT....18
DEM1.W510.9 REMOVAL OF PART OF A BUILDING....19
DEM1.W520.9 DISPOSAL OF MATERIALS TO BE COLLECTED/RECYCLED OFF SITE....19

DEM2 ASBESTOS REMOVAL....20

MATERIALS....20

DEFINITIONS....20
DEM2.M010.9 GENERAL....20
DEM2.M020.9 DEFINITIONS AND EXPLANATORY NOTES....20

ASBESTOS REMOVAL PLANT AND EQUIPMENT....27
DEM2.M110.9 GENERAL....27
DEM2.M120.9 PROVISION....27
DEM2.M130.9 VIEWING PANEL....28

PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING....28
DEM2.M210.9 CLOTHING....28
DEM2.M220.9 RESPIRATORS....29
DEM2.M230.9 RESPIRATOR FILTERS....29

WORKMANSHIP....30

GENERAL....30
DEM2.W010.9 ASBESTOS REMOVAL WORK....30
DEM2.W020.9 SPECIALIST ASBESTOS REMOVAL CONTRACTOR....30
DEM2.W030.9 SITE VISIT AND INSPECTION....30
DEM2.W040.9 SURVEY AND REPORT....30
DEM2.W050.9 SUPERVISION BY REGISTERED ASBESTOS CONSULTANT....30
DEM2.W060.9 METHOD STATEMENT....30
DEM2.W070.9 SITE SUPERVISOR....31
DEM2.W080.9 PREVENTION OF NUISANCE....31
DEM2.W090.9 SITE ORGANISATION CHART....31
DEM2.W100.9 NOTIFICATIONS....31
DEM2.W110.9 INSPECTION OF PREPARATORY WORKS....31

STATUTORY OBLIGATIONS, CODES OF PRACTICE AND OTHER REQUIREMENTS32
DEM2.W310.9 SAFETY, HEALTH AND WELFARE 32
PROTECTIVE ENCLOSURES 33
DEM2.W410.9 ERECTION OF TARPAULIN ENCLOSURE 33
DEM2.W420.9 DAMAGE TO ENCLOSURE 33
ASBESTOS REMOVAL 33
DEM2.W510.9 METHODOLOGY 33
DEM2.W520.9 GENERAL PREPARATION PROCEDURES 33
DEM2.W530.9 GENERAL PRECAUTIONARY PROCEDURES 33
DEM2.W540.9 REMOVAL OF BALCONY GRILLE PANELS (INCLUDING PANELS ENCAPSULATED ON ONE SIDE) 34
DEM2.W550.9 REMOVAL OF BALCONY GRILLE PANELS (ENCAPSULATED ON BOTH SIDES) 35
DEM2.W560.9 REMOVAL OF STAIRCASE GRILLE PANELS 36
DEM2.W570.9 REMOVAL OF ROOF INSULATION TILES 37
DEM2.W580.9 REMOVAL OF REFUSE CHUTES 38
DEM2.W590.9 REMOVAL OF INTERNAL CHIMNEY FLUES 39
DEM2.W600.9 REMOVAL OF EXTERNAL CHIMNEY FLUES WITH SURFACE LAGGING 40
DEM2.W610.9 REMOVAL OF SANDWICHED FLUES 42
DEM2.W620.9 REMOVAL OF ASBESTOS-CONTAINING CORRUGATED SHEET ROOFING 43
DEM2.W630.9 REMOVAL OF CEMENT COVERED CORRUGATED ASBESTOS SHEET ROOFING 43
DEM2.W640.9 REMOVAL OF CHALKBOARDS CONTAINING ASBESTOS 44
DEM2.W650.9 REMOVAL OF BUILDING SERVICES INSTALLATION 45
DEM2.W660.9 REMOVAL OF BUSBAR RISER TRUNKING 45
DEM2.W670.9 REMOVAL OF FLEXIBLE JOINT OR CAULKING TO CONDUIT OR TRUNKING THROUGH FLOOR SLABS 45
WORK ON COMPLETION 46
DEM2.W710.9 GENERAL 46
DEM2.W720.9 BALCONY AND STAIRCASE GRILLE PANELS 47
DEM2.W730.9 ROOF INSULATION TILES 47
DEM2.W740.9 REFUSE CHUTES 47
DEM2.W750.9 INTERNAL CHIMNEY FLUES 48
DEM2.W760.9 EXTERNAL CHIMNEY FLUES WITH SURFACE LAGGING 48
DEM2.W770.9 SANDWICHED FLUES 48
DEM2.W780.9 CORRUGATED SHEETS AND CEMENT COVERED CORRUGATED SHEETS 49
DEM2.W790.9 BUSBAR RISER TRUNKING AND BUILDING SERVICES INSTALLATION 49
DEM2.W800.9 CHALKBOARDS 49
DEM2.W810.9 DISPOSAL OF WASTE 49
EMERGENCY PROCEDURES 50
DEM2.W910.9 GENERAL 50
DEM2.W920.9 SPILLAGE OF ASBESTOS DEBRIS 50
DEM2.W940.9 FIRE 50
DEM2.W950.9 ACCIDENT 50
DEM2.W960.9 TYPHOON SIGNAL NUMBER 3 AND ABOVE 51
DEM2.W970.9 PERSONAL PROTECTION DECONTAMINATION 51
DEM2.W980.9 ACCEPTANCE OF ASBESTOS REMOVAL WORK 51
TESTING 52

AIR MONITORING TEST 52
DEM2.T010.9 AIR MONITORING TESTS BORNE BY EMPLOYER 52
DEM2.T020.9 AIR MONITORING TESTS BORNE BY CONTRACTOR 52
DEM2.T030.9 SURVEILLANCE TESTS BY DIRECT TESTING CONTRACTOR 52
DEM2.T040.9 AIR MONITORING TESTS 53

DEM1 DEMOLISHING STRUCTURES

GENERAL

DEMOLITION SUB-CONTRACTOR

DEM1.G010.9 INFORMATION ON DEMOLITION SUB-CONTRACT

In the event that parts of the demolition works are to be sub-contracted in accordance with PRE.B6.035, submit with the tender the following information:

1. Letter of intent from the proposed sub-contractor whom the tenderer intends to employ for the Contract should the tenderer be awarded the Contract, indicating his willingness to carry out the proposed parts of the demolition works;
2. The names of the directors or sole proprietor and site representatives of the proposed sub-contractor;
3. The activity and the scope of the proposed sub-contract.

DEM1.G020.9 CONDITIONS ON DEMOLITION SUB-CONTRACT

1. In the event that parts of demolition works are to be sub-contracted in accordance with PRE.B6.035, incorporate the following conditions into the sub-contract:
   a. The activity and the scope of the sub-contract;
   b. The sub-contractor is not allowed to sub-contract the demolition works;
   c. A probity clause shall be included in the sub-contract such that:

      "If the sub-contractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Contractor, Hong Kong Housing Authority or Housing Department, the Contractor shall at liberty forthwith terminate the employment of the sub-contractor under the sub-contract. The Contractor, Hong Kong Housing Authority or Housing Department shall hold the sub-contractor liable for any loss or damage which the Contractor, Hong Kong Housing Authority or Housing Department may thereby sustain."
2. Before execution of the sub-contract works, submit to the CM a signed copy of the sub-contract or written confirmation signed by the Contractor and the sub-contractor confirming that the conditions stated in sub-clause (1) above have been included into the sub-contract.

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DESIGN

GENERAL

DEM1.D010.9 EXISTING INFORMATION

1. The information on the structure to be demolished as contained in the Contract is given in good faith and without prejudice to the Contractor's liability under the Contract;
2. The demolition plan for the preparation of the method statements, which is issued as a reference for adoption or proposed deviation as per DEM1.D220, is specified in Project Specific Specification.

DEM1.D020.9 CONTRACTOR'S RESPONSIBILITY

Accept sole responsibility for the execution of the demolition works including but not limited to the preparation of the method statements as specified in DEM1.D220 notwithstanding that such method statements may have followed the demolition plan which is for reference only.

DEM1.D030.9 STANDARDS AND STATUTORY REQUIREMENTS

1. Comply with all requirements relevant to demolition works issued by the Government of HKSAR and/or statutory authorities;
2. Where this Specification includes provisions additional to, or more stringent than those of the Building Regulations, the provisions of this Specification will prevail overall.

DEM1.D040.9 NON-COMPLIANCE

1. In the event of non-compliance with the restrictions specified regarding the method of demolition to be employed and the sequence of operations to be followed, an Instruction to cease work may be issued by the CM;
2. Bear any extra time or cost compensation in respect of or resulting from such Instruction to cease work.

DEM1.D050.9 REGISTERED STRUCTURAL ENGINEER & REGISTERED GEOTECHNICAL ENGINEER

1. Appoint a Registered Structural Engineer (RSE) registered under Buildings Department for the preparation and endorsement of the method statements, with drawings and design calculation, and any other submissions as required by this Specification;
2. The duties and roles of the RSE include but not limited to:
    a. Take up the full design responsibility for method statements and all related drawings and calculation as required under this Specification;
    b. Take up the role of Contractor's Representative and the highest grade TCP in the Contractor's Stream under SP;
    c. Check that assumptions made in the design of temporary works and method statements are validated on Site;

d. Prepare a risk assessment report with the Safety Officer including an inspection schedule for all staff such as RSE, site engineer, Safety Officer, site agent, site supervisor / foreman on all critical activities in demolition work;

e. Pay regular site visits for proper control of the works and submit reports after each visit to certify the work is safe;

f. Carry out inspection on other activities which, in his professional judgement, are critical and require close supervision.

3. The frequency of RSE's visits shall be a minimum of two visits per each month;

4. In case of change of RSE, the new RSE has to endorse and re-submit the method statements prepared by the former RSE and take up the role of Contractor's Representative and the highest grade TCP in the Contractor's Stream under SP;

5. When specified in Project Specific Specification, appoint a Registered Geotechnical Engineer (RGE) registered under Buildings Department for the preparation and endorsement of the geotechnical report / supporting documentation for the submissions as per above sub-clause (1).

SURVEY AND PREPARATORY WORK

DEM1.D110.9 SURVEY

Prior to commencement of Work,

1. Visit the Site and inspect the appropriate drawings and demolition plan as issued by the CM to ascertain the extent and scope of the demolition works required;

2. Identify demolition procedures for any unconventional structural elements.

DEM1.D120.9 EXISTING SERVICES

Before commencement of demolition works,

1. Locate and identify position of existing services affected by the works;

2. Ensure all statutory authority's installations have been safely disconnected and associated fittings and equipment have been removed;

3. Be responsible for liaison with the relevant Government Departments and utilities companies for disconnecting existing utilities and services within the Site. Allow sufficient time in the programme for the utilities and services disconnections.

DEM1.D130.9 SURVEY ON MATERIALS WITH POTENTIAL DANGER

1. Within 14 days following the notified date for the commencement of the Works, carry out survey on the presence of wastewater, hazardous materials, matters arising from toxic chemicals, etc. and possible presence of materials which can contribute to contaminations on the environment;

2. Submit method of removal for CM's approval within 14 days in case of any of these materials being identified.

DEM1.D140.9 SURVEY ON MATERIALS TO BE COLLECTED/RECYCLED

1. Carry out a survey before the demolition process to ascertain the types and quantities of materials to be collected/recycled as specified in DEM1.M025;

2. Identify also the recovery/recycling companies or organizations for recovery and recycling of the materials other than those specified in DEM1.M025;

3. Submit the survey record for CM's approval within 21 days from the notified date for the commencement of the Works.

SUBMISSIONS

DEM1.D210.9 SUBMISSIONS PRIOR TO CONSENT APPLICATION

1. Submit three sets of the following documents to CM for approval at such date which shall be a date within 14 days after the notified date for commencement of the Works and minimum 42 days before application for consent of demolition works under DEM1.D230:
   a. SP for the Contractor's Stream as specified in DEM1.W110;
   b. Method statements as specified in DEM1.D220.
2. Allow a minimum of 42 days for the first submission and a minimum of 37 days for any subsequent re-submission required for obtaining the Approval;
3. Allow sufficient time in the programme of Works for obtaining the said Approval and subsequent re-submissions.

DEM1.D220.9 METHOD STATEMENTS

1. Submit the method statements prepared and endorsed by the RSE and RGE according to DEM1.D050 for CM's approval. Details of the method statements shall be as specified in Project Specific Specification;
2. The method statements shall comply with this Specification and all statutory requirements relevant to demolition works;
3. The method statements shall also comply with the following codes:
   a. Code of Practice for Demolition of Buildings 2004 (CoPDem) issued by Buildings Department;
   b. Code of Practice for Bamboo Scaffolding Safety (CoPScaffold) issued by Labour Department;
   c. Code of Practice for Site Supervision 2009 (CoPSS) issued by Buildings Department.

DEM1.D230.9 CONSENT TO COMMENCE DEMOLITION WORKS

1. Submit the supporting documents specified in Project Specific Specification and allow a minimum of 21 days for granting the consent to commence demolition works;
2. Do not commence demolition works without a written consent from the CM and until all precautionary measures as stated in DEM1.W210 are complete.

DEM1.D240.9 COMMENCEMENT OF DEMOLITION WORKS

Notify the CM and submit Form ICU 10 after obtaining the consent and before commencing the demolition works.

DEM1.D250.9 COMPLETION OF DEMOLITION WORKS

1. For Contract without phased completion, submit Form ICU 14A to notify the CM of the completion of the demolition works as detailed in the demolition plan at least 18 days prior to the completion of the demolition works;

2. For Contract with phased completion and for each Section as per PRE.B4.080, submit Form ICU 14A to notify the CM of the completion of the demolition works as detailed in the demolition plan at least 18 days prior to the completion of the demolition works in that Section.

MATERIALS

MATERIALS ARISING FROM THE DEMOLITION WORKS

DEM1.M010.9 MATERIALS NOT REQUIRED FOR RE-USE

Unless otherwise specified at DEM1.M020, all materials arising from demolition including electric light fittings, fans, water heaters etc. and all playground equipment, which are to be removed from Site as work proceeds, are property of the Contractor.

DEM1.M020.9 MATERIALS REQUIRED BY THE AUTHORITY

Materials which are remained the property of the Authority are specified in the Project Specific Specification.

DEM1.M025.9 MATERIAL TO BE COLLECTED/RECYCLED

Materials to be collected/recycled are specified in the Project Specific Specification.

DEM1.M030.9 HARDCORE

Brick rubble or other hard materials as sub-clause (2) of EAR1.M240 arising from the demolition may be re-used as hardcore.

DEM1.M040.9 EXCAVATED MATERIALS SUITABLE FOR FILLING

1. Unless certified otherwise by the CM, all materials excavated are deemed suitable for filling purposes;
2. The CM's decision regarding the suitability of excavated materials for filling purposes applies only to this Contract and only to the extent that such opinion is not subsequently changed.

WORKMANSHIP

GENERAL

DEM1.W010.9 SEQUENCE

1. Do not proceed with the demolition of the building and associated structures before all reusable and recyclable materials as specified in DEM1.M025 are removed from the building or the structure;
2. Unless otherwise approved by the CM, carry out demolition work on a floor to floor basis commencing at roof/top floor level as applicable;
3. Where there are any structural strengthening works found in the building, do not dismantle any existing steel props, steel truss, etc. forming part of the structural strengthening works in a floor prior to the demolition of that floor;
4. Ensure all operators and workers involved understand clearly the method and sequence of demolition. Draw sketches with explanation in Chinese illustrating the work sequences and post them in a conspicuous position on Site.

DEM1.W020.9 METHODS OF DEMOLITION

1. Use only hand held equipment for the salvage of reusable and recyclable materials from structures;
2. Use of the following demolition methods will not be permitted:
   a. 'Swinging ball';
   b. 'Drop ball';
   c. 'Blasting'.

SUPERVISION

DEM1.W110.9 SUPERVISION PLAN

1. The SP shall comply in all respects with the requirements stated in the TMSP and CoPSS;
2. Complete and submit Form ICU206 for the SP for demolition works under the Contractor's Stream in accordance with TMSP, and the CoPSS;
3. The submitted SP shall include the following additional safety supervision requirements at critical stages of the works unless otherwise approved by the CM:

Critical Stages of the Works	Contractor's Stream					
	AS	CR/T5[Note]	T4	T3	T2	T1
Cantilevered Structures	Bi-weekly	Bi-weekly	Full Time	Full Time	-	Full Time
Factory Block	Bi-weekly	Bi-weekly	Full Time	Full Time	-	Full Time

Note: As specified in DEM1.D050, the RSE shall take up the role of Contractor's Representative (CR) and the highest grade TCP in Contractor's Stream under SP.

DEM1.W120.9 TECHNICALLY COMPETENT PERSONS

1. Appoint TCPs under the Contractor's Stream for demolition works as per the submitted Supervision Plan required in DEM1.W110 for the duration of the Contract;
2. The appointed TCP shall oversee the entire process of demolition works and whose duties include but not limited to:
   a. Inspect precautionary measures;
   b. Ensure effectiveness of propping system;
   c. Prevent overloading of floors.
3. Post details of appointed TCPs in the specified Form ICU20 in a prominent position adjacent the Works.

DEM1.W130.9 FLAGMAN

During removal of demolition material arrange for a flagman to be in attendance at each site entrance and exit used for this purpose.

DEM1.W140.9 SITE VIDEO RECORDING SYSTEM

1. Provide, operate and maintain, including all necessary cables, wirings, lightings and other accessories, a video recording system to record the entire demolition process with the following essential features:
   a. The video cameras used in the system should be of high resolution, lowlight and colour type;
   b. Power backup should be provided to cater for accidental breakdown of the power supply to the system;
   c. Videos captured by the system shall be recorded continuously without break unless agreed by the CM; and
   d. Videos shall be captured in a format acceptable to CM.
2. Install a minimum number of video cameras per block at strategic locations as specified in Project Specific Specification. Re-locate the video cameras from time to time to suit the progress of the demolition works as instructed by the CM;
3. Securely protect the video cameras from being damaged or blocked so that the entire demolition process including movement of debris and the overall sequences of demolition can be recorded;
4. Design and construct all necessary temporary works, including any supporting frames and protections, for the video cameras and their accessories, even at high level;
5. Provide the software and hardware for CM's viewing the recorded videos and keep the videos for at least 14 days;
6. Post sufficient notices at conspicuous positions to notify the workers and staff about the purpose of video recording system in accordance with Data Protection Principles set out in the Personal Data (Privacy) Ordinance.

SAFETY AND PROTECTION

DEM1.W210.9 PRECAUTIONARY MEASURES

1. Carry out necessary surveys as the demolition proceeds to detect hazards resulting from the activities and inform the CM forthwith;
2. In the salvage of reusable and recyclable materials, do not use cutting torches until the work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations, and maintain adequate ventilation when using cutting torches;
3. Do not commence demolition works until the following procedures and works are complete:
    a. Removal of the reusable and recyclable materials as specified in DEM1.M025 from structures;
    b. Granting of written consent by the CM as specified in DEM1.D230;
    c. Erection of hoardings, covered walkways, etc as specified in PRE.B10.710 to PRE.B10.730;
    d. Erection of shoring, strutting, protective screening etc as specified in PRE.B8.875, DEM1.W220 and DEM1.W230;
    e. Removal of all asbestos containing materials and provision of associated protective works as specified in Worksection DEM2 in individual building blocks or structures prior to the demolition of those individual building blocks or structures;
    f. Provision of water supply at points of demolition works action as specified in PRE.B8 and to CM's satisfaction;
    g. Installation of debris chutes outlet enclosures as specified in PRE.B8 and to CM's satisfaction;
    h. Disconnection and termination of all utility services as specified in DEM1.D120;
    i. Sealing all sewers and drainage connection to prevent building debris, soil and etc. from entering public sewers and drains.

DEM1.W220.9 SHORING AND STRUTTING

1. Provide, maintain, alter and adapt all temporary supports and strutting of adequate strength to support walls, floors, roofs etc and ensure safety of the public, operatives and adjoining property;
2. Submit details of the proposed methods of support designed by Registered Structural Engineer for CM's approval unless specified otherwise by the CM;
3. Remove all temporary supports on completion and make good to works disturbed.

DEM1.W230.9 PROTECTION OF ADJOINING AREAS

1. Protect adjoining areas from the risk of falling debris with a protective screen enclosure encasing the whole building to be demolished;
2. Protect adjoining areas from the risk of fire by the following:
    a. Provide and properly maintain a sufficient number of portable fire fighting appliances during the course of demolition works: minimum 1 fire extinguisher and 2 buckets of sand in each staircase on each floor;

b. Provide and maintain the water supply including the installation of water tank, pump or apparatus as necessary for sprinkling the working floor continually to suppress risk of fire when flame cutting is carried out within 5 m from the scaffolding; and

c. Provide full time supervision by a competent supervisor when flame cutting is carried out within 5 m from the scaffolding.

3. Employ a Registered Structural Engineer to prepare design and method statement for scaffolding, catch platform, covered walkway with steel catch platform, protective canopy, etc. for submission to CM's approval. Their design and construction shall include but not limited to:

a.

i. Unless otherwise specified in Project Specific Specification, construct screen with ordinary tarpaulin sheets supported by adequately sized bamboo scaffolding or other framework and erected according to the Construction Sites (Safety) Regulations and the Code of Practice for Bamboo Scaffolding Safety (CoPScaffold);

ii. Provide fire-retardant tarpaulin sheets instead of ordinary tarpaulin sheets to the faces of the blocks as specified in Project Specific Specification;

iii. The fire-retardant tarpaulin sheets shall be light weight and constructed of fire retardant materials meeting one of the following requirements:

- Class B material as specified in BS 5867; or
- Flame retardant test for certain items, light weight cloths methods, provided by the Fire Retardant Regulations for Protective Canvas for Construction, Japan Ministerial Ordinance of the Ministry of Home Affair; or
- Any equivalent standard criteria or testing approved by the CM.

b.

i. Unless otherwise specified in the Project Specific Specification, construct bamboo scaffolding in single row;

ii. Construct bamboo scaffolding in double row for the faces of the blocks as specified in Project Specific Specification.

c. Maintain height of screen at a minimum level of 1000 mm above the structure being demolished;

d. Construct screen in 3 layers, with minimum overlapping width of 300 mm, and fix screen to the frame at regular intervals - the innermost net of minimum 3.5 mm diameter heavy duty nylon (maximum mesh grid opening 50 mm), tarpaulin sheet and the outermost nylon net of minimum 1.0 mm diameter (maximum mesh grid opening 20 mm), all materials use shall resist ultra-violet light deterioration;

e. For scaffoldings higher than 15 m above the ground floor level, provide steel brackets anchored to the existing structure or other support system at interval of not more than 15 m to support the scaffolding;

f. Tie scaffolding to the buildings at intervals of not more than 4 m in both horizontal and vertical directions to firm supports to guard against storms / typhoon. Check ties effectively restraining scaffolding at all times, particularly before and after storms / typhoons;

g. Dismantling of the scaffolds shall coincide with the demolition progress. When the wall ties are disconnected due to the demolition of the building structure, the unsecured section of the scaffoldings shall be removed accordingly. In all times, the unbraced sections shall not be higher than 2 m from the nearest anchor;

h. Inspect and reinstate the ties for scaffolding if any of the ties are fixed onto materials or fixtures specified in DEM1.M025.

4. Provide additional protective canopy for blocks close to the streets as specified in Project Specific Specification;

5. Carry out vibration monitoring at locations specified by the CM during demolition and the peak particle velocities at these locations specified shall not exceed 15 mm/sec for prolonged vibration caused by mechanical demolition;

6. Maintain safe ingress and egress for adjoining properties at all the times.

DEM1.W240.9 CATCHFAN

1. Construct catchfan as specified in Project Specific Specification to prevent fall of demolition debris around perimeter of building under demolition;

2. Construct catchfan at a vertical distance of not more than 10 m below the working floor;

3. Erect sloping catchfan with a horizontal extension of at least 1500 mm from the exterior face of the scaffold;

4. The typical angle of inclination shall be 20° to 45° from the horizontal plane.

DEM1.W250.9 SUPPORTING EXISTING STRUCTURES

1. Support existing structures as necessary during cutting of new openings or replacement of structural members;

2. Prior to commencement of works, submit details of all intended arrangements for structural support designed by Registered Structural Engineer for CM's approval;

3. Do not remove supports until new work is capable of carrying all loads.

DEM1.W260.9 PARTLY DEMOLISHED STRUCTURES

Leave the Site and partly demolished structures in a safe condition at the end of each day's work. No accumulation of debris, particularly at working floors and at ground floor, which causes excessive pressure on the floors, slopes, retaining structures, hoardings/covered walkways and walls of adjoining buildings.

DEM1.W270.9 WEATHERPROOFING RETAINED AREAS OF PARTIALLY DEMOLISHED BUILDINGS

1. Protect retained building structure and interiors exposed during course of demolition works with a temporary weather-tight screen erected 1000 mm back from perimeter edge of floor;

2. Construct screens with close boarding fixed to framing and faced outside with roofing felt of an Approved type;

3. Cover the exposed floor beyond the screening with roofing felt of similar type to that used to face screens;

4. Form a waterproof seal between floor and screen;

5. Construct doors in the screens and fix with secure fastenings and hanging devices as necessary to provide authorised access.

DEM1.W280.9 PREVENTION OF OVERLOADING

1. Do not overload the structure under demolition with the reusable and recyclable materials, demolition plant and/or resulting debris;
2. Provide temporary shoring and strutting in accordance with the demolition plan or Approved method statement;
3. Bear all costs of temporary shoring or strutting required;
4. Maximum weight of mobile equipment on suspended floors is not to exceed 11,600 kg. The use of plants heavier than 11,600 kg are subject to the requirements of sub-clause (2) above and CM's approval;
5. Unless approved by the CM, the minimum number of consecutive floors required to distribute mobile equipment loading through popping is 5;
6. Unless approved by the CM, the minimum number of consecutive floors required to distribute localize loading from temporary ramp through propping is 5;
7. Maximum spacing of steel props in each direction is 1.2 m;
8. Use steel props of minimum bearing capacity 25 kN (45 kN for local area under temporary ramp);
9. Secure and wedge tight top and bottom supports of props. Fix bracings/ties to the props to provide lateral restraints in at least two directions;
10. Do not allow mobile equipment to move to within 2 m of the building edge, 1 m of any floor opening or on to any cantilevered structures;
11. Provide adequate spreader for props bearing on ground, where necessary, to avoid any undue settlement.

DEM1.W290.9 OVERHEAD WIRES

Prevent damage to overhead wires during demolition operations.

DEM1.W300.9 RISK OF FIRE OR EXPLOSION

Take precautions to prevent fire or explosion from gas or vapour release, electricity or any other source, especially when removing tanks or pipes which may have contained flammable liquids or gases.

DEM1.W310.9 DAILY SITE INSPECTION IN THE MORNING

1. Do not commence any demolition works on each day unless the daily morning site inspection has been carried out by the Safety Officer and the TCP(s) specified in the SP;
2. Submit to CM a plan, including the inspection route(s), check list(s) and the name of Safety Officer and TCP(s), for carrying out the daily morning site inspection;
3. Revise the plan from time to time to suit the actual site progress and resource.

DEM1.W320.9 INDUCTION TRAINING

1. Implement a site specific induction training system to ensure that all workers and machine operators fully understand the demolition sequences and precautionary measures before allowing them to work on Site;
2. Keep a proper record of the trained workers/operators and submit to CM monthly.

DEM1.W330.9 CLEAR EMERGENCY ACCESS

Maintain at all times at least one clear emergency access at the working floor during demolition for the safe passage of all personnel.

DEM1.W340.9 ROUTINE DAILY SITE INSPECTION BY CM

During demolition works, CM may carry out routine site inspection at any time during each working day. For safety reason, the demolition works, in particular those on working floors, may be required to be temporarily suspended if instructed by CM. Allow time and cost for the routine site inspection of CM. No claim whatsoever will be entertained for the interruption, if any, of the demolition works.

DEMOLITION WORKS

DEM1.W410.9 SORTING PROCESSING AND REMOVAL OF DEMOLITION MATERIAL

1. Submit a method statement to the CM indicating proposed sorting and processing method;
2. Unless specified otherwise, sort and process the materials to be collected or recycled arising from the demolition works;
3. Separate out all timber, steel, rubbish, materials to be collected/recycled as specified in DEM1.M025 and other decomposable material;
4. Arrange for collection and removal of the materials to be collected/recycled off site in accordance with their types as specified in DEM1.M025;
5. Break down large sized demolition fragments of building debris to 250 mm maximum size all round;
6. Remove materials arising from demolition from site as work proceeds; and
7. Submit the name of recycle collection companies and their collection receipt for record.

DEM1.W420.9 DISMANTLING AND STORAGE OF MATERIALS REQUIRED BY THE AUTHORITY

Carefully dismantle and remove to store materials specified at DEM1.M020.

DEM1.W430.9 UNDERGROUND FEATURES

Report to CM details of any underground tanks, wells etc discovered during demolition works and await his Instructions.

DEM1.W440.9 DISUSED DRAIN AND MANHOLES

Allow disused drains to vent built-up gases before proceeding with works below ground level as follows:

1. Pipework: plug ends of disused drains by filling bore with 15/20 grade concrete 150 mm or diameter of pipe if greater;
2. Manholes: plug ends of pipes as sub-clause (1) above. Break up top 300 mm of chamber and fill void with hardcore.

DEM1.W450.9 SORTING AND REMOVAL OF EXCAVATED MATERIAL

1. Sort suitable and unsuitable materials into separate temporary spoil heaps in locations agreed with the CM;

2. Remove unsuitable materials from site as work proceeds.

DEM1.W460.9 FILLING VOIDS

1. After excavation, backfill and compact voids with suitable material such as Approved excavated material and/or general filling material as specified in EAR1;
2. Level to adjacent paving level with compacted hardcore 100 mm thick;
3. Do not use unsuitable materials such as salvaged materials or debris arising from demolition for backfilling;
4. The opinion of the CM as to the suitability of filling materials applies to the Contract only and only to the extent that such opinion is not subsequently changed.

DEM1.W470.9 LEVELLING

Unless otherwise Instructed, level off the site to the satisfaction of CM on completion of the work.

DEM1.W480.9 REQUIREMENT FOR STUDIES DURING CONTRACT PERIOD

1. Carry out as instructed structural monitoring, non-destructive testing, concrete cores extraction, concrete sampling and exposures, and partial or full cutting of reinforcement bars;
2. Provide adequate water, electricity supply and temporary falsework;
3. Construct temporary falsework capable of sustaining the self-weight of the canopy for designated area underneath first floor canopy, as instructed by CM.

DEM1.W490.9 STRUCTURE SUPPORTING GROUND

1. Where adjacent land or building may be affected, submit temporary support details prepared by Registered Structural Engineer for CM's approval;
2. Submit detailed temporary support system prepared by Registered Structural Engineer for CM's approval where the retaining structure is:
   a. Higher than 3 m in height; and
   b. Liable to affect any road, building, structure, slope steeper than 30º or water mains 75 mm in diameter or greater, the affected area being defined as within the 45º line up from the retaining wall base to the ground surface at wall crest.

DEM1.W500.9 OPERATION OF POWERED MECHANICAL PLANT OR EQUIPMENT

1. Operate mechanical plant or equipment for demolition work by competent operators under the immediate supervision of a TCP as specified in DEM1.W120;
2. Submit full details including names, addresses, qualifications and experience of these operators for applying the consent to commence demolition works under DEM1.D220;
3. The operators of powered mechanical plant or equipment used in demolition works shall meet the requirements as specified in Building (Demolition Works) Regulations, Clause 9 (3);
4. The operators shall have completed a training course in "Demolition of Building Course for Plant Operators" organized by the Construction Industry Training Authority (CITA) and obtained the relevant certificate and shall have at least three years experience in operating the particular plant or equipment. Equivalent training and certificates issued by a recognised examining body may also be favourably considered by the CM for meeting the requirement;

5. Notify the CM within 7 days of the change in the appointment of the operator and provide the personal particulars, qualifications and experience of the new operator.

DEM1.W510.9 REMOVAL OF PART OF A BUILDING

Where the removal of a part of a building or structure may result in another part of the building, adjoining slope, retaining wall or land becoming unsafe, submit a temporary support proposal prepared by Registered Structural Engineer. Support external features, enclosure walls, parapets and cantilevered construction such as canopies, cornices and balconies before the anchorage or holding down load is removed.

DEM1.W520.9 DISPOSAL OF MATERIALS TO BE COLLECTED/RECYCLED OFF SITE

1. Provide sufficient space within the Site for the storage of the materials to be collected/recycled specified in DEM1.M025 before removing them from the Site;
2. Produce a Material for Salvage Form (MSF) for each and every vehicular trip transporting reusable and recyclable materials as follows:
    a. Propose the format of the MSF for CM's agreement;
    b. The MSF shall contain the following information:
        i. Contract title, Name of Contractor, Contract No.;
        ii. Location of Site;
        iii. The name of the recovery/recycling company;
        iv. The vehicle registration number;
        v. Approximate load;
        vi. Type of salvaged materials;
        vii. Time of departure.
    c. Complete the MSF in duplicate except for the entry of the "time of departure" before leaving the Site.
3. Prior to the vehicle leaving the Site, present to the site supervisory staff of the CM the completed Form for inserting the time of departure and signing. Forward a copy of the MSF to the site supervisory staff for record;
4. Employ a contractor, who shall be a recovery/recycling company listed in the "Directory of Recovery/Recycling Companies in Hong Kong" maintained by the Environmental Protection Department of the Government of the Hong Kong Special Administrative Region, to salvage the reusable and recyclable materials; and
5. All materials to be collected/recycled shall become the property of the Contractor when they are removed from the site.

DEM2 ASBESTOS REMOVAL

MATERIALS

DEFINITIONS

DEM2.M010.9 GENERAL

Where used in this Worksection the following definitions apply. Words in upper case italics within the definitions indicate that a separated definition is provided.

DEM2.M020.9 DEFINITIONS AND EXPLANATORY NOTES

1. ABATEMENT: all procedures taken to control fibre release during removal, encapsulation, enclosure and repair of *ASBESTOS CONTAINING MATERIALS*;
2. AGGRESSIVE SAMPLING: method of sampling in which the individual collecting the air sample uses mechanical equipment to stir settled dust and simulate normal activity in the sample area;
3. AIRLOCK: a system permitting entrance and exit whilst restricting air movement between contaminated and uncontaminated areas. Consisting of two curtained doorways at least 1 m apart to allow the doorway sheeting to overlap and close off the opening before proceeding through the second doorway, thereby preventing flow-through contamination. (See also *HYGIENE UNIT)*;
4. AIR MONITORING: the measurement or determination of airborne *ASBESTOS* fibre concentrations in the air at specific locations;
5. AIR MOVER: a portable exhaust system equipped with HEPA filter capable of creating a negative pressure differential of at least 15 Pa and 6 air changes per hour between the outside and inside of the *CONTAINMENT*;
6. AIR SAMPLING: the process of measuring the fibre content of a known volume of air during a specific period of time, complying with the NIOSH Standard Analytical Method, the UK EH10 coupled with MDHS 39/3 or an updated method specified by the Authority; or methods accredited under HOKLAS which are laid down in the laboratory manual;
7. AMBIENT AIR MONITORING: the measurement or determination of airborne *ASBESTOS* fibre concentrations within the vicinity of the Site;
8. AMENDED WATER: water to which a saturated solution of a *WETTING AGENT* has been added;
9. AREA AIR SAMPLING: the method of *AIR SAMPLING* where the sampling equipment is situated at a stationary location within the contaminated *WORK AREA*;
10. ASBESTOS CONTAINING MATERIAL (ACM): *ASBESTOS* or any material/product containing greater than 1% asbestos by weight;
11. ASBESTOS CONTAINING WASTE MATERIAL: ACM or materials contaminated with asbestos which requires disposal;
12. ASBESTOS: the minerals chrysotile, amosite, crocidolite, fibrous tremolite, fibrous anthophyllite and fibrous actinolite or substances containing such minerals;

13. BACKGROUND MONITORING: the measurement or determination of airborne *ASBESTOS* fibre concentrations within the Site and outside the building prior to commencement of the work as follows:
    a. Sampler: an air sampling pump fitted with an Approved type cowl;
    b. Filter: 25 mm cellulose ester filter of pore size 0.8 - 1.2 μm;
    c. Sampling pump: a battery-run or mains-run pump capable of maintaining a low rate of at least 2 litres per minute for at least 4 hours;
    d. Sampling point:
        i. A minimum of 2 samples, or as specified in the individual air monitoring strategy (depending on the size of the site), taken on different sides of the contained/segregated work area;
        ii. Samples taken as close to the work site as possible, of the area where those not involved in the abatement works are likely to pass or occupy;
        iii. Sampling locations shall be as far as possible the same as the *ENVIRONMENT SAMPLES.*
    e. Sampling rate: a minimum of 2 litres per minute taken with a calibrated pump and checked with a calibrated rotameter equivalent flow measurement device regularly during the sampling period;
    f. Sampling time: not less than 4 hours.
14. BACKGROUND SAMPLE: a sample taken prior to commencement of the asbestos removal works;
15. CLEAN ROOM/END: an uncontaminated area or room within the *HYGIENE UNIT* with the provision for storage of personal clothing and protective equipment;
16. CLEARANCE AIR MONITORING: the employment of *AGGRESSIVE SAMPLING* techniques with a volume of air, collected to determine the airborne concentration of residual fibres, performed as the final abatement activity, using the following:
    a. Sampler: an air sampling pump with an Approved type of cowl;
    b. Filter: 25 mm cellulose ester filter of pore size 0.8- 1.2 μm;
    c. Sampling pump: battery-run or mains-run pump capable of maintaining a flow of at least 4 litres per minute for 4 hours;
    d. Sampling point:
        i. Static;
        ii. A minimum of 1 sample for an area up to 8 m^2 and 2 samples for an area between 8-25 m^2;
        iii. One further sample for each additional 25 m^2;
        iv. If the enclosure is higher than 2 m, the above should be converted to a volume criteria e.g.:

            2 samples for the first 75 m^3 and one further sample for each additional 75 m^3;
        v. If the contained space is further subdivided by larger pieces of equipment or walls take more samples than specified above;
        vi. Position sampler 1-2 m above the floor with the cowl pointing downwards;
        vii. Sampling is to be aggressive, see item (2) above;

viii. Do not proceed with air sampling if debris is visible within the work area.

(The sampling point and number of samples required are dependent upon the site layout and the Air Monitoring Strategy agreed by the CM. The Guidelines on Air Monitoring included in each removal method of the ACM's are for reference only.)

e. Sampling rate: minimum of 4 litres per minute taken with a calibrated pump and checked, with a calibrated rotameter equivalent flow measurement device, regularly during the sampling period;

f. Sampling time: to be set to give a total sampling volume of a minimum of 480 litres;

g. Reporting: if more than 1 sample is taken, obtain results by pooling a minimum of 2 samples of at least 240 litres each, taken within 4 m of each other. Results may be taken simultaneously or one after another. At the evaluation state the same number of graticule areas are inspected on each filter and the counts combined to give one measurement based on at least 480 litres. If the total volume is 480 litres for two or more samples, 200 graticle areas must be examined on each filter. For larger volumes reduce the number of graticule areas to be counted proportionally.

17. CLEARANCE TEST SAMPLE: a sample taken after *ASBESTOS* has been removed to ascertain whether *WORKING ZONE* has been thoroughly decontaminated. A visual inspection to detect gross contamination must be carried out before one or more static samples are taken to establish the fibre level in the *WORKING ZONE*. Disturbance of surface dust is essential during the sampling period. When the clearance indicator shows a fibre level of 0.01 fibre/ml or below, the Working Zone can be declared fit for re-occupation. Where results exceed the clearance indicator, thoroughly re-clean the Working Zone and re-sample;

18. CONTAINMENT: a temporary timber or metal framed structure lined with 3 layers of 0.15 mm thick polythene sheeting to floors and walls, completely sealing off the work area. All sheet joints to be overlapping and properly sealed, with the innermost floor sheeting extending at least 500 mm up each wall surface;

19. CURTAINED DOORWAY: a device consisting of a minimum of 3 overlapping plastic sheets over an existing or temporarily framed doorway. The first sheet is fixed at the top and left side, the second at the top and right side and the third at the top and left side. Weights are to be attached to the bottom of all sheets to ensure that the sheets hang straight and maintain a seal over the doorway when not in use;

20. DECONTAMINATION FACILITIES: a series of connected rooms, separated from the *WORK AREA* and from each other by *AIRLOCKS*, used for the decontamination of operatives, materials, waste containers and equipment;

21. DEMOLITION: the dismantling or razing of a building, including all incidental operations (except asbestos removal);

22. DIRECT TESTING CONTRACTOR: a laboratory appointed by the CM and paid by the Authority to carry out asbestos associated tests;

23. DIRTY END: a contaminated area or room, which is part of the HYGIENE UNIT, with the provision to store contaminated clothing and equipment;

24. DISTURB: any action taken which may alter, change or stir, such as, but not limited to, the removal, encapsulation, enclosure or repair of any *ASBESTOS CONTAINING MATERIAL*;

25. ENCAPSULANT (SEALANT) OR ENCAPSULATING AGENT: a material applied to the ACM which temporarily controls the possible release of asbestos fibres from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant). This may also be used to seal surfaces from which the ACM has been removed;
26. ENCAPSULATION: concealing the ACM either with a sealant, by cementitious rendering or by cladding, to prevent the release of asbestos fibres;
27. ENCLOSURE: the construction of airtight walls and ceilings between the ACM and the facility environment, around surfaces coated with ACM or any other appropriate procedure which prevents the release of asbestos fibres;
28. ENVIRONMENTAL SAMPLE: a sample taken in the vicinity of the asbestos work area, especially within occupied areas where the fibre levels may be higher than the general ambient level as a consequence of a failure of precautionary measures taken in the asbestos work area. Without any established ambient level standard, environmental samples are often compared to the clearance indicator in deciding whether significant environmental pollution has occurred around the work site. A flow rate of up to 8 litre/min may be used to achieve the desired fibre density on the filter:
    a. Sampler: an air sampling pump with an Approved type of cowl;
    b. Filter: 25 mm cellulose ester filter of pore size 0.8-1.2 μm;
    c. Sampling pump: battery-run or mains-run pump capable of maintaining a flow rate of 2 litres per minute for a minimum of 4 hours;
    d. Sampling point:
        i. A minimum of 2 samples, or as specified in the individual air monitoring strategy, taken on different sides of the contained/segregated work area;
        ii. Samples taken, as close to the work site as possible, of the area where those not involved in the abatement works are likely to pass or occupy.
    e. Sampling rate: minimum of 2 litres per minute taken with a calibrated pump and checked, with a calibrated rotameter equivalent flow measurement device, regularly during the sampling period;
    f. Sampling time: not less than 4 hours.
29. EQUIPMENT ROOM: see *DIRTY END*;
30. FIBRE: an acicular single crystal or a similarly elongated polycrystalline aggregate which displays resemblance to organic fibres, with properties such as flexibility, high aspect ratio, silky lustre, axial lineation and which has attained its shape primarily through growth rather than cleavage;
31. FIXED OBJECT: equipment or furniture within the *WORK AREA* which may not be removed;
32. FOAM METHOD: a method, used by the Housing Department, to remove asbestos-containing balcony grilles where the grilles are sandwiched between two plywood boards, the space between the two boards is injected with quick setting polyurethane foam allowing the grille to remain intact whilst being removed by chiselling the surrounding concrete;
33. FRIABLE ASBESTOS MATERIAL: any *ASBESTOS* or *ACM* which can be crumbled, pulverized or reduced when dry, by hand or a similar mechanical pressure;

34. GLOVE BAG METHOD: a method for removing friable asbestos-containing material from heating, ventilation and air conditioning ducts, short piping runs, valves, joints, elbows and other non-planar surfaces in a non-contained work area. The glove bag assembly is a manufactured device consisting of a glove bag (constructed of at least 0.15 mm thick transparent plastic), two inward-projecting long-sleeve gloves, one inward-projecting waterwand sleeve, an internal tool punch and an attached labelled receptacle for asbestos waste. The glove bag is constructed and installed in such a manner that it surrounds the object or area to be decontaminated and contains all asbestos fibres released during the removal process;
35. GLOVE METHOD: any method whereby a transparent, soft PVC structure equipped with integral gloves is used as mini-containment for small-scale asbestos removal. The glove method can be applied in the removal of balcony grille panels;
36. HEPA FILTER: a High Efficiency Particulate Air filter capable of trapping and retaining particles (asbestos fibres) with an efficiency complying with BS 3928:1969 or US Military Standard No. 282 in association with Army Instruction Manual 136-300-175 or Approved equivalent;
37. HEPA VACUUM EQUIPMENT: vacuuming equipment with HEPA;
38. HYGIENE UNIT:
    a. A 3 compartment, air-locked chamber comprising a *DIRTY END*, a shower area and a *CLEAN END,* constructed with timber frames, 0.15 mm thick opaque polythene sheeting and sealed with 75 mm adhesive tape;
    b. The Dirty End is separated from the shower area by a door. A further door separates the entry point. The Dirty End may be used as a temporary store for soiled equipment and footwear;
    c. The Clean End is separated from the shower area by a door. A further door separates the exit. The Clean End may be used as a temporary store for personal clothing. A mirror should be provided to ensure workers obtain a good facefit with the Respiratory Protective Equipment;
    d. All waste water must pass through an approved aquarium type or similar filter for removal of particles down to 5 microns in suspension before being discharged into the soil and waste drainage system;
    e. An induced draft should be introduced inside the Hygiene Unit to achieve an air flow from the Clean End to the Dirty End;
    f. A pre-fabricated Hygiene Unit may also be used to perform the same function;
    g. The Hygiene Unit and *AIRLOCK* are similar, although their names are derived from their different specific functions.
39. ISOLATION BARRIER: the construction of partitions, the placement of solid materials and the sealing of apertures to isolate the *WORK AREA* from the surrounding area, containing asbestos fibre release;
40. LEAK SAMPLE: static samples taken immediately outside the contained *WORK AREA* to ensure that dust generated within the contained area is not released into the surrounding environment.

    Criterion for leakage detection is generally the same as for the *CLEARANCE INDICATOR* and immediate remedial action must be taken should a leakage occur:
    a. Sampler: air sampling pump with an Approved type of cowl;
    b. Filter: 25 mm cellulose ester filter of pore size 0.8-1.2 μm;
    c. Sampling pump: battery-run or mains-run, capable of maintaining a minimum flow of 4 litres per minute for up to 4 hours;

d. Sampling point: to be located in at least one of the following:

i. 2 area samples outside *CONTAINMENT* in uncontaminated area of the premises but remote from the decontamination unit;

ii. 1 area sample inside the clean room of the decontamination unit;

iii. 1 area sample within 1500 mm from the unobstructed exhausted of the HEPA air mover.

e. Sampling rate: 1 to 4 litres per minute taken, with a calibrated rotameter or equivalent flow measurement device, regularly during the sampling period;

f. Sampling time: set to give a total sample volume of at least 480 litres.

41. LOG: a record of all activities that have occurred during the project also identifying the building owner, agent, Contractor, operatives and other information such as equipment malfunctions, contamination beyond the work area etc;

42. MATERIAL LOCK: a compartment attached to the *CONTAINMENT* provided for temporary storage and transit of asbestos abatement equipment and asbestos waste;

43. NEGATIVE AIR PRESSURE EQUIPMENT: see *AIR MOVER;*

44. NEGATIVE PRESSURE MONITOR: a monitoring device with an alarm setting and continuous print-outs and permanent record facility for monitoring of the negative pressure inside the *CONTAINMENT*;

45. OCCUPIED AREA: an area of the work site where no abatement work is taking place and where the use of *PERSONAL PROTECTIVE EQUIPMENT* is not required;

46. PENULTIMATE TEST SAMPLE: take air sample after final cleaning, when the innermost plastic layer, upon drying from the spraying of PVA, is removed and the second plastic sheeting HEPA vacuumed and wet-wiped. Employ an aggressive sampling technique and the acceptance limit is 0.01 fibre/ml;

47. PERSONAL AIR MONITORING: a method used to determine employees' exposure to airborne fibres. Samples are collected outside the respirator in the operative's breathing zone:

a. Sampler: air sampling pump fitted with an approved cowl;

b. Filter: 25 mm cellulose ester filter of pore size 0.8-1.2 µm;

c. Sampling pump: battery-run, sampling pump to be carried on the operatives belt;

d. Sampling point: sampler, fixed to operative's clothing and within the breathing zone (200 mm from nose and mouth). The cowl of the sample must point downwards;

e. Sampling rate: 1 - 4 litres per minute checked, with a calibrated rotameter or equivalent flow measurement device, regularly during the sampling period;

f. Sampling time: to be set according to the following criteria:

i. To be a period of 4 hours. Where the level is higher, a shorter period must be used to avoid filter over-loading. This period must be long enough to be representative of the 4 hour period. Samples taken over several separate periods may also be used to calculate the 4 hour TWA value;

ii. Minimum sampling time: 10 minutes; adjust the sampling time such that fibre density on the filter lies within 100 - 400 fibre/m^2;

iii. In order to test the respiratory protective equipment is adequate for the asbestos dust exposure, liaise with the Direct Testing Contractor to conduct the personal samples to measure the representative asbestos dust exposure, including the periods when the asbestos dust exposure are expected to be maximum.

48. PERSONAL PROTECTIVE EQUIPMENT: appropriate protective clothing e.g. gloves, eye protection, footwear, headgear and Approved respiratory equipment acceptable to the CM;

49. PERSONAL SAMPLES: an air sample taken as close to the breathing zone of an operative as possible, to indicate the ambient level of exposure. An appropriate amount of the work period should be covered either by continuous sampling or by short term samples. For known procedures which have been thoroughly evaluated before, such extensive sampling is not required but minimal batch samples can be taken to ensure that the levels of fibre release are indeed comparable:

    Sampling rate: 1 litre per minute;

50. RE-ASSURANCE SAMPLE: a sample taken in areas where Containment is not required or where it has been removed. See also *CLEARANCE TEST*;

51. REMOVAL: the stripping of any *ACM* from surfaces or components of a facility or taking out structural components;

52. REPLACEMENT MATERIAL: any material used to replace an *ACM* that does not contain *ASBESTOS*;

53. SECURE STORE: a buffer store for asbestos waste used prior to transportation to a dumping site. The store must be located close to the asbestos removal works, be weather-proof and structurally strong enough to withstand strong winds and accidental disturbances, with a lockable door/cover and posted with appropriate warning labels. It is preferable that a permanent space inside a building be converted into the Secure Store e.g. a refuse room, empty flat, empty bay with a temporary lockable door free of debris, dirt, objects and water accumulations. If located externally it may be a lockable metal skip adjacent to the building block and covered with tarpaulin sheets to keep water out or an area hoarded with plywood of at least 18 mm thick with no floor clearance and a water-proof slanting canopy where practicable; or use tarpaulin sheets as the cover for large hoarded area;

54. SHIFT: an operative's daily term of work;

55. SHOWER ROOM: a room between the *CLEAN END* and the *DIRTY END* in the *HYGIENE UNIT*, equipped with controllable hot and cold water for showering purposes, a shower tray and of a minimum size of 2000 mm (height) x 1000 mm (width) x 1000 mm (length). Provide at a ratio of 1 Shower Room for every 6 operatives engaged in asbestos removal works;

56. SMOKE TEST: a test carried out using non-toxic smoke to ensure airtightness of the *CONTAINMENT before commencement of work*. Following a successful test, switch on the *AIR MOVER* to exhaust smoke from the *CONTAINMENT* and check the absolute filter to ascertain whether the smoke has been screened effectively. The CM must be notified of test and be present whilst the test is carried out;

57. SPECIALIST ASBESTOS REMOVAL CONTRACTOR: any Sub-contractor employed by the Contractor to execute the asbestos removal works chosen from the Approved list;

58. SURFACTANT: a chemical wetting agent added to water to improve penetration;

59. VIEWING PANEL: a 2 mm thick, clear acrylic sheet, size 600 mm x 600 mm per layer of polythene sheeting built into the *CONTAINMENT* at a designated area to enable work inside the Containment to be viewed. A hinged wooden door may be installed for the Viewing Panel should the Containment be housed within a hoarding;
60. VISIBLE EMISSIONS: any emissions containing particulate material which can be visually detected without the aid of instruments;
61. WASHROOM: a room between the *WORK AREA* and the holding area in the equipment decontamination enclosure where equipment and waste containers are *WET CLEANED* and/or *HEPA* vacuumed prior to disposal;
62. WASTE DECONTAMINATION ENCLOSURE SYSTEM: an area designated for the controlled transfer of materials and equipment, consisting of a buffer zone and a holding area;
63. WET CLEANING: the removal of *ASBESTOS* fibres from building surfaces using cloths or cleaning tools dampened with water;
64. WET METHODS: *AMENDED WATER* or removal encapsulants used to minimize the generation of fibres during disturbance of *ACM;*
65. WETTING AGENT: a chemical to be added to water to improve penetration;
66. WORK AREA: designated rooms, spaces or areas of the building or structure where asbestos abatement activities are taking place;
67. WORKING ZONE: the zone where asbestos removal is being, or has been, undertaken which includes the *WORK AREA* and all access routes (before passing the *CLEARANCE TEST*). All operatives, equipment and bagged waste withdrawing from the Working Zone must undergo thorough decontamination through a *MATERIAL LOCK*. Only in the event of it being impracticable to install a Material Lock may a *HYGIENE UNIT* be used.

ASBESTOS REMOVAL PLANT AND EQUIPMENT

DEM2.M110.9 GENERAL

1. Ensure all plant, including scaffolding and mechanical hoisting equipment, tools and vehicles to be used during the asbestos removal works is uncontaminated, well maintained and in good working order;
2. Provide for the inspection of the CM certified records that all plant and equipment including HEPA filters and respirators have been regularly maintained;
3. Decontaminate all plant, scaffolding and equipment prior to removal from site.

DEM2.M120.9 PROVISION

Provide all plant, equipment and materials, including the following, for the execution of the asbestos removal works. Ensure their suitability for the particular application and of sufficient quantity for the scope and extent of the asbestos removal works:

1. Hygiene unit (as defined in DEM2.M020);
2. Heavy duty vacuum cleaner: an Approved type suitable for use on asbestos removal and fitted, on site, with a HEPA filter (as defined in DEM2.M020);
3. Small vacuum unit for personal cleaning:
    a. Fitted on site just prior to use, with a HEPA filter;

b. Located at exit to asbestos removal work area or dirty end (as defined in DEM2.M020) where the hygiene unit is attached to exit of the asbestos removal work area;

4. Negative pressure monitor (as defined at DEM2.M020): for use when full containment approach is adopted to give a continuous, permanent record of the negative pressure measured. An audible alarm must be fitted to give warning of insufficient pressure differential;
5. Asbestos waste containers: complying with the Code of Practice on the Handling, Transportation and Disposal of Asbestos Wastes issued by the Environmental Protection Department. Nylon woven sacks may be used as the innermost bag (i.e. triple bagging) when the debris contains sharp edges and/or proves to be too heavy for the plastic waste bags;
6. Air movers: (as defined in DEM2.M020):
   a. An Approved type;
   b. Fitted with a pre-filter and HEPA filter;
   c. With a negative pressure of at least 15 kPa;
   d. Capable of performing at least 6 air changes per hour;
7. Polyvinyl acetate emulsion adhesive (PVA): aqueous solution and expanded foam in aerosol cans;
8. Cleaning and personal hygiene consumables;
9. Water spray equipment for damping the asbestos element to minimize the release of air borne particles;
10. Wetting agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether at a ratio of 1:1 or equivalent;
11. Amended water (as defined in DEM2.M020).

DEM2.M130.9 VIEWING PANEL

1. Location: within the screening to the work area and in a position where all or most of the asbestos removal works can be viewed;
2. Size: 600 mm x 600 mm;
3. Construction: 2 mm thick clear acrylic sheet per layer of polythene sheeting with 50 mm minimum lap affixed and sealed with 50 mm wide vinyl tape to sheeting.

PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING

DEM2.M210.9 CLOTHING

1. Provide the following protective clothing for use by operatives:
   a. Disposable, impervious protective overalls with zipper fastening, integral hoods, elasticated cuffs and ankles;
   b. Rubber knee length boots with non-slip soles, or shoe covers;
   c. Eye protection and hard hats, where their use is appropriate;
   d. Disposable gloves.
2. Provide the above protective clothing for use by the Authority's staff;

3. Use of other items of disposable clothing e.g. woven fabric overalls, or shorts and hair covers may be permitted where heat stress or discomfort are factors. Prior approval must be obtained from the Labour Department.

DEM2.M220.9 RESPIRATORS

1. Provide for all persons on site the appropriate respiratory protective equipment:
   a. Type approved under the Factories and Industrial Undertakings (Asbestos) Special Regulations for the specific use;
   b. Ori-nasal half face mask type fitted with HEPA filter: for use under all circumstances;
   c. Full face positive pressure respirator: for use when required by this Specification.
2. Provide each operative with own face piece. Ensure face piece is cleaned before each re-use as a minimum requirement.

DEM2.M230.9 RESPIRATOR FILTERS

Ensure that:

1. Filters are removed from respirators under wet conditions and are treated as contaminated waste;
2. New filters are placed in the respirator prior to re-use;
3. Sufficient spare filters are held on site at all time.

WORKMANSHIP

GENERAL

DEM2.W010.9 ASBESTOS REMOVAL WORK

1. Carry out the asbestos removal work as specified in Project Specific Specification;
2. The information provided on the extents of asbestos removal work are known to be in existence to the best knowledge of the Housing Authority but may not be exhaustive.

DEM2.W020.9 SPECIALIST ASBESTOS REMOVAL CONTRACTOR

1. Employ a firm whose name is included in the Register of Asbestos Contractors kept by Environment Protection Department to carry out the asbestos removal works;
2. Such firm shall be a Sub-contractor to the Main Contractor and employed at his own expense;
3. Submit with tender a letter of intent from the Specialist Asbestos Removal Contractor indicating their willingness to carry out the asbestos removal works, which includes a Method Statement as specified.

DEM2.W030.9 SITE VISIT AND INSPECTION

Before tendering, visit the site and inspect the appropriate drawings to ascertain the full extent of the asbestos removal work and the conditions affecting its execution.

DEM2.W040.9 SURVEY AND REPORT

Within 14 days of notification of the start of the contract, a confirmatory survey for the whole site is carried out by a Registered Asbestos Consultant employed by the Contractor under Air Pollution Control Ordinance to Submit the Asbestos Investigation Report to CM and Environmental Protection Department. The survey covers the whole site and materials, rubbish lying on the ground to establish the presence of asbestos containing materials other than those already identified in this Specification or shown on the drawings.

DEM2.W050.9 SUPERVISION BY REGISTERED ASBESTOS CONSULTANT

If asbestos containing materials which are to be removed are not materials under the exemption list published by Environmental Protection Department (EPD), employ a Registered Asbestos Consultant:

1. To submit Asbestos Abatement Plan to EPD for the planned removal of ACM and / or an Operation and Maintenance Plan for deferred treatment, e.g. encapsulation, enclosure, of the same; and
2. To control and supervise the abatement of all asbestos containing materials, all in accordance with Air Pollution Control Ordinance.

DEM2.W060.9 METHOD STATEMENT

Submit for Approval, 2 weeks prior to commencement of the asbestos removal works, a Method Statement containing:

1. Details of the ACM to be removed and the proposed zoning and sequence of the asbestos removal works;

2. Method of removal of ACM and control of air-borne dust to be employed;
3. Method of disposal of contaminated materials from the point of action to the secure store;
4. Description of the hygiene unit and decontamination facilities, including waste water treatment to be used, prior to discharge off site.

DEM2.W070.9 SITE SUPERVISOR

Submit to the Authority within 7 days of notification of commencement of the asbestos removal works, details of the Site Supervisor to be employed, including name, qualifications and experience:

1. Site Supervisor to:
   a. Register with Environmental Protection Department;
   b. Posses at least 2 years relevant supervisory experience, capable to make decisions in case of emergency;
   c. Be conversant with the Authority's requirement for the removal of ACM. Hold a relevant certificate issued by the Occupational Safety and Health Council, or equivalent, indicating competence in the safe handling of asbestos and be trained in asbestos removal work;
   d. Be present full time on site every day during the course of asbestos removal work;
   e. Ensure that the asbestos removal work complies with the requirements of this Specification and oversee all safety procedures;
   f. Liaise with the Direct Testing Contractor and ensure the works continue with the DTC in attendance at a suitable time.

DEM2.W080.9 PREVENTION OF NUISANCE

1. Occupied premises: proceed with the minimum of inconvenience and nuisance to occupants of premises in the vicinity of the asbestos removal works;
2. Prevent dust arising by frequent water spraying, or other Approved methods;
3. Erect dust barriers where directed by the CM to prevent air borne dust affecting adjacent, occupied blocks.

DEM2.W090.9 SITE ORGANISATION CHART

Post a site organisation chart identifying the Specialist Asbestos Removal Contractor in a prominent location adjacent to the asbestos removal works.

DEM2.W100.9 NOTIFICATIONS

At least 28 days prior to asbestos removal, give notice to the Environmental Protection Department (EPD) and the Labour Department (LD).

DEM2.W110.9 INSPECTION OF PREPARATORY WORKS

24 Hours prior to commencement of the asbestos removal works, notify the CM that air monitoring arrangements and preparatory works are made and precautionary measures are ready for inspection and request consent from the CM before proceeding with removal.

STATUTORY OBLIGATIONS, CODES OF PRACTICE AND OTHER REQUIREMENTS

DEM2.W310.9 SAFETY, HEALTH AND WELFARE

Comply with the provisions of the following:

1. Factories and Industrial Undertakings (Asbestos) Regulation made under the Factories and Industrial Undertaking Ordinance (CAP 59);
2. Construction Sites (Safety) Regulations made under the Factories and Industrial Undertaking Ordinance (CAP 59);
3. Factories and Industrial Undertakings (Notification of Occupational Diseases) Regulations made under the Factories and Industrial Undertaking Ordinance (CAP 59);
4. Code of Practice on Safety and Health at Work with Asbestos, issued by the Labour Department;
5. Code of Practice on Handling, Transportation and Disposal of Asbestos Waste, issued by the Environmental Protection Department;
6. Guidance Notes on Health Hazards in Construction, issued by the Labour Department;
7. Health Hazards of Asbestos, issued by the Labour Department;
8. Guide to Occupational Diseases Prescribed for Compensation Purposes, issued by the Labour Department;
9. Air Pollution Control Ordinance (CAP 311);
10. Pneumoconiosis and Mesothelioma (Compensation) Ordinance (CAP 360);
11. Waste Disposal Ordinance (CAP 354);
12. Code of Practice on Asbestos Control: Safe Handling of Low Risk Asbestos Containing Material, issued under Section 37 of the Air Pollution Control Ordinance (CAP 311);
13. Code of Practice on Asbestos Control: Asbestos Work Using Full Containment or Mini Containment Method, issued under Section 37 of the Air Pollution Control Ordinance (CAP 311);
14. Code of Practice on Asbestos Control: Asbestos Work Using Glove Bag Method, issued under Section 37 of the Air Pollution Control Ordinance (CAP 311);
15. Code of Practice on Asbestos Control: Preparation of Asbestos Investigation Report, Asbestos Management Plan and Asbestos Abatement Plan, issued under Section 37 of the Air Pollution Control Ordinance (CAP 311);
16. 3 Leaflets published by EPD:
    a. Environmental Asbestos Control;
    b. Asbestos Removal of Unauthorised Building Works;
    c. Banning Asbestos.
17. Practice Note 2/97 Handling of Asbestos Containing Materials in Buildings issued by the Professional Persons Environmental Consultative Committee;
18. Code of Practice for Demolition of Buildings published by the Buildings Department.

PROTECTIVE ENCLOSURES

DEM2.W410.9 ERECTION OF TARPAULIN ENCLOSURE

1. Erect tarpaulin enclosure in accordance with the following requirements:
   a. Prior to commencement of asbestos removal work;
   b. Constructed from tarpaulin sheeting supported by substantial bamboo scaffolding or similar;
   c. Enclosure to encase entire block, extending from ground level to 1000 mm above roof parapet of block being demolished;
   d. Overlap tarpaulin sheets on all four sides by 200 mm minimum. Ensure airborne dust is retained within enclosure during asbestos removal;
   e. Do not disturb or damage asbestos containing material during erection of enclosure.
2. Submit details of protective enclosure to CM prior to erection. Do not disturb asbestos containing materials. If disturbed, stop work and propose remedial actions.

DEM2.W420.9 DAMAGE TO ENCLOSURE

1. Upon discovery of any damage to enclosure, immediately make good to the satisfaction of the CM;
2. Allow for time and additional costs incurred for repairing any damage to enclosure.

ASBESTOS REMOVAL

DEM2.W510.9 METHODOLOGY

The removal and disposal of asbestos containing materials are from top down on a zone by zone basis unless otherwise approved by the CM. Consider the following methods and procedures for asbestos removal as minimum requirements. Adoption does not release the Contractor from any responsibilities or liabilities under the terms of the Contract. Alternative methods of working may be employed, subject to Approval and submission of details provided that all regulations and restrictions imposed by the Environmental Protection Department and the Labour Department are complied with.

DEM2.W520.9 GENERAL PREPARATION PROCEDURES

1. Ensure all access points between the working zone and non-working zone are sealed with 2 sheets of polythene sheet or similar;
2. Post warning notices on the non-working zone side prohibiting access to the works of non-authorized personnel;
3. Construct viewing panels as DEM2.M130.

DEM2.W530.9 GENERAL PRECAUTIONARY PROCEDURES

Where the presence of amosite or crocidolite asbestos fibres is known or discovered in the asbestos containing materials being removed, ensure operatives wear full-face positive pressure respirators as at DEM2.M220 and DEM2.M230.

DEM2.W540.9 REMOVAL OF BALCONY GRILLE PANELS (INCLUDING PANELS ENCAPSULATED ON ONE SIDE)

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:
   a. Access balconies from the living room area of each domestic unit through a designated route and a hygiene unit;
   b. Removal operators in the working zone are to wear ori-nasal half face masks fitted with Approved air filters, Approved disposable coveralls and knee length rubber boots with non-slip soles. Wear gloves if it is considered necessary;
   c. Ensure operatives working on the external face of the balcony panel use a safety harness attached to a secure anchorage or life line;
   d. Ensure operatives on the external face secure all tools and equipment to a safety line;
   e. Remove all existing metal guard grilles, glazing, toilet walls and bases, cooking benches and other fittings or furniture which may obstruct access to the balcony grille panels. Transport all debris from the removal works by an Approved route.
2. Removal:
   a. Clear up as work proceeds. Prevent debris accumulating on the floor and becoming further broken or crushed;
   b. During the removal operation, continuously spray panels and surrounding concrete surfaces with water containing a wetting agent;
   c. Place a primary, 5 mm thick, pre-cut and drilled plywood panel against the external face of each grille panel. Fit in position by four set screws retained by locknuts protruding through the grille panel. If panels are encapsulated on one side, the plywood board on the encapsulated side may be waived if approved by CM;
   d. Position a secondary, 5 mm thick, plywood panel against the internal face of the grille panel, fixed in position by the wing nuts on the bolts from the primary panel;
   e. Fix a third 5 mm thick, plywood panel against the external face of the balcony. Fit with non-intercellular nitrile, neoprene rubber seals, contoured to ensure no leakage of debris or dust occurs during removal of the grille panel. Cover the internal face and seals of the panel with a double layer of 0.15 mm polythene, secured by waterproof self-adhesive vinyl tape;
   f. Where panels are encapsulated on one side, the use of plywood board on the encapsulated side may be waived if Approved;
   g. Fill the cavity space between the primary and secondary boards with high density polyurethane foam to encapsulate the grille panels. If isocyanate foam is used provide an appropriate respirator for use by operatives;
   h. Cover the balcony floor with a double layer of 0.15 mm thick polythene sheeting, secured by waterproof self adhesive vinyl tape;
   i. Install a screen in the space above the spandrel beam and the underside of the upper balcony beam. Construct frame using a timber framework supporting a woven, nylon tarpaulin sheet;

j. Using a powered, low voltage chisel or hand chisel, chip away concrete spandrel beams and posts to the top and sides of the grille panel to expose the full extent of grille panel reinforcement bar fixings, leaving the grille panel unrestrained. Cut all exposed grille panel reinforcing bars with bolt cutters. Ensure eye protectors are worn by operatives during this operation;

k. Remove the base ledge of the balcony wall adjoining the panel with a hand chisel;

l. Free the grille panel from the surrounding concrete and reinforcing bars and lift clear of the balcony wall cavity. Secure a tie wire fitted with a turnbuckle to the exposed spigot and the nearer floor-mounted eye bolt;

m. Vacuum and wet clean the encapsulated grille panel after removal from the wall cavity;

n. Secure the exposed edges of the grille panel with 2 layers of 0.15 mm thick polythene, secured in place by waterproof, self-adhesive tape.

DEM2.W550.9 REMOVAL OF BALCONY GRILLE PANELS (ENCAPSULATED ON BOTH SIDES)

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:

   a. Access balconies from the living room area of each domestic unit through a designated route and a hygiene unit;

   b. Removal operatives in the working zone are to wear Approved ori-nasal half face masks fitted with air filters, Approved disposable coveralls and knee length rubber boots with non-slip soles. Wear gloves if it is considered necessary;

   c. Ensure operatives working on the external face of the balcony panel use a safety harness attached to a secure anchorage or life line;

   d. Ensure operatives on the external face secure all tools and equipment to a safety line;

   e. Remove all existing metal guard grilles, glazing, toilet walls and bases, cooking benches and other fittings or furniture which may obstruct access to the balcony grille panels. Transport all debris from the removal works by an Approved route.

2. Removal:

   a. Clear up as work proceeds. Prevent debris accumulating on the floor and becoming further broken or crushed;

   b. During the removal operation, continuously spray panels and surrounding concrete surfaces with water containing a wetting agent;

   c. Fix a 5 mm thick, plywood panel against the external face of the balcony wall. Fit with non-intercellular nitrile neoprene rubber seals, contoured to ensure no leakage of dust. Cover the internal face and seals of the panel and the floor of the balcony with a double layer of 0.15 mm thick, polythene sheeting, secured by waterproof, self adhesive vinyl tape;

   d. Install a screen in the space above the spandrel beam and the underside of the upper balcony beam. Construct screen using a timber framework, supporting a woven, nylon tarpaulin sheet;

e. Using a powered, low-voltage chisel or hand chisel, chip away the concrete on the spandrel beams and posts to the top and sides of the grille panel to expose the full extent of grille panel reinforcement bar fixings, leaving the grille panel unrestrained. Cut all exposed grille panel reinforcing bars with bolt cutters. Ensure eye protectors are worn by operatives during this operation;

f. Remove the base ledge of the balcony wall adjoining the panel with a hand chisel;

g. Free the grille panel from the surrounding concrete and reinforcing bars and lift clear of the balcony wall cavity. Secure a tie wire fitted with a turnbuckle to the exposed spigot and the nearer floor-mounted eye bolt;

h. Vacuum and wet clean the encapsulated grille panel after removal from the wall cavity;

i. Secure the exposed edges of the grille panel with 2 layer of 0.15 mm thick polythene, secured in place by waterproof, self-adhesive tape.

DEM2.W560.9 REMOVAL OF STAIRCASE GRILLE PANELS

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:

   a. Access staircases from the inside of the building through the designated route and a hygiene unit as DEM2.W540;

   b. Removal operators in the working zone are to wear ori-nasal half face masks fitted with Approved air filters, Approved disposable coveralls and knee length rubber boots and non-slip soles. Wear gloves if it is considered necessary;

   c. Position a full height screen across the staircase landing and linking lobby to prevent the escape of debris. Construct screen using a timber framework supporting 0.15 mm thick polythene sheeting. The timber frame if well-covered and cleaned up can be re-used. Erect partial screening where necessary to avoid cross contamination of other work areas;

   d. Remove any demolition debris from stairwells or lobbies prior to commencement of asbestos removal work;

   e. Cover the floor areas between the grille block panels and the screen with a double layer of 0.15 mm thick polythene sheeting secured by waterproof, self adhesive vinyl tape;

   f. Secure, using direct fastening anchor bolts, a purpose made plywood screen, maintained in good condition for re-use, to cover the external face of the grille block panel. Fix a double layer of 0.15 mm thick polythene sheeting to the internal face of the screen.

2. Removal:

   a. Clear up as work proceeds. Prevent debris accumulating on the floor where it may be further broken or crushed;

   b. Prior to removal, spray working area and panels with water containing a wetting agent;

   c. Use hand tools to remove panels. Spray water containing a wetting agent to working area and exposed edges of the panel;

   d. Chase out grooves in the panel openings to remove all visible traces of the panels;

e. Position a vacuum cleaner (as DEM2.M120) near the panel, enabling the suction hose to be as near as is practical to the work area. Ensure that during the asbestos removal works the vacuum unit is in continuous operation;

f. Remove panels block by block, avoiding fragmentation;

g. Place blocks inside 0.15 mm thick polythene disposal sacks and seal with waterproof, self adhesive tape. Additional sacks may be required if deemed necessary by the CM;

h. Remove all remaining debris at the end of each work shift.

DEM2.W570.9 REMOVAL OF ROOF INSULATION TILES

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:

   a. Access asbestos removal work area through a designated route and the hygiene unit;

   b. Isolate asbestos removal work area from internal spaces with 0.15 mm thick polythene sheeting;

   c. Exclude all personnel not directly involved with the work. Post warning notices prohibiting access and alert others not involved in the work of the presence of asbestos;

   d. All removal operatives are to wear Approved ori-nasal half masks fitted with Approved air filters, Approved disposable coveralls and knee length rubber boots with non-slip soles. Wear full face positive pressure respirator if asbestos other than chrysotile is present. Wear gloves if it is considered necessary;

   e. Take full account of prevailing weather conditions, and the following, to avoid dispersion of asbestos fibres to adjoining buildings:

      i. Under normal conditions: schedule asbestos removal works on a daily basis to allow for preparation, removal, bagging and cleaning up of debris;

      ii. During windy conditions: seek Approval to continue prior to commencement of the asbestos removal works. Erect a suitable 1000 mm high wind break of tarpaulin sheeting supported on a substantial bamboo framework;

      iii. Special circumstances (e.g. working immediately adjacent adjoining residential accommodation): prevent entry of asbestos dust by erecting a 2000 mm high screen, fabricated from tarpaulin sheets supported on a bamboo frame. Extend the screen on both sides by 2000 mm minimum beyond the edge of the block to be demolished. Ensure all screens are secured against the wind.

2. Removal:

   a. Clear up as asbestos removal works proceed bagging all resulting debris on removal of tiles. Prevent debris accumulating on the floor and becoming further broken or crushed. Remove all remaining debris at the end of each workshift;

   b. Spray amended water using a low pressure water spray onto the roof tiles during the course of the removal works;

   c. Use hand tools for the removal operation. Take care whilst lifting the tiles to ensure breakage is kept to a minimum;

d. Use hand chisels to remove all the remaining portions of tiles from the cement screed.

DEM2.W580.9 REMOVAL OF REFUSE CHUTES

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:
   a. Be aware of the potential high risk to nearby residents of this type of removal work and pay particular attention to minimizing the release of dust from the asbestos removal works;
   b. Removal operators in the working zone are to wear ori-nasal half faced masks fitted with Approved HEPA filters, Approved disposable coveralls and shoe covers. Full face positive pressure respirators fitted with HEPA filters are worn if amosite or crocidolite are present;
   c. Carry out removal under total containment and negative pressure of 15 Pa and 6 nos. of air changes per hour minimum. Reliance on air monitoring outside the containment will not be considered sufficient;
   d. Ensure the construction of the containment conforms to the following:
      i. Unless a two floor containment zone is Approved, each floor constitutes a separate containment zone;
      ii. Each zone, including the chute aperture at each zone boundary, is completely sealed from the next. No debris is allowed to fall to the zone below the rough chute opening;
      iii. The vent pipe at roof level and the portion at ground level are included within the containment;
      iv. Removal work commences from the top working downwards;
      v. Each containment is treated as a separate entity, with a hygiene unit, an air mover and a viewing panel for external inspection of the asbestos removal works. Leave a sufficient clear space from the flue to enable the whole section of flue to be removed and manoeuvred inside the containment zone;
      vi. Construct using a timber framework faced with 2 layers of 0.15 mm thick polythene sheeting. Make airtight by sealing all joints with Approved foam sealant, spray glue and tape.
   e. Prior to commencement of asbestos removal work:
      i. Carry out a visual inspection and a smoke test with non-toxic smoke to ensure air-tightness of the containment;
      ii. On completion of successful test: switch the air-mover to exhaust smoke from the containment and carry out a visual test to ensure that the absolute filter screens out the smoke effectively and the pressure gauge indicates normal.
   f. If the test is unsuccessful: seal the air-mover and remove from site for servicing.
2. Removal:
   a. Run air movers continuously throughout the removal works and until satisfactory clearance test results are obtained;

b. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor and becoming further broken or crushed. Minimize fibre release by wetting with amended water and HEPA vacuuming to remove debris as it is created;

c. Take down chute sections within the work zone using non-power hand tools. Do not disturb the seal between the zone below;

d. Cover and seal both sides of the short chute section passing through floor. Construct seal from timber framing faced both sides with polythene sheeting;

e. Carry out visual inspection and clearance test in the containment zone of that part of the chute removed; then

f. Repeat removal operations in next zone down, removing small section left in the upper zone from the zone below without disturbing the enclosure. The inside of the enclosing structure left on the upper zone must be decontaminated from below.

DEM2.W590.9 REMOVAL OF INTERNAL CHIMNEY FLUES

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:

   a. Carry out removal of asbestos lagging under total containment and a negative pressure of 15 Pa minimum. Make efforts to minimize fibre release within the containment, reliance on air monitoring outside the containment will not be considered sufficient;

   b. Ensure the construction of the containment conforms to the following:

      i. Each floor constitutes a separate containment zone. Provide separate containments for the portions at the roof and kitchen level (ground floor level);

      ii. Removal work commences from the top working downwards;

      iii. Each containment is treated as a separate entity, with a hygiene unit, an air mover and a viewing panel for external inspection of the asbestos removal works. Leave a clear space of 1500 mm minimum from the flue to enable the whole section of flue to be removed and manoeuvred inside the containment zone;

      iv. Construct using a timber framework faced with 3 layers of 0.15 mm thick polythene sheeting. Make airtight by sealing all joints with an approved foam sealant, spray glue and tape.

   c. Prior to commencement of asbestos removal work:

      i. Carry out a smoke test with non-toxic smoke to ensure air-tightness of the containment;

      ii. On completion of successful test: switch the air-mover to exhaust smoke from the containment and carry out a visual test to ensure that the absolute filter screens out the smoke effectively and the pressure gauge indicates normal;

      iii. If the test is unsuccessful: seal the air-mover and remove from site for servicing.

   d. Removal operators are to wear Approved full face positive pressure respirators fitted with HEPA filters, Approved disposable coverall and shoe cover.

2. Removal:

a. Run air movers continuously to provide at least 6 air changes per hour throughout the removal works and until satisfactory clearance tests are obtained;

b. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor and becoming further broken or crushed. Minimize fibre release by wetting with amended water and HEPA vacuuming to remove debris as it is created;

c. Carry out asbestos removal to a maximum of two adjoining vertical zones at any one time. Treat each horizontal as a separate zone;

d. Where only surface lagging is to be removed from the chimney flue, apply wetting agent in accordance with the manufacturer's recommendations to all surfaces of the internal chimney flue lagging as the works proceed. Ensure complete penetration of the lagging material before removing. Completely de-lagg the section of the flue within a zone using non-power hand tools, decontaminate and carry out a clearance test prior to commencing asbestos removal work on any further zone;

e. Where the flues are of asbestos cement or in a poor condition carry out the following:

i. Within each containment zone: double wrap flue section in polythene sheeting and remove with the lagging using non-power hand tools. Double wrap flue sections in polythene sheeting before removal from containment;

ii. Remove the portion of the flue that passes through the floor slab once the containment zone on the floor below has been constructed and its air mover has been switched on. The holes left are completely sealed;

iii. Removal work in 2 adjoining zones may be carried out at one time if containment zone has been built below and its air mover switched on.

DEM2.W600.9 REMOVAL OF EXTERNAL CHIMNEY FLUES WITH SURFACE LAGGING

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:

a. Carry out the removal of asbestos lagging under total containment and a negative pressure of 15 Pa minimum. Make efforts to minimize fibre release within the containment, reliance on air monitoring outside the containment will not be considered sufficient;

b. Design and construct containment in a manner which minimizes risk of exposure;

c. When designing and constructing the external containment structure, consider the following:

i. Asbestos removal work method to be employed;

ii. Safety aspects of working at height;

iii Maintaining the weatherproof integrity of the structure.

d. Erect a suitable double scaffolding, comprising the following:

i. An access staircase outside the containment. Where the staircase is constructed of bamboo or similar, ensure gaps between steps do not exceed 300 mm and landings have supports at 300 mm maximum centres, sturdy enough to support a fully laden man plus equipment;

ii. A work platform every two floors inside the containment;

iii. A safe internal access within the containment;

iv. A hoist system for transportation of waste;

v. A tarpaulin cover to encase the structure externally, securely fixed to withstand wind conditions.

e. Dismantle existing installations including ventilation ducts that obstruct access to the flue. Do not disturb the flue during this operation and the erection of the scaffolding;

f. Ensure the construction of the containment conforms to the following:

i. Line the platform inside the containment with 18 mm thick plywood covered with 2 layers of 0.15 mm thick polythene sheeting. Support all joints in the plywood lining;

ii. Construct using a timber framework faced with 3 layers of 0.15 mm thick polythene sheeting securely fixed to battens tied to the scaffolding structure. Make airtight by sealing all joints with an Approved foam sealant, spray glue and tape;

iii. Install florescent tubing or similar non-heat producing lighting inside the containment to provide adequate illumination;

iv. Treat each containment zone as a separate entity, with a hygiene unit, an air mover and a viewing panel for external inspection of the asbestos removal works.

g. Prior to commencement of asbestos removal work:

i. Carry out a smoke test with non-toxic smoke to ensure air-tightness of the containment;

ii. On completion of a successful test: switch the air-mover to exhaust smoke from the containment and carry out a visual test to ensure that the absolute filter screens out the smoke effectively and the pressure gauge indicates normal;

iii. If the test is unsuccessful: seal the air-mover and remove from site for servicing.

h. Removal operators are to wear Approved full face positive pressure respirators fitted with HEPA filters, Approved disposable coverall and shoe cover.

2. Removal:

a. Run air movers continuously throughout the asbestos removal works and until satisfactory clearance tests are obtained;

b. Clear up asbestos proceeding from top to bottom zone by zone as the removal work proceeds. Each zone is approximately 2 floors in height. Prevent debris accumulating on the floor and becoming further broken or crushed. Minimize fibre release by wetting with amended water and HEPA vacuuming to remove debris as it is created;

c. Carry out asbestos removal to a maximum of two adjoining vertical zones at any one time. Treat each horizontal section as a separate zone;

d. Keep fibre release to a minimum by wetting with amended water and a HEPA vacuum to remove debris as it is created. Completely de-lagg the section of the flue within a zone using non-power hand tools, decontaminate and carry out a clearance test prior to commencing asbestos removal work on any further zone;

e. Where the external flue is in a poor condition, remove flue section with lagging to a maximum of 2000 mm in length, using non-powered hand tools. Double wrap flue sections in polythene sheeting prior to removal from containment.

DEM2.W610.9 REMOVAL OF SANDWICHED FLUES

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:

   a. Carry out the asbestos removal work under total containment and a negative pressure of 15Pa minimum. Make efforts to minimize fibre release within the containment. Ensure containment is large enough to allow manoeuvring of the floor sections but not greater than eight floors in height;

   b. Remove the whole flue to get rid of asbestos lagging. Ensure fibre release within the containment is minimized. Reliance on air monitoring outside the containment will not be considered sufficient;

   c. Design and construct the containment to minimize the risk of exposure to asbestos containing materials;

   d. When designing and constructing the external containment structure, consider the following:

      i. Asbestos removal work method to be employed;

      ii. Safety aspects of working at height;

      iii. Maintaining the weatherproof integrity of the structure.

   e. Erect a suitable double scaffolding, comprising the following:

      i. An access staircase outside the containment.

      ii. A work platform every two floors inside the containment;

      iii. A safe internal access within the containment;

      iv. A hoist system for transportation of waste;

      v. A tarpaulin cover to encase the structure externally, securely fixed to withstand wind conditions.

   f. Dismantle existing installations including ventilation ducts that obstruct access to the flue. Do not disturb the flue during this operation and the erection of the scaffolding;

   g. Ensure the construction of the containment conforms to the following:

      i. Construct using a scaffolding framework, faced with 2 layers of 0.15 mm thick polythene sheeting fixed to battens. Make airtight by sealing all joints with an Approved foam sealant, spray glue and tape.

   h. Treat each containment zone as a full height separate entity, with a hygiene unit, an air mover and a viewing panel for external inspection of the asbestos removal works;

   i. Prior to commencement of asbestos removal work:

      i. Carry out a smoke test with non-toxic smoke to ensure air-tightness of the containment;

      ii. On completion of successful test: switch the air-mover to exhaust smoke from the containment and carry out a visual test to ensure that the absolute filter screens out the smoke effectively and the pressure gauge indicates normal;

iii. If the test is unsuccessful: seal the air-mover and remove from site for servicing.

2. Removal:

   a. Run air movers continuously throughout the asbestos removal works to provide at least 6 air changes per hour and maintain a negative pressure of at least 15 Pa and until satisfactory clearance tests are obtained;

   b. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor and becoming further broken or crushed. Minimize fibre release by wetting with amended water and HEPA vacuuming to remove debris as it is created;

   c. Remove whole flue complete to ensure removal of all asbestos lagging;

   d. Treat each horizontal section as a separate zone. Commence removal work from the top working downwards. Wet exposed lagging and insulation with Amended Water and keep them damp all the time;

   e. Dismantle the flue in sections by unbolting the flanged joints, preventing where possible damage to the flue walls. Seal both ends of the flue with PVC tape before transferring by hoist to ground level.

DEM2.W620.9 REMOVAL OF ASBESTOS-CONTAINING CORRUGATED SHEET ROOFING

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:

   a. Access the asbestos removal work area through a designated route and the hygiene unit;

   b. Clean area beneath the roofing and lay 2 layers of plastic sheeting over the floor area to collect debris;

   c. Treat asbestos cement sheets being removed as asbestos waste;

   d. Fix suitable signs;

   e. All workers must wear Approved half-face ori-nasal respirators and disposable coveralls with a hood during the removal work.

2. Removal:

   a. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor or ground and becoming further broken or crushed;

   b. During the asbestos removal operation continuously spray roofing sheets and surrounding roof surface with amended water to keep them wet all the time;

   c. Remove and dispose of asbestos cement roofing sheets with care, avoiding free fall of asbestos containing debris from a height above 500 mm;

   d. Remove sheets intact as far as is practicable using non-power hand tools. Keep unavoidable breakage to a minimum;

   e. Wrap all removed sheets in 2 layers of 0.15 mm thick polythene and label as asbestos waste. Collect the debris into the labelled asbestos waste bags and seal securely with PVC tape.

DEM2.W630.9 REMOVAL OF CEMENT COVERED CORRUGATED ASBESTOS SHEET ROOFING

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520;

a. Access the asbestos removal work area through a designated route and the hygiene unit;

b. All workers must wear Approved half face ori-nasal respirators and disposable coveralls during the removal work.

2. Removal:

a. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor and becoming further broken or crushed;

b. During the removal operation continuously spray roofing sheets and surrounding roof sheets with amended water;

c. Remove and dispose of asbestos cement roofing sheets with care, avoiding free fall of asbestos containing debris from a height above 500 mm. Where a hazard of falling debris above this height exists, carry out the following, or similar Approved operation ensuring no free falling of asbestos debris:

i. Securely connect a steel lifting frame of sufficient strength onto and across the underside for subsequent lifting of the roof;

ii. Fix four wire slings of sufficient strength to the four upturns of the steel beams with the free ends fixed to a crane. Avoid staying directly below;

iii. Once the complete roof is suspended from above by the crane, cut and remove all supports lower down onto the floor and disconnect the wire slings.

d. Remove sheets intact as far as is practicable using non-power hand tools. Keep unavoidable breakage to a minimum;

e. Wrap all removed sheets in 2 layers of 0.15 mm thick polythene and label as asbestos waste.

DEM2.W640.9 REMOVAL OF CHALKBOARDS CONTAINING ASBESTOS

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520;

a. Access the asbestos removal work area through a designated route and the hygiene unit. Fix a suitable sign;

b. Removal operators in the working zone are to wear ori-nasal half face masks fitted with Approved air filters, Approved disposable coveralls and knee length rubber boots with non-slip soles. Wear gloves if it is considered necessary;

c. Dispose contaminated clothing and used respirator filters after each shift;

d. Line the floor of the classroom within 2000 mm of the chalkboard with 2 layers of polythene sheeting.

2. Removal:

a. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor and becoming further broken or crushed;

b. Remove the chalkboard in one piece using hand tools, wrap in 2 layers of 0.15 mm thick polythene sheeting and seal with PVC tape and label;

c. Use a mist spray during the removal process to suppress dust release. Remove any dust or debris generated immediately by vacuuming and wet-wiping;

d. Wet wipe and clean walls and floors within 2 metres with HEPA vacuum cleaner.

DEM2.W650.9 REMOVAL OF BUILDING SERVICES INSTALLATION

1. Preparation procedures: comply with the general preparation procedures as DEM2.W520:
   a. Removal operators in the working zone are to wear ori-nasal half face masks fitted with Approved air filters, Approved disposable gloves.
2. Removal:
   a. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor and becoming further broken or crushed;
   b. Do not disturb the ACM whilst dismantling or dismounting any building services installation;
   c. Where part of an installation containing asbestos is required to be detached, carefully remove in tact;
   d. Continually spray amended water onto the installations during the whole period of the removal;
   e. Wrap the removed installation in 2 layers of 0.15 mm thick polythene sheeting, seal with PVC tape and label.

DEM2.W660.9 REMOVAL OF BUSBAR RISER TRUNKING

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:
   a. All Workers must wear Approved half face ori-nasal respirators fitted with Approved air filters, Approved disposable coveralls and gloves;
   b. Use polythene sheeting to line the floor around the busbar riser trunking to collect any scattered debris;
   c. Line caulking on the ceiling of the floor below with a polythene bag or sheet, fitted with a HEPA vacuum cleaner to draw any fibre generated in the removal of caulking from above. Dispose of as asbestos waste.
2. Removal:
   a. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor and becoming further crushed or broken;
   b. Carefully chisel off all caulking with minimum generation of dust. Remove all asbestos fibres by thoroughly vacuuming and wiping with a clean, dry cloth the outside of the busbar riser trunking, the concrete kerb and the ceiling of the floor below;
   c. Remove the whole section of busbar riser trunking without disturbing the fire barrier or breaking the concrete kerb and wrap in 0.15 mm thick polythene sheeting, seal with tape and dispose of as asbestos waste. Wrap both ends of the trunking to prevent dropping any accessory of the fire barrier;
   d. Handle caulking for underground cable, conduit or trunking through floor slab in a similar manner.

DEM2.W670.9 REMOVAL OF FLEXIBLE JOINT OR CAULKING TO CONDUIT OR TRUNKING THROUGH FLOOR SLABS

1. Preparation procedures: in addition to the general preparation procedures as DEM2.W520:
   a. Use polythene sheeting to line the area of floor adjacent to caulking removal works to collect any scattered debris;

b. Wet the flexible joint/gasket or caulking with wetting agent.

2. Removal:

a. Clear up as asbestos removal work proceeds. Prevent debris accumulating on the floor and becoming further crushed or broken;

b. Vacuum clean the flexible joint/gasket or caulking and the adjacent ducting with HEPA vacuum cleaner;

c. Wet the flexible joint/gasket or caulking with wetting agent and wrap it with 2 layers of plastics;

d. Carefully chisel off all caulking. Spray the flexible joint with amended water to keep it wet. Remove all asbestos fibres by thoroughly vacuuming and wiping with a clean, dry cloth the outside of the trunking;

e. Wrap the flexible joint/gasket or caulking in double layers of 0.15 mm polythene sheets for disposal.

WORK ON COMPLETION

DEM2.W710.9 GENERAL

Carry out the following operations on completion of the asbestos removal work:

1. Designate a secure area located at ground level to use as a secure area to receive bagged asbestos waste;
2. Install a closed hoist to transport the bagged asbestos waste to ground level;
3. Collect debris into labelled asbestos waste bags and seal securely with PVC tape;
4. Double bag all labelled asbestos waste in an airlock before transferring to the hoist area. Take care at all times when handling the bags to avoid damage;
5. Remove all plastic, protective sheeting and timber framing and dispose of as contaminated waste. Where permitted by the CM, well covered and cleaned timber frame and external cover panels may be re-used;
6. Wrap all items too large to fit normal waste disposal sacks using 0.15 mm thick polythene sheeting, secured by vinyl tape and label clearly as asbestos waste;
7. Take all sacks and wrapped debris to a designated collection point through an Approved route, vacuum and wet clean and place in a further 0.15 mm thick polythene bag or wrap in a second layer of 0.15 mm thick polythene, sealed using waterproof, self adhesive vinyl tape;
8. Metal drums may be used as an alternative to polythene bags, provided the following is complied with:

a. Conform with EPD disposal requirements;

b. Do not place or roll drums directly onto asbestos roof tiles, or cause crushing of tiles;

c. Make available a cleared area for the storage of drums containing asbestos debris;

d. Seal and remove all drums, whether or not filled, from the work area to the storage area at the end of each day's work and ensure that the drums undergo decontamination prior to removal;

e. Sack barrows may be used in the Work Area for transportation of drums;

f. Take steps to prevent dust releasing from drums.

9. Vacuum and wet clean nylon tarpaulin screen, and all tools and equipment for re-use after a satisfactory re-assurance test has been carried out. Tools and equipment are secured inside polythene bags before taken off the site;
10. Ensure each asbestos removal working zone/containment is clean and dust free before the workmen leave site at the end of each day's work;
11. Remove all dust and debris from operators' clothing and footware after a work shift or on leaving the site;
12. Arrange for a clearance/reassurance test and an inspection by the CM to be carried out for the whole working zone after the area is vacuumed and wet cleaned. If the test result indicates fibre levels in excess of 0.01 fibres per ml, reclean the working zone and carry out a further test, at the Contractor's own expense and with no claim for any extension of time;
13. Number all bags containing asbestos waste using a waterproof pen. The Authority's site staff will keep a record of the waste;
14. Pass all waste water through an Approved filter to remove all particles to a level of 5 microns in suspension before discharging into the drainage system.

DEM2.W720.9 BALCONY AND STAIRCASE GRILLE PANELS

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. Vacuum and wet clean walls and floor of the balcony and any areas within the asbestos removal working zone. The polythene sheeting on the floor of the balcony is placed in asbestos disposal bags and disposed of as contaminated waste;
2. Vacuum and wet clean the area surrounding the grille panel cavity;
3. Seal filled sacks with waterproof, self adhesive vinyl tape. Large or unweidy items may be wrapped in 0.15 mm thick polythene sheet, secured by vinyl tape and labelled as asbestos waste;
4. On satisfactory completion of the clearance test, spray PVA on polythene covering to the panels at the external face of the balcony wall and the polythene sheeting before dismantling the containment and dispose as contaminated waste;
5. At the end of each day's work, allow for the complete removal of the grille panel and the clearing up of the debris in a flat.

DEM2.W730.9 ROOF INSULATION TILES

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. Thoroughly clean the roof screed, all containmented surfaces and equipment with a vacuum cleaner and wet cloths as soon as debris is produced;
2. Transfer labelled asbestos waste bags to a clean area outside the Work Area where they are wiped clean and double-bagged.

DEM2.W740.9 REFUSE CHUTES

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. Double wrap chute sections in polythene sheets before passing out of the containment;
2. On satisfactory completion of the clearance test, spray PVA on the polythene sheeting before dismantling the containment;

3. Remove timber frame and dispose of as asbestos waste. Re-use timber shuttering if it has been well covered during the asbestos removal works and has been thoroughly cleaned;
4. Number bags and wrapped chute sections and provide record to HD site staff. Provide a certificate from the dump site to HD site staff.

DEM2.W750.9 INTERNAL CHIMNEY FLUES

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. Double bag all asbestos waste bags in the middle chamber of the airlock before transferring to the ground level secure store;
2. On completion of removal of the lagging, wire brush the surfaces of the flue to remove any remaining debris;
3. Arrange for a Penultimate Tests after inspection by CM that the area is free of debris and dust. If test results exceed 0.01 fibres/ml, reclean the area and carry out further Penultimate Test. If test results satisfactory, wet wipe and vacuum the area and arrange for a final clearance test;
4. Number bags and wrapped flue sections and provide record to HD site staff. Provide a certificate from the dump site to HD site staff;
5. On satisfactory completion of the final clearance test, spray PVA on the polythene sheeting before dismantling the containment.

DEM2.W760.9 EXTERNAL CHIMNEY FLUES WITH SURFACE LAGGING

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. On completion of removal of the lagging, wire brush the surfaces of the flue to remove any remaining debris;
2. Install a hoist system within the tarpaulin enclosure for transportation of the bagged asbestos waste to ground level. The hoist is closed cage type;
3. Arrange for a Penultimate Tests after inspection by CM that the area is free of debris and dust. If test results exceed 0.01 fibres/ml, reclean the area and carry out further Penultimate Test. If test results satisfactory, wet wipe and vacuum the area and arrange for a final clearance test;
4. Number bags and wrapped flue sections and provide record to HD site staff. Provide a certificate from the dump site to HD site staff;
5. On satisfactory completion of the clearance test, spray PVA on the polythene sheeting before dismantling the containment.

DEM2.W770.9 SANDWICHED FLUES

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. Wipe clean flue sections and wrap in polythene before removing from the containment;
2. Install a hoist system within the tarpaulin enclosure for transportation of the bagged asbestos waste to ground level. The hoist is closed cage type;
3. Arrange for a Penultimate Tests after inspection by CM that the area is free of debris and dust. If test results exceed 0.01 fibres/ml, reclean the area and carry out further Penultimate Test. If test results satisfactory, wet wipe and vacuum the area and arrange for a final clearance test;

4. Number bags and wrapped flue sections and provide record to HD site staff. Provide a certificate from the dump site to HD site staff;
5. On satisfactory completion of the clearance test, spray PVA on the polythene sheeting before dismantling the containment.

DEM2.W780.9 CORRUGATED SHEETS AND CEMENT COVERED CORRUGATED SHEETS

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. Thoroughly clean by wet wiping, HEPA vacuuming and manual scraping any debris adhering to the floor, the steel structure and the steel runners etc.;
2. Clean Work Area before the end of the day;
3. Number bags and wrapped flue sections and provide record to HD site staff. Provide a certificate from the dump site to HD site staff.

DEM2.W790.9 BUSBAR RISER TRUNKING AND BUILDING SERVICES INSTALLATION

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. Vacuum and wipe with clean, dry cloth all surfaces within the rooms to both floors to remove any asbestos fibres. Only contaminated tools may be cleaned with a damp cloth;
2. Wet wipe outer surface of the bagged waste and wrapped ACM. Wrap in another polythene sheet or bag and label outside the working area.

DEM2.W800.9 CHALKBOARDS

In addition to the relevant general requirements as DEM2.W710 carry out the following:

1. Vacuum and wipe clean the area adjacent to the asbestos removal works to a distance of 2000 mm;
2. Wet wipe outer surface of the bagged waste and wrapped ACM. Wrap in another polythene sheet or bag and label outside the working area.

DEM2.W810.9 DISPOSAL OF WASTE

1. Dispose of all asbestos waste in a designated site and in strict accordance with the 'Code of Practice on the Handling, Transport and Disposal of Asbestos Waste', issued by the Environmental Protection Department (EPD);
2. Temporarily store all asbestos waste in sealed bags in a secure Approved store. Remove waste from store commencing from the top working downwards unless otherwise Instructed;
3. On completion of asbestos removal to an entire floor invite the CM to inspect the works and check the number of waste bags for that zone prior to removing the bags to the secure store;
4. To avoid over accumulation of waste at the appointed site, provide information to EPD stating the proposed schedule for disposal of asbestos waste;
5. Provide transport and all necessary equipment required for disposal of asbestos waste;
6. Collect all water used within the asbestos removal works, including that used in washing facilities, by means of sumps and pumps and pass through an aquarium type filter or similar Approved to remove particles down to 5 microns in suspension before discharging into the drainage system;

7. Inform the CM at least 7 days prior to disposal of waste from site. Inform the CM the type of waste and the number and location of packages to be disposed prior to removing from site. Submit a signed copy of each delivery note to the CM;
8. Asbestos removal work will not be permitted to proceed to more than two floors below a level if provisional acceptance of the asbestos removal work has not been obtained from the CM;
9. Upon satisfactory visual inspection of the works by the CM on completion of one entire floor, arrange for Clearance/Reassurance Tests to be carried out by the Direct Testing Contractor.

EMERGENCY PROCEDURES

DEM2.W910.9 GENERAL

If during the course of the asbestos removal works any of the following situations occur, inform the CM and carry out the following specified procedures immediately. Any stoppage or reduction in output resulting in compliance with this clause will not result in any extension of time for completion or to any additional costs claimed.

DEM2.W920.9 SPILLAGE OF ASBESTOS DEBRIS

1. Stop all processes which may result in the production of asbestos dust;
2. Spray all surfaces and debris within the asbestos removal work area with amended water in a fine mist spray, using airless spray equipment;
3. Bag all loose asbestos debris present in the asbestos removal work area and remove to a secure store. Wipe clean and vacuum all surfaces when the surface is dry;
4. Prepare the site of the remedial work for inspection by the CM and air testing prior to recommencing removal work.

DEM2.W940.9 FIRE

1. Spray all surfaces and debris within the asbestos removal work area with amended water in a fine mist spray, using airless spray equipment once the fire has been extinguished and the Site is safe for re-entry;
2. Bag all loose asbestos debris present in the asbestos removal work area and remove to a secure store. Wipe clean and vacuum all surfaces when the surface is dry;
3. Prepare the Site for inspection by the CM and air testing prior to recommencing removal work.

DEM2.W950.9 ACCIDENT

1. Stop all work and if necessary remove worker(s) to a safe area;
2. If a worker has collapsed remove face mask (in all other cases the face mask should be left in place), carry out normal emergency first aid procedures and arrange to transfer the worker to hospital. Personal decontamination should be carried out if possible;
3. Where it is impossible to carry out decontamination procedures on the worker, inform the medical team to enable them to take the appropriate safety measures;
4. Bag all loose asbestos debris present in the asbestos removal work area and remove to a secure store. Wipe clean and vacuum all surfaces and any adjoining area contaminated during the emergency;

5. Prepare the Site for inspection by the CM and air testing prior to recommencing removal work.

DEM2.W960.9 TYPHOON SIGNAL NUMBER 3 AND ABOVE

1. Stop all processes which may result in the production of asbestos dust;
2. Spray all surfaces and debris within the asbestos removal work area with amended water in a fine mist spray, using airless spray equipment;
3. Bag all loose asbestos debris present in the asbestos removal work area and remove to a secure store. Wipe clean and vacuum all surfaces;
4. Cut off all power and water supplies and secure all loose equipment against typhoon damage;
5. Arrange a revised inspection by the CM before the workers leave Site;
6. Recommence the removal works once the No 3 typhoon signal has been lowered, the necessary cleaning up work and repairs to containment have been completed and permission has been given by the CM.

DEM2.W970.9 PERSONAL PROTECTION DECONTAMINATION

Prior to leaving the site ensure all operatives:

1. Are provided with showering facilities and all items including sponge and brush necessary to clean respiratory equipment and protective clothing;
2. Wet and remove all dust and debris from working clothing and footwear using an Approved vacuum cleaner before going out of the working area;
3. Follow the designated route to the hygiene unit. On entering the dirty end wet their respirators and protective clothing, contaminated equipments are stored in labelled waste disposal receptacle in the dirty area;
4. Remove clothing after wetting thoroughly in the dirty area of the hygiene unit, and place into a labelled disposal bin. Remove footwear and leave for cleaning and decontamination;
5. Pass into the shower area, wash thoroughly particularly hair and finger nails, discarding the respirator filter in a designated bin;
6. Do not remove respiratory protective equipment until in the shower and the respirator has been washed;
7. Place respirators in a drying compartment of the clean area of the unit after washing, change cloths in the clean area;
8. Vacuum, wet clean and secure inside polythene bags all tools and equipment prior to removal from the asbestos removal work site.

DEM2.W980.9 ACCEPTANCE OF ASBESTOS REMOVAL WORK

1. Provisional acceptance is based on visual inspection by the CM together with air test results of Penultimate Tests within the acceptance limit;
2. Upon completion of asbestos removal and clearance of asbestos waste and equipment, the CM conducts a final inspection;
3. Final acceptance is based on visual inspection by the CM together with Final Clearance Test results within the acceptance limit;
4. After final acceptance, the site is safe to continue with demolition work.

TESTING

AIR MONITORING TEST

DEM2.T010.9 AIR MONITORING TESTS BORNE BY EMPLOYER

The Authority will employ at its own expense a Direct Testing Contractor to carry out air monitoring test as follows to measure the asbestos fibre content in the air outside and within the site during the asbestos removal works. The Authority will keep a record of all air monitoring test results for tests carried out by the Direct Testing Contractor on Site for inspection by the Contractor:

1. Prior to commencement of the asbestos removal work: air sampling tests (environmental test) shall be carried out to ascertain the background level of air quality in the vicinity of the block at locations outside the hoarding in a convenient open area, within the adjacent blocks and on the edge of the estate, and at other locations as agreed;
2. During asbestos removal work: air sampling tests (environmental test) shall be carried out daily at regular sampling points to establish the fibre level of airborne dust at the closest sensitive receptor and around the demolition site; and
3. On completion of the asbestos removal works: air sampling tests shall be carried out to ascertain the air quality for clearance and reassurance (clearance test and reassurance test) in accordance with the following table:

Items	Clearance/Reassurance
Balcony grille	1 in 10 flats (min. 2 per zone)
Stair grille	1 in 5 grille (min. 1 per zone)
Roof tile	min. 3 per roof
Refuse chute	1 per zone (3 for the first 10 m^3 of containment size)
Chimney	1 per zone (3 for the first 10 m^3 of containment size)
Corrugated sheet	1 per zone
Chalk board	1 per 10 nos. (min. 1 per zone)

DEM2.T020.9 AIR MONITORING TESTS BORNE BY CONTRACTOR

Appoint an Approved independent asbestos laboratory registered under Air Pollution Control Ordinance to carry out air monitoring tests, except those tests stated in DEM2.T010 which are to be carried out by the Direct Testing Contractor, to ensure conformity with the requirements of this Specification.

DEM2.T030.9 SURVEILLANCE TESTS BY DIRECT TESTING CONTRACTOR

For air monitoring tests that are carried out by the Approved independent laboratory, CM may employ Direct Testing Contractor to carry out parallel tests.

DEM2.T040.9 AIR MONITORING TESTS

1. Testing arrangements:
   a. Comply with the air monitoring requirements in the Asbestos Abatement Plan as approved by EPD;
   b. Arrange and allow for coordination of the air monitoring operations within the programme for the asbestos removal works;
   c. Arrange a representative to present at all stages of the air monitoring tests if possible. Non-attendance at test will not invalidate test results.
2. Testing methods:
   a. As DEM2.M020;
   b. Do not exceed the following levels during and on completion of the asbestos removal works and provide the appropriate respiratory protective equipment for personnel involved:
      i. During asbestos removal works:
         - Amosite or crocidolite: 0.2 fibre per millilitre;
         - Other types of asbestos: 0.5 fibre per millilitre.
      ii. On completion of asbestos removal works (final clearance test / reassurance test) when no visible debris is apparent: 0.01 fibre per millilitre. If the limit is exceeded, reclean the working zone and repeat final clearance / reassurance test after 24 hours, all extra time and costs are to be borne by the contractor;
      iii. Environmental air level outside tarpaulin / hoarding must not differ significantly from background level and in any case must not exceed Environmental Control Level of 0.01 fibre per millilitre.
3. Non-compliance:
   a. Where the fibre count exceeds the acceptable limit:
      i. Stop all processes which may result in the production of asbestos dust;
      ii. Spray all surfaces and debris within the asbestos removal work area with amended water in a fine mist spray, using airless spray equipment;
      iii. Bag all loose asbestos debris present in the asbestos removal work area and remove to a secure store. Wipe clean and vacuum all surfaces;
      iv. Together with the CM, investigate the integrity of the containment, identify the cause of the limit exceedance and take immediate measures, as directed by the CM, to rectify the situation.
   b. In the event of air monitoring test result failures resulting from the Contractor's non-compliance with the workmanship requirements of this Worksection, bear all costs in relation to tests carried out and those tests required subsequent to rectification of the works to confirm compliance.

HONG KONG HOUSING AUTHORITY

SPECIFICATION LIBRARY 2022 (BATCH 4) EDITION

Foundation Works Specification

PIL PILING AND FOOTING

PIL1 PILING AND FOOTING 11

GENERAL 11

DEFINITIONS 11

PIL1.G010.9 DEFINITIONS 11

PIL1.G020.9 CODE OF PRACTICE FOR FOUNDATIONS 2017 11

DESIGN RESPONSIBILITY 11

PIL1.G110.9 DESIGN RESPONSIBILITY 11

STANDARDS 11

PIL1.G210.9 PILING 11

PIL1.G220.9 PILE CAPS AND FOOTINGS 11

PIL1.G230.9 STATUS OF THE SPECIFICATION 11

PIL1.G240.9 OTHER WORKSECTIONS 12

PIL1.G250.9 CONTRACTOR'S DESIGN FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 12

PILE TYPES 12

PIL1.G310.9 GENERAL 12

PIL1.G320.9 TYPE 1 PILES 12

PIL1.G330.9 TYPE 2 PILES 12

PIL1.G340.9 TYPE 3 PILES 12

PIL1.G350.9 TYPE 4 PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 12

PIL1.G355.9 TYPE 4 PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 12

PIL1.G360.9 TYPE 5 PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 13

PIL1.G365.9 TYPE 5 PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 13

PIL1.G370.9 TYPE 6 PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 13

PIL1.G372.9 TYPE 6 PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 13

PIL1.G375.9 TYPE 7 PILES 13

PIL1.G380.9 ALTERNATIVE TYPES OF PILE - FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 13

SITE INVESTIGATION 13

PIL1.G410.9 PRELIMINARY INVESTIGATIONS 13

PIL1.G420.9 EXISTING BOREHOLE INFORMATION 14

PIL1.G430.9 CONTRACTOR'S RESPONSIBILITY 14

PIL1.G440.9 ADDITIONAL INVESTIGATIONS 14

PIL1.G450.9 DEFINITION OF "BEDROCK" 14

PIL1.G460.9 WORKS REQUIRED TO BE CARRIED OUT BY A RSC(GIFW) UNDER THE CONTRACT 14

PIL1.G470.9 BACKFILLING OF DRILLHOLES 15

APPROVED CONTRACTORS AND SUBCONTRACTORS 15

PIL1.G510.9 APPROVED CONTRACTORS FOR PILING WORKS - FOR ENGINEER'S DESIGN PILING CONTRACT 15

PIL1.G512.9 APPROVED CONTRACTORS FOR PILING WORKS - FOR CONTRACTOR'S DESIGN PILING CONTRACT 15

PIL1.G515.9 APPROVED CONTRACTORS FOR PILING WORKS - FOR ENGINEER'S DESIGN COMBINED PILING AND BUILDING CONTRACT 16
PIL1.G517.9 APPROVED CONTRACTORS FOR PILING WORKS - FOR CONTRACTOR'S DESIGN COMBINED PILING AND BUILDING CONTRACT 17
PIL1.G520.9 SUB-CONTRACTOR FOR CONSTRUCTION OF FOOTING - FOR BUILDING CONTRACT WITH FOOTING CONSTRUCTION 17
PIL1.G530.9 DEFINITION OF "PILING SUBCONTRACTOR" FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 17
PIL1.G535.9 DEFINITION OF "PILING SUBCONTRACTOR" FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 18
PIL1.G540.9 DEFINITION OF "PILING SUB-SUBCONTRACTOR" FOR ENGINEER'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY 18
PIL1.G545.9 DEFINITION OF "PILING SUB-SUBCONTRACTOR" FOR CONTRACTOR'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY 18
PIL1.G550.9 RESTRICTION ON PILING SUBCONTRACT 18
PIL1.G560.9 RESTRICTION ON PILING SUB-SUBCONTRACT - FOR COMBINED PILING AND BUILDING CONTRACT ONLY 18
PIL1.G570.9 INFORMATION ON PILING SUBCONTRACT 18
PIL1.G580.9 INFORMATION ON PILING SUB-SUBCONTRACT - FOR COMBINED PILING AND BUILDING CONTRACT ONLY 19
PIL1.G590.9 CONDITIONS ON PILING SUBCONTRACT - FOR ENGINEER'S DESIGN PILING CONTRACT ONLY 19
PIL1.G595.9 CONDITIONS ON PILING SUBCONTRACT - FOR CONTRACTOR'S DESIGN PILING CONTRACT ONLY 20
PIL1.G600.9 CONDITIONS ON PILING SUBCONTRACT - FOR ENGINEER'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY 21
PIL1.G605.9 CONDITIONS ON PILING SUBCONTRACT - FOR CONTRACTOR'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY 22
PIL1.G610.9 CONDITIONS ON PILING SUB-SUBCONTRACT - FOR ENGINEER'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY 23
PIL1.G615.9 CONDITIONS ON PILING SUB-SUBCONTRACT - FOR CONTRACTOR'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY 23
PIL1.G620.9 SUBMISSION OF CONTRACT DOCUMENTS OF PILING SUB-CONTRACT 24
PIL1.G630.9 SUBMISSION OF CONTRACT DOCUMENTS OF PILING SUB-SUBCONTRACT - FOR COMBINED PILING AND BUILDING CONTRACT ONLY 25

DESIGN 26

GENERAL 26

PIL1.D010.9 GENERAL 26
PIL1.D020.9 ACCEPTABLE PILE TYPES 26
PIL1.D030.9 ACCEPTANCE OF THE DESIGN 26
PIL1.D040.9 DESIGN CERTIFYING CONSULTANT 26

INFORMATION TO BE SUPPLIED WITH TENDER 26

PIL1.D110.9 SUBMISSIONS 26
PIL1.D120.9 ADDITIONAL REQUIREMENTS FOR TYPES 5, 6 AND 7 PILES 26

DESIGN SUBMISSIONS 27
PIL1.D210.9 SUBMISSIONS OF PILING AND/OR FOOTING DESIGN AT COMMENCEMENT OF THE WORKS 27
PIL1.D220.9 SUBMISSIONS OF AMENDMENT OF PILING AND/OR FOOTING DESIGN 27
DESIGN PARAMETERS 27
PIL1.D320.9 DESIGN LOAD 27
PIL1.D330.9 TYPES OF PILE IN ONE CAP 27
PIL1.D340.9 PILE SPACING 27
PIL1.D350.9 STRESS IN STEEL FOR PILING DESIGN 27
PIL1.D360.9 STRESS IN CONCRETE FOR PILING DESIGN 27
PIL1.D370.A WIND EFFECT 28
PIL1.D380.9 RESISTANCE TO SLIDING, UPLIFT, OVERTURNING AND BUOYANCY 28
PIL1.D390.9 SAFE LOAD CARRYING CAPACITY 28
PIL1.D395.9 SAFE LOAD CARRYING CAPACITY - TYPE 7 PILES FOR CONTRACTOR'S DESIGN 30
PIL1.D400.9 GROUP REDUCTION FACTOR 30
PIL1.D410.9 PILES FOUND ON BEDROCK 30
PIL1.D420.9 CASING THICKNESS 30
PIL1.D430.9 BOND STRENGTH IN TYPES 5 AND 6 PILES 30
PIL1.D440.9 UNDERGROUND OBSTRUCTIONS IN TYPE 7 PILES FOR CONTRACTOR'S DESIGN 31
SETTLEMENT ANALYSIS 31
PIL1.D510.9 REQUIREMENT 31
PIL1.D520.9 BLOCK SETTLEMENT AND DIFFERENTIAL SETTLEMENT 31
PIL1.D530.9 SCOPE OF CALCULATIONS 32
PIL1.D540.9 BASIS OF ANALYSIS 32
PIL1.D550.9 SCHEDULE 32
PIL1.D560.9 ELASTICITY MODULUS 32
PIL1.D570.9 SUBMISSION - ACTUAL CONDITIONS OF INSTALLATION 32
RESISTANCE TO HORIZONTAL FORCES 32
PIL1.D610.9 GENERAL 32
PIL1.D620.9 TYPE 5 PILES 33
PIL1.D630.9 HORIZONTAL RESISTANCE BY PILE CAPS ONLY 33
PIL1.D640.9 HORIZONTAL RESISTANCE BY PILES ONLY WITH PILE TOPS FIXED AGAINST ROTATION 33
PIL1.D650.9 HORIZONTAL RESISTANCE BY PILES ONLY WITH FLEXIBLE PILE CAPS OR HINGED END CONDITIONS 34
PIL1.D660.9 HORIZONTAL RESISTANCE BY PILES AND PILE CAPS TOGETHER 34
PIL1.D670.9 HORIZONTAL RESISTANCE BY ROCK SOCKET 34
NEGATIVE SKIN FRICTION 34
PIL1.D710.9 GENERAL 34
PIL1.D720.9 BASIC FORMULA 35
PIL1.D730.9 AVERAGE SOIL PROPERTIES 35
PIL1.D740.9 GROUPING EFFECT 35
PIL1.D760.9 REDUCTION OF NEGATIVE SKIN FRICTION 35
PILE CAP DESIGN 35
PIL1.D810.9 STANDARDS 35
PIL1.D820.9 SUBMISSIONS (CONSTRUCTION OF PILE CAP IS NOT PART OF THE CONTRACT) 36

PIL1.D830.9 SUBMISSIONS (CONSTRUCTION OF PILE CAP IS PART OF THE CONTRACT) 36

DESIGN GUIDELINES 36

PIL1.D910.9 MANDATORY GUIDELINES 36
PIL1.D920.9 RECOMMENDED GUIDELINES 36
PIL1.D930.9 CONTRACTOR'S RESPONSIBILITY 36

MATERIALS 37

GENERAL 37

PIL1.M010.9 INFORMATION TO BE SUPPLIED WITH TENDER 37
PIL1.M020.9 SAMPLES 37
PIL1.M030.9 TEST CERTIFICATES 37
PIL1.M040.9 QUALITY ASSURANCE 37
PIL1.M050.9 COLOUR CODE SYSTEM OF STEEL PILE SECTIONS 37

STEEL PILES 38

PIL1.M110.9 'H' PILES AND PLATES 38
PIL1.M120.9 STEEL PIPE PILES 38

PERMANENT CASINGS 38

PIL1.M210.9 TYPE 5 PILES 38

PILE SHOES 38

PIL1.M310.9 GENERAL 38
PIL1.M320.9 TYPES 1A AND 1B PILES 38
PIL1.M330.9 STRAPS AND FASTENINGS FOR CAST PILE SHOES FOR TYPES 1A AND 1B PILES 38
PIL1.M340.9 TYPE 1C PILES 39
PIL1.M350.9 TYPE 4 PILES 39

GROUT AND CONCRETE 39

PIL1.M410.9 GROUT 39
PIL1.M420.9 GROUT FOR TYPES 5, 6 AND 7 PILES 39
PIL1.M430.9 FILLING TO STEEL PIPE PILES 39
PIL1.M440.9 CONCRETE FOR PILE CAPS AND FOOTINGS 39

ANCILLARY MATERIALS 40

PIL1.M510.9 PAINT FOR STEEL PILES AND STEEL OR CAST IRON COMPONENTS 40
PIL1.M520.9 WELDING ELECTRODES 40
PIL1.M540.9 EARTH FILLING 40

MECHANICAL COUPLER FOR TYPE 5 PILES 40

PIL1.M610.9 TYPE OF MECHANICAL COUPLER 40
PIL1.M620.9 SUBMISSION 40
PIL1.M630.9 QUALITY ASSURANCE SCHEME FOR MECHANICAL COUPLER 40

WORKMANSHIP 41

GENERAL 41

PIL1.W010.9 REQUIREMENTS OF THE CONTRACT 41
PIL1.W020.9 REQUIREMENTS OF THE CONTRACTOR'S DESIGN 41
PIL1.W030.9 DELIVERY, HANDLING AND STORAGE OF PILES 41
PIL1.W040.9 COLOUR MARKINGS OF STEEL PILE SECTIONS BY STOCKISTS OR SUPPLIERS PRIOR TO DELIVERY 41
PIL1.W055.9 CONTOUR PLAN SUBMISSION FOR TYPE 4 PILES 41
PIL1.W070.9 SUBMISSION OF DRIVING FORMULA FOR TYPE 4 PILES 42

PROTECTION 43

PIL1.W110.9 COATING STEEL PILES AND COMPONENTS 43

ACCURACY AND TOLERANCES 43
PIL1.W210.9 GENERAL 43
PIL1.W220.9 EXCESSIVE DEVIATION 43
PLANT AND EQUIPMENT 43
PIL1.W310.9 APPROVAL 43
PIL1.W320.9 SUBMISSIONS 43
PIL1.W330.9 PILE HAMMER 43
PIL1.W340.9 FOLLOWERS 44
PIL1.W350.9 VERIFICATION OF EFFICIENCY 44
PIL1.W360.9 VIBRATION CONTROL 44
PIL1.W370.9 EXCESSIVE VIBRATION 44
PIL1.W380.9 DEPLOYMENT OF SELF-OWNED PILING PLANTS FOR PILING CONTRACT 44
PIL1.W390.9 DEPLOYMENT OF SELF-OWNED PILING PLANTS FOR COMBINED PILING AND BUILDING CONTRACT 45
DRIVING 45
PIL1.W410.9 LENGTH OF DRIVEN PILES 45
PIL1.W420.9 PROXIMITY TO CAST INSITU PILES 45
PIL1.W430.9 DRIVING STRESSES FOR STEEL PILES 45
PIL1.W440.9 TEMPORARY BRACING FOR DRVIEN PILES 45
PIL1.W450.9 BITUMEN SLIP LAYER FOR DRIVEN PILES 45
PIL1.W460.9 PROPRIETARY PILES WITH PROTECTIVE COATING 45
PIL1.W470.9 DRIVING PILES DESIGNED NOT TO REST ON BEDROCK - FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 45
PIL1.W480.9 DRIVING PILES DESIGNED NOT TO REST ON BEDROCK - FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 45
PIL1.W490.9 DRIVING PILES DESIGNED TO REST ON BEDROCK 47
PIL1.W500.9 FOUNDING LEVEL OF DRIVEN PILES 47
PIL1.W510.9 PENETRATION OF DRIVEN PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 47
PIL1.W515.9 PENETRATION OF DRIVEN PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 47
PIL1.W520.9 FINAL SETS OF DRIVEN PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 47
PIL1.W525.9 FINAL SETS OF DRIVEN PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 47
PIL1.W530.9 STEEL SET CHAIR 47
INSTALLATION OF TYPE 3 PILES 48
PIL1.W610.9 BELL-OUT 48
PIL1.W620.9 RISK MANAGEMENT PLAN FOR TYPE 3 PILE 48
INSTALLATION OF TYPES 5, 6 AND 7 PILES 48
PIL1.W710.9 GENERAL 48
PIL1.W720.9 TRIAL PILES 48
PIL1.W730.9 INCLINATION OF PILES 49
PIL1.W740.9 CHANGE IN SUB-SOIL CONDITIONS FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 49

PIL1.W745.9 CHANGE IN SUB-SOIL CONDITIONS FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 49
PIL1.W750.9 PREBORED HOLE AND COVER FOR TYPE 6 PILES 49
PIL1.W760.9 TEST BORING PROPOSAL FOR TYPE 6 PILES 49
PIL1.W770.9 TEST BORING PROPOSAL - TYPE 7 PILES FOR CONTRACTOR'S DESIGN 49
PIL1.W775.9 TEST BORING PROPOSAL - TYPE 7 PILES FOR ENGINEER'S DESIGN 50
PIL1.W780.9 INSTALLATION PROCEDURES FOR TYPE 7 PILES 50
PIL1.W790.9 REVIEW LOADING TEST RESULTS AND PROPOSED PILE LENGTHS - TYPE 7 PILES FOR CONTRACTOR'S DESIGN 51
PIL1.W795.9 REVIEW LOADING TEST RESULTS - TYPE 7 PILES FOR ENGINEER'S DESIGN 51

FOUNDING OF BORED PILES 51
PIL1.W810.9 FOUNDING OF TYPE 3 PILES 51
PIL1.W820.9 FOUNDING OF TYPES 5 AND 6 PILES 52
PIL1.W830.9 PROVING BEDROCK 52

UNDERGROUND OBSTRUCTIONS 52
PIL1.W910.9 OBSTRUCTIONS TO PILES FOR CONTRACTOR'S DESIGN 52
PIL1.W915.9 OBSTRUCTIONS TO PILES FOR ENGINEER'S DESIGN 52
PIL1.W920.9 INTENDED MEANS OF OVERCOMING UNDERGROUND OBSTRUCTIONS TO PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 53
PIL1.W930.9 INTENDED MEANS OF OVERCOMING UNDERGROUND OBSTRUCTIONS TO PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 53
PIL1.W940.9 DESIGN CHANGES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 53
PIL1.W950.9 EXCAVATION OR PRE-BORING 53
PIL1.W955.9 SUBMISSION ON OVERCOMING ANTICIPATED UNDERGROUND OBSTRUCTIONS BEFORE PILE DRIVING OPERATION FOR TYPE 4 PILES 54

PILE SHAFT CASINGS 55
PIL1.W1010.9 LININGS TO INSITU PILES FOR CONTRACTOR’S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 55
PIL1.W1015.9 LININGS TO INSITU PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 55
PIL1.W1020.9 PILE TYPE 2 55
PIL1.W1024.9 TEMPORARY CASING FOR TYPE 3 PILES 55
PIL1.W1027.9 LEFT-IN TEMPORARY CASING FOR TYPE 3 PILES 55
PIL1.W1030.9 TYPE 5 PILES 55
PIL1.W1040.9 TEMPORARY CASING FOR TYPE 6 PILES 56

GROUTING PILE TYPES 2 AND 3 56
PIL1.W1110.9 PRESSURE GROUTING 56
PIL1.W1120.9 BASE OF TYPE 3 PILES 56

GROUTING TYPES 5, 6 AND 7 PILES 56
PIL1.W1210.9 BATCHING 56
PIL1.W1220.9 USE OF ADMIXTURES 56
PIL1.W1230.9 MIXING AND SIEVING 56
PIL1.W1240.9 TESTING 56
PIL1.W1250.9 PREPARATION (FOR TYPES 5 AND 6 PILES) 57
PIL1.W1260.9 INJECTION 57

CONCRETING 57
PIL1.W1310.9 GENERAL 57
PIL1.W1320.9 TYPE 3 PILES 57
PIL1.W1330.9 CONTINUITY FOR TYPES 1C, 3 AND 5 PILES 57
PIL1.W1340.9 REINFORCEMENT TO PILE TYPES 1 AND 2 57
PIL1.W1350.9 REINFORCEMENT TO TYPE 5 PILES 57
FINISHING OFF PILE HEADS 57
PIL1.W1410.9 CAST INSITU PILES 57
PIL1.W1420.9 CUT OFF LEVELS 58
PIL1.W1430.9 CUTTING AND TRIMMING 58
PIL1.W1440.9 PRELIMINARY AND ABANDONED PILES 58
PIL1.W1450.9 DOWEL BARS 58
PIL1.W1460.9 CUTTING OFF STEEL PILES 58
PIL1.W1470.9 BEARING PLATES FOR STEEL PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 58
PIL1.W1475.9 BEARING PLATES FOR STEEL PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 58
PIL1.W1480.9 ALTERNATIVE LOAD TRANSFER DETAILS FOR STEEL PILES 58
PIL1.W1490.9 WORK AT COMPLETION (WHERE CONSTRUCTION OF PILE CAP DOES NOT FORM PART OF THE CONTRACT) 58
PILING RECORDS 59
PIL1.W1510.9 GENERAL 59
PIL1.W1520.9 STANDARD FORM 59
PIL1.W1525.9 PILING RECORDS FOR TYPE 7 PILES 59
PIL1.W1530.9 RECORDS OF TEMPORARY COMPRESSION FOR DRIVEN PILE 60
PIL1.W1540.9 SUBMISSION OF RECORD PLAN 60
PIL1.W1550.9 FOUNDING LEVEL RECORD 60
PIL1.W1560.9 BORING RECORDS FOR TYPES 6 AND 7 PILES 60
REMEDIAL MEASURES 60
PIL1.W1610.9 PILES DESIGNED TO REST ON BEDROCK FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 60
PIL1.W1620.9 RISING PILES (FOR DRIVEN PILE) 60
PIL1.W1630.9 DEFECTIVE PILES 61
PIL1.W1640.9 NON-COMPLIANCE (FOR TYPE 7 PILES) 61
SPLICING PILES 61
PIL1.W1710.9 GENERAL 61
PIL1.W1720.9 STRENGTH OF SPLICES 61
WELDING 61
PIL1.W1810.9 TESTING OF WELDERS 61
PIL1.W1820.9 ADVERSE WEATHER CONDITIONS 61
PIL1.W1830.9 WELDED JOINTS 61
PIL1.W1840.9 TACK WELDS 61
PIL1.W1850.9 STANDARDS 61
PIL1.W1860.9 PREPARATION 62
PIL1.W1870.9 PILE SHOES 62
PIL1.W1880.9 FINISHING 62
PIL1.W1890.9 DEFECTS 62
PIL1.W1900.9 ETCHED SECTIONS 62

RECORDS AND CERTIFICATES 62
PIL1.W2010.9 REPORT ON COMPLETION OF PILING WORKS FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 62
PIL1.W2020.9 REPORT ON COMPLETION OF PILING WORKS FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 63
PIL1.W2030.9 CERTIFICATION FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 64
PIL1.W2040.9 CERTIFICATION FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 64
PILE CAPS AND FOOTINGS 64
PIL1.W2110.9 GENERAL 64
PIL1.W2120.9 APPROVED DESIGN FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 64
PIL1.W2130.9 STARTER BARS FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 65
PIL1.W2135.9 STARTER BARS FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 65
PIL1.W2140.9 BACKFILLING EXCAVATIONS 65
PIL1.W2150.A ALTERNATIVE PROPOSAL FOR CONCRETE COMPRESSIVE STRENGTH TEST 65
PIL1.W2160.9 FOUNDING AND PROVING BEDROCK FOR FOOTINGS 66
MECHANICAL COUPLER FOR TYPE 5 PILES 66
PIL1.W2210.9 QUALIFIED SUPERVISION 66
PIL1.W2220.9 INSPECTION LOG BOOK 66
TESTING 67
TESTING GENERALLY 67
PIL1.T010.9 NUMBER AND DISPOSITION OF TEST PILES 67
PIL1.T020.9 REQUIRED MINIMUM NUMBER OF TESTS 67
PIL1.T030.A PROOF TEST 67
PIL1.T040.9 BATCH OF MECHANICAL COUPLER FOR TYPE 5 PILES 68
PRELIMINARY DRIVEN PILES 68
PIL1.T110.9 PRELIMINARY PILES - TYPES 1, 2 AND 4 FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 68
PIL1.T120.9 PRELIMINARY PILES - TYPES 1, 2 AND 4 FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 69
PIL1.T130.9 INSTRUMENTATION 69
PIL1.T140.9 FAILURE OF PRELIMINARY PILES 70
SAMPLING AND TESTING FOUNDING LEVELS TO PILE TYPES 3, 4, 5, 6 AND 7 70
PIL1.T210.9 PROVING BEDROCK BEFORE INSTALLATION OF TYPE 3 PILES 70
PIL1.T220.9 PROVING BEDROCK BEFORE REACHING FOUNDING LEVEL FOR TYPE 3 PILES 70
PIL1.T230.9 PROVING BEDROCK BEFORE INSTALLATION OF TYPES 5 AND 6 PILES AND OF TYPE 4 PILE DRIVEN TO BEDROCK 71
PIL1.T240.9 PROVING BEDROCK DURING INSTALLATION OF TYPES 5 AND 6 PILES AND OF TYPE 4 PILE DRIVEN TO BEDROCK 71
PIL1.T250.9 PROVING BEDROCK AFTER INSTALLATION OF TYPES 5 AND 6 PILES AND OF TYPE 4 PILE DRIVEN TO BEDROCK 72
PIL1.T260.9 FOUNDING LEVEL FOR TYPE 7 PILES 72

TESTING GROUT FOR TYPES 3, 5, 6 AND 7 PILES 72
PIL1.T310.9 DEFINITION OF 'BATCH' 72
PIL1.T320.9 TEST FOR BLEEDING AND FREE EXPANSION 72
PIL1.T330.9 FLOW CONE EFFLUX TEST 73
PIL1.T340.A TEST FOR CRUSHING STRENGTH 73
VISUAL INSPECTION 74
PIL1.T410.9 REQUIREMENT 74
PIL1.T420.9 METHOD 74
PIL1.T430.9 CRITERIA FOR FAILURE 74
DESTRUCTIVE TESTS ON SAMPLES OF TYPES 4 AND 6 PILES 74
PIL1.T510.9 GENERAL 74
PIL1.T520.9 SAMPLES 74
PIL1.T530.9 NON-COMPLIANCE 74
PIL1.T540.9 PREMATURE INSTALLATION 75
LOADING TESTS GENERALLY 75
PIL1.T610.9 REQUIREMENT FOR TESTING 75
LOADING TESTS OF PRELIMINARY PILES 76
PIL1.T710.9 TESTING EQUIPMENT 76
PIL1.T720.9 CALIBRATION OF HYDRAULIC EQUIPMENT 76
PIL1.T730.9 MEASUREMENT OF TEST LOADS 76
PIL1.T740.9 TEMPERATURE VARIATIONS 76
PROCEDURE FOR LOAD TESTS OF PRELIMINARY PILES 76
PIL1.T810.9 ANCHORAGES 76
PIL1.T820.9 PILE CAP TO TEST PILE 76
PIL1.T830.9 LOADING OF A PRELIMINARY PILE 76
PIL1.T840.9 SEQUENCE 77
PIL1.T850.9 RECORDING AND CHECKING DATA 77
PIL1.T860.9 CONTRACTOR'S REPRESENTATIVE 77
PIL1.T870.9 COMPLETION 77
PIL1.T880.9 RECORDS AND SUBMISSION OF REPORT TO THE CM 78
LOAD TEST RESULTS OF PRELIMINARY PILES 78
PIL1.T910.9 FAILURE LOAD 78
PIL1.T920.9 RESIDUAL SETTLEMENT 78
LOADING TESTS OF WORKING PILES 78
PIL1.T1010.9 GENERAL 78
PIL1.T1020.9 LOADING OF A WORKING PILE 78
PIL1.T1030.9 LOADING TYPES 5, 6 AND 7 PILES 79
PIL1.T1040.9 SEQUENCE 79
LOAD TEST RESULTS OF WORKING PILES 79
PIL1.T1110.9 FAILURE LOAD AND RESIDUAL SETTLEMENT 79
REMEDIAL WORKS TO RECTIFY FAILED PILES 80
PIL1.T1120.9 FAILED PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 80
PIL1.T1130.9 FAILED PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 80
CONCRETE CORE TESTING (FULL-LENGTH CONCRETE CORE) FOR TYPE 1C AND TYPE 3 PILES 80
PIL1.T1210.A GENERAL 80
PIL1.T1220.A CORE DIMENSIONS AND SAMPLE SIZE 81
PIL1.T1230.9 REINSTATEMENT OF CORE HOLES 81
PIL1.T1240.A CRITERIA FOR FAILURE OR NON-COMPLIANCE OF PILE IN CONCRETE CORE TESTING 81

PIL1.T1250.9 REQUIREMENT FOR FURTHER TESTS 82

DESTRUCTIVE TESTING OF SAMPLES OF PRECAST CONCRETE PILES 82

PIL1.T1310.9 GENERAL 82
PIL1.T1320.9 SAMPLE SIZE 82
PIL1.T1330.9 CORING 83
PIL1.T1340.9 TEST FAILURE 83
PIL1.T1350.9 PREMATURE DRIVING 83

FURTHER INSPECTION AND TESTING 83

PIL1.T1410.9 REQUIREMENT 83
PIL1.T1420.9 SAMPLE EVALUATIONS 83

NON-DESTRUCTIVE TESTS ON WELDS 83

PIL1.T1510.9 GENERAL 83
PIL1.T1520.9 TYPES OF TEST AND SAMPLE SIZE 84

NON-DESTRUCTIVE TESTS ON PILES 84

PIL1.T1610.9 GENERAL 84
PIL1.T1620.9 RELATIONSHIP TO LOAD TESTING OR CORE TESTING 86
PIL1.T1630.9 TEST REPORT 86
PIL1.T1640.9 TESTING OF PILES DRIVEN BY HYDRAULIC HAMMERS FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 86
PIL1.T1645.9 TESTING OF PILES DRIVEN BY HYDRAULIC HAMMERS FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT 87
PIL1.T1650.9 CHECKING OF SIZE OF PILE SHAFT AND BELL-OUT OF TYPE 3 PILE 88

CONFIRMATORY CORE TESTING OF FOUNDING STRATA OF TYPE 3 PILES 89

PIL1.T1710.9 REQUIREMENT FOR CONFIRMATORY CORE TESTING 89
PIL1.T1720.9 EQUIPMENT AND METHOD 90
PIL1.T1730.9 TREATMENT OF SPECIMENS 90
PIL1.T1740.9 REINSTATEMENT OF CORE HOLES 90
PIL1.T1750.9 CRITERIA FOR FAILURE OR NON-CONFORMITY OF PILE IN CONFIRMATORY CORE TESTING 90

MECHANICAL COUPLER FOR TYPE 5 PILES 90

PIL1.T1810.9 RATE OF SAMPLING 90
PIL1.T1820.9 METHOD OF TESTING 90
PIL1.T1830.9 COMPLIANCE CRITERIA 90
PIL1.T1840.9 TIME REQUIRED FOR TESTING 90

APPENDICES 91

PIL1.APPEND2.9 CALCULATION OF NUMBER OF FURTHER INSPECTIONS/TESTS 91
PIL1.APPEND3.9 PILE DRIVING RECORD (PRECAST CONCRETE, PREFABRICATED STEEL AND DRIVEN CAST-IN-PLACE PILES) 92
PIL1.APPEND4.9 PILE DRIVING RECORD (BORED CAST-IN-PLACE PILES) 94
PIL1.APPEND5.9 PILE LOAD TEST RECORD 96

PIL1 PILING AND FOOTING

GENERAL

DEFINITIONS

PIL1.G010.9 DEFINITIONS

In this Worksection, the following definitions are used:

1. "Piling Contract" shall mean a foundation contract for which the scope of works includes construction of foundation and does not include the construction of superstructure;
2. "Combined Piling and Building Contract" shall mean a contract for which the scope of works includes the construction of both the foundation and the superstructure;
3. "Contractor's Design Piling Contract / Combined Piling and Building Contract" shall mean a Piling Contract / Combined Piling and Building Contract for which the scope of works includes design of piles and/or pile caps and/or footings;
4. "Engineer's Design Piling Contract / Combined Piling and Building Contract" shall mean a Piling Contract / Combined Piling and Building Contract for which the scope of works does not include design of piles and/or pile caps and/or footings and the design of such works is provided by the CM.

PIL1.G020.9 CODE OF PRACTICE FOR FOUNDATIONS 2017

In this Specification, the Code of Practice for Foundations shall mean the Code of Practice for Foundations 2017 issued in April 2017 by the Buildings Department of the Hong Kong Special Administrative Region, and its subsequent amendment(s).

DESIGN RESPONSIBILITY

PIL1.G110.9 DESIGN RESPONSIBILITY

The design responsibility for piles, pile caps and footings is to be specified in the Project Specific Specification.

STANDARDS

PIL1.G210.9 PILING

Comply with the Code of Practice for Foundations and the relevant Building Regulations of Hong Kong.

PIL1.G220.9 PILE CAPS AND FOOTINGS

Comply with the 'Concrete Works' Worksection of this Specification in respect of all materials and workmanship for footings, reinforced concrete pile caps and for structural concrete above piles, unless otherwise specified.

PIL1.G230.9 STATUS OF THE SPECIFICATION

Where this Specification includes provisions additional to, or more stringent than those of the aforementioned British Standards, Code of Practice for Foundations or Building Regulations, the provisions of this Specification shall prevail overall.

PIL1.G240.9 OTHER WORKSECTIONS

Comply with the relevant provisions of other Worksections of this Specification and in particular with the following:

1.	EAR1	Excavation and Filling;
2.	CON1	Insitu Concrete;
3.	CON2 or FOR	Formwork;
4.	CON3	Reinforcement;
5.	STR1	Structural Steel.
6.	CON9	Off-site Reinforcement Prefabrication Yard

PIL1.G250.9 CONTRACTOR'S DESIGN FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

In the event of any conflict, contradiction or ambiguity between the Contractor's design and this Specification, the provisions of this Specification shall prevail.

PILE TYPES

PIL1.G310.9 GENERAL

1. This Specification applies to pile types 1 to 7 as defined in clauses PIL1.G320 to PIL1.G375 below;
2. Where relevant, this Specification applies equally to any other type of pile.

PIL1.G320.9 TYPE 1 PILES

1. Type 1a piles shall mean precast reinforced concrete piles complying with the requirements stated in clause 5.4.3 of the Code of Practice for Foundations;
2. Type 1b piles shall mean precast prestressed spun concrete piles complying with the requirements stated in clause 5.4.4 of the Code of Practice for Foundations;
3. Type 1c piles shall mean driven cast-in-place concrete piles complying with the requirements stated in clause 5.4.5 of the Code of Practice for Foundations.

PIL1.G330.9 TYPE 2 PILES

Driven steel tube with detachable toe and precast concrete pile insert (steel tube to be withdrawn).

PIL1.G340.9 TYPE 3 PILES

Large diameter bored cast insitu concrete piles:

1. Cast with inserted precast concrete annuli; or
2. Cast with left-in-place lining; or
3. Cast with temporary steel casing.

PIL1.G350.9 TYPE 4 PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Driven steel H-piles of sizes, masses, grades and material properties to the standards as specified in the Drawings.

PIL1.G355.9 TYPE 4 PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Driven steel piles of types and brands recognized by BD. Submit the recognition documentation of the proposed piles issued by BD with the tender.

PIL1.G360.9 TYPE 5 PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Minipiles, being defined as piles consist of a number of steel reinforcing bars encased by grout inside drill hole and comply with the requirements stated in clause 5.4.8 of the Code of Practice for Foundations, derive the structural capacity solely from the steel reinforcing bars.

PIL1.G365.9 TYPE 5 PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Minipiles, being defined as piles consist of a number of steel reinforcing bars encased by grout inside drill hole and comply with the requirements stated in clause 5.4.8 of the Code of Practice for Foundations, derive the structural capacity solely from the steel reinforcing bars.

PIL1.G370.9 TYPE 6 PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Socketed steel H-piles, being defined as piles installed by inserting steel H-piles, which their sizes, masses, grades and material properties are to the standards as specified in the Drawings, in pre-bored holes sunk into bedrock as defined in PIL1.G450 and subsequently grouting the pre-bored hole.

PIL1.G372.9 TYPE 6 PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Socketed steel H-piles, being defined as piles installed by inserting steel H-piles of types and brands recognized by BD in pre-bored holes sunk into bedrock as defined in PIL1.G450 and subsequently grouting the pre-bored hole. Submit the recognition documentation of the proposed piles issued by BD with the tender.

PIL1.G375.9 TYPE 7 PILES

Pakt-In-Place (PIP), Continuous Flight Auger Pile (CFA) as stated in clause 5.4.6(2) of the Code of Practice for Foundations or piles formed by similar techniques, being defined as non-percussive cast in-situ concrete piles with diameters not exceeding 610 mm and formed by boring with a continuous flight auger without temporary steel casing. The bored hole is filled with grout placed by pumping through the hollow orifice of the auger pipe at the pile base while withdrawing the auger from the hole.

PIL1.G380.9 ALTERNATIVE TYPES OF PILE - FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Where the Contractor proposes a type of pile other than the types specified in clauses PIL1.G320 to PIL1.G375, he must submit, with his tender, the testing regime and the acceptance standard of the quality of the piles for Approval.

SITE INVESTIGATION

PIL1.G410.9 PRELIMINARY INVESTIGATIONS

1. Tenderers may make preliminary investigations or sink test piles as they require and at their own cost. Arrangements for access to the Site can be made, on application to the CM, at least seven days in advance;
2. The period for carrying out site investigation by tenderers is specified in the Project Specific Specification.

PIL1.G420.9 EXISTING BOREHOLE INFORMATION

Certain logs of exploratory boreholes made on Site and reports of laboratory soil test results are available for inspection by appointment at the CM's office during normal working hours. Copies of the drillhole logs and reports may also be made available to tenderers who have previously applied to the CM in writing and subject to payment of a charge for photocopying. Such information as is contained in the drillhole logs and reports is given in good faith and without prejudice to the Contractor's liabilities under the Contract.

PIL1.G430.9 CONTRACTOR'S RESPONSIBILITY

The onus is on the Contractor to satisfy himself as to the nature of the Site sub-soil conditions and to make any site investigation to obtain all information which may affect the Works.

PIL1.G440.9 ADDITIONAL INVESTIGATIONS

1. The Contractor may make such other site investigations during the Contract as he deems necessary and at his own expense;
2. The CM may order such other site investigation during the Contract as he deems necessary.

PIL1.G450.9 DEFINITION OF "BEDROCK"

1. In this Specification, "bedrock" is defined as:
   a. Rock mass of at least 5 m thick measured downwards from the pile base for Types 1, 2, 3 and 4 piles;
   b. Rock mass of at least 5 m thick or of thickness not less than the designed length of the rock socket, whichever is the greater, measured downwards from the rockhead of the specified category of rock for Type 5 and 6 piles.
2. The 'rock mass' used in sub-clause (1) shall refer to the following category of rock:
   a. For Types 1, 2, 3 and 4 piles: Rock not inferior to category 1(d) or 2 rock as described in Table 2.1 of the Code of Practice for Foundations;
   b. For Types 5 and 6 piles: Category 1(a), 1(b) or 1(c) rock as described in Table 2.1 of the Code of Practice for Foundations.
3. The Uniaxial Compressive Strength (UCS) and point load index strength stated in Table 2.1 of the Code of Practice for Foundations shall be determined by the following tests:
   a. Uniaxial Compressive Strength (UCS): ASTM Designation: D2938 - 95 Standard Test Method for Unconfined Compression Strength of Intact Rock Core Specimens;
   b. Point Load Tests: ISRM "Suggested Method for Determining Point Load Strength" 1985 Edition.
4. Refer to EAR1.W940 sub-clause (2) for definition of "bedrock" for footings;
5. In this Specification, the definition of "total core recovery of the designated grade" shall follow Notes (4) and (5) of Table 2.1 of the Code of Practice for Foundations.

PIL1.G460.9 WORKS REQUIRED TO BE CARRIED OUT BY A RSC(GIFW) UNDER THE CONTRACT

1. All works required to be carried out by a RSC (GIFW) under the CoPSS, including the sampling and testing founding levels to pile Types 3 to 7 inclusive as described in PIL1.T210 to PIL1.T240 inclusive and PIL1.T260 and confirmatory core testing of founding strata of Type 3 piles as described in PIL1.T1710 to PIL1.T1750 inclusive, shall be considered as ground investigation works under the contract;
2. Comply with the requirements of clause PRE.B9.250 for all works stated in sub-clause (1) of this clause.

PIL1.G470.9 BACKFILLING OF DRILLHOLES

1. Unless otherwise instructed by the CM or unless the method or materials of backfilling of drillholes is specifically stated in other parts of the Specification, fill all drillholes with granular material (or with 4:1 cement bentonite grout where Instructed) and compact to the original density of the ground or a higher density;
2. Fill in and compact any subsequent depression of the ground;
3. Do not fill drillholes without the CM's permission.

APPROVED CONTRACTORS AND SUBCONTRACTORS

PIL1.G510.9 APPROVED CONTRACTORS FOR PILING WORKS - FOR ENGINEER'S DESIGN PILING CONTRACT

1.
   a. Contractor must be on the following Category of Housing Authority List of Piling Contractors:
      i. Type 1, 2, & 4 Piles - Percussive Piles Category;
      ii. Type 3 Pile - Large Diameter Bored Piles Category;
      iii. Any acceptable pile types other than Type 1, 2, 3 & 4 Piles - Large Diameter Bored Piles Category or Percussive Piles Category.
   b. In the event that more than one type of piles are used in the Contract, the Contractor must be on the appropriate Categories of Housing Authority List of Piling Contractors for all the pile types used.
2. In the event that the Contractor employ a Piling Sub-contractor to carry out the following piling activities, select the Piling Sub-contractor from the list given in sub-clause (3) below:
   a. Pile driving of Type 1, 2, & 4 Piles;
   b. Excavation and concreting of Type 3 Pile;
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles.
3. The Piling Sub-contractor must be on the following list:
   a. Appropriate Category of Housing Authority List of Piling Contractors; or
   b. Buildings Department List of Registered Specialist Contractors (Foundation) who has undertaken in the past five years at least three contracts in relevant piling works under ICU’s procedures or BD’s control and of contract value not less than $20M in one of the contracts and in aggregates total of not less than $40M.
4. Piling Sub-contractor for pile types other than Type 3 not on the lists in sub-clause (3) above may be considered and subject to CM's approval.

PIL1.G512.9 APPROVED CONTRACTORS FOR PILING WORKS - FOR CONTRACTOR'S DESIGN PILING CONTRACT

1.
   a. Contractor must be on the following Category of Housing Authority List of Piling Contractors:
      i. Type 1, 2, & 4 Piles - Percussive Piles Category;
      ii. Type 3 Pile - Large Diameter Bored Piles Category;
      iii. Any acceptable pile types other than Type 1, 2, 3 & 4 Piles - Large Diameter Bored Piles Category or Percussive Piles Category.

b. In the event that more than one type of piles are used in the Contract, the Contractor must be on the appropriate Categories of Housing Authority List of Piling Contractors for all the pile types used.

2. In the event that the Contractor employ a Piling Sub-contractor to carry out the following piling activities, select the Piling Sub-contractor from the list given in sub-clause (3) below:
   a. Pile driving of Type 1, 2, & 4 Piles;
   b. Excavation and concreting of Type 3 Pile;
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles;
   d. Foundation design.
3. The Piling Sub-contractor must be on the following list:
   a. Appropriate Category of Housing Authority List of Piling Contractors; or
   b. Buildings Department List of Registered Specialist Contractors (Foundation) who has undertaken in the past five years at least three contracts in relevant piling works under ICU's procedures or BD's control and of contract value not less than $20M in one of the contracts and in aggregates total of not less than $40M.
4. Piling Sub-contractor for pile types other than Type 3 not on the lists in sub-clause (3) above may be considered and subject to CM's approval.

PIL1.G515.9 APPROVED CONTRACTORS FOR PILING WORKS - FOR ENGINEER'S DESIGN COMBINED PILING AND BUILDING CONTRACT

1. The Contractor must employ a Piling Sub-contractor to carry out the following piling activities unless the Contractor is on the relevant Category of the Housing Authority List of Piling Contractors and takes up the role of Piling Sub-contractor in carrying out the respective piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles;
   b. Excavation and concreting of Type 3 Pile;
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles.
2. Requirements on Piling Sub-contractor:
   a. The Piling Sub-contractor must be on the following Category of the Housing Authority List of Piling Contractors:
      i. Type 1, 2, & 4 Piles - Percussive Piles Category;
      ii. Type 3 Pile - Large Diameter Bored Piles Category;
      iii. Any acceptable pile types other than Type 1, 2, 3 & 4 Piles - Large Diameter Bored Piles Category or Percussive Piles Category.
   b. In the event that more than one type of piles are used in the Contract, the Piling Sub-contractor must be on the appropriate Categories of Housing Authority List of Piling Contractors for all the pile types used.
3. In the event that the Piling Sub-contractor employ a Piling Sub-sub-contractor to carry out the piling activities stated in sub-clauses (1)(a) to (1)(c) above, the Piling Sub-sub-contractor must be on the following list:
   a. Appropriate Category of Housing Authority List of Piling Contractors; or
   b. Buildings Department List of Registered Specialist Contractors (Foundation) who has undertaken in the past five years at least three contracts in relevant piling works under ICU's procedures or BD's control and of contract value not less than $20M in one of the contracts and in aggregates total of not less than $40M.
4. Piling Sub-sub-contractor for pile types other than Type 3 not on the lists in sub-clause (3) above may be considered and subject to CM's approval.

PIL1.G517.9 APPROVED CONTRACTORS FOR PILING WORKS - FOR CONTRACTOR'S DESIGN COMBINED PILING AND BUILDING CONTRACT

1. The Contractor must employ a Piling Sub-contractor to carry out the following piling activities unless the Contractor is on the relevant Category of the Housing Authority List of Piling Contractors and takes up the role of Piling Sub-contractor in carrying out the respective piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles;
   b. Excavation and concreting of Type 3 Pile;
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles;
   d. Foundation design.
2. Requirements on Piling Sub-contractor:
   a. The Piling Sub-contractor must be on the following Category of the Housing Authority List of Piling Contractors:
      i. Type 1, 2, & 4 Piles - Percussive Piles Category;
      ii. Type 3 Pile - Large Diameter Bored Piles Category;
      iii. Any acceptable pile types other than Type 1, 2, 3 & 4 Piles - Large Diameter Bored Piles Category or Percussive Piles Category.
   b. In the event that more than one type of piles are used in the Contract, the Piling Sub-contractor must be on the appropriate Categories of Housing Authority List of Piling Contractors for all the pile types used.
3. In the event that the Piling Sub-contractor employ a Piling Sub-sub-contractor to carry out the piling activities stated in sub-clauses (1)(a) to (1)(d) above, the Piling Sub-sub-contractor must be on the following list:
   a. Appropriate Category of Housing Authority List of Piling Contractors; or
   b. Buildings Department List of Registered Specialist Contractors (Foundation) who has undertaken in the past five years at least three contracts in relevant piling works under ICU’s procedures or BD’s control and of contract value not less than $20M in one of the contracts and in aggregates total of not less than $40M.
4. Piling Sub-sub-contractor for pile types other than Type 3 not on the lists in sub-clause (3) above may be considered and subject to CM's approval.

PIL1.G520.9 SUB-CONTRACTOR FOR CONSTRUCTION OF FOOTING - FOR BUILDING CONTRACT WITH FOOTING CONSTRUCTION

1. In the event that the Contractor employs sub-contractor to carry out construction of footings, the sub-contractor must be on the following list:
   a. Buildings Department List of Registered General Building Contractors; or
   b. Buildings Department List of Registered Specialist Contractors (Foundation).
2. In this specification, construction of footing shall mean construction of spread and/or raft footing and include fixing of starter bars, if any.

PIL1.G530.9 DEFINITION OF "PILING SUBCONTRACTOR" FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. In this specification, Piling Subcontractor shall mean the subcontractor employed by the Contractor for the following piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles; and/or
   b. Excavation and/or concreting of Type 3 Pile; and/or
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles.

2. Such contract between the Contractor and the Piling Subcontractor shall be termed the Piling Subcontract.

PIL1.G535.9 DEFINITION OF "PILING SUBCONTRACTOR" FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. In this specification, Piling Subcontractor shall mean the subcontractor employed by the Contractor for the following piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles; and/or
   b. Excavation and/or concreting of Type 3 Pile; and/or
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles; and/or
   d. Foundation design.
2. Such contract between the Contractor and the Piling Subcontractor shall be termed the Piling Subcontract.

PIL1.G540.9 DEFINITION OF "PILING SUB-SUBCONTRACTOR" FOR ENGINEER'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY

1. In this specification, Piling Sub-subcontractor shall mean the subcontractor employed by the Piling Subcontractor for the following piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles; and/or
   b. Excavation and/or concreting of Type 3 Pile; and/or
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles.
2. Such contract between the Piling Subcontractor and the Piling Sub-subcontractor shall be termed the Piling Sub-subcontract.

PIL1.G545.9 DEFINITION OF "PILING SUB-SUBCONTRACTOR" FOR CONTRACTOR'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY

1. In this specification, Piling Sub-subcontractor shall mean the subcontractor employed by the Piling Subcontractor for the following piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles; and/or
   b. Excavation and/or concreting of Type 3 Pile; and/or
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles; and/or
   d. Foundation design.
2. Such contract between the Piling Subcontractor and the Piling Sub-subcontractor shall be termed the Piling Sub-subcontract.

PIL1.G550.9 RESTRICTION ON PILING SUBCONTRACT

The number of Piling Subcontractor shall be limited to one per each type of piles unless otherwise approved by the CM.

PIL1.G560.9 RESTRICTION ON PILING SUB-SUBCONTRACT - FOR COMBINED PILING AND BUILDING CONTRACT ONLY

The number of Piling Sub-subcontractor shall be limited to one per each type of piles unless otherwise approved by the CM.

PIL1.G570.9 INFORMATION ON PILING SUBCONTRACT

Submit with the tender the following information:

1. Letter of intent from the proposed Piling Subcontractor whom the tenderer intends to employ for the Contract should the tenderer be awarded the Contract, indicating his willingness to carry out the proposed Piling Subcontract;
2. The names of the directors or sole proprietor and site representatives of the proposed Piling Subcontractor;
3. The piling activity and the scope of the proposed Piling Subcontract;
4. The minimum numbers of self owned piling plants and directly employed piling plant operators to be provided by the tenderer;
5. The minimum numbers of self owned piling plants and directly employed piling plant operators to be provided by the proposed Piling Subcontractor.

PIL1.G580.9 INFORMATION ON PILING SUB-SUBCONTRACT - FOR COMBINED PILING AND BUILDING CONTRACT ONLY

Submit with the tender the following information:

1. Letter of intent from the proposed Piling Sub-subcontractor whom the proposed Piling Subcontractor intends to employ for the subcontract should the proposed Piling Subcontractor be awarded the subcontract, indicating his willingness to carry out the proposed Piling Sub-subcontract;
2. The names of the directors or sole proprietor and site representatives of the proposed Piling Sub-subcontractor;
3. The piling activity and the scope of the proposed Piling Sub-subcontract;
4. The minimum numbers of self owned piling plants and directly employed piling plant operators to be provided by the proposed Piling Subcontractor;
5. The minimum numbers of self owned piling plants and directly employed piling plant operators to be provided by the proposed Piling Sub-subcontractor.

PIL1.G590.9 CONDITIONS ON PILING SUBCONTRACT - FOR ENGINEER'S DESIGN PILING CONTRACT ONLY

Incorporate the following conditions into the Piling Sub-contract:

1. The piling activity and the scope of the Piling Sub-contract;
2. The Piling Sub-contractor is not allowed to subcontract the following piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles; and / or
   b. Excavation and / or concreting of Type 3 Pile; and / or
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles.
3. For the types of plants listed below which are required to be used on Site for piling works, the Piling Sub-contractor shall deploy and use only his self-owned plants save when necessary, he may use Contractor's self-owned plants deployed in accordance with PIL1.W380:
   a. Crawler crane;
   b. Oscillator or rotator;
   c. Reverse circulation drill (RCD);
   d. Pile driving hammer;
   e. Pile driving rig.
4. The Piling Sub-contractor shall comply with the following in deploying self-owned plants listed in sub-clauses (3)(a) to (3)(e) above:
   a. Self-owned plants of the Piling Sub-contractor shall mean plants owned by the Piling Sub-contractor or by the Piling Sub-contractor's parent, sister or subsidiary company for the exclusive use of the Piling Sub-contractor;
   b. All the plants deployed to Site shall be in good working conditions;

c. Deploy at least one number of self-owned plant that are required to be used on Site;

d. Submit documents to prove his ownership of the plants and, if applicable, the relationship between the Piling Sub-contractor and the Piling Sub-contractor's parent, sister or subsidiary company;

e. Submit document to confirm no further subcontracting of his part of the works.

5. The Contractor shall supply piling materials, which form whole or part of permanent works, to the Piling Sub-contractor;

6. A probity clause shall be included in the Piling Sub-contract such that:

"If the Piling Sub-contractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Contractor, Hong Kong Housing Authority or Housing Department, the Contractor shall at liberty forthwith terminate the employment of the Piling Sub-contractor under the Piling Subcontract. The Contractor, Hong Kong Housing Authority or Housing Department shall hold the Piling Sub-contractor liable for any loss or damage which the Contractor, Hong Kong Housing Authority or Housing Department may thereby sustain."

PIL1.G595.9 CONDITIONS ON PILING SUBCONTRACT - FOR CONTRACTOR'S DESIGN PILING CONTRACT ONLY

Incorporate the following conditions into the Piling Sub-contract:

1. The piling activity and the scope of the Piling Sub-contract;

2. The Piling Sub-contractor is not allowed to subcontract the following piling activities:

a. Pile driving of Type 1, 2, & 4 Piles; and / or

b. Excavation and / or concreting of Type 3 Pile; and / or

c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles; and / or

d. Foundation design.

3. For the types of plants listed below which are required to be used on Site for piling works, the Piling Sub-contractor shall deploy and use only his self-owned plants save when necessary, he may use Contractor's self-owned plants deployed in accordance with PIL1.W380:

a. Crawler crane;

b. Oscillator or rotator;

c. Reverse circulation drill (RCD);

d. Pile driving hammer;

e. Pile driving rig.

4. The Piling Sub-contractor shall comply with the following in deploying self-owned plants listed in sub-clauses (3)(a) to (3)(e) above:

a. Self-owned plants of the Piling Sub-contractor shall mean plants owned by the Piling Sub-contractor or by the Piling Sub-contractor's parent, sister or subsidiary company for the exclusive use of the Piling Sub-contractor;

b. All the plants deployed to Site shall be in good working conditions;

c. Deploy at least one number of self-owned plant that are required to be used on Site;

d. Submit documents to prove his ownership of the plants and, if applicable, the relationship between the Piling Sub-contractor and the Piling Sub-contractor's parent, sister or subsidiary company;

e. Submit document to confirm no further subcontracting of his part of the works.

5. The Contractor shall supply piling materials, which form whole or part of permanent works, to the Piling Sub-contractor;
6. A probity clause shall be included in the Piling Sub-contract such that:

   "If the Piling Sub-contractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Contractor, Hong Kong Housing Authority or Housing Department, the Contractor shall at liberty forthwith terminate the employment of the Piling Sub-contractor under the Piling Subcontract. The Contractor, Hong Kong Housing Authority or Housing Department shall hold the Piling Sub-contractor liable for any loss or damage which the Contractor, Hong Kong Housing Authority or Housing Department may thereby sustain."

PIL1.G600.9 CONDITIONS ON PILING SUBCONTRACT - FOR ENGINEER'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY

Incorporate the following conditions into the Piling Sub-contract:

1. The piling activity and the scope of the Piling Sub-contract;
2. The Piling Sub-contractor is not allowed to subcontract the following piling activities to more than one Piling Sub-subcontractor:
   a. Pile driving of Type 1, 2, & 4 Piles; and / or
   b. Excavation and / or concreting of Type 3 Pile; and / or
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles.
3. For the types of plants listed below which are required to be used on Site for piling works, the Piling Sub-contractor shall deploy at least one number of self-owned plant for each type of the plants, unless otherwise allowed by the CM:
   a. Crawler crane;
   b. Oscillator or rotator;
   c. Reverse circulation drill (RCD);
   d. Pile driving hammer;
   e. Pile driving rig.
4. The Piling Sub-contractor shall comply with the following in deploying self-owned plants listed in sub-clauses (3)(a) to (3)(e) above:
   a. Self-owned plants of the Piling Sub-contractor shall mean plants owned by the Piling Sub-contractor or by the Piling Sub-contractor's parent, sister or subsidiary company for the exclusive use of the Piling Sub-contractor;
   b. All the plants deployed to Site shall be in good working conditions;
   c. Submit documents to prove the plant ownership and, if applicable, the relationship between the Piling Sub-contractor and the Piling Sub-contractor's parent, sister or subsidiary company;
   d. For piling works undertaken by Piling Sub-subcontractor, deployment of self-owned plants of the Piling Sub-subcontractor to Site shall comply with the requirements stated in PIL1.G610;
   e. The self-owned plants deployed to Site according to sub-clauses (3)(a) to (3)(e) may be used by the Piling Sub-subcontractor when necessary.
5. A probity clause shall be included in the Piling Subcontract such that:

"If the Piling Sub-contractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Contractor, Hong Kong Housing Authority or Housing Department, the Contractor shall at liberty forthwith terminate the employment of the Piling Sub-contractor under the Piling Subcontract. The Contractor, Hong Kong Housing Authority or Housing Department shall hold the Piling Sub-contractor liable for any loss or damage which the Contractor, Hong Kong Housing Authority or Housing Department may thereby sustain."

PIL1.G605.9 CONDITIONS ON PILING SUBCONTRACT - FOR CONTRACTOR'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY

Incorporate the following conditions into the Piling Sub-contract:

1. The piling activity and the scope of the Piling Sub-contract;
2. The Piling Sub-contractor is not allowed to subcontract the following piling activities to more than one Piling Sub-subcontractor:
   a. Pile driving of Type 1, 2, & 4 Piles; and / or
   b. Excavation and / or concreting of Type 3 Pile; and / or
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles; and / or
   d. Foundation design.
3. For the types of plants listed below which are required to be used on Site for piling works, the Piling Sub-contractor shall deploy at least one number of self-owned plant for each type of the plants, unless otherwise allowed by the CM:
   a. Crawler crane;
   b. Oscillator or rotator;
   c. Reverse circulation drill (RCD);
   d. Pile driving hammer;
   e. Pile driving rig.
4. The Piling Sub-contractor shall comply with the following in deploying self-owned plants listed in sub-clauses (3)(a) to (3)(e) above:
   a. Self-owned plants of the Piling Sub-contractor shall mean plants owned by the Piling Sub-contractor or by the Piling Sub-contractor's parent, sister or subsidiary company for the exclusive use of the Piling Sub-contractor;
   b. All the plants deployed to Site shall be in good working conditions;
   c. Submit documents to prove the plant ownership and, if applicable, the relationship between the Piling Sub-contractor and the Piling Sub-contractor's parent, sister or subsidiary company;
   d. For piling works undertaken by Piling Sub-subcontractor, deployment of self-owned plants of the Piling Sub-subcontractor to Site shall comply with the requirements stated in PIL1.G610;
   e. The self-owned plants deployed to Site according to sub-clauses (3)(a) to (3)(e) may be used by the Piling Sub-subcontractor when necessary.
5. A probity clause shall be included in the Piling Subcontract such that:

   "If the Piling Sub-contractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Contractor, Hong Kong Housing Authority or Housing Department, the Contractor shall at liberty forthwith terminate the employment of the Piling Sub-contractor under the Piling Subcontract. The Contractor, Hong Kong Housing Authority or Housing Department shall hold the Piling Sub-contractor liable for any loss or damage which the Contractor, Hong Kong Housing Authority or Housing Department may thereby sustain."

PIL1.G610.9 CONDITIONS ON PILING SUB-SUBCONTRACT - FOR ENGINEER'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY

Incorporate the following conditions into the Piling Sub-subcontract:

1. The piling activity and the scope of the Piling Sub-subcontract;
2. The Piling Sub-subcontractor is not allowed to subcontract the following piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles; and / or
   b. Excavation and / or concreting of Type 3 Pile; and / or
   c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles.
3. For the types of plants listed below which are required to be used on Site for piling works, the Piling Sub-subcontractor shall deploy and use only his self-owned plants save when necessary, he may use the Piling Sub-contractor's self-owned plants deployed in accordance with PIL1.G600:
   a. Crawler crane;
   b. Oscillator or rotator;
   c. Reverse circulation drill (RCD);
   d. Pile driving hammer;
   e. Pile driving rig.
4. The Piling Sub-subcontractor shall comply with the following in deploying self-owned plants listed in sub-clauses (3)(a) to (3)(e) above:
   a. Self-owned plants of the Piling Sub-subcontractor shall mean plants owned by the Piling Sub-subcontractor or by the Piling Sub-subcontractor's parent, sister or subsidiary company for the exclusive use of the Piling Sub-subcontractor;
   b. All the plants deployed to Site shall be in good working conditions;
   c. Deploy at least one number of self-owned plant that are required to be used on Site;
   d. Submit documents to prove his ownership of the plants and, if applicable, the relationship between the Piling Sub-subcontractor and the Piling Sub-subcontractor's parent, sister or subsidiary company;
   e. Submit document to confirm no further subcontracting of his part of the works.
5. The Piling Sub-contractor shall supply piling materials, which form whole or part of permanent works, to the Piling Sub-subcontractor;
6. A probity clause shall be included in the Piling Sub-subcontract such that:

   "If the Piling Sub-subcontractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Piling Sub-contractor, the Contractor, Hong Kong Housing Authority or Housing Department, the Piling Sub-contractor shall at liberty forthwith terminate the employment of the Piling Sub-subcontractor under the Piling Sub-subcontract. The Piling Sub-contractor, the Contractor, Hong Kong Housing Authority or Housing Department shall hold the Piling Sub-subcontractor liable for any loss or damage which the Piling Sub-contractor, the Contractor, Hong Kong Housing Authority or Housing Department may thereby sustain."

PIL1.G615.9 CONDITIONS ON PILING SUB-SUBCONTRACT - FOR CONTRACTOR'S DESIGN COMBINED PILING AND BUILDING CONTRACT ONLY

Incorporate the following conditions into the Piling Sub-subcontract:

1. The piling activity and the scope of the Piling Sub-subcontract;
2. The Piling Sub-subcontractor is not allowed to subcontract the following piling activities:
   a. Pile driving of Type 1, 2, & 4 Piles; and / or

b. Excavation and / or concreting of Type 3 Pile; and / or

c. Construction of any acceptable pile types other than Type 1, 2, 3 & 4 Piles; and / or

d. Foundation design.

3. For the types of plants listed below which are required to be used on Site for piling works, the Piling Sub-subcontractor shall deploy and use only his self-owned plants save when necessary, he may use the Piling Sub-contractor's self-owned plants deployed in accordance with PIL1.G600:

   a. Crawler crane;

   b. Oscillator or rotator;

   c. Reverse circulation drill (RCD);

   d. Pile driving hammer;

   e. Pile driving rig.

4. The Piling Sub-subcontractor shall comply with the following in deploying self-owned plants listed in sub-clauses (3)(a) to (3)(e) above:

   a. Self-owned plants of the Piling Sub-subcontractor shall mean plants owned by the Piling Sub-subcontractor or by the Piling Sub-subcontractor's parent, sister or subsidiary company for the exclusive use of the Piling Sub-subcontractor;

   b. All the plants deployed to Site shall be in good working conditions;

   c. Deploy at least one number of self-owned plant that are required to be used on Site;

   d. Submit documents to prove his ownership of the plants and, if applicable, the relationship between the Piling Sub-subcontractor and the Piling Sub-subcontractor's parent, sister or subsidiary company;

   e. Submit document to confirm no further subcontracting of his part of the works.

5. The Piling Sub-contractor shall supply piling materials, which form whole or part of permanent works, to the Piling Sub-subcontractor;

6. A probity clause shall be included in the Piling Sub-subcontract such that:

   "If the Piling Sub-subcontractor or any of his agents or employees are found to have offered or given advantage, gratuity, bonus, discount, bribe or loan of any sort to any agent or employee of the Piling Sub-contractor, the Contractor, Hong Kong Housing Authority or Housing Department, the Piling Sub-contractor shall at liberty forthwith terminate the employment of the Piling Sub-subcontractor under the Piling Sub-subcontract. The Piling Sub-contractor, the Contractor, Hong Kong Housing Authority or Housing Department shall hold the Piling Sub-subcontractor liable for any loss or damage which the Piling Sub-contractor, the Contractor, Hong Kong Housing Authority or Housing Department may thereby sustain."

PIL1.G620.9 SUBMISSION OF CONTRACT DOCUMENTS OF PILING SUB-CONTRACT

1. Before execution of the Piling Sub-contract works, submit to the CM a written confirmation signed by the Contractor and the Piling Sub-contractor confirming that the conditions stated in PIL1.G590 or PIL1.G600, as appropriate, have been included into the Piling Sub-contract;

2. In the event that the Contractor takes up the role of Piling Sub-contractor as allowed in PIL1.G515 for Combined Piling and Building Contract, submit to CM a written confirmation signed by the Contractor confirming that he shall take up the role of Piling Sub-contractor and act as if he is the Piling Sub-contractor in addition to his capacity.

PIL1.G630.9 SUBMISSION OF CONTRACT DOCUMENTS OF PILING SUB-SUBCONTRACT - FOR COMBINED PILING AND BUILDING CONTRACT ONLY

Before execution of the Piling Sub-subcontract works, submit to the CM a written confirmation signed by the Piling Sub-contractor and the Piling Sub-subcontractor confirming that the conditions stated in PIL1.G610 have been included into the Piling Sub-subcontract.

DESIGN

GENERAL

PIL1.D010.9 GENERAL

All specification clauses in this section shall be applied to Contractor's Design Piling Contract / Combined Piling and Building Contract only unless otherwise stated.

PIL1.D020.9 ACCEPTABLE PILE TYPES

1. Only the type or types of piles specified in the Project Specific Specification shall be acceptable to be used in this Contract unless otherwise proposed by the Contractor and subsequently Approved by the CM in accordance with sub-clause (2) below;
2. Notwithstanding sub-clause (1) above, the Contractor may propose any other alternative types of pile as in clause PIL1.G380. The proposed alternative types of pile must be accepted by the Buildings Department of the Hong Kong Special Administrative Region;
3. Do not base the design on a system of hand dug caissons.

PIL1.D030.9 ACCEPTANCE OF THE DESIGN

Acceptance of the Contractor's design, whether prior to or during the contract period, will not relieve the Contractor's responsibility to comply with this Specification.

PIL1.D040.9 DESIGN CERTIFYING CONSULTANT

A director of the Design Certifying Consultant, who must be a Registered Structural Engineer registered with the Building Authority, must certify and sign all layouts, details and calculations submitted to the CM, including those for tendering purposes.

INFORMATION TO BE SUPPLIED WITH TENDER

PIL1.D110.9 SUBMISSIONS

Submit three copies of each of the following with the tender:

1. Fully detailed design and specification proposals for the Works;
2. Complete set of calculations;
3. Drawings showing the number and positions of the piles;
4. The estimated average, maximum and minimum net lengths of the piles below cut-off level;
5. Drawings showing the layout, details and founding levels of footings, if any;
6. Any other requirement as detailed elsewhere in this Specification.

PIL1.D120.9 ADDITIONAL REQUIREMENTS FOR TYPES 5, 6 AND 7 PILES

Submit also:

1. Details of grout mix as PIL1.M410 and PIL1.M420;
2. Sequence and timing of grouting, including details of secondary pressure grouting;
3. Details of drilling method and equipment;
4. Details of reinforcement (including area of reinforcement at root of screw to coupler), pipe section, spacers, couplings and related test reports for Type 5 piles only;

5. Fabrication details of steel reinforcement cage (including installation details of single sonic access tube) for Type 7 piles only.

DESIGN SUBMISSIONS

PIL1.D210.9 SUBMISSIONS OF PILING AND/OR FOOTING DESIGN AT COMMENCEMENT OF THE WORKS

Submit four copies of drawings, calculations and any other relevant documents related to piling and/or footing design for Approval not later than 7 days from the notified date for commencement of the Works. The submissions shall include relevant foundation plans and supporting documents as described in clause 2.7 and clause 5.4.1, as appropriate, of the Code of Practice for Foundations. Any submission not to the satisfaction of the CM shall be re-submitted. Allow 37 days for each submission and re-submission for the checking of the CM.

PIL1.D220.9 SUBMISSIONS OF AMENDMENT OF PILING AND/OR FOOTING DESIGN

In the event that amendment of piling and/or footing design is required, submit four copies of drawings, calculations and any other relevant documents related to the amendment for Approval. Any submission not to the satisfaction of the CM shall be re-submitted. Allow 42 days for each submission and re-submission for the checking of the CM.

DESIGN PARAMETERS

PIL1.D320.9 DESIGN LOAD

All loads shown on the CM's drawings are deemed dead loads and imposed loads as defined in the Building (Construction) Regulations, irrespective of whether they are indicated on the drawings as characteristic or designed loads. Such loads have not been multiplied by the partial safety load factors.

PIL1.D330.9 TYPES OF PILE IN ONE CAP

Allow only one type of pile in each pile cap.

PIL1.D340.9 PILE SPACING

Comply with clause 5.1.3 of the Code of Practice for Foundations.

PIL1.D350.9 STRESS IN STEEL FOR PILING DESIGN

1. For Type 4 piles, comply with clause 2.5.5(4) of the Code of Practice for Foundations;
2. For Type 5 piles, comply with clauses 5.4.8(2)(a) and 5.4.8(2)(c) of the Code of Practice for Foundations;
3. For Type 6 piles, comply with clause 2.5.5(4) of the Code of Practice for Foundations;
4. For the combined effects of dead, imposed and wind loads, the allowable stress in sub-clauses (1), (2) & (3) above may be increased by not more than 25% where such increase is solely due to wind loads.

PIL1.D360.9 STRESS IN CONCRETE FOR PILING DESIGN

1. For Types 1a and 2 piles, comply with Regulation 26 of Building (Construction) Regulations and clause 2.5.5(2) of the Code of Practice for Foundations;
2. For Types 1c and 3 piles, comply with Regulation 27 of Building (Construction) Regulations and clause 2.5.5(2) of the Code of Practice for Foundations.

PIL1.D370.A WIND EFFECT

Design the foundations to comply with the "Code of Practice on Wind Effects in Hong Kong 2019" issued by the Buildings Department of the Hong Kong Special Administrative Region.

PIL1.D380.9 RESISTANCE TO SLIDING, UPLIFT, OVERTURNING AND BUOYANCY

1. Design the foundations to comply with Section 15 of the Building (Construction) Regulations of Hong Kong and clauses 2.5.4 and 5.1.6 of the Code of Practice for Foundations;
2. Comply also with clause 5.3.3 of the Code of Practice for Foundations regarding uplift resistance of piles.

PIL1.D390.9 SAFE LOAD CARRYING CAPACITY

1. The combined effects of dead, imposed and wind loads including negative skin friction shall not exceed the safe load carrying capacity of an individual pile times the group reduction factor, if necessary, in accordance with PIL1.D400;
2. The safe load carrying capacity of an individual pile shall not exceed the allowable structural capacity of the pile based on the allowable stresses in steel and concrete stipulated in PIL1.D350 and PIL1.D360, respectively;
3. The compressive safe load carrying capacity of an individual Type 3 pile founded on Category 1(a), 1(b), 1(c), 1(d) or 2 rock defined in PIL1.G450 shall not exceed the sum of:
   a. the area of the designed pile base times 10 MPa, 7.5 MPa, 5 MPa, 3MPa or 3 MPa respectively; and
   b. the bond or frictional resistance of the pile in a rock socket as allowed in clause 5.4.7 of the Code of Practice for Foundations.
4. The safe load carrying capacity of an individual Type 5 and Type 6 pile shall be derived according to the design principles stated in clause 5.4.8 and 5.4.2 respectively of the Code of Practice for Foundations;
5. For piles in compression designed not to rest on bedrock defined in PIL1.G450, base the pile design, in addition to the driving formula if the pile is a driven pile, on static formulae to achieve the required embedded length of the piles in the bearing stratum by using one of the following references:
   a. Poulos H.G. and Davis E.H. (1980) - Pile Foundation Analysis and Design - John Wiley & Sons, New York, New York;
   b. Tomlinson M.J. (1995) - Foundation Design and Construction, 6th Edition - John Wiley & Sons, New York, New York;
   c. Tomlinson M.J. (1994) - Pile Design and Construction Practice, 4th Edition - E&FN Spon, London.
6. Propose the driving formula and the associated parameters for the CM's approval. Where hydraulic hammers are used, adopt the modified Hiley formula:

$$Q = \frac{K_h E}{(2s + c_1 + c_2 + c_3)}$$

where

Q = safe compressive load carrying capacity (kN);

E = Driving energy of the hammer immediately before impact (KNmm);

s = set per blow (mm);

c_1 = temporary compression allowance for pile head and cap (mm);

c_2+c_3 = elastic rebound (mm); and

K_h = Hydraulic Hammer Factor that, in any event should not be greater than the following values:

K_h = 0.6 where a pile cushion is used; and

K_h = 0.7 where no pile cushion is used; and

Appropriate adjustment should be made to the Kh value if a lower value is obtained from load testing results as stated in sub-clause (7) below;

7. Demonstrate the adequacy of the proposed driving formula or the modified Hiley formula and the associated parameters stated in sub-clause (6) in the determination of safe load carrying capacity of the pile by conducting load test(s) stipulated in PIL1.T810 to PIL1.T880. Verify the value of E in the modified Hiley formula by a method agreed by the CM;
8. The overall length of each pile must be the greater of those derived from the following formulae:
   a. The driving formula or the modified Hiley formula as stated in sub-clause (6) above; or
   b. The static formula as stated in sub-clause (5).
9. Adopt an installation method that will ensure that the required embedded length is achieved;
10. For the purpose of design calculations for the safe load carrying capacity of piles in compression, the design soil parameters (bulk unit weight, effective cohesion and effective friction angle) of different soil type shall not exceed the values given in the Project Specific Specification;
11. Design ground water level shall be as given in the Project Specific Specification;
12. Make a detailed submission to the CM to substantiate any proposed modification to the soil parameters stated in sub-clause (10) above and:
    a. Verify the proposed values by carrying out necessary Approved laboratory tests. The CM reserves the right to reject any proposed modification which is not to his entire satisfaction;
    b. Submit, with the tender, details of the proposed tests all to the CM's satisfaction. Arrange for a sufficient number of laboratory tests to establish the lower bound design values for each major stratum with sufficient independent results for that stratum. Have all laboratory tests for this purpose carried out at own cost and without any extension of time.
13. Notwithstanding sub-clause (10) above, in relation to the design, the Contractor may establish unit side resistance and unit tip resistance of the driven piles to be used in the Contract for various ground conditions and depths by preliminary pile loading tests in addition to those described in PIL1.T110 or separate side resistance and tip resistance tests. If design parameters derived from loading tests are to be used, submit the locations and instrumentation details of the proposed preliminary piles for such verification purpose, and a testing programme all to the satisfaction of the CM with the tender. The number of preliminary piles shall be sufficient to establish the lower bound design value for each major stratum with sufficient independent results for that stratum. Carry out all loading tests for this purpose at own cost, without any extension of time and complete them within two months of the notified date for the commencement of the Works. In the event of any failure to complete the above loading tests within two months of the notified date for the commencement of the Works, then no piling work, except for the loading tests, will be permitted to proceed any further until the completion of the loading tests, unless otherwise Approved. Bear the cost of any delay in this connection. No claim for additional costs or any extension of time will be considered by the CM;
14. In checking the allowable buckling capacity of Types 5 and 6 piles, the lateral restraints from the grout, steel casing if permanent and the surrounding soil may be allowed. Do not apply sub-clause (5) above to Types 5 and 6 piles.

PIL1.D395.9 SAFE LOAD CARRYING CAPACITY - TYPE 7 PILES FOR CONTRACTOR'S DESIGN

1. The theoretical safe compressive load carrying capacity (Qp) in kN of Type 7 pile shall be the sum of allowable skin friction capacity (qs) along the whole pile shaft and allowable end bearing capacity (qb) of the pile base:

   $Q_p = q_s + q_b$

   $= \mu \Sigma N_{av} P L_i + 5 N A$

   where

   μ = designed friction coefficient in kN/m² per SPT "N" value and to be verified by trial pile (maximum value to be used is limited to 1.6);

   N_{av} = average SPT "N" value along the pile shaft in blows / 300 mm (maximum value to be used is limited to 40);

   P = perimeter of the pile in m;

   L_i = length of the pile shaft section i in m;

   N = SPT value at the pile base in blows / 300 mm (maximum value to be used is limited to 200);

   A = bearing area of the pile base in m²;

   Shaft friction in filling materials and marine deposits shall be ignored;
2. Notwithstanding sub-clause (1) above, the Contractor shall build in a greater margin of safety in his design where necessary and subject to the CM's approval, having regard to the sub-soil conditions of the site and his method of pile installation;
3. The allowable compressive stress of grout shall be 5 N/mm² and may be increased by 25% where such increase is solely due to wind loads;
4. For axially loaded piles designed to take tension, provide reinforcement with tension lap length along the full length of the pile. For piles designed to take vertical and lateral loads, provide sufficient reinforcement to resist all actions including bending moment. Allow a minimum cover of 75 mm to reinforcement.

PIL1.D400.9 GROUP REDUCTION FACTOR

Allow for the reduction of bearing capacity of individual piles in a group in accordance with the requirements stated in clause 5.1.2 of the Code of Practice for Foundations.

PIL1.D410.9 PILES FOUND ON BEDROCK

Do not apply any group reduction factor where the piles are designed to found on bedrock defined in PIL1.G450. Submit details indicating the levels of pile bases for safe bearing of the proposed piles with the tender. For Type 4 Piles driven to bedrock, comply with clause 5.4.11 of the Code of Practice for Foundations.

PIL1.D420.9 CASING THICKNESS

Ensure that the thickness of casing to pile shaft for piles types 2 and 3 is sufficient to withstand soil and water pressure. If directed by the CM, increase the thickness of the casing at no extra cost to the Authority.

PIL1.D430.9 BOND STRENGTH IN TYPES 5 AND 6 PILES

The rock socket must be founded in bedrock as PIL1.G450 and:

1. Design bond strength between rock and grout: not exceeding the value of the presumed allowable bond or friction between rock and concrete or grout for piles as stated in Table 2.2 of clause 2.2.2 of the Code of Practice for Foundations;

2. Design bond strength between grout and steel H-pile for Type 6 piles or grout and steel bars for Type 5 piles : not exceeding the allowable value stated in clause 2.5.5(4) or 5.4.8(2) respectively of the Code of Practice for Foundations;
3. If a different bond strength value is proposed, submit with the tender, details of the proposed founding method, design parameters, proposed testing methods to be applied to the trial pile (including loading test), design calculations, testing programme and proof of the validity of the parameters to the CM's satisfaction before applying them to the design. Establish the proposed value of bond strength between grout and rock with a sufficient number of tests or test piles. Carry out all the tests for this purpose without any extension of time and bear all associated costs;
4. Ignore the contribution of the grout to the structural capacity of the piles.

PIL1.D440.9 UNDERGROUND OBSTRUCTIONS IN TYPE 7 PILES FOR CONTRACTOR'S DESIGN

1. For the underground obstruction encountered in the top few metres of the ground, subject to the CM's approval, remove the underground obstruction by some suitable forms of excavation and re-install the pile at its design location. Ignore the positive shaft friction above the bottom level of the obstruction in calculation of the allowable skin friction capacity of the pile;
2. For the underground obstruction encountered at greater depths causing auger refusal, such as the rate of penetration of the drilling is less than 300mm per minute, follow the procedures below:
   a. If the pile is closer than 6 pile diameters from any completed Type 7 pile, the drilling hole shall be backfilled with cement grout and the pile shall be relocated;
   b. For a pile with a centre to centre distance greater than 6 pile diameters from any completed pile, subject to the CM's approval, remove the obstruction by a method approved by the CM, backfill the bored hole with sand before re-installation of the pile. Ignore the positive shaft friction above the bottom level of the obstruction in calculation of the allowable skin friction capacity of the pile.

SETTLEMENT ANALYSIS

PIL1.D510.9 REQUIREMENT

Design piles and/or footings which are not to be completely resting on bedrock to include settlement calculations based on the design layout and depths of piles to be installed and/or footings to be constructed.

PIL1.D520.9 BLOCK SETTLEMENT AND DIFFERENTIAL SETTLEMENT

1. Comply with the requirements stated in clause 2.3.2 of the Code of Practice for Foundations;
2. Consider the effects of block and differential settlements on the performance of buildings or structures in the design;
3. Design the foundation to satisfy the following requirements:
   a. The maximum angular rotation of the horizontal load-bearing surface of the pile cap and / or footing at any location under wind or other transient loads will not exceed the value given in the Project Specific Specification throughout its design life; and
   b. The differential settlement between columns / vertical elements within the same building or structure under working loads will not exceed the value given in the Project Specific Specification throughout their design life; and
   c. The maximum total settlement will not exceed the value given in the Project Specific Specification throughout their design life.

PIL1.D530.9 SCOPE OF CALCULATIONS

Clearly show in the calculations, the total and differential settlement at the end of the construction period of building structures and also in the long term. Demonstrate also in the design calculations, that the differential settlement criterion for the structure, set out in PIL1.D520 above, will not be exceeded. The following may be considered in the design to minimize differential settlement:

1. Stiffness and layout of pile cap;
2. Pile location and pile size;
3. Any additional factors which the Contractor considers appropriate.

PIL1.D540.9 BASIS OF ANALYSIS

Base the settlement analysis in clause 2.3.1 of the Code of Practice for Foundations and / or on one of the following publications:

1. Poulos H.G. and Davis E.H. (1980) - Pile Foundation Analysis and Design - John Wiley & Sons, New York, New York;
2. Tomlinson M.J. (1995) - Foundation Design and Construction, 6th Edition - John Wiley & Sons, New York, New York;
3. Tomlinson M.J. (1994) - Pile Design and Construction Practice, 4th Edition - E&FN Spon, London.

PIL1.D550.9 SCHEDULE

Include, in the design, a separate schedule of basic principles, procedures and assumptions citing the source reference, page numbers and, in addition, the method of deriving rock mass and/or soil mass properties used in the design.

PIL1.D560.9 ELASTICITY MODULUS

For the assessment of foundation settlement, do not choose an elasticity modulus of soil greater than FN and in no case greater than 200 MN/m²:

where:

E	=	elasticity modulus of soil in MN/m²;
N	=	Standard Penetration Test (SPT) results prior to pile installation;
F	=	0.8 for N less than 100, and 1.0 for N equal to or greater than 100.

PIL1.D570.9 SUBMISSION - ACTUAL CONDITIONS OF INSTALLATION

Submit a settlement analysis based on the actual conditions of piles installed before commencement of construction of pile caps and:

1. Consider the effect of block settlement;
2. Verify the assumed parameters and bear the cost of such verification.

RESISTANCE TO HORIZONTAL FORCES

PIL1.D610.9 GENERAL

1. Piles (either vertical or raking), or pilecaps or both may be designed to resist horizontal forces and tenderers must submit with their tenders, detailed calculations which demonstrate that the design is both structurally and geotechnically acceptable. Make calculations in accordance with the criteria set out in PIL1.D620 to PIL1.D670;
2. Footings may be designed to resist horizontal forces and tenderers must submit with their tenders, detailed calculations which demonstrate that the design is both structurally and geotechnically acceptable;

3. The formulae and publications given in this sub-section are for reference only. The designer may use data from other publications, but in this event, he must demonstrate that the publication proposed is applicable to the loading, building structures and founding material in this Contract. The publication proposed must be wholly compatible with the basic source data of this site. If the references in the publication proposed are derived from overseas, produce precedent cases to demonstrate that the design methods and procedures have been successfully applied in Hong Kong. No matter what publication is used in the Contractor's design, the Contractor will not be relieved of his design responsibilities under the Contract..

PIL1.D620.9 TYPE 5 PILES

Do not design Type 5 piles to resist horizontal loads unless they are designed as raking piles.

PIL1.D630.9 HORIZONTAL RESISTANCE BY PILE CAPS ONLY

1. Maximum horizontal displacement of pilecaps: 25 mm;
2. Design piles to resist any effect of pile cap movement due to horizontal forces;
3. Do not permit the allowable stresses in the piles to be exceeded.

PIL1.D640.9 HORIZONTAL RESISTANCE BY PILES ONLY WITH PILE TOPS FIXED AGAINST ROTATION

1. Use the following formulae to determine the deflections and moments of the piles:

a. $$T = \left(\frac{EI}{n_h}\right)^{\frac{1}{5}}$$

b. $$M_p = F_m(PT)$$

c. $$D_p = F_d\left(\frac{PT^3}{EI}\right)$$

where:

E = elastic modulus of pile material in kN/m².

I = moment of inertia of pile cross section in m^4.

n_h = coefficient of variation of sub-grade reaction in kN/m³. For the purpose of calculation, a suggested value of n_h is given in the Project Specific Specification. Take responsibility to ensure that the assumed value of n_h on which the design is based is adequate for this Contract. Carry out boreholes, soil tests and other tests to verify to the satisfaction of the CM, the assumed value of n_h. Should the values of n_h so verified require more piles and / or pile cap quantities, carry out any necessary redesign, extra piling work etc. at own expense and without any extension of time.

T = relative stiffness of pile soil system, m.

M_p = moment at depth z, KNm.

D_p = deflection at depth z, m (25 mm maximum).

F_m = moment coefficient at depth z, as given in page 7.2 - 239 Fig. 12 of "FOUNDATIONS AND EARTH STRUCTURES, DESIGN MANUAL 7.2", May 1982 Edition, published by the Department of the Navy, Naval Facilities Engineering Command.

F_d = deflection coefficient at depth z as given in page 7.2 - 239 Fig 12 of "FOUNDATIONS AND EARTH STRUCTURES, DESIGN MANUAL 7.2", May 1982 Edition, published by the Department of the Navy, Naval Facilities Engineering Command.

P = horizontal load in kN.

2. Check the combined effect due to horizontal forces and vertical forces;

3. For a group of piles, reduce the coefficient of variation of sub-grade reaction (n_h), which is a function of pile spacing in the direction of loading, as below:

Spacing	n_h group	Spacing	n_h group
8D	$1.00n_h$	4D	$0.40n_h$
6D	$0.70n_h$	3D	$0.25n_h$

Notes:

(1) D = pile diameter or diagonal width. Pile spacing normal to the direction of loading has no influence provided it is greater than 2.50D.

(2) Subgrade reaction is to be reduced in the direction of loading.

PIL1.D650.9 HORIZONTAL RESISTANCE BY PILES ONLY WITH FLEXIBLE PILE CAPS OR HINGED END CONDITIONS

All as PIL1.D640 above, except that the coefficients symbolized by the terms F_m and F_d are as given in page 7.2 - 238, Fig 11 of "FOUNDATIONS AND EARTH STRUCTURES, DESIGN MANUAL 7.2", May 1982 Edition, published by Department of the Navy, Naval Facilities Engineering Command.

PIL1.D660.9 HORIZONTAL RESISTANCE BY PILES AND PILE CAPS TOGETHER

1. Utilise a rational soil mechanics approach in the design and demonstrate the compatibility of the method chosen with the sub-soil conditions and the method and result of testing. The derivation of parameters and the method of computations must be mutually compatible and consistent;
2. Maximum design displacement of pile caps and piles: 25 mm;
3. The following publications may be used for reference:
   a. Section 4.2, chapter 4 of "ELASTIC SOLUTIONS FOR SOIL AND ROCK MECHANICS" by H.G. Poulos and E. H. Davis, 1974 for relating the displacement and forces in the cap:

      Maximum values for E (Young's Modulus for soil) shall be as given in the Project Specific Specification.

      Suggested values of V (Poisson's ratio for soil) shall be as given in the Project Specific Specification.

      It is the Contractor's responsibility to ensure that the values of E and V taken are adequate. The Contractor is to carry out boreholes, soil tests and other tests as necessary to verify his assumed values of E and V. If the values of E and V so verified require more piles and/or pile cap quantities, then the Contractor is to carry out any necessary redesign, extra piling work etc at his own expense and without any extension of time;

   b. "FOUNDATIONS AND EARTH STRUCTURES DESIGN MANUAL 7.2", May 1982 Edition for calculating the displacement, moments and forces on the piles.

PIL1.D670.9 HORIZONTAL RESISTANCE BY ROCK SOCKET

Check for any additional stresses induced in the rock socket when the piles are designed with rock socket to resist horizontal loads. Comply with the requirements stated in clause 5.3.4 of the Code of Practice for Foundations.

NEGATIVE SKIN FRICTION

PIL1.D710.9 GENERAL

Make allowance in design calculations for negative skin friction and comply with clause 5.2 of the Code of Practice for Foundations.

PIL1.D720.9 BASIC FORMULA

1. The negative skin friction (NSF) caused by the settlement of the soil mass, is estimated by means of the equation in clause 5.2.2 of the Code of Practice for Foundations;
2. The minimum depth of the consolidation strata, *l*, for different blocks / structures shall be as given in the Project Specific Specification;
3. Take responsibility to ensure that the assumed value of *l* on which the design is based is adequate for this Contract. Carry out boreholes, to the satisfaction of the CM, to verify the assumed value of *l*. Should the values of *l* so verified be greater than those on which the design is based, carry out any necessary redesign, extra piling work etc based on the greater values of *l* so verified at own expense and without any extension of time. Should the values of *l* so verified be less than the minimum values stated above, use the minimum values stated above in the design. In no case must *l* be longer than the length of the pile, measuring from ground level;
4. Water table level shall be as given in the Project Specific Specification;
5. Ground level shall be as given in the Project Specific Specification;
6. The at-rest earth pressure coefficient, K_0, shall be as given in the Project Specific Specification;
7. Make allowance for the effect of NSF between ground level and the soffit of the pile cap.

PIL1.D730.9 AVERAGE SOIL PROPERTIES

For the purposes of calculating negative skin friction, apply the average soil properties below ground as given in the Project Specific Specification.

PIL1.D740.9 GROUPING EFFECT

Calculate the effect on negative skin friction of grouping effect based on the proposed design and the principles stated in clause 5.2.2 of the Code of Practice for Foundations. Submit all calculations with the tender.

PIL1.D760.9 REDUCTION OF NEGATIVE SKIN FRICTION

The design negative skin friction may be reduced in the case of tenders based on piles coated with a bitumen slip layer, provided that such material is acceptable to BD and provided that the proposed reduction in the design negative skin friction can be substantiated by reliable full scale field tests, preferably carried out locally under similar soil conditions. No reduction in negative skin friction due to grouping and boundary effects is permitted for bitumen coated piles. Tenders on this basis must include:

1. Proposed methods for proving that the slip layer is undamaged during pile driving and for determining the design reduction;
2. A guarantee that sufficient quantity of the material proposed for the slip layer will be available to enable the Works to be executed within the Contract period and that if it is not, the Contractor will redesign the piling system and execute it at no extra cost to the Authority and with no extension of time claimed.

PILE CAP DESIGN

PIL1.D810.9 STANDARDS

Comply with Code of Practice for Structural Use of Concrete 2013 and Code of Practice for Foundations issued by the Buildings Department in respect of all design for reinforced concrete pile caps and for structural concrete above piles.

PIL1.D820.9 SUBMISSIONS (CONSTRUCTION OF PILE CAP IS NOT PART OF THE CONTRACT)

1. Prepare and submit a layout design of the pile caps with the tender, together with the schedule of pile cap quantities required by the Special Conditions of Tender;
2. Within two months following the notified date for commencement of the Works, complete the design of pile caps and submit four copies of working drawings and design calculations for Approval. Submit for further Approval any revisions made subsequent to this Approval within fourteen days following the completion of all piling works to each block/structure. Submit to the CM a complete set of the negatives for all working drawings of pile caps within fourteen days after the certified completion of the Contract;
3. Submit, with the tender, design calculations and details of reinforcement for pile caps for structural members specified in the Project Specific Specification.

PIL1.D830.9 SUBMISSIONS (CONSTRUCTION OF PILE CAP IS PART OF THE CONTRACT)

Submit the following:

1. With the tender: drawings showing the layout and details of all the pile caps, together with all design calculations etc;
2. Within two months following the notified date for the commencement of the Works and before the commencement of any pile cap works on Site: four copies of working drawings for the pile caps for Approval. Submit, for Approval, any revisions made subsequent to this Approval.

DESIGN GUIDELINES

PIL1.D910.9 MANDATORY GUIDELINES

Comply with the mandatory design guidelines as given in the Project Specific Specification.

PIL1.D920.9 RECOMMENDED GUIDELINES

Recommended design guidelines which are considered suitable for the purpose of this Contract are included in the Project Specific Specification but the Contractor may propose a different design method for this part of the work.

PIL1.D930.9 CONTRACTOR'S RESPONSIBILITY

The provision of the mandatory and/or recommended guidelines in PIL1.D910 and PIL1.D920 above does not relieve the Contractor of any of his design responsibilities under the Contract.

MATERIALS

GENERAL

PIL1.M010.9 INFORMATION TO BE SUPPLIED WITH TENDER

Submit information of major materials proposed to be used in the piling works with the tender.

PIL1.M020.9 SAMPLES

Test representative samples of all materials being incorporated into the permanent works to show compliance with this Specification.

PIL1.M030.9 TEST CERTIFICATES

On Site delivery verification:

1. Submit to the CM the manufacturer's test certificates for each batch of piles delivered to Site;
2. Where piles Types 1(a), 1(b) and/or 2 are used in this Contract, and when the piles are not cast on the Site, submit the manufacturer's certificate signed by the manufacturer's engineer who should hold the qualification of MICE or MIStructE or MHKIE for each delivery of piles to Site stating:
   a. That the piles have been manufactured in accordance with the manufacturer's standards Approved by the Authority;
   b. That the piles are satisfactory for the purpose intended;
   c. What mix proportion and admixtures have been used in the concrete;
   d. The results of all cube and core tests.
3. Where piles Types 4 and/or 6 are used in this Contract, submit the test certificates endorsed by the manufacturer for each delivery of steel H-piles to Site stating the results of chemical composition analysis, tensile tests and impact tests in accordance with the requirements of BS EN 10025 Part 1-6:2004.

PIL1.M040.9 QUALITY ASSURANCE

Carry out and conduct quality assurance on the production of pile Types 1a, 1b and 2 and/or Approved special proprietary types of piles under an Approved quality assurance scheme. The scheme must be inspected and certified by an independent engineer who should also hold the qualification as MHKIE, MICE or MIStructE.

PIL1.M050.9 COLOUR CODE SYSTEM OF STEEL PILE SECTIONS

Colour Code System:

1. Submit for Approval a colour code system in the Quality Control System as stipulated in PRE.B8.1425 for identification of steel pile sections for Types 4 and 6 Piles;
2. A batch of steel pile sections is defined as each delivery of steel pile sections to Site under one delivery order. Upon delivery of the steel pile sections to Site and before the material test results are known, apply colour markings (other than red and green) at both ends of the pile sections in accordance with the Approved colour code system submitted in sub-clause (1) above;
3. Upon material test results (including retest as permitted under the Specification) being available, change the colour at both ends of the pile sections as follows:
   a. Green colour: for steel pile sections conforming to the Specification;

b. Red colour: for steel pile sections not conforming to the Specification.

STEEL PILES

PIL1.M110.9 'H' PILES AND PLATES

Quality requirements:

1. Complying with BS EN 10025 Part 1-6:2004; and
2. Use steel H-piles of types and brands recognized by BD. Material properties shall comply with the requirements stated in the recognition documentation issued by BD. Each section shall contain manufacturer's identification marked on it by means of engraving or similar techniques approved by the CM.

PIL1.M120.9 STEEL PIPE PILES

Quality requirements:

1. Complying with BS 3601:1987 or BS 6323:Parts 1 and 2:1982, except as regards the requirements of hydraulic pressure tests.

PERMANENT CASINGS

PIL1.M210.9 TYPE 5 PILES

1. Material: Grade S275 to BS EN 10210 Part 1-2:2006 for Hot-Finished Hollow Section and BS EN 10219 Part 1-2:2006 for Cold-Formed Hollow Section;
2. Minimum thickness: 5.0 mm;
3. Internal diameter: not less than the finished pile diameter shown or scheduled on the Drawings;
4. Free from:
   a. Significant distortion and of uniform cross-section throughout the whole length;
   b. Internal projections which might prevent the proper formation of the piles.

PILE SHOES

PIL1.M310.9 GENERAL

1. Submit full details of pile shoes together with the tender when specified in the Project Specific Specification;
2. Take all necessary precautions including, where appropriate, or if required in the Project Specific Specification, the provision of specially designed pile shoes to protect the ends of the piles during driving.

PIL1.M320.9 TYPES 1A AND 1B PILES

Provide flat or pointed co-axial shoes and:

1. Steel pile shoes: manufactured from steel complying with Grade S275 to BS EN 10025:2004;
2. Cast steel pile shoes: manufactured from steel complying with BS 3100:1991, grade A;
3. Cast steel pile shoes: manufactured from chill hardened iron, as used for making grey iron castings, complying with BS 1452:1996, grade 150 and free from major blow holes and other surface defects.

PIL1.M330.9 STRAPS AND FASTENINGS FOR CAST PILE SHOES FOR TYPES 1A AND 1B PILES

Manufactured from steel complying with Grade S275 to BS EN 10025:2004, cast into the point of the shoe to form an integral part of the shoe.

PIL1.M340.9 TYPE 1c PILES

1. Manufactured from durable materials Approved by the CM and capable of withstanding driving stresses without damage;
2. Designed to provide a watertight joint with permanent casings.

PIL1.M350.9 TYPE 4 PILES

Fit piles with Approved toe protection. The protection must be adequate to resist the driving stress.

GROUT AND CONCRETE

PIL1.M410.9 GROUT

Consisting of ordinary Portland cement and water and:

1. Containing sand, PFA and admixtures only when Approved;
2. With a minimum cementitious content of 600 kg/m³;
3. When used to fill core holes, having a minimum characteristic compressive strength at 28 days of not less than the specified grade strength of the concrete surrounding the core hole;
4. With a maximum amount of bleeding of 2% in the first 3 hours and not exceeding 4% in total. The water must be reabsorbed by the grout during the 24 hours after mixing;
5. With a maximum free expansion of 10% at the nominal temperature;
6. With any Approved admixtures being chloride-free;
7. With a maximum total chloride content, expressed as a percentage relationship between the chloride ion and the cementitious content by mass in the grout, of 0.1%.

PIL1.M420.9 GROUT FOR TYPES 5, 6 AND 7 PILES

In addition to the requirements of PIL1.M410 above, ensure that grout for Types 5, 6 and 7 piles complies with the following:

1. Water used in the grout must be clean and fresh with a temperature not exceeding 30°C nor less than 5°C;
2. Additives and admixtures complying with BS 5075:1982 and only used with the prior agreement of the CM;
3. Non-shrink and having a minimum characteristic compressive strength of 30 N/mm² at 28 days;
4. For Type 7 piles,
   a. Maximum grout temperature shall not exceed 38°C;
   b. Sample each truckload of grout by using a 225 to 350 ml capacity disposable glass or cup to evaluate premature setting or initial set of the grout mix. Reject the use of the grout if the initial set has occurred under the condition of the grout starting forming the shape of the container when tilted.

PIL1.M430.9 FILLING TO STEEL PIPE PILES

Fill for:

1. The uppermost 3 m from cut off level: concrete grade 10/20;
2. The remainder: Approved decomposed rock fill.

PIL1.M440.9 CONCRETE FOR PILE CAPS AND FOOTINGS

1. For Contractor's Design Piling Contract / Combined Piling and Building Contract: use Grade 30/20;

2. For Engineer's Design Piling Contract / Combined Piling and Building Contract: concrete grade is specified in Drawings;
3. Maximum free water/cement ratio allowed: as CON1.M1170;
4. Inclusion of PFA as partial cement replacement: as CON1.M170 and CON1.M1190.

ANCILLARY MATERIALS

PIL1.M510.9 PAINT FOR STEEL PILES AND STEEL OR CAST IRON COMPONENTS

Approved proprietary epoxy based paint.

PIL1.M520.9 WELDING ELECTRODES

As Worksection STR1.

PIL1.M540.9 EARTH FILLING

General Fill Material and Special Fill Material as EAR1.M220.

MECHANICAL COUPLER FOR TYPE 5 PILES

PIL1.M610.9 TYPE OF MECHANICAL COUPLER

The quality requirements of mechanical coupler shall be in accordance with CON3.M310.

PIL1.M620.9 SUBMISSION

Submission of the details of the mechanical coupler shall be in accordance with CON3.M320.

PIL1.M630.9 QUALITY ASSURANCE SCHEME FOR MECHANICAL COUPLER

Details of quality assurance scheme for mechanical coupler shall be in accordance with the Project Specific Specification.

WORKMANSHIP

GENERAL

PIL1.W010.9 REQUIREMENTS OF THE CONTRACT

Construct the works in a manner such as to satisfy the requirements of the Contract. In the event of any failure to comply with this requirement, rectify as necessary, until the requirements of this Specification are met.

PIL1.W020.9 REQUIREMENTS OF THE CONTRACTOR'S DESIGN

For Contractor's design piling contract / combined piling and building contract, the specification for design applies equally to construction. In the event of any failure to comply with this requirement, redesign and construct as necessary, until the requirements of this Specification are met.

PIL1.W030.9 DELIVERY, HANDLING AND STORAGE OF PILES

Carry out delivery, handling and lifting with due care and to Approval. Stack piles neatly, off the ground.

PIL1.W040.9 COLOUR MARKINGS OF STEEL PILE SECTIONS BY STOCKISTS OR SUPPLIERS PRIOR TO DELIVERY

1. Obtain steel pile sections from stockists / suppliers for Types 4 and 6 Piles preferably without red and / or green colour markings at either end of the steel pile sections;
2. If steel pile sections with red colour marking, or with other colour marking covering a previous red colour marking, or with green colour marking at either end of the steel pile sections are to be supplied:
    a. Provide in advance of delivery of steel pile sections to Site an explanation of the presence of the said colour marking(s) to the satisfaction of the CM. In addition, for steel pile sections with red colour marking or other colour marking covering a previous red colour marking, provide to the CM before delivery to Site a written confirmation each from the Contractor and the stockist / supplier that the steel pile sections have not been rejected by other project(s);
    b. The CM may refuse entry of steel pile sections to Site if:
        i. No explanation is provided in advance; or
        ii. The provided explanation is not satisfactory.

PIL1.W055.9 CONTOUR PLAN SUBMISSION FOR TYPE 4 PILES

1. Within 14 days from the notified date for commencement of the Works, submit a location plan showing the existing ground investigation drillholes and include any proposed additional ground investigation drillholes in accordance with the Specification for the approval of the CM before drilling work commences on Site;
2. Within two months from the notified date for commencement of the Works, complete the proposed additional drillholes, draw up a plan showing the contours of soil material with SPT N-value equal to or greater than 200 and submit to the CM for approval. The contours shall depict the highest level where SPT N-value is equal to or greater than 200 for at least the next 5m below;
3. Within 14 days after completion of the additional drillholes in the sub-clause (2) above, submit a plan showing the minimum depth of each pile, based on the Approved contour plan. The minimum depth shall in all cases be deeper than or equal to the depth as estimated from the Approved contour plan;

4. The contour plan in sub-clause (2) above shall be prepared and certified by the Design Certifying Consultant as provided in PRE.B6.060 and submit to the CM for approval;
5. Failure to comply with the above requirements may cause delay in the commencement of driving piles to final set. The Contractor shall be responsible for any time and cost implication in connection with such failure in complying with the above requirements.

PIL1.W070.9 SUBMISSION OF DRIVING FORMULA FOR TYPE 4 PILES

1. Within 14 days from the notified date for commencement of the Works, submit for Approval by the CM a proposed driving formula with the appropriate choice of parameters for the Contractor's own plant and machinery, taking into account the complexity of the ground conditions and the tentative founding level of piles;
2. Include in the proposal a testing regime and acceptance criteria to ascertain the validity, applicability and reliability of the driving formula. The testing regime shall include test driving on pile(s) and any other additional tests to substantiate the driving formula. Bear cost and time for such additional tests. Allow 30 days for the CM to give comments on the proposal. Only implement the testing regime on Site after a written permission to commence is granted by the CM;
3. Substantiate the validity, applicability and reliability of the driving formula with the results of the test driving on pile(s) and any other tests proposed by the Contractor to the satisfaction of the CM. Review, modify and re-execute the testing regime as the case requires;
4. Submit final set tables based on the Approved driving formula and in a format to the satisfaction of the CM;
5. Do not commence driving without written permission from the CM, except for the implementation of the testing regime stated in sub-clause (2) above. Allow 42 days for the CM to approve the final set tables in sub-clause (4) above. Allow a further 22 days for obtaining the CM's written permission to commence driving using the Approved final set tables;
6. Ensure that the allowable pile capacity of the piles is achieved and developed after the final set driving with the use of the Approved driving formula. The ultimate pile capacity shall have such a safety factor as the proposed driving formula requires but the safety factor on design capacity of pile shall be not less than 2;
7. All submissions in relation to the proposed driving formula shall be prepared and certified by the Design Certifying Consultant as provided in PRE.B6.060;
8. During the progress of works, the Contractor may submit for Approval by the CM an alternative driving formula in accordance with the above sub-clauses (1) to (7).
9. Make due allowance in the programme for the time required for the above requirements. The Contractor shall not be entitled to any claim for extension of time and additional cost in relation to submission of driving formula or alternative driving formula;
10. Approval for the use of the driving formula or alternative driving formula shall not relieve the Contractor of any responsibility with respect to the required pile capacities under the Contract.

PROTECTION

PIL1.W110.9 COATING STEEL PILES AND COMPONENTS

Protect all steel piles from cut off level to a level as given in the Project Specific Specification and all steel and cast iron components in contact with soil of all other types of pile from corrosion by coating with at least two coats of an Approved coal tar epoxy paint. Apply the paint to a sufficient thickness to be suitable for resistance to damage during the driving process and be durable without deteriorating in the substrata environment. Prepare steel or metal surfaces and apply paint in accordance with the manufacturer's instructions.

ACCURACY AND TOLERANCES

PIL1.W210.9 GENERAL

1. Carefully set out the foundations, locate the piles in the correct positions and spacing and install the piles either plumb positions or to exact inclinations all in accordance with Drawings;
2. For manufacturing and installation tolerances, refer to Appendix H "Schedule of Tolerances" to this Specification and clause 7.5 of the Code of Practice for Foundations;
3. The permissible deviation shall not result in any part of the foundation element extending outside the site boundary.

PIL1.W220.9 EXCESSIVE DEVIATION

In the event of any pile varying from its correct position by more than either of the permitted tolerances for out of plumb and eccentricity, the CM may, if he deems it necessary, require the Contractor, to drive an additional pile or piles or to provide beams or other such works as are necessary to make good this or any other deviation.

PLANT AND EQUIPMENT

PIL1.W310.9 APPROVAL

Obtain Approval for plant and equipment before use.

PIL1.W320.9 SUBMISSIONS

1. Submit full details of plant, driving rig and hammer proposed to be used, with the tender;
2. For Type 7 piles, submit full details of plant, piling rig and auger proposed to be used, with the tender.

PIL1.W330.9 PILE HAMMER

1. Use a steel pile hammer capable of driving the pile to the required depth without overstressing or damage. For driven piles, ensure the weight of the hammer is at least half that of the pile and sufficient to achieve the required efficiency;
2. Where hydraulic hammers are used, submit technical details of both the hammer mechanism and instrumentation system. All hydraulic hammers should have on-board instrumentation capable of reporting the following data both for individual blows and for variable-sized groups of blows:
    a. Hammer model and serial no. (header only);
    b. Time and date (header only);
    c. Blow number;
    d. Blow-rate;

e. Impact energy;
f. Stroke height (single-acting only).

PIL1.W340.9 FOLLOWERS

Where followers are used, make allowance for a reduction of the efficiency of the pile hammers and the followers when calculating the driving resistance.

PIL1.W350.9 VERIFICATION OF EFFICIENCY

Verify the efficiency of the pile hammers and the followers by calculation and insitu demonstration.

PIL1.W360.9 VIBRATION CONTROL

1. Measure the peak particle velocity arising from piling and rock excavation machines and processes for foundation work;
2. Provide Approved equipment for measuring peak particle velocity for the exclusive use of the CM or his representatives and provide any necessary attendance during the course of the Contract;
3. Unless otherwise specified in the Project Specific Specification, comply with the requirements regarding peak particle velocity stated in Appendix A of PNAP APP-137 and clause 7.2.6 of the Code of Practice for Foundations;
4. Comply with any other requirements specified in the Project Specific Specification.

PIL1.W370.9 EXCESSIVE VIBRATION

Where the peak particle velocity is found to exceed the limits given in PIL1.W360 above, stop the machines or piling operations immediately:

1. Do not recommence work so suspended until effective means, or replacement machines, have been employed to reduce the peak particle velocity to within the acceptable limits;
2. Bear the cost of any stoppage under the terms of this clause and complete the Works without any consequent extension of time.

PIL1.W380.9 DEPLOYMENT OF SELF-OWNED PILING PLANTS FOR PILING CONTRACT

1. For the types of plants listed below which are required to be used on Site for piling works, deploy at least one number of self-owned plant for each type of the plants, unless otherwise allowed by the CM:
   a. Crawler crane;
   b. Oscillator or rotator;
   c. Reverse circulation drill (RCD);
   d. Pile driving hammer;
   e. Pile driving rig.
2. Comply with the following in deploying self-owned plants listed in sub-clauses (1)(a) to (1)(e) above:
   a. Self-owned plants shall mean plants owned by the Contractor or by the Contractor's parent, sister or subsidiary company for the exclusive use of the Contractor;
   b. All the plants deployed to Site shall be in good working conditions;
   c. Submit documents to prove the ownership of the plants and, if applicable, the relationship between the Contractor and the Contractor's parent, sister or subsidiary company;
   d. The self-owned plants deployed to Site in accordance with sub-clauses (1)(a) to (1)(e) may be used by the Piling Sub-contractor when necessary.

3. For piling works undertaken by Piling Sub-contractor, deployment of self-owned plants of the Piling Sub-contractor to Site shall comply with the requirements stated in PIL1.G590.

PIL1.W390.9 DEPLOYMENT OF SELF-OWNED PILING PLANTS FOR COMBINED PILING AND BUILDING CONTRACT

For piling works undertaken by Piling Sub-contractor, deployment of self-owned plants of the Piling Sub-contractor to Site shall comply with the requirements stated in PIL1.G600.

DRIVING

PIL1.W410.9 LENGTH OF DRIVEN PILES

Drive to a minimum net length below cut off level of 4500 mm.

PIL1.W420.9 PROXIMITY TO CAST INSITU PILES

Do not carry out driving within 3 m radius of any cast insitu pile within 48 hours of its being concreted.

PIL1.W430.9 DRIVING STRESSES FOR STEEL PILES

Do not exceed calculated driving stresses of 0.9 × yield stress unless Approved.

PIL1.W440.9 TEMPORARY BRACING FOR DRVIEN PILES

Provide such temporary bracings as may be required during construction that are capable of keeping each pile accurately in its correct position. The method of bracing must be acceptable to the CM and must not be removed without prior Approval.

PIL1.W450.9 BITUMEN SLIP LAYER FOR DRIVEN PILES

Choose from either of the following methods and submit, with the tender, details of the method it is intended to adopt:

1. Case driven piles with bitumen slip layer for the depth over which the bitumen slip layer is to be provided; or
2. Excavate the ground within the depth over which the bitumen slip layer is to be provided prior to piling, and return and well ram the excavated material to a density not less than that of the surrounding soil on completion of the piling.

PIL1.W460.9 PROPRIETARY PILES WITH PROTECTIVE COATING

Proprietary pile types incorporating a protective coating without the requirement of casing or excavation, may be accepted subject to demonstration of the coating's effectiveness under site conditions and to spot checks on site.

PIL1.W470.9 DRIVING PILES DESIGNED NOT TO REST ON BEDROCK - FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Drive each pile to such layer or level as may be determined by a pile driving formula or static formula as PIL1.D390, whichever is the deeper, proposed by the Contractor and Approved by the CM.

PIL1.W480.9 DRIVING PILES DESIGNED NOT TO REST ON BEDROCK - FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. Drive each pile to the level as may be determined by either sub-clause (1)(a) or (1)(b) as follows:

a.

i. The proposed minimum pile length based on agreed SPT-N≥200 contours as required in PIL1.W055 plus ……. m, unless otherwise accepted by the CM;

ii. Satisfying the Approved pile driving formula as required in PIL1.W070.

or

b. A pile depth greater than that required by sub-clause (1)(a) if considered necessary by the CM, after taking into account the ground conditions and other relevant information, and satisfying the Approved pile driving formula as required in PIL1.W070.

2. Adopt a pile installation method, including but not limited to pre-boring, to ensure the required depth of pile is achieved without any damage, dislocation in position, out of plumb and reduction of its load carrying capacity;
3. Do not drive a pile beyond the level as determined by sub-clause (1)(a)(i) unless it has been substantiated that the pile has not reached its design capacity at the level as determined by sub-clause(1)(a)(ii) by either final set measurements as specified in PIL1.W520 using the Approved pile driving formula as required in PIL1.W070, or the set measurements using hydraulic hammer as specified in sub-clause (5), as appropriate;
4. Unless otherwise approved by the CM, drive the pile to reach the level as determined by sub-clause (1)(a)(ii) progressively at an interval of not more than one metre beyond the level as determined by sub-clause (1)(a)(i) to avoid excessive driving of the pile. At the beginning of each of these intervals, take final set measurements as specified in PIL1.W520 using the Approved pile driving formula as required in PIL1.W070, or set measurements using hydraulic hammers as specified in sub-clause (5), as appropriate;
5. For any pile pitched by using hydraulic hammers and then driven to final sets by using drop hammers or other Approved types of hammers as allowed in PIL1.W520, establish a set of proposed hammer switching criteria for the CM's approval prior to installation of working piles to avoid excess pitching of the pile. The hammer switching criteria shall include but not be limited to a correlation between the final set measurements using drop hammers or other Approved types of hammers and the corresponding set measurements using hydraulic hammers, the results of pile driving analyser tests including CAPWAP analyses where appropriate, and the results of available static load tests;
6. Review the proposed hammer switching criteria as specified in sub-clause (5) in respect of their accuracy, reliability and applicability from time to time when more measurements and testing data are available, and submit any necessary revisions of the proposed hammer switching criteria to the CM for approval. No extra cost and extension of time shall be entertained in the establishment of the proposed hammer switching criteria including their subsequent revisions;
7. Bear the cost for any pile length driven beyond the level as determined by sub-clause (1)(a)(i) if the Contractor fails to take the final set measurements and / or the set measurements as specified in sub-clauses (4) and (5). The Contractor shall only be paid for the pile length to the level as determined by sub-clause (1)(a)(i);
8. Where a pile depth greater than that required by sub-clause (1)(a) is considered necessary by the CM as mentioned in sub-clause (1)(b) above, the full length of pile up to the depth as instructed by the CM shall be measured and paid accordingly;
9. Final set measurements and set measurements mentioned in the Specification shall include but not be limited to the measurements of set per blow, and temporary compression of pile and quake (elastic rebound) for determination of load carrying capacity of the pile.

PIL1.W490.9 DRIVING PILES DESIGNED TO REST ON BEDROCK

Drive piles designed without allowance for group reduction factor and based on founding on bedrock as defined in PIL1.G450 to refusal or to a final set not less than 10 blows per 10 mm with a hammer capacity adequate to allow twice of the safe load carrying capacity of the piles to be developed. Propose a pile hammer with details of the hammer, hammer efficiency and hammer capacity to be used, support the proposed hammer efficiency and hammer capacity by pile driving analyser tests and obtain approval from the CM before pile driving commences. For Type 4 piles designed to rest on bedrock, comply with clause 5.4.11 of the Code of Practice for Foundations and carry out test driving on at least two numbers of piles selected by the CM prior to commencement of pile installation.

PIL1.W500.9 FOUNDING LEVEL OF DRIVEN PILES

For foundation designed to rest on bedrock, carry all foundations down to the insitu decomposed rock or bedrock as defined in PIL1.G450, and do not allow founding on boulders.

PIL1.W510.9 PENETRATION OF DRIVEN PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

In addition to the requirements specified elsewhere in this Specification, ensure penetration of driven piles into insitu decomposed rock is adequate to allow the pile to develop twice the allowable bearing capacity specified in the Drawings.

PIL1.W515.9 PENETRATION OF DRIVEN PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

In addition to the requirements specified elsewhere in this Specification, ensure penetration of driven piles into insitu decomposed rock is adequate to allow the pile to develop twice the safe load carrying capacity stipulated in PIL1.D390.

PIL1.W520.9 FINAL SETS OF DRIVEN PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Use either of the following methods to drive the piles to final sets:

1. Use hydraulic hammers to drive the piles to final sets according to the modified Hiley formula specified in the Drawings;
2. Use drop hammers or other Approved types of hammers to drive the piles to final sets according to an Approved driving formula.

PIL1.W525.9 FINAL SETS OF DRIVEN PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Use either of the following methods to drive the piles to final sets:

1. Use hydraulic hammers to drive the piles to final sets according to the modified Hiley formula stated in PIL1.D390;
2. Use drop hammers or other Approved types of hammers to drive the piles to final sets according to an Approved driving formula.

PIL1.W530.9 STEEL SET CHAIR

Propose a steel set chair with a slot for CM’s agreement to restrict the vertical movement of pencil for recording the final set:

1. A schematic sketch of a conceptual design of the steel set chair is given by Drawing No. CPT/SC/S/SK001 in Appendix C to this Specification;
2. The sketch is for reference only and given in good faith without prejudice to the Contractor's responsibilities and liabilities under the Contract.

INSTALLATION OF TYPE 3 PILES

PIL1.W610.9 BELL-OUT

1. Form bell-out, if any, using an expandable drill bit mounted onto a reverse circulation drill rig or other means approved by CM;
2. Ensure that the size of the bell-out tools is checked and calibrated on ground before construction of the bell-out;
3. For Contractor's Design Piling Contract / Combined Piling and Building Contract, size of bell-out shall comply with clause 5.4.7 of the Code of Practice for Foundations.

PIL1.W620.9 RISK MANAGEMENT PLAN FOR TYPE 3 PILE

Submit to the CM a risk management plan for Type 3 Pile within 21 days from the notified date for commencement of the Works. The risk management plan shall include, but not be limited to, identification of possible risks arising from or in connection with the following which may affect the quality of pile and or delay concreting work of pile beyond the statutory permitted working hours:

1. Extraction of temporary steel casing;
2. Concrete supply;
3. Concreting equipment;
4. Complex geotechnical conditions.

The plan shall also include analysis, assessment and evaluation of the risks identified and measures or action plans for avoiding, reducing or eliminating the risks.

INSTALLATION OF TYPES 5, 6 AND 7 PILES

PIL1.W710.9 GENERAL

Install piles without the use of bentonite slurry or other drilling muds.

PIL1.W720.9 TRIAL PILES

1. For Types 5 and 6 piles, install one vertical trial pile:
   a. At a location agreed by the CM before the installation of any pile;
   b. To demonstrate that the Contractor's proposed installation method will produce piles complying with this Specification; and
   c. To carry out loading test according to the load testing requirements for working piles as and when Instructed.
2. For Type 7 piles, install at least two trial piles:
   a. Of such length as calculated using two μ values agreed by the CM, taking into account the Contractor's capability and equipment to be used in pile installation, for the safe load carrying capacity;
   b. At a location agreed by the CM before the installation of any pile;
   c. To demonstrate that the Contractor's proposed installation method will produce piles complying with this Specification; and
   d. To carry out loading test according to the load testing requirements for working piles as and when Instructed in order to validate the design and method of construction and to determine an appropriate μ value for the design of piles.
3. Subject to the CM's approval, a working pile may be selected as the trial pile;
4. For Types 6 and 7 piles, prior to installation of any other piles, submit a trial pile test installation report including but not be limited to the anticipated rates of advancement of boring operation in different soil/rock strata for the remaining piles upon satisfactory completion of trial pile installation.

PIL1.W730.9 INCLINATION OF PILES

1. For Types 5 and 6 piles, check the inclination of piles, during installation, at every pile location. Arrange for a number of piles, as directed by the CM, to be checked by the use of an inclinometer or other Approved method before grouting and record the inclinations and orientations of the holes;
2. For Type 7 piles, check the inclination of piles, during installation, at every pile location. Arrange for a number of piles, as directed by the CM, to be checked by the use of an Approved method before grouting and record the inclinations and orientations of the holes.

PIL1.W740.9 CHANGE IN SUB-SOIL CONDITIONS FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

If, during the installation of the piles, the excavated materials are found to be different from those specified in this Specification / the Drawings, or if such a situation is suspected, notify the CM.

PIL1.W745.9 CHANGE IN SUB-SOIL CONDITIONS FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

If, during the installation of the piles, the sub-soil conditions prove to be different from those in the submitted design, or if such a situation is suspected, notify the CM and submit proposals to cope with the revealed sub-soil conditions.

PIL1.W750.9 PREBORED HOLE AND COVER FOR TYPE 6 PILES

Ensure that the prebored hole shall be large enough to enable the installation of the steel H-pile and to allow a minimum cover of 40 mm to the steel H-pile (except at the base). Before inserting the steel H-pile in the prebored hole, ensure that the hole shall be cleaned and free from debris and soil.

PIL1.W760.9 TEST BORING PROPOSAL FOR TYPE 6 PILES

Provide test boring proposal giving details of the actual boring system to be used on Site, operating mechanism of the drill bit, maximum volume of air supply and pressure to be applied in different soil and rock strata, minimum rate of advancement of drill bit, ground and piezometer monitoring arrangement, criteria for satisfactory performance of the boring operation, monitoring procedures for checking the rates of boring operation and any necessary precautionary measures to prevent excessive overbreak or ground loss and undue disturbance to sub-soil.

PIL1.W770.9 TEST BORING PROPOSAL - TYPE 7 PILES FOR CONTRACTOR'S DESIGN

Prior to installation of trial piles and working piles, submit test boring proposal for the installation of Type 7 piles, which shall include but not be limited to the following information for the CM's approval:

1. Full technical details of the piles including grout strength, reinforcement details, cover to reinforcement, pile diameters and lengths;
2. Method statements for pile installation including equipment to be used, sequences of operation, drilling method, grouting method and installation of reinforcement cage;
3. All temporary works and precautionary measures required for prevention of settlement of adjacent ground during piling operation;
4. Ground settlement monitoring proposal;
5. Method of overcoming underground obstructions;
6. Grout mix and admixture;
7. Grout rate and pressure;
8. Minimum grout head to be maintained;

9. Testing regime and quality control for grouting;
10. Contingency plan for inclement weather during grouting and back-up plant and grout pump in case of breakdown.

PIL1.W775.9 TEST BORING PROPOSAL - TYPE 7 PILES FOR ENGINEER'S DESIGN

Prior to installation of trial piles and working piles, submit test boring proposal for the installation of Type 7 piles, which shall include but not be limited to the following information for the CM's approval:

1. Method statements for pile installation including equipment to be used, sequences of operation, drilling method, grouting method and installation of reinforcement cage;
2. All temporary works and precautionary measures required for prevention of settlement of adjacent ground during piling operation;
3. Ground settlement monitoring proposal;
4. Method of overcoming underground obstructions;
5. Grout mix and admixture;
6. Grout rate and pressure;
7. Minimum grout head to be maintained;
8. Testing regime and quality control for grouting;
9. Contingency plan for inclement weather during grouting and back-up plant and grout pump in case of breakdown.

PIL1.W780.9 INSTALLATION PROCEDURES FOR TYPE 7 PILES

1. In this clause, the following definitions are used:
   a. Incremental grout factor for 1.5 m increment - Actual grout volume placed divided by theoretical grout volume for the 1.5 m increment;
   b. Total grout factor - Actual grout volume placed divided by theoretical grout volume of pile;
   c. Grout-return depth - The depth of the auger tip when the grout on the auger flight reaches the ground surface;
   d. Auger refusal - The rate of auger penetration is less than 300 mm per minute of drilling.
2. Ensure that the size of the auger is checked and verified on ground before excavation of the piles. Advance the auger at a continuous rate preventing removal of excessive soil. Stop advancement after reaching the required embedment depth;
3. Prior to raising the auger, maintain a minimum grout head of 2 m. Determine the grout quantity by counting pump strokes and using the pre-determined grout volume per pump stroke. Maintain positive (clockwise) rotation of the auger at all times during placement of the grout. Coordinate the rate of grout injection and auger withdrawal so as to maintain:
   a. Sufficient grout head at all times;
   b. The incremental grout factor for each 1.5 m increment shall be not less than the smallest value obtained in the trial pile installation and in no case less than 1.15;
   c. The total grout factor shall be not less than the value established in the trial pile installation and in no case less than 1.4;
   d. The grout-return depth shall be equal to or greater than the grout head pumped at the bottom of the pile and shall be at least 2 m.
4. If grout pumping is interrupted for any reason, or if discontinued grout or slurry return at the ground surface is observed, or when grout pumping is interrupted or discontinued during pumping each truckload of grout, lower the auger at least 1.5 m below the level where the interruption occurred while pumping grout continuously;

5. If the volume of grout placed in any 1.5 m increment resulting in the incremental grout factor less than the minimum value observed in the trial pile installation, lower the auger 1.5 m or to the bottom of the pile if that is less, followed by controlled auger withdrawal while maintaining grout injection;
6. Provide auger turning and hoisting equipment enabling the auger to be rotated continuously in a positive (clockwise) direction while being withdrawn at a steady and continuous rate while pumping grout;
7. Clear away promptly the excess spoil accumulated around the auger due to the drilling process and grout injection;
8. Reinforcement cages to be free of soil, auger spoil or other deleterious materials prior to insertion into the grouted shafts;
9. Upon completion of the grouting operation and before the grout reaching its initial set, install the reinforcement cage immediately by lowering the reinforcement cage under its own weight to the specified level within the pile shaft. Prohibit vibrating or pushing the cage with equipment;
10. Pile excavation shall not be carried out within a centre to centre distance of 6 pile diameters from any pile under excavation or any newly cast pile with completion time elapsed not more than 24 hours.

PIL1.W790.9 REVIEW LOADING TEST RESULTS AND PROPOSED PILE LENGTHS - TYPE 7 PILES FOR CONTRACTOR'S DESIGN

1. After completion of loading tests of trial piles with satisfactory results, review and revise the method statements and proposed pile lengths submitted under PIL1.W770 as necessary. Prior to commencement of working piles, submit the revised method statements and proposed lengths of working piles with technical justifications to the CM for approval;
2. The proposed pile lengths in sub-clause (1) above shall in no case be less than the design pile lengths specified in the Contract. Bear all costs and time so incurred for any extra pile lengths installed beyond those specified in the Contract.

PIL1.W795.9 REVIEW LOADING TEST RESULTS - TYPE 7 PILES FOR ENGINEER'S DESIGN

After completion of loading tests of trial piles with satisfactory results, review and revise the method statements as necessary. Prior to commencement of working piles, submit the revised method statements with technical justifications to the CM for approval.

FOUNDING OF BORED PILES

PIL1.W810.9 FOUNDING OF TYPE 3 PILES

1. Comply with the following requirements for Contractor's Design Piling Contract / Combined Piling and Building Contract:
   a. Excavate to form foundation for Type 3 piles so that the pile bases are socketed into bedrock as previously described in PIL1.G450 and the socket depth shall comply with Note (3) of Table 2.1 of the Code of Practice for Foundations, or such other depths specified by the CM;
   b. If the centre to centre spacing of two adjacent Type 3 piles is less than 2.5 times the diameter of the larger pile base and the difference in founding levels of these two piles is greater than the clear distance between their bases on plan, justify to the CM's satisfaction by an elastic analysis that:

i. The compressive stress in the longer pile, including any additional stress induced by the shorter pile and/or any additional stress induced by any unfavorable ground conditions, will not exceed the limiting value set in PIL1.D360; and

ii. The bearing stress on the founding material supporting the longer pile, including any additional stress induced by the shorter pile and/or any additional stress induced by any unfavorable ground conditions, will not exceed the safe load carrying capacity set in PIL1.D390;

iii. When Instructed, carry out additional ground investigation works to justify the subsurface conditions assumed in his analysis to the CM's satisfaction at no additional cost and time.

c. Notwithstanding the requirements of sub-clause (b) above, comply also the requirements stated in the last paragraph of clause 5.4.7 of the Code of Practice for Foundations, where steep bedrock profile is identified;

2. Comply with the following requirements for Engineer's Design Piling Contract / Combined Piling and Building Contract:

Excavate to form foundation for Type 3 piles so that the pile bases are socketed into bedrock as previously described in PIL1.G450 and the socket depth shall comply with Note (3) of Table 2.1 of the Code of Practice for Foundations, or such other depths specified by the CM.

PIL1.W820.9 FOUNDING OF TYPES 5 AND 6 PILES

Found the rock socket in bedrock as PIL1.G450.

PIL1.W830.9 PROVING BEDROCK

1. See PIL1.T220 for Type 3 piles; and
2. See PIL1.T230 and PIL1.T250 for Types 5 and 6 piles.

UNDERGROUND OBSTRUCTIONS

PIL1.W910.9 OBSTRUCTIONS TO PILES FOR CONTRACTOR'S DESIGN

1. When underground obstructions are encountered at any depth during piling operations, propose full details of the intended means of overcoming underground obstructions (the "intended means") for Approval prior to the works being put in hand, which Approval shall not relieve the Contractor of the responsibility for designing, constructing and completing the Works in accordance with the Contract;
2. The intended means shall not cause any adverse impact including, but not limited to, considerations of lateral stability, safe load carrying capacity and/or structural integrity, on the pile to be constructed and the piles already constructed; and
3. The Approved intended means shall be implemented and the obstructions shall be overcome by the Contractor at his own risk in respect of cost and time including the cost and time necessary to obtain Approval.

PIL1.W915.9 OBSTRUCTIONS TO PILES FOR ENGINEER'S DESIGN

1. When underground obstructions are encountered at any depth during piling operations, propose full details of the intended means of overcoming underground obstructions (the "intended means") for Approval prior to the works being put in hand, which Approval shall not relieve the Contractor of the responsibility for constructing and completing the Works in accordance with the Contract; and
2. The intended means shall not cause any adverse impact including, but not limited to, considerations of lateral stability, safe load carrying capacity and/or structural integrity, on the pile to be constructed and the piles already constructed.

PIL1.W920.9 INTENDED MEANS OF OVERCOMING UNDERGROUND OBSTRUCTIONS TO PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Subject to Approval, the intended means stated in PIL1.W910 may include, but are not limited to, the following:

1. For Type 1, 2 and 4 piles,
   a. Re-design of piles and/or pile caps;
   b. Extraction and re-driving of piles;
   c. Abandonment of piles and provision of replacement piles; and/or
   d. Removal of underground obstructions by excavation and/or pre-boring through the underground obstructions.
2. For Type 3 piles,
   a. Re-design of piles and/or pile caps;
   b. Abandonment of piles and provision of replacement piles; and/or
   c. Removal of underground obstructions by excavation and/or chiseling.
3. For Type 5, 6 and 7 piles,
   a. Re-design of piles and/or pile caps;
   b. Abandonment of piles and provision of replacement piles; and/or
   c. Removal of underground obstructions by excavation and/or coring through the underground obstructions.

PIL1.W930.9 INTENDED MEANS OF OVERCOMING UNDERGROUND OBSTRUCTIONS TO PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Subject to Approval, the intended means stated in PIL1.W910 may include, but are not limited to, the following:

1. For Type 1, 2 and 4 piles,
   a. Extraction and re-driving of piles; and/or
   b. Removal of underground obstructions by excavation and/or pre-boring through the underground obstructions.
2. For Type 3 piles, removal of underground obstructions by excavation and/or chiselling;
3. For Type 5, 6 and 7 piles, removal of underground obstructions by excavation and/or coring through the underground obstructions.

PIL1.W940.9 DESIGN CHANGES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Where the intended means of overcoming obstructions involve any changes to the design of the piles and pile caps accepted by the Employer at the date of acceptance of the Tender, any reduction in cost as may have resulted from the changes shall be subject to reduction in accordance with the provision of the Contract.

PIL1.W950.9 EXCAVATION OR PRE-BORING

Where underground obstructions are removed by excavation or pre-boring, cart away the excavated materials and backfill the boreholes or voids with Special Fill Material or other materials approved by the CM, well compacted, all to Approval.

PIL1.W955.9 SUBMISSION ON OVERCOMING ANTICIPATED UNDERGROUND OBSTRUCTIONS BEFORE PILE DRIVING OPERATION FOR TYPE 4 PILES

1. Within 14 days from the notified date for commencement of the Works and before pile driving operation, submit a detailed proposal for overcoming anticipated underground obstructions to the CM for approval, taking into account the Contractor's own resources of labour, plant and equipment. The proposal shall not cause any adverse impact to, including but not be limited to, lateral stability, bearing capacity, and / or structural integrity of the pile to be constructed and the piles already constructed;
2. In the event that pre-boring is proposed to be adopted for overcoming anticipated underground obstructions as per sub-clause (1) above, the proposal shall also include detailed planning of locations and depths of wash bored holes and / or other methods acceptable to the CM to identify the extent, locations and depths of the anticipated underground obstructions;
3. Subject to no adverse comment by the CM, carry out the investigation as in sub-clause (2) above at the Contractor's own time and cost to identify the extent, locations and depths of the anticipated underground obstructions. In case wash bored holes are proposed, they shall be conducted by a RSC(GIFW) as specified in PIL1.G460;
4. Within 7 days upon completion of the investigation, prepare and submit to the CM for agreement a layout plan showing the number, locations and depths of the proposed pre-bored holes, which shall be reviewed and resubmitted when more information about the anticipated underground obstructions is available. The CM will consider available ground investigation, wash-boring results, other investigation findings, and other supporting documents as he considers relevant in approving or disapproving the proposed pre-boring requirements. The CM shall have sole discretion on the location and depth of pre-bored holes;
5. Subject to the approval by the CM, carry out the pre-bored holes to remove the anticipated underground obstructions. The Contractor shall make due allowance in his programme and pricing to comply with this requirement;
6. The Contractor shall be entitled to payment for the cost of Approved pre-boring work valued at the rates priced in the Bills of Quantities, but not be entitled to any claim for extension of time or any other cost claim. For the avoidance of doubt, irrespective of the repetitive operations of Approved pre-boring work done for the installation of a pile due to multi-layers of obstructions, the Contractor is only entitled to payment for one pre-bored hole based upon the deepest depth of pre-boring, subject to the requirement that the pile is successfully installed eventually;
7. When the pre-boring proposed by the Contractor for a specific pile location was disapproved by the CM, but subsequently underground obstructions are encountered during installation of the pile and pre-boring is further proposed by the Contractor and Approved by the CM, the Contractor is entitled to payment for the cost of pre-boring as per sub-clause (6) above but not entitled to any claim for extension of time or any other additional cost;
8. When no ground investigation and no pre-boring as in sub-clause (2) above are proposed by the Contractor for a specific pile location, but underground obstructions are encountered during installation of the pile and pre-boring is proposed by the Contractor and Approved by the CM, the Contractor is not entitled to payment for the cost of pre-boring and any claim on extension of time. The Contractor shall bear the risk in respect of cost and time to overcome the underground obstructions for that pile;
9. Other than the payment as per sub-clauses (6) and (7) above, the Contractor shall not be entitled to any other additional costs or claim for extension of time in connection with overcoming underground obstructions;

10. Bear all responsibility in the planning, executing and completing the Works and allow sufficient time in programme of the Works for the above requirements.

PILE SHAFT CASINGS

PIL1.W1010.9 LININGS TO INSITU PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. Provide left-in steel linings when cast insitu piles are used and:
   a. Extend the lining from cut-off level down to a level as given in the Project Specific Specification;
   b. Ensure that the length of the lining is adequate for the purpose;
   c. Increase the depth of the lining to suit actual site conditions, to prevent necking and bear the cost and time of such lengthening; and
   d. Ensure that the lining does not protrude above the cut-off level or down into the bell-out and/or the designed rock socket.

PIL1.W1015.9 LININGS TO INSITU PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. Provide left-in steel linings as given in the Project Specific Specification.

PIL1.W1020.9 PILE TYPE 2

Until insertion of precast concrete units, case the pile shafts for their entire length or for such length acceptable to the CM. Ensure casing is watertight and of sufficient strength to withstand soil pressure. Obtain Approval for details of casing.

PIL1.W1024.9 TEMPORARY CASING FOR TYPE 3 PILES

1. Provide temporary casing to the pile shaft for its entire length down to the inferred rockhead level of bedrock or such other depths acceptable to the CM;
2. Ensure casing is watertight and of sufficient strength to withstand soil pressure. Obtain Approval for details of casing;
3. Carry out all measures as considered necessary to prevent collapse of the bored hole during excavation and concreting;
4. Bear all responsibility in planning, executing and completing the Works and allow sufficient time in the programme of the Works for the above requirements; and
5. Bear all additional costs, including the cost of any temporary casing inevitably left in the ground in the course of pile construction for whatever reason by Contractor and no extension of time will be entertained for complying with the requirements of this clause.

PIL1.W1027.9 LEFT-IN TEMPORARY CASING FOR TYPE 3 PILES

1. When specified in the Drawings or as Instructed, leave the temporary casing behind to such depth as determined by the CM;
2. The Contractor may adjust the left-in temporary casing in sub-clause (1) above to a lower depth as considered necessary to suit the proposed method and sequence of construction. In this case, the Contractor shall bear all additional costs and no extension of time will be entertained for the adjustment.

PIL1.W1030.9 TYPE 5 PILES

Case pile shafts for their entire length except for that section in bedrock and ensure:

1. Casings are joined, where necessary, with watertight joints;
2. Casings are clean and free of any material adhering to them when first inserted into the pile position;

3. Dents in the casings do not exceed 5 mm in depression;
4. The gap between the casing and soil is filled with grout or other Approved material.

PIL1.W1040.9 TEMPORARY CASING FOR TYPE 6 PILES

1. Ensure that temporary casing shall be lowered at the same time when the hole is made and that the casing must be seating on rock head or top of rock socket before the rock socket hole is formed;
2. Ensure also that the temporary casing shall be free from distortion, internal projection and hardened grout.

GROUTING PILE TYPES 2 AND 3

PIL1.W1110.9 PRESSURE GROUTING

Where pressure grouting is required for the type of piling system proposed for this Contract, submit proposals for and details of the grouting with the tender.

PIL1.W1120.9 BASE OF TYPE 3 PILES

Grout the base of large diameter bored piles if soft material, debris, mud etc is found between the bottom of the concrete and the bearing stratum by test and:

1. Obtain Approval for the proposal and details of the grouting.

GROUTING TYPES 5, 6 AND 7 PILES

PIL1.W1210.9 BATCHING

1. Batch dry materials by weight;
2. Measure the amount of water used by use of a calibrated flowmeter or a measuring tank.

PIL1.W1220.9 USE OF ADMIXTURES

State the use of admixtures prior to the commencement of trial piling and give evidence that the admixtures:

1. Will allow pumping to be carried out successfully;
2. Will yield concrete or grout of the required strength and durability;
3. Have been used successfully in previous practice.

PIL1.W1230.9 MIXING AND SIEVING

1. Mix grout by adding approximately two thirds of the cement to the water, followed by the additive, if any, then followed by the remaining third of the cement;
2. Use a high speed colloidal grout mixer with a minimum speed of 1000 rpm and mix for a sufficient time to produce a grout of uniform consistency;
3. Obtain Approval for the use of any alternative mixing procedures;
4. After mixing, keep the grout continuously agitated and, prior to injection, pass the grout through a nominal 2.36 mm sieve;
5. Use the grout as soon as possible after mixing and, in any case, within 30 minutes of the addition of cement unless special retarding agents are used.

PIL1.W1240.9 TESTING

Test after mixing and sieving and before injection as PIL1.T330.

PIL1.W1250.9 PREPARATION (FOR TYPES 5 AND 6 PILES)

Before steel reinforcement and/or steel H-pile is inserted in the pre-bored hole, clean the hole to ensure that it is free from debris and soil by a method approved by the CM.

PIL1.W1260.9 INJECTION

Obtain prior Approval for the method of placing the grout and:

1. Use an injection pump of the positive displacement type;
2. Measure the grout intake volume by a method agreed by the CM. Calibrate the measuring device and submit a calibration report to the CM 7 days before trial mix of grout is made;
3. Fill the entire shaft, inside the casing, solidly with grout, without voids, honeycombing or other defects; and
4. Cast each pile in one continuous operation and under no circumstances leave a pile partially grouted even if this involves working beyond normal hours and rates are to allow for such circumstances.

CONCRETING

PIL1.W1310.9 GENERAL

1. Obtain Approval for the method of placing concrete;
2. Ensure that the entire shaft is solidly filled with concrete without voids, honeycombing or other defects.

PIL1.W1320.9 TYPE 3 PILES

For Type 3 piles, concrete may be placed under water subject to Approval and on submission of details. Clean the base of the excavation by using air lifting equipment or other Approved method, all subject to Approval.

PIL1.W1330.9 CONTINUITY FOR TYPES 1c, 3 AND 5 PILES

1. Cast each pile in one continuous operation. In no case will it be permissible for a pile to be left partly concreted;
2. Submit a concreting plan for each Type 3 pile to the CM at least one week prior to commencement of concreting works to the respective pile for agreement. The concreting plan shall include an hourly concreting schedule and contingency measures to be taken for any slippage in concreting which may affect the timely completion of the scheduled concreting works. The contingency measures shall include, but not limited to, abandoning the retraction of part or entire length of the temporary casing to shorten the concreting time.

PIL1.W1340.9 REINFORCEMENT TO PILE TYPES 1 AND 2

Distribute reinforcement for pile types 1 and 2 uniformly. Ensure reinforcement is sufficient to withstand handling and driving stresses without fracture or cracking of the concrete.

PIL1.W1350.9 REINFORCEMENT TO TYPE 5 PILES

Lengthen the reinforcement by staggering the couplers using Approved methods. Separate each reinforcement bar by spacers at regular intervals.

FINISHING OFF PILE HEADS

PIL1.W1410.9 CAST INSITU PILES

Cast insitu piles to a level of 750 mm above cut off levels.

PIL1.W1420.9 CUT OFF LEVELS

The top of pile cap levels shown on tender Drawings are provisional and may be altered if so required by the CM. It follows that the cut off levels of piles may also be varied. However, the extent of the variations will be limited to ±1 metre of the levels shown on the tender Drawings.

PIL1.W1430.9 CUTTING AND TRIMMING

1. For Type 7 pile, a minimum period of 7 days has to elapse after completion of pile casting prior to cutting and trimming of pile head;
2. Excavate to expose, cut off and trim pile heads to the required levels, backfill with General Filling Material and import Special Filling Material to make up voids, and remove debris from Site.

PIL1.W1440.9 PRELIMINARY AND ABANDONED PILES

Excavate to expose, cut off and trim pile heads of any non-working preliminary piles to 2000 mm below finished ground level and of any abandoned piles to a level as given in the Project Specific Specification and backfill with General Filling Material, importing Special Filling Material to make up voids, and remove debris from Site.

PIL1.W1450.9 DOWEL BARS

For concrete piles, provide dowel bars. Straighten dowel bars subsequent to trimming pile head.

PIL1.W1460.9 CUTTING OFF STEEL PILES

For steel piles, execute cutting by Approved means. In the event of damage being done to the head of the pile, cut off the defective parts and make good the pile to the satisfaction of the CM.

PIL1.W1470.9 BEARING PLATES FOR STEEL PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. Weld a bearing plate to the top of each steel pile and ensure bearing plates are installed in accordance with the Drawings so that the imposed loads on bearing plates do not exceed the capacities of bearing plates as allowed in the Code of Practice for the Structural Use of Steel 2011.

PIL1.W1475.9 BEARING PLATES FOR STEEL PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. Weld a bearing plate to the top of each steel pile, sufficient to transfer the required load all to Approval;
2. Ensure bearing plates are proportioned so that the imposed loads on bearing plates do not exceed the capacities of bearing plates as allowed in the Code of Practice for the Structural Use of Steel 2011.

PIL1.W1480.9 ALTERNATIVE LOAD TRANSFER DETAILS FOR STEEL PILES

Obtain Approval for alternative load transfer details.

PIL1.W1490.9 WORK AT COMPLETION (WHERE CONSTRUCTION OF PILE CAP DOES NOT FORM PART OF THE CONTRACT)

At completion of the Works, where the method of working gives rise to changes in the levels from those agreed at the commencement of the Works, level off the Site to remove all high spots and fill in all hollows.

PILING RECORDS

PIL1.W1510.9 GENERAL

Keep accurate and comprehensive records of each pile installed and submit daily a copy of these records signed by the site representative, to the CM, of each pile installation to its final position.

PIL1.W1520.9 STANDARD FORM

Keep each record on standard forms as shown in Appendices III and IV to this Worksection showing, as appropriate to pile type, the following:

1. Pile reference number;
2. Date pile driven or installed;
3. Position of pile in the works and ground level at pile position;
4. Type and size of hammer and stroke;
5. Set throughout penetration of pile including the set for the last ten blows;
6. Measurements of temporary compression in the pile;
7. Details of any interruption in driving of the pile;
8. Details of obstructions and delays;
9. Level of tip of pile after completion of driving;
10. Length of pile;
11. Volume of concrete or grout placed in pile;
12. Length and toe level of casing;
13. Drilling rate and materials encountered;
14. Inclination of pile as installed per metre depth of pile;
15. Any other data requested by the CM;
16. Penetration of pile into bedrock.

PIL1.W1525.9 PILING RECORDS FOR TYPE 7 PILES

Keep each pile installation record in an approved format for the following:

1. Pile reference number;
2. Weather conditions and temperature;
3. Date pile installed;
4. Position of pile in the works and ground level at pile position;
5. Grout truck number, arrival time on-site, batch time and batch volume;
6. Grout sampling time and time of initial set;
7. Grout cubes made by the Contractor;
8. Flow cone test results;
9. Auger diameter (actual diameter each time measured in field);
10. Time period for drilling of pile;
11. Rate of penetration of auger (revolution per auger pitch);
12. Abnormal drilling behaviour;
13. Details of obstructions and delay;
14. Pile drilled length/pile tip and top elevation;
15. Theoretical pile volume;
16. Time period for grouting of pile;
17. Range in pressure observed during grouting;
18. Grout return depth;

19. Grout volume pumped per 1.5 m increment of pile length;
20. Total number of pump strokes to complete pile (actual grout volume);
21. Total grout factor;
22. Reinforcing steel cage installed in the pile;
23. Special remarks (e.g. time of and reason for interruptions during grouting, extra grout cubes made);
24. Any other data requested by the CM.

PIL1.W1530.9 RECORDS OF TEMPORARY COMPRESSION FOR DRIVEN PILE

Keep and submit to the CM records of field measurements of temporary compression during the driving of the piles to the final set stages by recording same on a card or graph paper attached to the face of the pile.

PIL1.W1540.9 SUBMISSION OF RECORD PLAN

After completing all piling works of a block/structure or part of a block/structure as agreed by the CM, furnish to the CM four copies of a piling record plan showing, as appropriate, the position, identity number, length and final set of all the piles installed for that block/structure or that part of the block/structure. The piling record plan should not contain any amendments which have not been Approved. Submit four copies of a record plan showing offset of piles, if any. In addition, submit electronic copies of the record plans in a format as required by the CM.

PIL1.W1550.9 FOUNDING LEVEL RECORD

Provide a record of the founding level of the bedrock, for Approval.

PIL1.W1560.9 BORING RECORDS FOR TYPES 6 AND 7 PILES

Provide boring records in accordance with PIL1.W1510, PIL1.W1520, PIL1.W1525, PIL1.W1540 and PIL1.W1550 and including the advancement rate of drill bit, air/grout pressure used, volume of air/grout supply, flushing medium, settlement and groundwater drawdown records, as appropriate to pile type.

REMEDIAL MEASURES

PIL1.W1610.9 PILES DESIGNED TO REST ON BEDROCK FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

When piles originally designed in accordance with PIL1.D410 do not satisfy the founding conditions stated in that clause or the workmanship requirement stated in PIL1.W490, the original design would be rejected. In this case, redesign the pile(s) in the same pile cap already installed and to be installed, as piles not found on bedrock in accordance with all the requirements for piles not found on bedrock.

PIL1.W1620.9 RISING PILES (FOR DRIVEN PILE)

1. Measure the top level of each pile immediately after driving to such a layer or level as is required;
2. Carry out further levelling checks for pile rising as and when directed by the CM;
3. Re-drive piles which have risen for any reason, to the original level (or to such other level as the CM may determine) unless otherwise directed by the CM.

PIL1.W1630.9 DEFECTIVE PILES

If in the opinion of the CM, any pile is defective because of the pile having been constructed or driven outside the specified tolerances or having been damaged during driving or by the construction of another pile nearby or otherwise failing to conform to this Specification:

1. Pull out and replace the pile with a sound pile complying in all respects with the requirements of this Specification;
2. If the pile cannot be pulled out, carry out Approved remedial measures.

PIL1.W1640.9 NON-COMPLIANCE (FOR TYPE 7 PILES)

For Type 7 piles not complying with the specified requirements stated in PIL1.W780:

1. Lower the auger to the bottom of the pile while the grout is still fluid and re-grout the bored hole; or otherwise,
2. Demonstrate to the CM by tests that the piles in doubt can sustain the design loading. Bear all costs and no extension of time is allowed for such tests as a consequence of the above non-compliance; and
3. If the test results indicate that the piles in doubt fail to sustain the design loading, bear all costs and no extension of time is allowed for the execution of remedial measures, including but not limited to the installation of additional piles and modifications of tie beams and pile caps.

SPLICING PILES

PIL1.W1710.9 GENERAL

Where lengthening of a pile becomes necessary, or is directed by the CM, carry it out by the method directed or by any other Approved method. Do not resume the driving of a lengthened pile without the permission of the CM.

PIL1.W1720.9 STRENGTH OF SPLICES

Whenever necessary to splice a pile, the strength of the pile at the splice must be no less than the strength of pile at any normal section of the pile. Submit full details of proposed splicing methods with the tender.

WELDING

PIL1.W1810.9 TESTING OF WELDERS

As Worksection STR1.

PIL1.W1820.9 ADVERSE WEATHER CONDITIONS

Do not carry out welding under adverse weather conditions as determined by the CM.

PIL1.W1830.9 WELDED JOINTS

Joint all piles by butt-welding in such a manner that the full strength of the original section is developed and:

1. Provide adequate facilities for supporting and aligning piles prior to welding;
2. Ensure that the joints are waterproof in the case of pipe piles.

PIL1.W1840.9 TACK WELDS

Keep tack welds to a minimum.

PIL1.W1850.9 STANDARDS

Weld by electric arc welding:

1. Comply with Worksection STR1 for welding Standards;
2. Where grade S450 steel H-piles are used, ensure that welding procedures is carried out on Site and Approved.

PIL1.W1860.9 PREPARATION

Ensure the surface to be welded is free from all scale, grease, paint and rust and other matter.

PIL1.W1870.9 PILE SHOES

Ensure welding is:

1. Adequate to transmit the ultimate pile load and to prevent the detachment of the points in the case of withdrawal to remove obstructions;
2. In accordance with the manufacturer's recommendations.

PIL1.W1880.9 FINISHING

After every run of weld, chip out slags, and thoroughly wire brush surfaces.

PIL1.W1890.9 DEFECTS

Make good any defects in a weld, such as distortion, spatter, cracks, undercut, slag holes, unequal width of bead, irregular ripple etc to the satisfaction of the CM.

PIL1.W1900.9 ETCHED SECTIONS

Submit etched sections to the CM for examination when required.

RECORDS AND CERTIFICATES

PIL1.W2010.9 REPORT ON COMPLETION OF PILING WORKS FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. After all piles of a block or part of a structure as agreed by the CM have been installed, submit four copies of a report on completion of the piling works for that block or that part of the structure. The report shall be signed by the Authorized Signatory and the TCP Grade T4 as specified in the SP for foundation works and include the following:
    a. Scope of the Works and foundations adopted;
    b. General description of the geology of the Site, including an assessment report with rockhead contour plans as appropriate and at least one geological cross-section of the ground beneath that block or that part of the structure indicating the inferred soil layers' SPT - N values, bedrock and pile tip levels;
    c. Piling records as PIL1.W1510 to PIL1.W1560;
    d. Schedule and summary of all pile test results excluding the proof tests specified in PIL1.T030;
    e. As-built piling design certified by the Design Certifying Consultant;
    f. Details of laboratory tests, instrumented pile tests and other load tests if the soil parameters given in this Specification have been modified;
    g. Settlement analysis as PIL1.D510 to PIL1.D570 certified by the Design Certifying Consultant;
    h. Final ground investigation reports prepared by the Ground Investigation Contractor;
    i. Authorized Signatory's certification confirming that the completed piling works are satisfactory for the purpose intended and the piles, as installed, are properly penetrated into insitu decomposed rock or onto bedrock as approved by the CM;

j. Report of remedial work, if any;

k. Any other relevant information;

l. Conclusion.

2. After submitting the report specified in sub-clause (1) above, request the CM to select piles for proof tests. The Contractor may, however, seek the CM's agreement to select piles for proof tests after submitting part of the report; in such an event, submit the outstanding part of the report not later than the time of submitting Form ICU14 as specified in sub-clause (3) below. Allow the CM 21 days to select piles for proof tests in accordance with PIL1.T030. If resubmission of the report is required, allow the CM another 21 days to select piles for proof tests after resubmission;

3. Upon satisfactory completion of the proof tests, complete and submit Form ICU14 and report of further remedial work, if any, to the CM on block by block basis, unless otherwise agreed by the CM.

PIL1.W2020.9 REPORT ON COMPLETION OF PILING WORKS FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. After all piles of a block or part of a structure as agreed by the CM have been installed, submit four copies of a report on completion of piling works for that block or that part of the structure. The report shall be signed by the Authorized Signatory and the TCP Grade T4 as specified in the SP for foundation works and include the following:

   a. Scope of the Works and foundations adopted;

   b. General description of the geology of the Site, including an assessment report with rockhead contour plans as appropriate and at least one geological cross-section of the ground beneath that block or that part of the structure indicating the inferred soil layers' SPT - N values, bedrock and pile tip levels;

   c. Piling records as PIL1.W1510 to PIL1.W1560;

   d. Schedule and summary of all pile test results excluding the proof tests specified in PIL1.T030;

   e. Final ground investigation reports prepared by the Ground Investigation Contractor;

   f. Authorized Signatory's certification confirming that the completed piling works are satisfactory for the purpose intended and the piles, as installed, are properly penetrated into insitu decomposed rock or onto bedrock as approved by the CM;

   g. Report of remedial work, if any;

   h. Any other relevant information;

   i. Conclusion.

2. After submitting the report specified in sub-clause (1) above, request the CM to select piles for proof tests. The Contractor may, however, seek the CM's agreement to select piles for proof tests after submitting part of the report; in such an event, submit the outstanding part of the report not later than the time of submitting Form ICU14 as specified in sub-clause (3) below. Allow the CM 21 days to select piles for proof tests in accordance with PIL1.T030. If resubmission of the report is required, allow the CM another 21 days to select piles for proof tests after resubmission;

3. Upon satisfactory completion of the proof tests, complete and submit Form ICU14 and report of further remedial work, if any, to the CM on block by block basis, unless otherwise agreed by the CM.

PIL1.W2030.9 CERTIFICATION FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. Submit the following prior to serving notice in writing to the CM on completion of the Works in accordance with GCC Clause 8.7:
   a. Authorized Signatory's certification confirming that the completed job is satisfactory for the purpose intended and the piles, as installed, properly penetrate into insitu decomposed rock or onto bedrock as approved by the CM;
   b. Four copies of the as-built pile cap design and drawings based on the as-built piling layout and/or four copies of the as-built footing design and drawings; the as-built pile cap and/or footing design and drawings should be certified by the Design Certifying Consultant and should not contain any amendments which have not been Approved;
   c. Four copies of report listing the date of casting of concrete, the quality and quantity of materials used and the excavation record of each pile cap and/or footings;
   d. Four copies of final test reports on the pile caps and/or footings not carried out by the Direct Testing Contractors;
   e. Completed Form ICU 14;
   f. Any other relevant information.
2. Any submission not to the satisfaction of the CM shall have to be re-submitted. Allow 21 days for each submission and re-submission for the checking of the CM.

PIL1.W2040.9 CERTIFICATION FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. Submit the following prior to serving notice in writing to the CM on completion of the Works in accordance with GCC Clause 8.7:
   a. Authorized Signatory's certification confirming that the completed job is satisfactory for the purpose intended and the piles, as installed, properly penetrate into insitu decomposed rock or onto bedrock as approved by the CM;
   b. Four copies of the as-built pile cap drawings based on the as-built piling layout and/or four copies of the as-built footing drawings;
   c. Four copies of report listing the date of casting of concrete, the quality and quantity of materials used and the excavation record of each pile cap and/or footings;
   d. Four copies of final test reports on the pile caps and/or footings not carried out by the Direct Testing Contractors;
   e. Completed Form ICU 14;
   f. Any other relevant information.
2. Any submission not to the satisfaction of the CM shall have to be re-submitted. Allow 21 days for each submission and re-submission for the checking of the CM.

PILE CAPS AND FOOTINGS

PIL1.W2110.9 GENERAL

Execute the work described in this Sub-section in accordance with the provisions of the other relevant Worksections in this Specification.

PIL1.W2120.9 APPROVED DESIGN FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Construct the pile caps and/or footings in accordance with the Approved, submitted design.

PIL1.W2130.9 STARTER BARS FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Apart from the execution of the pile caps and/or footings, provide and execute starter bars shown on the Drawings.

PIL1.W2135.9 STARTER BARS FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Apart from the design and execution of the pile caps and/or footings, provide and execute starter bars shown on the Drawings.

PIL1.W2140.9 BACKFILLING EXCAVATIONS

Backfill excavation with Suitable Material up to the top level of the pile caps and/or footings and:

1. Form and maintain the sides of the backfill adjacent to the pile caps and/or footings to an angle of inclination as given in the Project Specific Specification;
2. Deposit surplus excavated Suitable Material on Site in stockpiles in Approved locations;
3. Remove Unsuitable Material from Site.

PIL1.W2150.A ALTERNATIVE PROPOSAL FOR CONCRETE COMPRESSIVE STRENGTH TEST

Where it is anticipated that the specified 28-day compressive strength tests for concrete of any pile caps / tie beams at pile cap level / footings such as raft footing, pad footing, strip footing, buoyancy raft, etc. cannot be completed upon the date for completion of the Works or the latest extended date for completion of the Works, whichever is the later, the CM may consider and approve at his own discretion without prejudice to the Contractor's responsibilities and liability under the Contract any proposal raised by the Contractor for earlier achievement of concrete strength for the completion of the Works after taking into account the timing of other tests of the Works, including but not limited to the use of a higher grade of concrete to that specified for the pile caps / tie beams / footings concerned, subject to the following:

1. Assess the results of these cube tests and core tests on basis of the grade of the concrete specified for the pile caps / tie beams / footings, but at the age less than 28 days in accordance with:
   a. Clauses CON1.T620 to CON1.T650 inclusive for cubes;
   b. Clause CON1.T760 for cores; and
   c. Do not make any adjustment to the measured strength in respect of the age of the cubes and cores when tested;
2. For the purpose of Clause 8.7(1) of the General Conditions of Contract, the tests on a date before the 28th day after casting which showed the achievement of the specified 28-day compressive strength shall be regarded as an alternative to the tests for compressive strength of concrete for pile caps / tie beams / footings to be carried out on the 28th day after casting as prescribed by the Contract. If the test results under the Approved proposal, assessed in accordance with sub-clause (1) above show that the strength of concrete have achieved the specified 28-day compressive strength and the results of all other tests also satisfied with the requirements as prescribed by the Contract, the Contractor may notify the CM the completion of the Works in accordance with Clause 8.7 of the General Conditions of Contract provided that the Contractor shall provide an additional undertaking stating that:

"If the results of tests for compressive strength of concrete for pile caps / tie beams / footings as carried out on the 28th day after casting, received by the CM on a date after the issue of the certificate of completion, fail to comply with the specified 28-day compressive strength tests requirements for concrete of the pile caps / tie beams / footings prescribed in the Contract, the Contractor shall carry out further tests and / or remedial works, all at the Contractor's expenses, and shall bear all costs, expenses and loss of the Employer due to failure of the tests. Irrespective of whether the Site or the concerned part thereof be handed over to others at a later date, or if the Site or the concerned part thereof has been handed to others before the commencement of the remedial works, the Employer shall be at liberty to carry out such remedial works by his own workers or by other contractors or allow the Contractor to carry out the whole or remaining part of the remedial works. In any case, the Contractor shall indemnify and keep indemnified the Employer against all losses, liabilities, damages, costs, legal costs, professional fees and other expenses of any nature whatsoever the Employer may suffer, sustain or incur, whether direct or consequential, arising out of or in connection with the carrying out and completion of the whole or remaining part of the remedial works."

3. The Contractor shall bear all associated costs and the extra time required for complying with the requirements of this clause.

PIL1.W2160.9 FOUNDING AND PROVING BEDROCK FOR FOOTINGS

Refer to EAR1.W930 and EAR1.W940.

MECHANICAL COUPLER FOR TYPE 5 PILES

PIL1.W2210.9 QUALIFIED SUPERVISION

Qualified supervision for mechanical coupler shall be in accordance with CON3.W310.

PIL1.W2220.9 INSPECTION LOG BOOK

1. Record the details in an inspection log book as per CON3.W320.
2. Keep the inspection log book on Site for CM’s inspection when required and submit the inspection log book to CM upon completion of the mechanical splice works.

TESTING

TESTING GENERALLY

PIL1.T010.9 NUMBER AND DISPOSITION OF TEST PILES

The number and disposition of the piles to be tested will be as Instructed. Make allowance for testing one preliminary pile early in the Contract to provide reasonable assurance that the Specification will be met.

PIL1.T020.9 REQUIRED MINIMUM NUMBER OF TESTS

1. Unless otherwise specified, the required minimum number of tests in this Worksection shall be calculated based on the testing frequency or sample size stated and the total number of piles installed in the whole Site. In case the calculated number of tests is not a whole number, any fraction of test shall be construed as one test;
2. Request the CM to select locations or piles for testing when all the piles have been installed and are ready for testing;
3. Upon agreement with the CM, the Contractor may request the CM to select locations or piles for testing when a portion of the piles have been installed and are ready for testing. In such an event, the required minimum number of tests for the portion shall be calculated based on the testing frequency or sample size stated and the total number of piles of that portion. In case the calculated number of tests is not a whole number, any fraction of test shall be construed as one test. As a consequence, the total number of tests carried out for all the portions may be more than the required minimum number of tests for the whole Site. Bear all additional costs and no extension of time is allowed.

PIL1.T030.A PROOF TEST

1. After receiving the report on completion of piling works as specified in PIL1.W2010 or PIL1.W2020, the CM shall select piles for proof test accordingly;
2. In this Specification, proof test shall mean:
   a. Loading test of working piles as specified in PIL1.T610 and PIL1.T1010 to PIL1.T1130 for Type 1, 2, 4, 5, 6 and 7 piles;
   b. Core test as specified in PIL1.T1210 to PIL1.T1250 for Type 1c piles and Type 3 piles.
3. Notwithstanding the samples size specified in PIL1.T610 for loading test and PIL1.T1220 for core test, the CM shall select at least 1 pile per block for each type of proof test. For Type 4 piles driven to bedrock, the CM may select samples more than the sample size specified in PIL1.T610;
4. Allow the Direct Testing Contractor the number of working days as specified in the Project Specific Specification to carry out each proof test commencing after special attendance as stipulated in Worksection PRE.B12 or PRE.C12 as appropriate has been satisfactorily provided;

5. When instructed by the CM, the Contractor shall propose for the CM's approval to employ an independent Ground Investigation Contractor in lieu of allowing Direct Testing Contractor as stated in this Specification and shall be in accordance with PRE.B9.250, to carry out core test stipulated in the above sub-clause (2)(b). The independent Ground Investigation Contractors shall have been registered under Housing Authority List of Ground Investigation Contractor and make full declaration on its relationship with the Contractor and piling sub-contractor, including whether or not it is a holding company, subsidiary, or an associated company of the Contractor and piling sub-contractor (i.e. any company which is the holding company or subsidiary company or sister company of the Contractor and piling sub-contractor). The Contractor, piling sub-contractor and the proposed independent Ground Investigation Contractor must avoid conflicts, whether actual, potential or perceived, whether financial or otherwise, arising between their duties or roles and their private interests. If the Contractor, piling sub-contractor or the proposed independent Ground Investigation Contractor is aware of any of such conflicts of interests, they must as soon as possible fully declare such conflicts, relationships (e.g. cross-directorship) or private interest (whether financial or otherwise) in such Contractor, piling sub-contractor or the proposed independent Ground Investigation Contractor. The CM may, at his sole discretion, approve the Contractor's proposal subject to in full compliance with Buildings Ordinance and its Regulations, the relevant code of practice and PNAPs.

PIL1.T040.9 BATCH OF MECHANICAL COUPLER FOR TYPE 5 PILES

A batch of mechanical coupler is as specified in CON3.T025.

PRELIMINARY DRIVEN PILES

PIL1.T110.9 PRELIMINARY PILES - TYPES 1, 2 AND 4 FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Before driving any pile, install at least one preliminary additional pile, for each of the proposed pile types to verify the proposed design methods and parameters and as follows:

1. Install the pile at a location outside the building structure and to a design depth, all as Approved;
2. Refer to PIL1.T130 for details of instrumentation;
3. Install a borehole adjacent to the preliminary pile and before it is driven to determine the geotechnical conditions;
4. Test the preliminary pile by Pile Driving Analyser with CAPWAP analysis after installation to the Approval founding depth;
5. Carry out a loading test on the preliminary pile as PIL1.T810 to PIL1.T880, immediately after driving to determine the ultimate side resistance and tip resistance of the pile;
6. Unless otherwise instructed by the CM, the Contractor may choose to pitch the first sections of working piles before the test result is known but in the case of a test failure, the Contractor must revise the design parameters and submit them for Approval. Any piles driven on the basis of the original proposal will be deemed to be unacceptable;
7. Carry out Approved remedial measures for such unacceptable piles including extracting and disposing, off Site, of any abandoned piles, where necessary, without any claim for extension of time;
8. Install a preliminary pile for the revised Approved design, repeating the procedure described above as necessary until a successful test result is achieved;

9. No claim for an extension of time will be allowed in connection with the provisions of this clause;
10. Trim down the preliminary pile to two metres below the finished ground level, or as directed, after completion of the loading test.

PIL1.T120.9 PRELIMINARY PILES - TYPES 1, 2 AND 4 FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Before driving any pile, install a preliminary additional pile, for each pile type to verify the driveability and the design assumptions as follows:

1. Install the pile at a location outside the building structure and to a design depth, all as Approved;
2. Refer to PIL1.T130 for details of instrumentation;
3. Install a borehole adjacent to the preliminary pile and before it is driven to determine the geotechnical conditions;
4. Test the preliminary pile by Pile Driving Analyser with CAPWAP analysis after installation to the Approval founding depth;
5. Carry out a loading test on the preliminary pile as PIL1.T810 to PIL1.T880, immediately after driving to determine the ultimate side resistance and tip resistance of the pile;
6. Unless otherwise instructed by the CM, the Contractor may choose to pitch the first sections of working piles before the test result is known. If any of the loading tests fail, the CM may order the installation of additional piles and the repetition of the procedures specified in this clause until a successful result is achieved.

PIL1.T130.9 INSTRUMENTATION

1. Instrument the preliminary pile with calibrated strain gauges to determine the distribution of side resistance in each major soil stratum down the pile and tip resistance in the bearing stratum during the loading test;
2. Propose, for the above purpose, the type, number and locations of strain gauges to be installed in each preliminary pile as well as the method of installation and protection of the strain gauges;
3. Acceptance of the Contractor's proposal by the CM shall not relieve the Contractor from the responsibility for ensuring the proper installation of the strain gauges and their satisfactory performance during load testing of the piles;
4. Check the performance of the strain gauges installed in the preliminary pile before and after installation of each segment of the pile into the ground, and before and during load testing of the pile;
5. The preliminary pile will be deemed unacceptable should there be more than 20% of the required total number of installed strain gauges not functioning properly during load testing of the pile;
6. Install an additional preliminary pile as PIL1.T110;
7. No claim for an extension of time will be allowed in connection with the provisions of this clause;
8. Take strain gauge reading at each incremental change of test load during the load test;
9. Present the strain gauge results by an Approved personal computer compatible spreadsheet software in both tabular and pictorial forms agreed by the CM;
10. Submit two copies of the data stored on floppy diskettes to the CM within one week after completion of the loading test.

PIL1.T140.9 FAILURE OF PRELIMINARY PILES

A preliminary pile is deemed to have failed the loading test when any of the following conditions occur in loading stage 2 as defined in PIL1.T830:

1. The settlement of the pile head reaches the magnitude of settlement at failure as defined in PIL1.T910;
2. The permanent settlement after removal of stage load 2 exceeds the permitted value specified in PIL1.T920.

SAMPLING AND TESTING FOUNDING LEVELS TO PILE TYPES 3, 4, 5, 6 AND 7

PIL1.T210.9 PROVING BEDROCK BEFORE INSTALLATION OF TYPE 3 PILES

1. Testing arrangements and testing samples:
   a. At every Type 3 pile location, carry out pre-drilling and take cores of minimum NX size to a minimum depth of 5000 mm into bedrock below the proposed pile base before commencement of excavation for the pile, when Instructed.
2. Testing methods:
   a. Extract rock core samples from the core holes in the presence of the CM or his representatives and provide records of bores for CM's inspection;
   b. When Instructed, carry out laboratory compression tests or field point load tests on recovered cores to determine rock strength;
   c. Submit to the CM ground investigation reports within 3 days after completion of coring and not less than 10 days prior to the commencement of pile excavation;
   d. Take further cores at any location as the Contractor deems necessary and at his own expense as stated in PIL1.G440;
   e. Keep the rock samples and a copy of the ground investigation reports in the container store rooms;
   f. Backfill the drillholes with cement grout or Approved material.
3. Test on bearing strata:
   a. Carry out the uniaxial compressive strength test or equivalent point load index test on the founding material for piles founded on Cat 1(c) or better rock in accordance with the testing methods stated in sub-clause (2)(b) above. Perform a minimum of 1 such test on rock specimen obtained at the location of each installed pile.

PIL1.T220.9 PROVING BEDROCK BEFORE REACHING FOUNDING LEVEL FOR TYPE 3 PILES

1. Testing arrangements and testing samples:
   a. When Instructed, upon excavation for Type 3 pile reaching bedrock as previously described in PIL1.G450, or the tentative founding level as specified in the Drawings or pile base, take an NX size core to a minimum depth of 5000 mm or such other depth as instructed by the CM into the bedrock below the proposed pile base. In order to ascertain bedrock profile within a pile, the CM may order more than one core per pile.
2. Testing methods:
   a. Extract rock core samples from the core holes in the presence of the CM or his representatives and provide records of bores for CM's inspection;
   b. When Instructed, carry out laboratory compression tests or field point load tests on recovered cores to determine rock strength;

c. Submit to the CM ground investigation reports within 3 days after completion of coring;

d. Take further cores at any location as the Contractor deems necessary and at his own expense as stated in PIL1.G440;

e. Keep the rock samples and a copy of the ground investigation reports in the container store rooms; and

f. Backfill the drillholes with cement grout or Approved material.

PIL1.T230.9 PROVING BEDROCK BEFORE INSTALLATION OF TYPES 5 AND 6 PILES AND OF TYPE 4 PILE DRIVEN TO BEDROCK

1. Testing arrangements and testing methods:
   a. Before the commencement of piling, carry out pre-drilling and take cores of minimum NX size down to at least 5 m deep into the bedrock below the rock head of the specified grade of rock, or to the bottom level of the designed rock socket length of the nearest pile, whichever is the deeper. Provide rock core samples and records of the bores for the CM's inspection. Backfill the drillholes with cement grout or Approved material. Submit to the CM ground investigation reports within 3 days after completion of the coring.
2. Testing samples:
   a. The number of drillholes required shall be such that the pile tip of every pile shall be within 5 metres from a drillhole and there shall be at least a drillhole at every pile cap location.

PIL1.T240.9 PROVING BEDROCK DURING INSTALLATION OF TYPES 5 AND 6 PILES AND OF TYPE 4 PILE DRIVEN TO BEDROCK

1. Testing arrangements:
   a. When Instructed, provide equipment for obtaining disturbed and undisturbed soil and rock samples in accordance with BS 5930:1981 from ground in the vicinity of the pile shaft during installation.
2. Testing methods:
   a. When Instructed, carry out the following tests on Site or in the laboratory as directed by the CM:
      i. The standard penetration test in accordance with BS1377 : 1975 (Test 19), modified by "Geoguide 2: Guide to Site Investigation", Hong Kong Government, 1987;
      ii. Point load test in accordance with ISRM "Suggested Method for Determining Point Load Strength", International Journal of Rock Mechanics, Mining Sciences & Geomechanics, 1985, Volume 22, No. 2, Pages 51-60;
      iii. Uniaxial compression strength test in accordance with ASTM Designation: D2938 – 86.
   b. When the drillhole reaches the rockhead, recover continuous rock cores to at least 5 m deep into the bedrock below the rock head of the specified grade of rock, or to the bottom level of the designed rock socket length of the nearest pile, whichever is deeper. Log all rock cores to ensure the quality of the rock socket;
   c. Provide suitable containers for samples of soil and ground water, ensuring that containers for cohesive material are airtight;
   d. Arrange for the testing of the samples in an Approved laboratory; and
   e. Backfill the drillholes with cement grout or Approved material.
3. Test on bearing strata for Types 5 and 6 Piles:

a. Carry out the uniaxial compressive strength test or equivalent point load index test on the founding material for piles socketed in Cat 1(c) or better rock in accordance with the testing methods stated in sub-clause (2)(a)(ii) and (iii) above. Perform at least 1 such test on rock specimen taken within 5m of each installed pile.

4. Submit to the CM ground investigation reports within 3 days after completion of the coring and test in sub-clause (2)(a)(i) above and test reports within 3 days after completion of the tests in sub-clause (2)(a)(ii) or (2)(a)(iii) above.

PIL1.T250.9 PROVING BEDROCK AFTER INSTALLATION OF TYPES 5 AND 6 PILES AND OF TYPE 4 PILE DRIVEN TO BEDROCK

1. Testing arrangements:
   a. After installation of the piles, the CM will order a Direct Testing Contractor to take cores of minimum NX size in accordance with the requirements stated in clause 7.4.4 of the Code of Practice for Foundations. The drillholes shall be in the vicinity of the piles;
   b. Provide attendance on the Direct Testing Contractor as described in Worksection PRE.B12 or PRE.C12, as appropriate; and
   c. Backfill the drillholes with cement grout or Approved material.
2. Testing samples:
   a. The number of drillholes required shall be at least 2 or 1% of the total numbers of piles, whichever is the greater.

PIL1.T260.9 FOUNDING LEVEL FOR TYPE 7 PILES

1. Testing arrangements and testing methods:
   a. Before the commencement of piling, carry out pre-drilling down to at least 5 m below the tentative founding level of the specified category in accordance with the Code of Practice for Foundations. Carry out standard penetration tests at maximum interval of 2 m along the drillholes from cut-off levels down to 5 m below the tentative founding levels. Provide records of the bores for the CM's inspection. Backfill the drillholes with cement grout or Approved material. Submit to the CM ground investigation reports within 3 days after completion of the coring.
2. Testing samples:
   a. The number of drillholes required shall be such that the pile tip of every pile shall be within 5 metres from a drillhole.

TESTING GROUT FOR TYPES 3, 5, 6 AND 7 PILES

PIL1.T310.9 DEFINITION OF 'BATCH'

1. For the tests specified in PIL1.T320 and PIL1.T330, a 'batch' of grout is any quantity of grout used for grouting in one continuous operation in one day;
2. For the test specified in PIL1.T340, a 'batch' of grout is the quantity of grout as stipulated in Clause 1.2 of CS1:2010.

PIL1.T320.9 TEST FOR BLEEDING AND FREE EXPANSION

1. Testing arrangements and testing samples:
   a. Provide one sample of grout from each batch not more than 30 minutes after mixing and protect from changes in moisture content before tests are carried out.
2. Testing methods:
   a. Divide each sample into three specimens and place a portion of each specimen in a covered cylinder with a diameter of 100 ±10 mm to a depth of 100 ±5 mm;

b. Measure the amount of bleeding and free expansion by a scale fixed to the outside of the cylinder.

3. Non-compliance:
   a. If the result of any test for the amount of bleeding or free expansion of the grout does not comply with the specified requirements, submit particulars of proposed changes to the materials, grout mix or methods of production to the CM and carry out further grouting trials unless otherwise permitted by the CM;
   b. For Type 7 piles, the acceptance criteria for the result of any test for the amount of bleeding or free expansion of the cement sand grout shall be reviewed, established and subject to the CM's agreement after conducting the trial mix of the grout.

PIL1.T330.9 FLOW CONE EFFLUX TEST

1. Testing samples:
   a. After mixing and sieving and prior to injection, take one sample from each batch.
2. Testing methods:
   a. Test the grout in accordance with ASTM C939-94 to determine the Flow Cone Efflux time;
   b. For Type 7 piles, a 19 mm diameter flowcone shall be used. Flow rates shall be within 15 to 25 seconds.
3. Non-compliance:
   a. Except with the CM's prior agreement for grout mixes containing additives and admixtures, grout having an efflux time of less than 15 seconds will be rejected.

PIL1.T340.A TEST FOR CRUSHING STRENGTH

1. Testing samples:
   a. Provide one sample (Type 3 Pile) from every 25 m^3 or every 25 batches, whichever is the smaller volume. At least one sample shall be provided from grout produced on any one day;
   b. Provide one sample (Types 5, 6 and 7 Piles) from every 10 m^3 or every 10 batches, whichever is the smaller volume. At least one sample shall be provided from grout produced on any one day;
   c. Each sample provided in sub-clauses (a) and (b) above shall not be taken at a time more than one hour after the grout is mixed and shall be protected from weather before test cubes are made.
2. Testing methods:
   a. The DTC shall prepare two cubes of 100 mm size from each sample, cure and test the cubes for crushing strength at 28 days in accordance with CS1:2010;
   b. The average of the two crushing strengths shall be taken as the test result. The criteria C1 and C2 shall be adopted as appropriate for assessing compliance stipulated in CON1.T640 and CON1.T660 of Worksection CON1;
   c. The test result shall comply with the following requirements:
      i. Individual test results: comply with the strength determined from limits given in Column B of the Table specified in CON1.T650 of Worksection CON1;

ii. Average strength determined from any group of four consecutive test results: comply with the strength determined from limits given in Column A of the Table specified in CON1.T650 of Worksection CON1. Where there are less than four available test results, treat the average of the first two or first three consecutive test results in the same manner as groups of four consecutive test results.

VISUAL INSPECTION

PIL1.T410.9 REQUIREMENT

When Instructed, open up for inspection any piles covered up as specified in the following clauses in this sub-section.

PIL1.T420.9 METHOD

Excavate to expose piles for a minimum of 750 mm from face of the pile all round and:

1. Plank and strut and shore all faces of the excavation and keep the excavation free from water by pumping or baling;
2. Wash surfaces of piles to be inspected clean of all silt, mud or other adhering material;
3. Deposit excavated material in temporary spoil heaps on Site;
4. After inspection, fill in and well ram to the entire satisfaction of the CM, around the piles with Special Filling Material suitable for the piling system adopted. If necessary, remove excavated Unsuitable Filling Material from site and make up voids with Special Filling Material.

PIL1.T430.9 CRITERIA FOR FAILURE

Piles that upon inspection are found to be honeycombed, necked or cracked are deemed to be defective.

DESTRUCTIVE TESTS ON SAMPLES OF TYPES 4 AND 6 PILES

PIL1.T510.9 GENERAL

Testing arrangements:

1. Allow for providing additional piles for testing, making samples of steel plates and their delivery.

PIL1.T520.9 SAMPLES

Testing samples:

1. The CM will order approximately 1% of the number of the steel piles delivered to Site to be subjected to testing in accordance with this sub-section before driving;
2. Take two samples from the steel plates at both ends of each of the chosen piles for tensile testing;
3. Tensile tests on steel samples will be carried out by Direct Testing Contractor.

PIL1.T530.9 NON-COMPLIANCE

In the event that the tensile test results fail to comply with this Specification, all piles delivered on the same date will be deemed unacceptable and must be removed from the Site.

PIL1.T540.9 PREMATURE INSTALLATION

Where piles are installed before test results are known, submit, for Approval, proposals for remedying any unacceptable piles already installed.

LOADING TESTS GENERALLY

PIL1.T610.9 REQUIREMENT FOR TESTING

1. Test the preliminary pile(s) in accordance with this sub-section but do not test pile(s) before the concrete and/or grout has attained sufficient strength to withstand the test loads;
2. Loading tests for working piles of each type of Types 1, 2, 4, 5, 6 and 7 Piles:
   a. Unless otherwise specified by the CM, the sampling rate for loading tests shall be in accordance with the following table:

Type of loading test	Category of pile	Sampling rate for loading tests
i. Compression Test	Pile designed to take compression only.	1% of or 1 number from the total number of piles under both categories, whichever is the greater
	Pile designed to take reversed tension and compression with tensile load resistance less than 50% of the compressive load resistance.	
ii. Tension Test	Pile designed to take tension only.	2% of or 1 number from the total number of piles under both categories, whichever is the greater
	Pile designed to take reversed tension and compression with tensile load resistance equals to or greater than 50% of the compressive load resistance.	

   b. For loading tests in compression, the CM will order the Direct Testing Contractor to carry out the tests in accordance with this Worksection;
   c. For loading tests in tension, submit details of tests for CM's approval and carry out the tests according to the Approved procedures.
3. Testing arrangements:
   a. Piles will not be tested before the concrete and/or grout has attained sufficient strength to withstand the test loads and selection of piles for testing shall be in accordance with PIL1.T030;
   b. Allow sufficient time in the programming of the Works for the CM to order the piles to be load tested and for performing the number of tests stated before completion of the Works or the respective Section thereof;
   c. Provide attendance on the Direct Testing Contractor as Worksection PRE.B12 or PRE.C12 as appropriate;
   d. Pave the area around the test pile with chunam or other materials approved by the CM immediately after the pile has been selected for load test. The extent of the paved area to be determined by the CM. Keep the paved area from being damaged prior to the load test;
   e. Provide adequate site safety to cater for the possible failure of the piles during testing;

f. For Type 7 piles, the pile shall be loaded at cut-off level. When the loading test is carried out before trimming the pile to cut-off level, the additional shaft friction above the cut-off level shall be taken into consideration for the test loading. The loading test proposal shall be submitted to the CM for approval at least 14 days before commencement of the loading test.

LOADING TESTS OF PRELIMINARY PILES

PIL1.T710.9 TESTING EQUIPMENT

1. Supply suitable platforms, hydraulic and other equipment together with four deflectometers reading to 0.025 mm and all other appliances necessary to record the settlement of the pile to Approval;
2. Ensure that the support of the reference beam is at least 2000 mm or 3 times the pile diameter, whichever is the greater, from the test and anchor piles.

PIL1.T720.9 CALIBRATION OF HYDRAULIC EQUIPMENT

Before commencement of the testing, submit to the CM, calibration test certificates from an independent laboratory in respect of all hydraulic equipment. Carry out the calibration:

1. In the period between the notified date for commencement of the Works and commencement of testing; or
2. Whenever the equipment has been adjusted.

PIL1.T730.9 MEASUREMENT OF TEST LOADS

Measure test loads by the use of a calibrated load cell and a calibrated pressure gauge included in the hydraulic system and:

1. Ensure that the load cell is axially loaded throughout the test;
2. Use the values given by the load cell for the interpretation of the test result, the pressure gauge readings being required as a check for gross error.

PIL1.T740.9 TEMPERATURE VARIATIONS

Provide suitable protection to minimise the effect of temperature variations on the test.

PROCEDURE FOR LOAD TESTS OF PRELIMINARY PILES

PIL1.T810.9 ANCHORAGES

1. Apply the load by jacking against suitable reactions provided by kentledge, anchor piles, or other anchorages to Approval;
2. Provide the centre of such reactions at a minimum distance of 2000 mm or three times the pile diameter, whichever is the greater, from the centre of the pile to be tested and from the centre of any adjacent pile.

PIL1.T820.9 PILE CAP TO TEST PILE

Extend the pile to be test loaded from its original level to a suitable level for the carrying out of the test and design and construct a suitable pile cap to the test pile.

PIL1.T830.9 LOADING OF A PRELIMINARY PILE

Apply and remove the test loading of a preliminary pile at cut off level or at other level agreed by the CM in three stages as follows:

Stage	Test Loading
1	100% P
2	200% P
3	360% P (for pile types 1 & 2) or 330% P (for pile type 4)

P = safe load carrying capacity as defined in PIL1.D390 for Contractor's Design Piling Contract / Combined Piling and Building Contract; or

P = safe load carrying capacity as specified by the CM for Engineer's Design Piling Contract / Combined Piling and Building Contract.

PIL1.T840.9 SEQUENCE

Adopt the following sequence of testing of preliminary pile unless otherwise instructed:

1. Apply the load in increments of 50%P up to the stage 1 test loading;
2. Do not apply increments of loading until the rate of settlement of the pile is less than 0.05 mm in 10 minutes;
3. Remove the test load and determine the recovery of the pile before resuming loading;
4. Repeat procedures in sub-clauses (1) and (2) above for the stage 2 test loading;
5. Maintain the full stage 2 test loading for 72 hours before removal;
6. Remove the test load and record the recovery of the pile;
7. Apply the load in increments of 50%P up to the stage 2 test loading allowing 20 minutes between load increments;
8. Maintain the stage 2 test loading for 20 minutes;
9. Apply the load in increments of 10%P until the stage 3 test loading or the failure load as defined in PIL1.T910 is reached, allowing 20 minutes between load increments;
10. Maintain the stage 3 test loading for 2 hours if failure of the pile does not occur;
11. Remove the test load in four equal decrements allowing 20 minutes between decrements, and record the recovery of the pile.

PIL1.T850.9 RECORDING AND CHECKING DATA

1. Carefully record the settlement of the pile under each increment of loading and the exact time at which such increment is applied or removed, in the presence of the CM;
2. Throughout the period of the test, make check observations of the settlement of the pile being tested by a suitable surveyor's level.

PIL1.T860.9 CONTRACTOR'S REPRESENTATIVE

Have a representative in attendance continuously throughout the period of the test to take and record all specified data hourly or at such other intervals as may be stipulated by the CM.

PIL1.T870.9 COMPLETION

On completion of the test, remove all testing equipment etc, demolish the test pile cap, make good the test pile and the Site back to their original condition and remove all debris arising from the test from the Site.

PIL1.T880.9 RECORDS AND SUBMISSION OF REPORT TO THE CM

Keep records of load tests on piles on the Site and submit a report to the CM within 12 hours of the test being completed. Keep the records on standard forms as shown in Appendix PIL1/V to this Worksection and available to the CM for inspection at all times. The records must include graphs showing load and settlement versus time, plotted in the format as agreed by the CM.

LOAD TEST RESULTS OF PRELIMINARY PILES

PIL1.T910.9 FAILURE LOAD

Keep records during loading and unloading. The ultimate or failure load of the pile is that load which produces a settlement of the pile head exceeding:

$f = D_e + D/120 + 4$ mm

where:

f = settlement at failure in mm.

D = least lateral dimension of the pile in mm.

De = elastic deformation of the pile shaft and is defined as:

$De = 3.7PLp/AE$ for stage 3 test loading for preliminary pile of pile types 1 & 2; or

$3.3PLp/AE$ for stage 3 test loading for preliminary pile of pile type 4; or

$2PLp/AE$ for all other stages of test loading for preliminary pile.

where:

P = as defined in PIL1.T830; unit in kN

Lp = pile length in mm

A = cross sectional area of pile in mm^2

E = Young's Modulus for pile material in kN/mm^2

PIL1.T920.9 RESIDUAL SETTLEMENT

When the rate of recovery after the removal of the maximum test load is less than 0.1 mm/hour observed in a period of not less than 15 minutes, the residual settlement at the head of the pile exceeding the greater of D/120 + 4 mm or 25% of the maximum pile head settlement during the test, will be deemed a failure of the pile.

LOADING TESTS OF WORKING PILES

PIL1.T1010.9 GENERAL

The Direct Testing Contractor will carry out load tests of working piles in accordance with the requirements of the Specification.

PIL1.T1020.9 LOADING OF A WORKING PILE

As ordered by the CM, the Direct Testing Contractor will apply and remove the test loading of a working pile at cut off level or at other level agreed by the CM, in two stages as follows:

Stage	Test Loading for Pile Types 1, 2, 4, 5, 6 & 7
1	100% P
2	200% P

P = safe load carrying capacity as defined in PIL1.D390 for Contractor's Design Piling Contract / Combined Piling and Building Contract; or

P = safe load carrying capacity as specified by the CM for Engineer's Design Piling Contract / Combined Piling and Building Contract.

PIL1.T1030.9 LOADING TYPES 5, 6 AND 7 PILES

The Direct Testing Contractor will not carry out the test until the grout has reached the 28-days characteristic compressive strength.

PIL1.T1040.9 SEQUENCE

The Direct Testing Contractor will adopt the following sequence of testing of working pile unless otherwise instructed:

1. Apply the load in increments of 50%P up to the stage 1 test loading;
2. Do not apply increments of loading until the rate of settlement of the pile is less than 0.05 mm in 10 minutes;
3. Remove the test load and determine the recovery of the pile before resuming loading;
4. Repeat procedures in sub-clauses (1) and (2) above for the stage 2 test loading;
5. Maintain the full stage 2 test loading for 72 hours before removal;
6. Remove the test load and record the recovery of the pile.

LOAD TEST RESULTS OF WORKING PILES

PIL1.T1110.9 FAILURE LOAD AND RESIDUAL SETTLEMENT

1. Keep records during loading and unloading. The ultimate or failure load of the pile is that load which produces a settlement of the pile head exceeding:

   $f = D_e + D/120 + 4$ mm

   where:

   f = settlement at failure in mm.

   D = least lateral dimension of the pile in mm.

   De = elastic deformation of the pile shaft and is defined as:

   De = 2PLp/AE for all other stages of test loading for working pile.

   where:

   P = as defined in PIL1.T1020 as appropriate; unit in kN

   Lp = pile length in mm (For pile with rock sockets, Lp should be measured to the centre of the rock socket. For pile without rock sockets, Lp should be taken as the entire length of the pile)

   A = cross sectional area of pile in mm^2

   E = Young's Modulus for pile material in kN/mm^2

2. Consider the following in calculating the D_e:
   a. For Type 5 pile, the contribution from steel bars, cement grout and steel casing along the whole pile length, Lp; and
   b. For Type 6 pile, the contribution from cement grout within the length of the rock socket.
3. When the rate of recovery after the removal of the maximum test load is less than 0.1 mm/hour observed in a period of not less than 15 minutes, the residual settlement at the head of the pile exceeding the greater of D/120 + 4 mm or 25% of the maximum pile head settlement during the test, will be deemed a failure of the pile.

REMEDIAL WORKS TO RECTIFY FAILED PILES

PIL1.T1120.9 FAILED PILES FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

Where a pile fails, install additional piles in accordance with the remedial proposal Approved and carry out all necessary tests to comply with the requirements of this Specification. The Contractor may be required to carry out all necessary tests as stated in PIL1.T210 to PIL1.T260 as appropriate in order to provide information for designing and positioning the additional piles to the CM's satisfaction. Carry out the extended/revised pile caps consequent upon the installation of the additional piles to an Approved design and in an Approved manner. Bear all additional costs and no extension of time will be entertained for complying with the requirements of this clause.

PIL1.T1130.9 FAILED PILES FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1. In the event that a pile fails, carry out investigation and report to the CM the causes of failure. The CM may further investigate the cause of failure and carry out any tests he deems necessary. Provide all necessary attendance to the CM's investigation and to the Direct Testing Contractor for execution of any tests as required by the CM for the investigation;
2. If the failure is due to poor workmanship or faulty materials, carry out remedial works, including but not limited to the carrying out of investigation and all necessary tests as stated in PIL1.T210 to PIL1.T260 as appropriate, submission of remedial proposal, construction of additional piles, extension/revision of pile caps and all associated tests, as follows:
    a. Rectify such non-compliance in accordance with this Specification;
    b. Where additional piles or extended/revised pile caps are required, carry out such works to an Approved design and in an Approved manner. Do not commence any remedial works until the remedial proposal is Approved; and
    c. Bear all time and costs associated with the remedial works.
3. If the failure is not due to poor workmanship or faulty materials, carry out remedial works, including but not limited to the carrying out of investigation and all necessary tests as stated in PIL1.T210 to PIL1.T260 as appropriate, construction of additional piles, extension/revision of pile caps and all associated tests, as may be Instructed to rectify such non-compliance all in accordance with this Specification, as follows:
    a. Mobilize within 7 days after issue of the instruction by the CM all necessary plant and equipment, and commence the remedial works that are considered necessary by the CM;
    b. When Instructed, submit for CM's agreement the method statement and programme for the remedial works; and
    c. Bear all costs and time due to any late mobilization of plant and equipment, delay in commencement of the remedial works and failure to execute the remedial works diligently.

CONCRETE CORE TESTING (FULL-LENGTH CONCRETE CORE) FOR TYPE 1C AND TYPE 3 PILES

PIL1.T1210.A GENERAL

Testing arrangements:

1. Core tests of piles as described in this sub-section will be carried out by Direct Testing Contractor(s), or by the independent Ground Investigation Contractor as stated in sub-clause (5) of PIL1.T030 when instructed by the CM;
2. The selection of piles for testing shall be in accordance with PIL1.T030;
3. Provide attendance to the Direct Testing Contractor(s) as Worksection PRE.B12 or PRE.C12, as appropriate;
4. Allow sufficient time in the programming of the Works for the CM to order the piles to be tested and for performing the number of tests stated before completion of the Works or the respective Section thereof.

PIL1.T1220.A CORE DIMENSIONS AND SAMPLE SIZE

The following works will be carried out by Direct Testing Contractor and / or by the independent Ground Investigation Contractor as stated in sub-clause (5) of PIL1.T030 when instructed by the CM:

1. Testing samples
   a. Take full-length concrete core specimens of minimum NX size for Type 1(c) piles or 100 mm diameter for Type 3 piles;
   b. Take cores of minimum NX size down to not less than 600 mm, or one half of the diameter of the pile base, whichever is the larger, into the rock below the pile base;
   c. Sample size: minimum 2 number or 5% of the total number of piles, whichever is the greater.
2. Testing methods:
   a. Laboratory compression tests on 3 core samples selected from the full length concrete core; acceptance criteria for concrete core compression tests are given in PIL1.T1240.

PIL1.T1230.9 REINSTATEMENT OF CORE HOLES

Fill core holes solid with non-shrinkage grout of at least the same crushing strength as the pile cored.

PIL1.T1240.A CRITERIA FOR FAILURE OR NON-COMPLIANCE OF PILE IN CONCRETE CORE TESTING

1. Concrete of the respective piles is considered failed if:
   a.
      i. The estimated in-situ cube strength of any core specimen is less than 75% of the specified grade strength or the average estimated in-situ cube strength of the three core specimens is less than 85% of the specified grade strength, for cases other than that stated in sub-clause (1)(a)(ii) below;
      ii. The estimated in-situ cube strength of any specimen is less than 60% of the specified grade strength or the average estimated in-situ cube strength of the three core specimens is less than 70% of the specified grade strength for the case where a reduction factor of 0.8 is applied to the design stresses of concrete placed under water; or
   b. The concrete cores show evidence of honeycombing or segregation of individual constituent materials; or
   c. In the opinion of the CM, the concrete fails to meet the specified requirements in any other respect.
2. The interface of concrete and rock of the respective pile is considered failed if, in the opinion of the CM, the concrete and rock of the core specimen is not in good contact;

3. The rock below the pile base is considered not complying with the requirements of this Specification if, by visual examination, the rock core obtained does not conform to the rock material specified in the design;
4. The respective pile will be considered not complying with the requirements of this Specification if any one of the failure or non-compliance criteria stated in sub-clause (1), (2) or (3) above is met; in such event:
   a. Comply with the requirements stated in PIL1.T1120 or PIL1.T1130 as appropriate;
   b. The CM may order the Direct Testing Contractor, or instruct the Contractor to employ the independent Ground Investigation Contractor as stated in sub-clause (5) of PIL1.T030 to carry out further tests on other piles, the number of piles to be tested for failure criteria as stated in sub-clause (1) shall be in accordance with PIL1.T1410 unless otherwise Approved.

PIL1.T1250.9 REQUIREMENT FOR FURTHER TESTS

Non-compliance:

1. Cube test results
   a. When concrete cube compressive test result does not comply with CON1.T630 to CON1.T660, the CM will order the Direct Testing Contractor to extract full length concrete core from each pile cast on the same concreting day and further select 3 core samples from each pile according to instruction of CM for compression test (the cores taken in this case are not included in the core sample specified in PIL1.T1220). Acceptance criteria and further actions arising from such tests shall be in accordance with PIL1.T1240.
2. Core test results
   a. When the concrete of a pile fails according to sub-clause (1)(a) of PIL1.T1240, no further test on concrete core of this pile is allowed.
3. Bear all costs and no extension of time is allowed for testing, remedial works and installation of additional pile(s) as a consequence of the above non-compliance.

DESTRUCTIVE TESTING OF SAMPLES OF PRECAST CONCRETE PILES

PIL1.T1310.9 GENERAL

Testing arrangements:

1. Allow for providing additional materials of piles for testing;
2. Arrange for the taking and testing of concrete cores by a Direct Testing Contractor employed direct by the Authority;
3. Provide attendance on the Direct Testing Contractor as PRE.B12.530 or PRE.C12.240 as appropriate and remove the tested piles from Site on completion of the tests.

PIL1.T1320.9 SAMPLE SIZE

Testing samples:

1. Where precast concrete piles (Types 1(a) and 2) are proposed for the Contract, the CM will order approximately 1% of the number of piles delivered to Site to be subjected to the tests as specified in the following clauses in this sub-section, prior to driving;
2. Where precast prestressed spun concrete piles (Type 1(b)) are proposed for the Contract, the CM will order at least 2% of the number of piles with a minimum of one pile per batch per delivery to Site to be subjected to the tests as specified in the following clauses in this sub-section, prior to driving.

PIL1.T1330.9 CORING

Testing methods:

1. For Types 1(a) and 2:
   a. Direct Testing Contractor will take cores in accordance with CON1.T710 to CON1.T760 from each of the chosen precast concrete piles for core test.
2. For Type 1(b):
   a. Direct Testing Contractor will take 3 sets of 3 cores (total 9 nos.) of 76 mm diameter taken normal to the length and from 3 transverse sections of a chosen precast prestressed spun concrete pile in accordance with CON1.T710 and CON1.T720 for core test;
   b. Where the estimated insitu cube strength of any individual core is less than 85% of the specified grade strength, comply with any instruction of the CM for the taking of additional core samples to make up a total of 12 numbers of core samples in the same concreting day for further tests. Allow the time without any claim for extension of time and bear all the costs for such extra work;
   c. Assess the coring test results in accordance with CON1.T760.
3. Do not apply the provisions of CON1.T770 to precast concrete piles generally nor those of CON1.T740 to precast prestressed spun concrete piles.

PIL1.T1340.9 TEST FAILURE

In the event that the coring test results fail to comply with the Specification, all piles concreted on the same day will be deemed to be unacceptable and must be removed from the Site.

PIL1.T1350.9 PREMATURE DRIVING

Where driving is carried out before test results are known, submit remedial proposals for those unacceptable piles, as described above, which have already been driven, for Approval.

FURTHER INSPECTION AND TESTING

PIL1.T1410.9 REQUIREMENT

If inspection, loading tests, core tests (for Type 3 piles) or weld tests show that any pile is not in accordance with the Specification or the Drawings, the CM may order further inspection/tests, the number to be calculated by the application of the formula given below and no extension of time will be allowed. Bear the cost of such further inspection/tests.

number of further inspections/tests = $\left(n^2 - 2n + 3\right)$

where n = total number of unsuccessful inspections/tests progressively until all inspections/ tests are successful.

PIL1.T1420.9 SAMPLE EVALUATIONS

Typical examples of evaluations of number of further inspections/tests are given in Appendix II to this Worksection, for illustrative purposes only.

NON-DESTRUCTIVE TESTS ON WELDS

PIL1.T1510.9 GENERAL

Testing arrangements:

1. Non-destructive tests on welds will be carried out by Direct Testing Contractor(s). Allow 3 working days for the execution of each weld test by the Direct Testing Contractor(s) commencing after special attendance as stipulated in Worksection PRE.B12 or PRE.C12 as appropriate has been satisfactorily provided;
2. Allow sufficient time in the programming of the Works for the CM to order the piles to be tested and for performing the number of tests stated before completion of the Works or the respective Section thereof.

PIL1.T1520.9 TYPES OF TEST AND SAMPLE SIZE

1. Testing methods and testing samples:
   a. During the progress of the works, the CM will require testing of the butt and fillet welded joints to all types of piles to be examined by non-destructive tests as follows:
      i. In accordance with the requirements stated in STR1.T120;
      ii. For full penetration butt weld, the testing frequency shall be 100%, in accordance with clause 14.3.6.1 of Code of Practice for the Structural Use of Steel 2011. The CM may, at his discretion, reduce such testing frequency to a minimum of 10%.
   b. In addition, the CM will order another Direct Testing Contractor to carry out the same test on 5% of the tested welds again.
2. Non-compliance:
   a. In the event that the result of test carried out by either one of the Direct Testing Contractors failed, the tested weld shall be deemed not complying with the requirement of the Contract.

NON-DESTRUCTIVE TESTS ON PILES

PIL1.T1610.9 GENERAL

1. Testing methods and test samples:
   a. In addition to the normal requirements for testing of the piles, a proportion of the installed piles will be tested by Direct Testing Contractor(s), using non-destructive tests which include the following types of test:

Type of Test	Number of Piles to be Tested
Pile driving analyser	i. Minimum 5% of the total number of all driven piles excluding Type 4 piles driven to bedrock and driven concrete piles ii Minimum 10% and 20% to verify the capacity and the integrity respectively of the total number of all Type 4 piles driven to bedrock in accordance with clauses 5.4.11(5)(c) and 5.4.11(5)(d) of Code of Practice for Foundations. iii Refer to sub-clause (1)(b) for driven concrete piles
Pile Integrity Test	i. Minimum 15% of the total number of all Type 7 piles for compliance with ASTM D5882 or other Approved standard ii. Refer to sub-clause (1)(b) for driven concrete piles
Sonic logging	i. 100% of the total number of all Type 3 piles ii. 100% of the total number of all Type 7 piles

   b. The total number of driven concrete piles tested by pile driving analyser and Pile Integrity Test, taken together, will be minimum 5% of the total number of all driven concrete piles;

c. In addition, the CM will order another Direct Testing Contractor or the Housing Department Materials Testing Laboratory to carry out the same tests on 5% to 10% of the tested piles again.

2. Testing arrangements:
   a. Inform the CM in writing at least 7 working days before all piles of each individual pile cap or every 20% of the total numbers of piles of the same block, whichever is less, are ready for the non-destructive test; allow at least 7 working days for the execution of non-destructive test on each pile by the Direct Testing Contractor(s);
   b. Provide attendance on the Direct Testing Contractors and / or Housing Department Material Testing Laboratory as Worksection PRE.B12 or PRE.C12 as appropriate;
   c. Allow sufficient time in the programming of the Works for the CM to order the piles to be tested and for performing the number of tests stated before completion of the Works or the respective Section thereof.
3. Preparation works for sonic logging (for Type 3 piles):
   a. Install sonic access tubes of mild steel with thickness not less than 2.5 mm for Type 3 pile of number as given in the following table:

Pile Diameter	No. of Sonic Access Tube
Less than 2 m diameter	4
Equal to or exceeding 2 m diameter	6

   b. Half of the number of the sonic access tubes installed in a Type 3 pile shall be used for both sonic logging test and confirmatory core testing. These tubes shall be of 150 mm internal diameter. The remaining half number of the sonic access tubes shall be used for sonic logging test only in accordance with the following table.

Pile Diameter (Pile Length)	Remaining half number of the Sonic Access Tube
Less than 2 m diameter (Length less than 50 m)	2 nos. of internal diameter not less than 42 mm
Less than 2 m diameter (Length equal to or longer than 50 m)	2 nos. of 150 mm internal diameter
Equal to or exceeding 2 m diameter (Length less than 50 m)	3 nos. of internal diameter not less than 42 mm
Equal to or exceeding 2 m diameter (Length equal to or longer than 50 m)	3 nos. of 150 mm internal diameter

   (Pile Length = length of bored pile measured from cut off level to founding level)
   c. Install sonic access tubes for both sonic logging test and confirmatory core testing and those for sonic logging test only in alternate positions along the perimeter inside the pile shaft;
   d. Fit all tubes with screw-on steel watertight shoes or other Approved means at both ends. Fix all tubes securely to the interior of the reinforcement cage of the pile by method to be approved by the CM;
   e. All sonic access tubes to be watertight including any joints, evenly spaced, parallel to each other and to the axis of the pile, free from corrosion with clean internal and external faces so as to allow free and unobstructed passage of the testing probes;

f. Plug or cap all sonic access tubes before concreting. Extend the tubes along the depth of the pile from 300 mm approximately above the pile top level down to 1 m above the pile base for the 150 mm diameter tubes used for both sonic logging test and confirmatory core testing, and down to 500 mm above the pile base for the remaining half number of the sonic access tubes used for sonic logging test only;

g. Fill up the sonic access tubes with water prior to concreting of pile and during testing;

h. Cut off all tubes flush with the concrete surface of pile and fill up the tubes with non-shrinkage grout of at least the same crushing strength as the concrete of the pile upon completion of all testing.

4. Preparation works for sonic logging (for Type 7 piles):

a. Install a single sonic access tube of uPVC with closed bottom end and internal diameter of 40 mm;

b. Fix the single tube securely to the centre of the reinforcement cage of the pile by method to be approved by the CM;

c. The single tube to be watertight including any joints, parallel to the axis of the pile, clean internal and external faces so as to allow free and unobstructed passage of the testing probe;

d. Plug or cap the single tube before inserting the reinforcement cage into the grouted shaft. Extend the single tube along the depth of the pile from 300 mm approximately above the pile top level down to the bottom level of the reinforcement cage for sonic logging test;

e. Fill up the single tube with water prior to installation of reinforcement cage and during testing;

f. Cut off the single tube flush with the grout surface of pile and fill up the tube with non-shrinkage grout of at least the same crushing strength as the grout of the pile upon completion of all testing.

PIL1.T1620.9 RELATIONSHIP TO LOAD TESTING OR CORE TESTING

The results of this testing will, in conjunction with other considerations, be used in selecting piles for load testing or core testing as appropriate.

PIL1.T1630.9 TEST REPORT

A report of these tests will be prepared by the Direct Testing Contractor(s) and will include the following:

1. Date of testing;
2. Pile reference number;
3. Measured pile length;
4. Record test data;
5. Defects such as cracks, fractures or other dis-continuities;
6. Pile stiffness for pile driving analyser.

PIL1.T1640.9 TESTING OF PILES DRIVEN BY HYDRAULIC HAMMERS FOR ENGINEER'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1.

a. For piles pitched by using hydraulic hammers, the pile driving analyser tests as stipulated in PIL1.T1610 shall be performed with CAPWAP analysis in accordance with the following table:

Pile Type (Type of Hammer Used for Final Set)	Number of Piles to be Tested by the Pile Driving Analyser (Number of Tests with CAPWAP Analysis)
All driven piles excluding Type 4 piles driven to bedrock and Type 1b piles (drop hammers or other types of hammers as allowed in PIL1.W520)	Minimum 5% of the total number of piles (at least half of the pile driving analyser tests)
Type 4 piles driven to bedrock (drop / hydraulic hammers or other types of hammers as allowed in PIL1.W520)	Minimum 10% and 20% to verify the capacity and the integrity respectively of the total number of all Type 4 piles driven to bedrock in accordance with clauses 5.4.11(5)(c) and 5.4.11(5)(d) of Code of Practice for Foundations. (all the pile driving analyser tests to verify the capacity)
Type 1b piles (drop hammers or other types of hammers as allowed in PIL1.W520)	Minimum 5% of the total number of piles (all the pile driving analyser tests)
All driven piles excluding Type 4 piles driven to bedrock (hydraulic hammers)	Minimum 10% of the total number of piles (all the pile driving analyser tests)

b. Unless otherwise agreed by the CM, use only hydraulic hammers to carry out the tests.

2. Prepare and submit a report of hydraulic hammer performance which should include particularly the following:
   a. Correlation of the results of final sets measurement, the results of pile driving analyser tests with or without CAPWAP and the results of static load tests;
   b. Back calculate the values of the Hydraulic Hammer Factor, "K_h", of the modified Hiley formula specified in the Drawings by using appropriate test results.

PIL1.T1645.9 TESTING OF PILES DRIVEN BY HYDRAULIC HAMMERS FOR CONTRACTOR'S DESIGN PILING CONTRACT / COMBINED PILING AND BUILDING CONTRACT

1.
   a. For piles pitched by using hydraulic hammers, the pile driving analyser tests as stipulated in PIL1.T1610 shall be performed with CAPWAP analysis in accordance with the following table.

Pile Type (Type of Hammer Used for Final Set)	Number of Piles to be Tested by the Pile Driving Analyser (Number of Tests with CAPWAP Analysis)
All driven piles excluding Type 4 piles driven to bedrock and Type 1b piles (drop hammers or other types of hammers as allowed in PIL1.W525)	Minimum 5% of the total number of piles (at least half of the pile driving analyser tests)

Type 4 piles driven to bedrock (drop / hydraulic hammers or other types of hammers as allowed in PIL1.W525)	Minimum 10% and 20% to verify the capacity and the integrity respectively of the total number of all Type 4 piles driven to bedrock in accordance with clauses 5.4.11(5)(c) and 5.4.11(5)(d) of Code of Practice for Foundations. (all the pile driving analyser tests to verify the capacity)
Type 1b piles (drop hammers or other types of hammers as allowed in PIL1.W525)	Minimum 5% of the total number of piles (all the pile driving analyser tests)
All driven piles excluding Type 4 piles driven to bedrock (hydraulic hammers)	Minimum 10% of the total number of piles (all the pile driving analyser tests)

b. Unless otherwise agreed by the CM, use only hydraulic hammers to carry out the tests.

2. Prepare and submit a report of hydraulic hammer performance which should include particularly the following:
   a. Correlation of the results of final sets measurement, the results of pile driving analyser tests with or without CAPWAP and the results of static load tests;
   b. Back calculate the values of the Hydraulic Hammer Factor, "K_h", of the proposed modified Hiley formula stated in PIL1.D390 by using appropriate test results.

PIL1.T1650.9 CHECKING OF SIZE OF PILE SHAFT AND BELL-OUT OF TYPE 3 PILE

1. Testing sample and method:
   a. Prior to installation of permanent lining and steel reinforcement of each Type 3 pile, check the correctness of the size of the pile shaft and the bell-out by using Ultrasonic Echo Sounder Test or other approved tests and submit the test report to the CM.
2. Testing method:
   a. Unless otherwise agreed by the CM, the testing equipment shall fulfil the following minimum quality and capability:
      i. Comply with the requirements of clause 8.12 of the Code of Practice for Foundations;
      ii. Be able to generate ultrasonic wave of suitable frequency and energy for reflection of the pile shaft and casing surface within 0.5 m to 8 m in distance;
      iii. Have four sensors each mutually perpendicular to one another and be able to provide two cross sectional profiles of the pile simultaneously in one go;
      iv. Have measurement accuracy within ±0.5% in horizontal distance;
      v. Be able to measure up to a depth as stated in the Project Specific Specification;
   b. The test report shall include the following:
      i. The profile of the pile;
      ii. The verticality of the pile – besides the verticality of the whole pile, the verticality of the pile from cut off level down to intermediate depths of maximum 10 m intervals shall be reported;

iii. The original electro-sensitive paper records which shall be endorsed by the QCM or SQCC of the Contractor and the field technician of the laboratory;

iv. Interpretation of the test results with respect to the acceptance criteria.

3. Testing arrangement:
   a. Employ a HOKLAS accredited laboratory to carry out the tests;
   b. Prior to the tests, seek the CM's agreement on the following:
      i. Testing procedures and equipment;
      ii. Acceptance criteria of the tests other than those stated in the Specification;
      iii. Test report format;
      iv. Submission arrangement of the test reports.
   c. In addition, the CM will order a Direct Testing Contractor to carry out the same tests on 5% of the total number of Type 3 piles; allow at least 7 working days for the execution of each test by the Direct Testing Contractor(s); provide attendance on the Direct Testing Contractor as specified in PRE.B12.520 or PRE.C12.260 as appropriate;
   d. Carry out investigation and rectify any defect or irregularities identified by the test and carry out further tests, all to the CM's satisfaction, before proceeding to the next stage of work;
   e. Allow sufficient time in the programming of the Works for the CM to order the piles to be tested and for performing the number of tests stated before completion of the Works or the respective Section thereof. No claim for additional cost and any extension of time as a result of complying this clause will be entertained by the CM.

CONFIRMATORY CORE TESTING OF FOUNDING STRATA OF TYPE 3 PILES

PIL1.T1710.9 REQUIREMENT FOR CONFIRMATORY CORE TESTING

1. Testing samples:
   a. Take core of minimum NX size down the concrete/rock interface through one of the sonic tubes with its end installed 1 m above the bottom of the pile; the core taken shall include the 1 m of concrete above the interface and at least 1 m of rock below the interface. Use triple-tube core-barrels to extract cores;
   b. Sample size: 100% of the total number of Type 3 piles.
2. Testing methods:
   a. Laboratory compression tests and/or field point load tests on core specimens to determine the concrete or rock strength when ordered.
3. Testing arrangement:
   a. Submit three copies of each of the reports of the confirmatory core tests within three working days after completion of each test;
   b. In addition, the CM will order a Direct Testing Contractor to carry out confirmatory core tests on 5% of the total number of Type 3 piles; allow at least 7 working days for the execution of each confirmatory core testing by the Direct Testing Contractor(s); provide attendance on the Direct Testing Contractor(s) as Worksection PRE.B12 or PRE.C12 as appropriate;
   c. Allow sufficient time in the programming of the Works for the CM to order the piles to be tested and for performing the number of tests stated before completion of the Works or the respective Section thereof.

PIL1.T1720.9 EQUIPMENT AND METHOD

Obtain Approval for the coring equipment and the method of executing the work.

PIL1.T1730.9 TREATMENT OF SPECIMENS

Deal with the concrete core specimens in accordance with CS1:2010 all as set out in Worksection CON1 of this Specification.

PIL1.T1740.9 REINSTATEMENT OF CORE HOLES

Fill core holes and sonic tubes solid with non-shrinkage grout of at least the same crushing strength as the pile cored.

PIL1.T1750.9 CRITERIA FOR FAILURE OR NON-CONFORMITY OF PILE IN CONFIRMATORY CORE TESTING

1. Concrete of the respective piles is considered failed if:
   a. The concrete cores show evidence of honeycombing or segregation of individual constituent materials; or
   b. In the opinion of the CM, the concrete fails to meet the specified requirements in any other respect.
2. The interface of concrete and rock of the respective pile is considered failed if, in the opinion of the CM, the concrete and rock of the core specimen is not in good contact;
3. The rock below the pile base is considered not complying with the requirements of this Specification if, by visual examination, the rock core obtained does not conform to the rock material specified in the design;
4. The respective pile will be considered not complying with the requirements of this Specification if any one of the failure or non-compliance criteria stated in sub-clause (1), (2) or (3) above is met; in such event, comply with the requirements stated in PIL1.T1120 or PIL1.T1130, as appropriate.

MECHANICAL COUPLER FOR TYPE 5 PILES

PIL1.T1810.9 RATE OF SAMPLING

Provide test specimens as per CON3.T510.

PIL1.T1820.9 METHOD OF TESTING

Testing for splicing assemblies without ductility requirement shall be in accordance with CON3.T520.

PIL1.T1830.9 COMPLIANCE CRITERIA

1. Compliance criteria for mechanical coupler without ductility requirement shall be in accordance with CON3.T530;
2. Any non-complying batch is to be removed from Site.

PIL1.T1840.9 TIME REQUIRED FOR TESTING

1. Allow time for the availability of test results as per CON3.T540;
2. Do not use the mechanical couplers until the relevant test specimens have passed all tests.

APPENDICES

PIL1.APPEND2.9 CALCULATION OF NUMBER OF FURTHER INSPECTIONS/TESTS

APPENDIX PIL1/II - CALCULATION OF NUMBER OF FURTHER INSPECTIONS/TESTS

Typical Examples for Illustrative Purposes Only

1. Loading test shows 2 piles failed to meet the requirements of the Contract.

2. The Contractor when required, at his own expense, is to carry out further tests in accordance with the formula of:

   $\left(n^2 - 2n + 3\right)$

   = 2^2 - 2 x 2 + 3

   = 3 further tests

3. If one of the above 3 further tests fails, the CM may order further tests to be carried out at the contractor's expense by re-applying the formula and taking into account the total number of failed piles. Altogether and based on the formula, the number of total retesting required:

   = 3^2 - 2 x 3 + 3

   = 6

   As 3 tests have been carried out the Contractor therefore when ordered by the CM is to carry out:

   6 - 3 = 3 further tests

4. If the next 3 further tests show further failed piles, the formula will be re-applied as before until all the tests are successful.

PIL1.APPEND3.9 PILE DRIVING RECORD (PRECAST CONCRETE, PREFABRICATED STEEL AND DRIVEN CAST-IN-PLACE PILES)

APPENDIX PIL1/III - PILE DRIVING RECORD (PRECAST CONCRETE, PREFABRICATED STEEL AND DRIVEN CAST-IN-PLACE PILES) (Sheet 1 of 2)

Contract No: ..... Title: .....

Contractor: .....

Pile Data

Ref. No: ..... Location: .....

Type: ..... Size: ..... Rake: .....

For precast concrete and steel piles; Preformed length: .....

For precast concrete piles; Date of casting: .....

Drive System Data

Hammer: type: ..... mass: ..... kg drop (at set): ..... mm rated energy ..... kJ

Helmet, dolly and anvil: type: ..... mass: ..... kg

Packing: type: ..... condition: ..... thickness: ..... mm

Levels

Commencing ground/sea bed* level (PD/CD)*: .....

Depth of overburden/height of working platform above sea bed level: .....

Reference working level/platform level*: ..... (*delete as appropriate)

Date & Time	Drop (m)	Depth Penetrated (m)	No. of blows per m +	Cumula-tive No. of blows	Indicate here length of individual segments, location of splices and testing carried out	Remarks (State details of obstruction, delays interruptions and location of concrete samples)++

\+ per 0.25 m for top 3.0 m of pile

++ for cast-in-place pile

APPENDIX PIL1/III - PILE DRIVING RECORD (PRECAST CONCRETE, PREFABRICATED STEEL AND DRIVEN CAST-IN-PLACE PILES) (Sheet 2 of 2)

Temporary Compression Record:

(on graph paper graduated in millimetres to be pasted in space below)

Final penetration depth: ..... mm

Temporary compression: ..... mm

Final set: ..... mm/last 10 blows

or: ..... blows/25 mm

Deviation from plumb or rake 1 in .....

Top of pile level: .....

Cut off level: .....

Pile head level: .....

Final toe level: .....

Deviation at cut-off level: x - x ..... mm
y - y ..... mm

For driven cast-in-place piles:

Length of temporary casing: ..... m

Length of permanent casing: ..... m

Length of cage reinf: ..... m

Concrete grade: .....

Date of concreting: .....

Theoretical vol. of concrete required: ..... m^3

Actual vol. of concrete placed: ..... m^3

Reported by:

.....
Contractor's Rep.

Date: .....

Witnessed by:

.....
COW/IOW/Engineer/Architect

Date: .....

PIL1.APPEND4.9 PILE DRIVING RECORD (BORED CAST-IN-PLACE PILES)

APPENDIX PIL1/IV - PILE DRIVING RECORD (BORED CAST-IN-PLACE PILES) (Sheet 1 of 2)

Contractor No: ..... Title: .....

Contractor: .....

Pile Data:

Ref. No: ..... Location: .....

Type: ..... Diameter: ..... mm Design Length: ..... mm Rake 1 in: .....

Bore Hole Record:

Commencing ground/sea bed* level (PD/CD*): .....

Depth of overburden/height of walking platform above sea bed level: ..... m

Casing/drilling fluid* type: .....

Reference working level/platform level*: ..... (*delete as appropriate)

Date & Time	Depth penetrated	Details of strata penetrated/ground water level	Details of soil testing, proving of bedrock and under-ream	Remarks (State details of obstruction, delays interruptions, and location of concrete samples)

Deviation from plumb or rake 1 in ..... Deviation at cut-off level: x - x ..... mm
y - y ..... mm

Length of temporary casing: ..... m Length of permanent casing: ..... m

APPENDIX PIL1/IV - PILE DRIVING RECORD (BORED CAST-IN-PLACE PILES) (Sheet 2 of 2)

Bore hole condition prior concreting:

Bottom visible/invisible*

Measured depth of bore: ..... m

Depth of water/drilling fluid*: ..... m

Damage and debris observations: .....

Concrete Record:

Concreting in dry/ by tremie*

Water inflow rate: ..... litre/sec

Concrete grade: .....

Slump: .....

Actual concreted level: .....

Cut-off level: .....

Overall $\frac{Lt}{La}$ =……% (*delete as appropriate)

Length of cage reinforcement: ..... m

Date & Time	**Delivery Note No./ Truck load No.**	**Quantity (m^3)**	**Theoreti-cal length filled Lt (m)**	**Actual length placed La (m)**	**Lt % La**	**Cumulative length placed (m)**	**Remarks (Interruptions in placing, cause of excessive ± Lt % La Location of concrete cubes. Ref No. of cubes taken etc.)**

Reported by: .....
Contractor's Rep.
Date: .....

Witnessed by: .....
COW/IOW/Engineer/Architect
Date: .....

PIL1.APPEND5.9 PILE LOAD TEST RECORD

APPENDIX PIL1/V - PILE LOAD TEST RECORD (Sheet 1 of 2)

Contract no: ..... Title: .....
Contractor: .....

Pile Data:

Ref No: ..... Location: .....
Type: ..... Size: .....
Pile dia*/diagonal width (D): ..... Gross pile length (Lp): .....
Sectional area (A): ..... Young's modulus (E): .....

Testing Data:

Safe load carrying capacity (P): .....

Pressure gauge No: ..... Calibration Cert. Ref: ..... Date: .....
Load cell No.: …….. Calibration Cert. Ref: ..... Date: …….

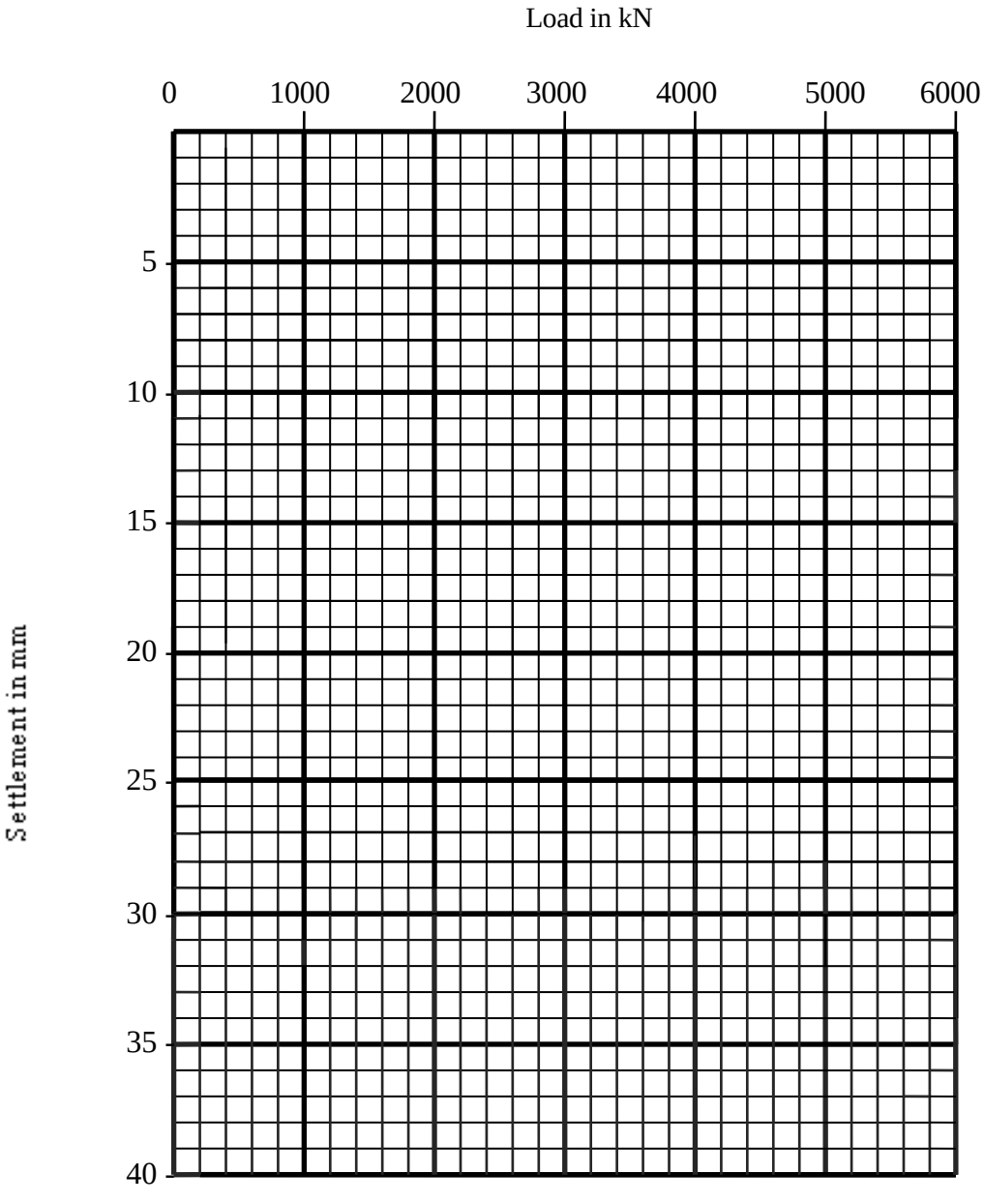
Dial gauge number	1	2	3	4
Serial number				
Calibration certificate reference				
Date calibration				

Level of fixed point on load reaction system:
before testing: .....
after testing: .....
ground settlement ……

Survey at pile head:
before testing: .....
after testing: .....

Date and Time	Load (kN)	Pressure Gauge Readings	Load Cell readings	Dial Gauge Readings					Cumulative Settlement (mm)	Witnessed by
				Dial 1	Dial 2	Dial 3	Dial 4	Average		

APPENDIX PIL1/V - PILE LOAD TEST RECORD (Sheet 2 of 2)



Maximum pile head settlement (mm): allowable $\frac{2PLp}{AE} + \frac{D}{120} + 4 =$ ..... Actual = ...

Residual settlement (mm): allowable = The greater of $(\frac{D}{120} + 4)$ **or 25% maximum pile head settlement during the test =**..... Actual = ...

Reported by: Witnessed by:

....

Contractor's Rep. COW/IOW/Engineer/Architect

Date: ..... Date: .....

HONG KONG HOUSING AUTHORITY

SPECIFICATION LIBRARY 2022 (BATCH 4) EDITION

Soft Landscape Works Specification

SLW SOFT LANDSCAPE WORKS

SLW1 GENERAL PLANTING REQUIREMENTS 9

MATERIALS 9

PLANTS GENERALLY 9

SLW1.M010.9 SPECIES 9
SLW1.M020.9 HEALTH 9
SLW1.M030.9 SOURCE 9
SLW1.M040.9 HABIT 9
SLW1.M050.9 NAME 9
SLW1.M060.9 SUBSTITUTION 9
SLW1.M070.9 PARASITIC PLANTS 9
SLW1.M080.9 NOXIOUS WEEDS 9

FERTILIZERS AND ADDITIVES 10

SLW1.M110.9 SLOW RELEASE FERTILIZER 10
SLW1.M130.9 QUICK RELEASE FERTILIZER 10
SLW1.M135.9 SPENT MUSHROOM COMPOST (SMC): 10
SLW1.M140.9 DISCOURAGEMENT OF VERMIN 11
SLW1.M150.9 LIMESTONE 11

CHEMICALS 11

SLW1.M220.9 PESTICIDES 11

MULCHES 11

SLW1.M310.A MULCHES 11

ANCILLARY MATERIALS 12

SLW1.M410.9 PLANT LABELS 12
SLW1.M420.9 PROTECTIVE FENCING 12
SLW1.M430.9 PEA GRAVEL 12
SLW1.M440.9 GRAVEL 12
SLW1.M450.9 GRAVEL FOR SAND BASED LAWN 12

WORKMANSHIP 13

PROGRAMME 13

SLW1.W010.9 PLANTING SEASON 13
SLW1.W020.9 PLANTING TREES 13
SLW1.W030.9 PLANTING SHRUBS 13

LIFTING PLANTS 13

SLW1.W110.9 ROOT PRUNING 13
SLW1.W120.9 WATERING AND LIFTING 13
SLW1.W130.9 PROTECTIVE WRAPPING 13

PROTECTION AND STORAGE PRIOR TO PLANTING 13

SLW1.W210.9 PROTECTION GENERALLY 13
SLW1.W220.9 STORAGE OF PLANTS ON SITE 13

PREPARATORY WORK 14

SLW1.W310.9 CLEARING 14
SLW1.W320.9 PREPARING PLANTS 14
SLW1.W330.9 WATERING 14

PLANTING 14

SLW1.W410.9 GENERAL 14
SLW1.W420.9 TIMING 14
SLW1.W430.9 FINISHED SOIL LEVELS 14
SLW1.W440.9 FINISHING 14
SLW1.W450.9 WATERING IN 14
SLW1.W460.N MULCH DELIVERY 14

POST PLANTING WORK **15**
SLW1.W510.9 WEEDING AND MAINTENANCE 15
SLW1.W520.9 WATERING PLANTS 15
SLW1.W530.9 ERECTING PROTECTIVE FENCING 15
DEALING WITH PARASITIC PLANTS **15**
SLW1.W610.9 GENERAL 15
SLW1.W620.9 LIGHTLY AFFECTED PLANTS 15
SLW1.W630.9 BADLY AFFECTED PLANTS 15
SLW1.W640.9 EXTENSIVE INFESTATION 15
SLW1.W650.9 CULTIVATION AFTER TREATMENT 15
USE OF CHEMICALS **15**
SLW1.W710.9 GENERAL 15
SLW1.W720.9 STORING, MIXING, APPLYING AND DISPOSING PESTICIDES 16
TREE REMOVAL **16**
SLW1.W810.9 GENERAL 16

SLW2 TREES **17**

MATERIALS **17**
GENERAL **17**
SLW2.M010.9 GENERAL PLANTING REQUIREMENTS 17
SLW2.M020.9 HOME GROWN TREES 17
SLW2.M030.9 IMPORTED TREES 17
SLW2.M040.9 FEATHERED TREES 17
SLW2.M050.9 SPECIES 17
SLW2.M060.9 TREE GIRTH 17
SLW2.M100.9 TREE QUALITY GENERAL 17
TREES CLASSIFIED BY SIZE **18**
SLW2.M110.9 SEEDLING TREES 18
SLW2.M120.9 WHIPS 18
SLW2.M130.9 LIGHT STANDARD TREES 18
SLW2.M140.9 STANDARD TREES 19
SLW2.M150.9 HEAVY STANDARD TREES 19
SLW2.M160.9 SEMI-MATURE TREES 20
CONIFERS AND PALMS **20**
SLW2.M210.9 CONIFERS 20
SLW2.M220.9 PALMS 20
TREE SUPPORTS ETC. **20**
SLW2.M310.9 METAL STAKES 20
SLW2.M320.A BAMBOO STAKES 21
SLW2.M330.9 TIES 21
SLW2.M340.9 GUYS 21
SLW2.M350.9 GUYING TURNBUCKLES 21
SLW2.M360.9 GUYING STAKES 21
SLW2.M365.9 UNDERGROUND GUYING SYSTEM 21
SLW2.M370.9 TRUNK PROTECTION 22
SLW2.M380.9 EYE BOLTS 22
SLW2.M390.9 ROOT BARRIERS AROUND TREE PITS 22
LABELS **22**
SLW2.M410.9 LABELS FOR USE 22
SLW2.M420.9 LABELS FOR STOCK 22
SLW2.M430.9 SECURING TREES IN PLANTERS WITH CONCRETE BASES 22

WORKMANSHIP **23**
GENERAL **23**
SLW2.W010.9 GENERAL PLANTING REQUIREMENTS 23
NOTCH PLANTING **23**
SLW2.W110.9 SEEDLING TREES 23
SLW2.W120.9 WHIPS 23
PIT PLANTING **23**
SLW2.W210.9 LIGHT STANDARD, STANDARD AND HEAVY STANDARD TREES, CONIFERS AND PALMS 23
SLW2.W220.9 SEMI-MATURE TREES 24
SLW2.W230.9 PLANTING IN PAVED AREAS 24
SLW2.W240.9 BACKFILLING WITH DG 24
SLW2.W250.9 TREE PIT DIMENSIONS 24
SLW2.W260.9 FIXING ROOT BARRIERS 25
FERTILIZING **25**
SLW2.W310.9 APPLICATION OF FERTILIZER 25
SUPPORTING TREES **25**
SLW2.W410.9 STAKES 25
SLW2.W420.9 SECURING TREES - GENERAL 25
SLW2.W430.9 SECURING TREES IN PLANTERS WITH CONCRETE BASES 26
SLW2.W440.9 SECURING HEAVY STANDARD AND SEMI-MATURE TREES IN PAVED AREAS AND PODIUM PLANTERS 26
LABELLING **26**
SLW2.W510.9 FIXING LABELS 26

SLW3 GROUND COVER, SHRUBS, CLIMBERS AND BAMBOOS **27**

MATERIALS **27**
GENERAL **27**
SLW3.M010.9 GENERAL PLANTING REQUIREMENTS 27
PLANTS **27**
SLW3.M110.9 SPECIES 27
SLW3.M120.9 GROUND COVER PLANTS 27
SLW3.M130.9 SMALL SHRUBS 27
SLW3.M140.9 LARGE SHRUBS 27
SLW3.M150.9 CLIMBERS 28
SLW3.M160.9 BAMBOOS 28
SUPPORTS **28**
SLW3.M210.9 STAKES 28
SLW3.M220.9 TIES 28
SLW3.M230.9 CLIMBER WIRES 28
SLW3.M240.9 TURNBUCKLES 28
SLW3.M250.9 TRUNK PROTECTION 28
SLW3.M260.9 GUYING STAKES 29
SLW3.M270.9 HORSESHOE NAILS 29
SLW3.M280.9 EYE BOLTS 29
LABELS **29**
SLW3.M310.9 LABELS FOR USE 29
SLW3.M320.9 LABELS FOR STOCK 29

WORKMANSHIP **30**
PLANTING GENERALLY **30**
SLW3.W010.9 SEQUENCE AND GENERAL PROCEDURE 30

SLW3.W020.9 PLANTING HOLE SIZES 30
SLW3.W030.9 CLIMBERS 30
SLW3.W040.9 BARE ROOTED PLANTS 30
SLW3.W050.9 PLANTING IN GRASS AREAS (EXISTING OR NEW) 30
SLW3.W060.9 PLANTING SHRUBS AND GROUND COVERS 30
SUPPORTING PLANTS OTHER THAN CLIMBERS 31
SLW3.W105.9 NON-CLIMBER SUPPORTS 31
SUPPORTING NON-SELF-CLINGING CLIMBERS 31
SLW3.W110.9 FIXING TO WALLS 31
SLW3.W120.9 FIXING TO PERGOLA COLUMNS 31
SLW3.W130.9 FIXING TO WIRE SUPPORTS ON PERGOLAS 31
SLW3.W140.9 FIXING TO BAMBOO STAKES 32
FERTILIZING 32
SLW3.W210.9 RATES OF APPLICATION 32
MULCHING 32
SLW3.W310.9 MULCHING DEPTHS 32
LABELLING 32
SLW3.W410.9 FIXING LABELS 32

SLW4 HERBACEOUS PLANTS 33

MATERIALS 33
PLANTS AND SEEDS 33
SLW4.M010.9 SPECIES 33
SLW4.M020.9 DEFINITIONS 33
SLW4.M030.9 BULBS 33
SLW4.M040.9 CORMS 33
SLW4.M050.9 TUBERS 33
SLW4.M060.9 HERBACEOUS PLANTS 33
STAKE TIES 33
SLW4.M110.9 TIES 33
WORKMANSHIP 34
GENERAL 34
SLW4.W010.9 GENERAL PLANTING REQUIREMENTS 34
SLW4.W020.9 PLANTING PROGRAMME 34
SLW4.W030.9 PLANTING IN SHRUB BEDS 34
SLW4.W040.9 PLANTING IN GRASSED AREAS 34
SOWING SEEDS 34
SLW4.W110.9 BROADCAST SOWING 34
PLANTING 34
SLW4.W210.9 BULBS, CORMS AND TUBERS 34
SLW4.W220.9 HERBACEOUS PLANTS 34

SLW5 AQUATIC PLANTS 35

MATERIALS 35
AQUATIC PLANTS 35
SLW5.M010.9 PLANTS 35
PLANTING MATERIALS 35
SLW5.M110.9 PLANTING MEDIUM 35
SLW5.M120.9 GRASS SODS 35
SLW5.M130.9 HESSIAN 35

CONTAINERS AND SUPPORTS **35**
SLW5.M210.9 UNGLAZED FIRECLAY CONTAINERS 35
SLW5.M220.9 PLASTICS MESH CONTAINERS 36
SLW5.M230.9 WIRE MESH CAGES 36
SLW5.M240.9 CONTAINER SUPPORTS 36
ANCILLARY MATERIALS **36**
SLW5.M310.9 BALLAST 36
SLW5.M320.9 TIES 36
WORKMANSHIP **37**
GENERAL **37**
SLW5.W010.9 GENERAL PLANTING REQUIREMENTS 37
SLW5.W020.9 PLANTING PROGRAMME 37
SLW5.W030.9 SOAKING PLANTS 37
PLANTING, SUPPORT AND PROTECTION **37**
SLW5.W110.9 PLANT BOX FILLING 37
SLW5.W120.9 PLANTING IN PLANT BOXES 37
SLW5.W130.9 PLANTING IN FIRECLAY CONTAINERS 37
SLW5.W140.9 PLANTING IN PLASTICS MESH CONTAINERS 37
SLW5.W150.9 PLACING CONTAINERS 38
SLW5.W160.9 BALLAST COVER 38
SLW5.W170.9 WIRE MESH CAGES 38

SLW6 INDOOR PLANTS **39**

MATERIALS **39**
GENERAL **39**
SLW6.M010.9 GENERAL PLANTING REQUIREMENTS 39
PLANTS **39**
SLW6.M110.9 GENERAL 39
SLW6.M120.9 ARTIFICIAL PLANTS 39
POTS **39**
SLW6.M210.9 PLAIN EARTHENWARE 39
SLW6.M220.9 DRAGON POTS 39
PLANTING MATERIALS **40**
SLW6.M310.9 POTTING COMPOST 40
SLW6.M320.9 POT DRAINAGE LAYER 40
SLW6.M330.9 PLANT BOX DRAINAGE LAYER 40
SLW6.M340.9 FILTER LAYER 40
ANCILLARY MATERIALS **40**
SLW6.M420.9 WIRE NETTING 40
SLW6.M430.9 WOOD CHIP MULCH 40
SLW6.M440.9 SURFACE COVER 40
WORKMANSHIP **41**
POTTING **41**
SLW6.W010.9 GENERAL 41
SLW6.W020.9 DRAINAGE LAYER 41
SLW6.W030.9 PLANTING 41
PLANTING IN PLANT BOXES **41**
SLW6.W110.9 DRAINAGE LAYER 41
SLW6.W120.9 SOILING 41
SLW6.W130.9 PLANTING 41
SLW6.W140.9 FERTILIZING 41

SLW6.W160.9 MULCHING 42
ARTIFICIAL PLANTS 42
SLW6.W210.9 PLANT BEDS 42
SLW6.W220.9 SECURING PLANTS 42
SLW6.W230.9 SURFACE COVER 42

SLW7 GRASSING 43

MATERIALS 43
SPRIGS 43
SLW7.M010.9 SPRIGS 43
SLW7.M020.9 SPRIG SPECIES 43
TURVES AND FIXINGS 43
SLW7.M110.9 TURVES 43
SLW7.M120.9 TURVES SPECIES 44
SLW7.M130.9 TURF PINS 44
SLW7.M140.9 SECURING PEGS 44
GRASS SEED 44
SLW7.M210.9 GRASS SEED MIX 44
SLW7.M220.9 GERMINATION 45
SLW7.M230.9 PURITY 45
SLW7.M240.9 CERTIFICATION 45
SLW7.M270.9 GRASS SEED MIX FOR USE IN GRASS PAVING SYSTEM 45
ANCILLARY MATERIALS 45
SLW7.M310.9 PRE-SEEDING FERTILIZER 45
SLW7.M330.9 SAND FOR TOP-DRESSING OR INFILLING 45
SLW7.M340.9 WEED-KILLER 45
SLW7.M350.9 MACHINERY AND TOOLS 46

WORKMANSHIP 47
GENERAL 47
SLW7.W010.9 PROGRAMME 47
PREPARATION 47
SLW7.W110.9 CULTIVATION 47
SLW7.W120.9 CULTIVATION ON EMBANKMENTS 47
SLW7.W130.9 STONE PICKING 47
SLW7.W140.9 FINISHED LEVELS 47
SPRIGGING 47
SLW7.W210.9 PROGRAMME 47
SLW7.W220.9 CULTIVATION 47
SLW7.W230.9 APPLYING PRE-SPRIGGING FERTILIZER 48
SLW7.W240.9 WATERING 48
SLW7.W250.9 SPRIGGING 48
SLW7.W260.9 POST-SPRIGGING OPERATION 48
SLW7.W270.9 RE-SPRIGGING 48
TURFING 48
SLW7.W310.9 PROGRAMME 48
SLW7.W320.9 CULTIVATION 48
SLW7.W330.9 APPLYING PRE-TURFING FERTILIZER 48
SLW7.W340.9 WATERING 49
SLW7.W350.9 DELIVERY AND STACKING 49
SLW7.W360.9 PLANKED SUPPORTS 49
SLW7.W370.9 TURF LAYING 49

SLW7.W380.9 SLOPES EXCEEDING 1:2 49
SLW7.W390.9 UNEVENNESS OF FINISHED LEVEL 49
SLW7.W400.9 ROLLERS 49
SLW7.W410.9 PERIMETERS 49
SLW7.W420.9 TURF JOINTS 50
SLW7.W430.9 SHRINKAGE 50
SLW7.W440.9 APPLYING POST-TURFING FERTILIZER 50
SLW7.W450.9 TURFING TAKE 50
SLW7.W460.9 LAYING TURF IN GRASS PAVING SYSTEM 50

SEEDING 50
SLW7.W510.9 STORING SEED 50
SLW7.W520.9 APPLYING PRE-SEEDING FERTILIZER 50
SLW7.W530.9 BROADCAST SOWING 50
SLW7.W540.9 RAKING, HARROWING AND ROLLING 51
SLW7.W550.9 APPLYING WEED-KILLER 51
SLW7.W560.9 TURF EDGING TO SEEDED AREAS 51
SLW7.W570.9 EDGE TRIMMING TO SEEDED AREAS 51
SLW7.W580.9 APPLYING POST-SEEDING FERTILIZER 51
SLW7.W590.9 GERMINATION OF BROADCAST SOWN SEED 51
SLW7.W592.9 APPLICATION OF GRASS SEED AND SOIL FILLING MIXTURE IN GRASS PAVING SYSTEM 51

POST PLANTING OPERATIONS 52
SLW7.W610.9 WATERING 52
SLW7.W620.9 ROLLING OF GRASSED AREAS 52
SLW7.W630.9 CUTTING 52
SLW7.W640.9 MOWING 52

SLW8 TREE SURGERY WORKS 53

MATERIALS 53

GENERAL 53
SLW8.M010.9 SCOPE OF WORK 53

WORKMANSHIP 54

TREE SURGERY 54
SLW8.W010.9 STANDARD 54
SLW8.W020.9 PRUNING TECHNIQUES 54
SLW8.W030.9 CUTTING BACK BARK 54
SLW8.W040.9 TIMING OF PRUNING 54
SLW8.W050.9 CAVITY TREATMENT 54
SLW8.W060.9 ADDITIONAL DAMAGE 54
SLW8.W070.9 TOOLS AND EQUIPMENT 54

SLW9 ESTABLISHMENT WORKS 55

WORKMANSHIP 55

DEFINITIONS 55
SLW9.W010.9 ESTABLISHMENT WORKS 55
SLW9.W020.9 ESTABLISHMENT PERIOD 55

GENERAL 55
SLW9.W100.9 TREE INVENTORY REPORT 55
SLW9.W110.9 VANDALISM DAMAGE TO PLANTING 55
SLW9.W120.9 TYPHOON DAMAGE 56
SLW9.W130.9 REPLACEMENT PLANTING 56

SLW9.W140.9 PLANT DIVISION 56
SLW9.W150.9 THINNING 56
SLW9.W160.9 PARASITIC PLANTS 56
SLW9.W170.9 RECORDS 57
SLW9.W180.9 WATER SUPPLY 57
SCHEDULES OF ESTABLISHMENT WORKS OPERATIONS 57
SLW9.W210.9 GENERAL 57
SLW9.W220.A FIRST TWELVE MONTHS OF ESTABLISHMENT PERIOD 57
SLW9.W230.A SECOND TWELVE MONTHS OF ESTABLISHMENT PERIOD 58
SLW9.W240.9 PRUNING SCHEDULE 59
ESTABLISHMENT OPERATIONS 65
SLW9.W300.9 MAKING GOOD ERODED SEEDED AREAS 65
SLW9.W310.9 WATERING 65
SLW9.W320.9 WEEDING 65
SLW9.W330.A FERTILIZING 66
SLW9.W340.9 TOP DRESSING TO GRASSED AREAS 67
SLW9.W350.9 AERATION 67
SLW9.W360.9 MULCHING 67
SLW9.W370.9 AERATION AND MULCHING 67
SLW9.W380.9 TOPPING UP GRAVEL MULCH TO TREE GRILLES 67
SLW9.W390.9 FIRMING UP 67
SLW9.W400.9 TREE SUPPORTS 67
SLW9.W410.9 GRASS CUTTING 67
SLW9.W420.9 PRUNING PROGRAMME 68
SLW9.W430.9 PRUNING PROCEDURES 68
SLW9.W440.9 TREATMENT OF PESTS AND FUNGAL GROWTH 68
SLW9.W445.9 CLEARANCE OF EXISTING VEGETATED AREAS 69
SLW9.W450.9 CARE OF INDOOR PLANTS 69
SLW9.W460.9 CARE OF ARTIFICIAL PLANTS 69
SLW9.W470.9 MAINTENANCE OF PROTECTIVE FENCING 69
SLW9.W480.9 REMOVAL OF PROTECTIVE FENCING 69
SLW9.W490.9 REMOVAL OF STAKES 69
SLW9.W500.9 REMOVAL OF HESSIAN BINDING TO TRANSPLANTED TREES 69
SLW9.W510.9 FINAL INSPECTION 69
MAINTENANCE FOR SAND BASED LAWN 69
SLW9.W610.9 GENERAL 69
SLW9.W620.9 CONTROL USAGE 69
SLW9.W630.9 OVERSEED DURING DRY SEASON 70
SLW9.W640.9 TURF MOWING 70
SLW9.W650.9 TOPDRESSING 70
SLW9.W660.9 DETHATCHING 70
SLW9.W670.9 SPIKING 70
SLW9.W680.9 FERTILIZATION 70

SLW1 GENERAL PLANTING REQUIREMENTS

MATERIALS

PLANTS GENERALLY

SLW1.M010.9 SPECIES

All plants, seeds etc. must be true to species.

SLW1.M020.9 HEALTH

Plants and seeds must be free from pests, disease, parasites, discolouration, and mechanical damage.

SLW1.M030.9 SOURCE

Obtain all plants from a recognised cultivated source and not from the wild.

SLW1.M040.9 HABIT

Ensure all plants exhibit the habit, growth and a well developed shape for the species specified and that all plants have a vigorous fibrous root system.

SLW1.M050.9 NAME

In the event of any discrepancy between the Scientific Name, English Common Name, and the Chinese Common Name for any plant specified, the Scientific Name shall prevail.

SLW1.M060.9 SUBSTITUTION

At no time, either make or allow any substitution, without prior Approval.

SLW1.M070.9 PARASITIC PLANTS

Do not allow any of the following species of parasitic plants to be present in any form on any plant or soil brought on to the Site:

1. Cuscuta australis (European Dodder);
2. Cuscuta chinensis (Chinese Dodder, Yellow Colour Thread);
3. Cuscuta reflexa (Yunnan Dodder);
4. Cassytha filiformis (Cassytha).

SLW1.M080.9 NOXIOUS WEEDS

Do not allow any of the following species of noxious weeds as defined by the Agriculture, Fisheries and Conservation Department (AFCD) to be present in any form on any plant or soil brought on to the Site:

1. Mikania micrantha (Mile-a-minute Weed)

Such noxious weeds shall be cleared manually from all affected areas within the Site and disposed off site, at the Contractor's expense, all in accordance with the guideline and practice notes promulgated by AFCD.

FERTILIZERS AND ADDITIVES

SLW1.M110.9 SLOW RELEASE FERTILIZER

Slow release fertilizer to be granular NPK chemical fertilizer with a minimum 12-week release period conforming to the following formula:

14 - 18	Parts N	(Nitrogen)
7 - 12	Parts P	(Phosphorus)
12 - 16	Parts K	(Potassium)
1 - 3	Parts MgO	(Magnesium Oxide plus other trace elements)

Apply at the rates specified in the appropriate planting Section.

SLW1.M130.9 QUICK RELEASE FERTILIZER

Quick release fertilizer to be granular NPK chemical fertilizer with a minimum two- week release period conforming with the following formula:

14 - 16	parts N	(Nitrogen)
14 - 16	parts P	(Phosphorus)
14 - 16	parts K	(Potassium)

Apply at the rates specified in the appropriate planting Section.

SLW1.M135.9 SPENT MUSHROOM COMPOST (SMC):

Option for Fertilizer

1. General

   Spent mushroom compost (SMC) is also commonly called spent mushroom substrate (SMS) and spent mushroom waste. This is the solid residue left after harvest of the mushrooms from the growing compost / substrate;

2. Composition:

   The following table lists out the specification of spent mushroom compost as fertilizer:

   a. Organic Matter: >85% (by dry weight);

   b. Chitin : 22 – 25%

      by Official Methods of Analysis of AOAC International, 2012 (19th edition) or latest revision as appropriate;

   c. Minimum N (Nitrogen) : 1.2 – 2.5%, by 'Kjeldahl' Method;

   d. Minimum P (Phosphorus) : 0.11 – 0.40%

      by Official Methods of Analysis of AOAC International, 2012 (19th edition) or latest revision as appropriate;

   e. K (Potassium), 2.7 - 3.7%

      by Official Methods of Analysis of AOAC International, 2012 (19th edition) or latest revision as appropriate;

   f. Mg(Magnesium), 0.2 - 0.3%

by Official Methods of Analysis of AOAC International, 2012 (19th edition) or latest revision as appropriate.

3. Certification: prior to use and deliver on Site, take samples of SMC for analysis at an Approved laboratory and within 14 calendar days, produce the laboratory's Certificate stating the composition as per Para. 2 above;
4. Apply with the dosage as specified in the appropriate Planting Section.

SLW1.M140.9 DISCOURAGEMENT OF VERMIN

Do not use peanut cake as a fertilizer, nor any other substance likely to encourage vermin.

SLW1.M150.9 LIMESTONE

1. Composition: ground limestone containing a minimum of 90% calcium and magnesium carbonates and capable of passing through a 10mm mesh sieve;
2. Certification: prior to use and for every 500kg delivered to Site, take samples of the limestone for analysis at an Approved laboratory and within 14 calendar days, produce the laboratory's Certificate stating:
   a. Calcium and magnesium carbonate content;
   b. The particle size.

CHEMICALS

SLW1.M220.9 PESTICIDES

Submit details of the pesticides for the approval of the CM. The pesticides must be registered under the Pesticide Ordinance (Cap. 133) with Agriculture, Fisheries and Conservation Department (AFCD) in Hong Kong, properly packed and clearly labelled bilingually both in English and Chinese and conform to regulations stipulated by the Government of the HKSAR.

MULCHES

SLW1.M310.A MULCHES

Mulch as shown on Drawings, to be:

1. Fibrous mulch to be organic material such as decomposed leaf litter, decomposed sawdust, prepared compost or spent mushroom compost; and / or
2. Wood chip mulch, to comprise:
   a. Particle size: in the range 10mm to 30mm;
   b. Thickness: in the range 2mm to 5mm.
3. Mulch derived from locally recyclable yard waste including, but not limited to, those produced by the yard waste recycling centre, Y • PARK and / or other wood shredding facilities operated by Environmental Protection Department (EPD), or as approved by the CM.

ANCILLARY MATERIALS

SLW1.M410.9 PLANT LABELS

Plant labels to be 120 mm x 80 mm x 2 mm thick, white acrylic or aluminium with:

1. 2 holes of 5 mm diameter, centred 50 mm apart, 10 mm from the top edge;
2. The Botanic name, English and Chinese Common names of the plant, heat - indented in black characters;
3. The size of the capital letter for Botanic and English Common names to be not less than 10 mm and the lower case to be not less than 7 mm;
4. Chinese characters not less than 13 mm high.

SLW1.M420.9 PROTECTIVE FENCING

Protective fencing as shown on Drawings, to be:

1. Proprietary bamboo fencing, comprising:
   a. 10 to 20 mm diameter bamboo palings fastened together at each joint with galvanized metal staples and washers, which when erected forms a framework with palings at 150 mm centres;
   b. Vertical support stakes and inclined support struts, 600 mm longer than the finished height of the fence, of either:
      i. 50 mm diameter bamboo; or
      ii. 30 x 30 x 3 mm mild steel angle, painted black with one priming coat and one finishing coat.
   c. Open ends of bamboo palings and stakes to be sealed with sealant approved by CM. No stagnant water should be found inside or outside of the stakes.
2. Proprietary plastic lattices to be of UV stabilized HDPE plastic resin with 70 mm grid opening, and 4.4 mm thick, with appropriate supporting system, colour as specified;
3. Finished height: Height of fencing, either 600 mm or 900 mm height as shown on Drawings, ±25 mm.

SLW1.M430.9 PEA GRAVEL

Pea gravel to be clean rounded river washed gravel:

Size: in the range 5 mm to 12 mm.

SLW1.M440.9 GRAVEL

Gravel to be clean broken stone:

Size: in the range 10 mm to 30 mm.

SLW1.M450.9 GRAVEL FOR SAND BASED LAWN

Gravel to be clean broken stone:

Size: 10mm ± 5mm.

WORKMANSHIP

PROGRAMME

SLW1.W010.9 PLANTING SEASON

Unless specified otherwise for individual species or types of planting, do not plant between the period 1st December to the end of February, without prior or agreement Approval from CM.

SLW1.W020.9 PLANTING TREES

Where trees are planted in grass or shrub areas, plant trees before the seeding/grassing or shrub planting operations.

SLW1.W030.9 PLANTING SHRUBS

Where shrubs are planted in grass areas, plant the shrubs before the seeding/grassing operations.

LIFTING PLANTS

SLW1.W110.9 ROOT PRUNING

Carry out root pruning and undercutting of the root system of the rootballed stock twelve months prior to lifting from the nursery.

SLW1.W120.9 WATERING AND LIFTING

Water plants grown in open ground prior to lifting and carefully lift to ensure the specified root ball is obtained.

SLW1.W130.9 PROTECTIVE WRAPPING

Wrap rootballs in moist hessian sacking, or an Approved equivalent protective wrapping.

PROTECTION AND STORAGE PRIOR TO PLANTING

SLW1.W210.9 PROTECTION GENERALLY

1. Adequately wrap and protect all plants to prevent mechanical damage, excessive transpiration and wilting during lifting, transportation and storage;
2. Protect all plants against excessive sunlight, wind and drought;
3. Keep plants moist at all times.

SLW1.W220.9 STORAGE OF PLANTS ON SITE

Maintain plants in good condition and:

1. Store plants, other than trees, on level ground, standing upright;
2. Store trees on level ground at an angle greater than 45° to the horizontal;

3. Where trees and shrubs are delivered to the Site with shoots and branches bundled, remove all tying materials immediately to prevent heating up and subsequent defoliation.

PREPARATORY WORK

SLW1.W310.9 CLEARING

Clear all areas to be planted of rubbish, weeds, deleterious matter, and stones larger than 25 mm in any dimension, and remove all such material from Site.

SLW1.W320.9 PREPARING PLANTS

1. Cut loose and remove all wrapping materials around roots and containers;
2. Trim any broken roots with secateurs or a sharp knife.

SLW1.W330.9 WATERING

Thoroughly soak all plants before planting. If rootballs or containers are very dry, immerse the roots in water until air bubbles cease to rise.

PLANTING

SLW1.W410.9 GENERAL

1. Carry out all planting works in accordance with good horticultural practice;
2. Do not leave pits excavated for planting on or adjacent to slopes, open during wet weather.

SLW1.W420.9 TIMING

Plant all plants in their final position within two days of delivery to Site.

SLW1.W430.9 FINISHED SOIL LEVELS

1. Ensure that the finished soil level round the plant is the same as that in which the plant was growing in the nursery or container, with the root collar at ground level;
2. When planting in grassed areas finish soil level 50 mm below the surrounding soil level to allow for mulching.

SLW1.W440.9 FINISHING

Rake planted areas through on completion of planting to leave the soil surface clean and tidy.

SLW1.W450.9 WATERING IN

Immediately after planting and before mulching, thoroughly water all plants at a rate of 10 litres/m², unless required otherwise by the CM, to settle the soil around the roots.

SLW1.W460.N MULCH DELIVERY

When Instructed by the CM, the Contractor shall collect and deliver the mulch derived from the approved locally recyclable yard waste centre(s) direct to the Site.

POST PLANTING WORK

SLW1.W510.9 WEEDING AND MAINTENANCE

Keep all planted areas weed free and maintain all plants in grass areas as SLW9.W320 during the contract period.

SLW1.W520.9 WATERING PLANTS

Continue watering as necessary to maintain a moist soil at all times during the Planting Period, having regard to the following or as directed by the CM:

1. Normally, water all planted areas on every day that the rainfall is less than 5 mm per day except on the day following a day that rainfall exceeded 20 mm per day or when the soil is saturated during the Time for Completion of the Works of the Planting Period;
2. For planted areas under cover, water every day unless the soil remains moist from previous day's watering during the Time for Completion of the Works of the Planting Period.

SLW1.W530.9 ERECTING PROTECTIVE FENCING

Erect fencing in locations shown on the Drawings, securing palings to support stakes with galvanized wire. Drive support stakes into the ground at 2000 mm centres.

DEALING WITH PARASITIC PLANTS

SLW1.W610.9 GENERAL

Report to the CM any case of parasitic plants, as SLW1.M070, being inadvertently brought on to the Site. Take whatever action is specified in the following clauses, relating to the degree of infestation and as Instructed.

SLW1.W620.9 LIGHTLY AFFECTED PLANTS

Remove all parts of the parasitic plant and burn off site.

SLW1.W630.9 BADLY AFFECTED PLANTS

Remove the host plant and burn off site.

SLW1.W640.9 EXTENSIVE INFESTATION

Clear the whole area of all plants and burn off site.

SLW1.W650.9 CULTIVATION AFTER TREATMENT

Cultivate the area by turning the soil over to a depth of 100 mm to prevent germination of the parasitic plant seeds.

USE OF CHEMICALS

SLW1.W710.9 GENERAL

Do not use pesticides without prior Approval.

SLW1.W720.9 STORING, MIXING, APPLYING AND DISPOSING PESTICIDES

Store, mix, apply and dispose in accordance with the requirements and the latest "Code of Practice for the Safe and Proper Use of Pesticides in Public Areas" of Agriculture, Fisheries and Conservation Department (AFCD) in Hong Kong and the manufacturer's instructions. Do not store pesticide on site without prior Approval.

TREE REMOVAL

SLW1.W810.9 GENERAL

Fell and remove from Site diseased and dead trees as shown on the Drawings or as instructed.

1. These works shall apply to those trees and palms transplanted to the Site by the Employer's Direct Contractor, as refer to PRE.B2.010 for relevance;
2. Take all necessary safety precautions to protect the people engaged in the tree felling and removal work, as well as the people and property in the vicinity throughout the whole process of tree felling;
3. Where applicable, the safety requirements and procedures as stipulated in the Guidelines on Arboriculture Occupational Safety and Health published by the Greening, Landscape and Tree Management Section of Development Bureau, HKSAR and other relevant guidelines published by other Government departments shall be applied;
4. All voids formed as a result of the above works shall be backfilled with fabricated soil as appropriate.

SLW2 TREES

MATERIALS

GENERAL

SLW2.M010.9 GENERAL PLANTING REQUIREMENTS

Read this Worksection in conjunction with the appropriate clauses in Worksection SLW1.

SLW2.M020.9 HOME GROWN TREES

Complying in all respects with the requirements of this Specification at the time of planting.

SLW2.M030.9 IMPORTED TREES

Complying in all respects with the requirements of this Specification at the time of planting.

SLW2.M040.9 FEATHERED TREES

Trees described as feathered in the planting schedule or on the Drawings, must exhibit the characteristics required for the type, size and species of tree as specified, with the head/crown of the tree a defined, straight and upright leader, its stem well furnished with unpruned lateral shoots.

SLW2.M050.9 SPECIES

Tree species to be as shown or scheduled on the Drawings.

SLW2.M060.9 TREE GIRTH

Tree girth is the circumference of a tree trunk measured at 1300mm above ground level. Refer to AFCD Practice note No. 02/2003 for measurement of a tree.

SLW2.M100.9 TREE QUALITY GENERAL

Trees of light standard tree or above to exhibit all the following characteristics:

1. Healthy stock grown in nursery and free from any kinds of structural defects, dieback, cavities and decaying wounds;
2. The form and density of the crown shall be typical of the species or cultivar;
3. Unless otherwise specified as multi-stem trees or typically inhered of the species or cultivar, the tree shall have one central leader. No co-dominant stems shall be occurred within the lower half of the crown;
4. Have good taper to support the tree in vertical form;
5. Branches:
    a. Scaffold branches shall be distributed along the centre leader evenly to form a balanced crown typical of the species or cultivar;
    b. Branch diameter shall not exceed two-third (i.e. aspect ratio less than 0.66) the diameter of the central leader measured 25 mm above the branch union;

c. The attachment of the scaffold branches shall be free of included bark;

d. Scaffold branches shall distribute evenly on all sides.

6. Roots:

a. The surface root shall be free of wounds, scrapes, broken or split wood;

b. Root distribution shall be uniform throughout the root ball and growth shall be appropriate for the species or cultivar;

c. Root collar shall be within the upper 50 mm of the soil;

d. Free of stem girdling roots over the root collar or kinked roots;

e. The centre of the stem shall be in the centre of the rootball;

f. Structural roots shall distribute evenly on all sides.

7. For container grown trees, the tree shall have well-established root system reaching the sides of the container to main a firm rootball, but shall not have excessive root growth encircling inside the container.

TREES CLASSIFIED BY SIZE

SLW2.M110.9 SEEDLING TREES

Seedling trees to exhibit all the following characteristics:

1. Age: between 1 and 2 years;
2. Conformation: a single slender stem;
3. With a well developed vigorous root system;
4. Height above soil level: between 150 mm and 600 mm;
5. Grown in a container not less than 75 mm in diameter and 100 mm deep or a tube not less than 60 mm in diameter and 150 mm long.

SLW2.M120.9 WHIPS

Whips to exhibit all the following characteristics:

1. Age: between 2 and 3 years;
2. Conformation: a single central stem and elementary branch system;
3. With a well developed vigorous root system;
4. Height above soil level: between 600 mm and 1500 mm;
5. Grown in a container not less than 125 mm in diameter and 150 mm deep.

SLW2.M130.9 LIGHT STANDARD TREES

Light standard trees to exhibit all the following characteristics:

1. Height from the root collar to the lowest branch:

a. between 1600 mm and 2100 mm for trees with main tree trunk, and

b. between …… mm and …… mm for …… form of tree;

2. Total height above soil level: between 2400 mm and 3000 mm;
3. Stem diameter measured at a point one metre above the root collar: between 25 mm and 50 mm;

4. Conformation: a sturdy straight stem with a well balanced branching head, or a well defined straight and upright leader with branches growing out from the stem with good symmetry, and a minimum length of 500 mm;
5. Rootball size:
    a. Diameter: not less than 300 mm;
    b. Depth: not less than 300 mm.
6. When container grown trees are required, grow the tree in a container not less than 350 mm diameter and 400 mm deep.

SLW2.M140.9 STANDARD TREES

Standard trees to exhibit all the following characteristics:

1. Stem height from the root collar to the lowest branch:
    a. between 1700 mm and 2200 mm for trees with main tree trunk, and
    b. between …… mm and …… mm for …… form of tree;
2. Total height above soil level: between 2750 mm and 3500 mm;
3. Stem diameter measured at a point one metre above the root collar: between 50 mm and 75 mm;
4. Conformation: a sturdy straight stem with a well balanced branching head, or a well defined straight and upright leader with branches growing out from the stem with good symmetry, and a minimum length of 600 mm;
5. Rootball dimensions:
    a. Diameter: not less than 450 mm;
    b. Depth: 300 mm.
6. When container grown trees are required, grow the tree in a container not less than 500 mm in diameter and 500 mm deep.

SLW2.M150.9 HEAVY STANDARD TREES

Heavy standard trees to exhibit all the following characteristics:

1. Stem height from the root collar to the lowest branch:
    a. between 1800 mm and 2400 mm for trees with main tree trunk, and
    b. between …… mm and …… mm for …… form of tree;
2. Total height above soil level: between 3500 mm and 5000 mm;
3. Stem diameter measured at a point one metre above the root collar: between 75 mm and 150 mm;
4. Conformation: a sturdy straight stem, with a well balanced branching head, or a well defined straight and upright leader with branches growing out from the stem with good symmetry, and a minimum length of 800 mm;
5. Root ball dimensions:
    a. Diameter: not less than 750 mm;
    b. Depth: 400 mm.
6. When container grown trees are required, grow the tree in a container not less than 750 mm in diameter and 600 mm deep.

SLW2.M160.9 SEMI-MATURE TREES

Semi-mature trees to exhibit all the following characteristics:

1. Stem height from soil level to the lowest branch:
   a. not less than 2000 mm for trees with main tree trunk, and
   b. between …… mm and …… mm for …… form of tree;
2. Total height above soil level: greater than 6000 mm;
3. Stem diameter measured at a point one metre above the root collar: greater than 150 mm;
4. Conformation: a sturdy, straight stem with a well balanced branching head, or a well defined straight and upright leader with branches growing out from the stem with good symmetry, and a minimum length of 1500 mm;
5. Root ball dimensions:
   a. Diameter: not less than 1200 mm;
   b. Depth: 600 mm.
6. A root system previously undercut a minimum of one year prior to lifting, to encourage compact fibrous growth.

CONIFERS AND PALMS

SLW2.M210.9 CONIFERS

Conifers to exhibit all the following characteristics:

1. A well developed upright stem and vigorous shoots with good symmetry;
2. A well-developed vigorous root system;
3. Minimum dimensions not less than those shown on the Drawings or plant schedule +300 mm, -0 mm;
4. A rootball appropriate and in proportion to the size of the plant.

SLW2.M220.9 PALMS

Palms to exhibit all the following characteristics:

1. A well developed, upright habit and vigorous fronds with good symmetry;
2. A well developed, vigorous root system;
3. Minimum dimensions not less than those shown on the Drawings or plant schedule +300 mm, -0 mm. Palms with multi-stems to be measured with overall height. Palms with single trunk to be measured with "Stem Height". "Stem Height" shall be measured from the root collar to the base of the growing tip;
4. A root ball appropriate and in proportion to the size of the plant.

TREE SUPPORTS ETC.

SLW2.M310.9 METAL STAKES

1. Material: mild steel angle, size: 30 mm x 30 mm x 3.5 mm thick;
2. Length: as specified in the table to SLW2.W420 ±50 mm;

3. With 5 mm to 10 mm diameter hole drilled 40-45 mm from the top;
4. Finish: Approved paint, applied prior to installation, with one coat primer and one black top coat;
5. Protective caps: black plastic or neoprene cap, min. 25 mm deep to fit tightly on top of metal stake.

SLW2.M320.A BAMBOO STAKES

Open ends of bamboo stakes shall be sealed. No stagnant water should be found inside or outside of the stakes:

1. Bamboo stakes for whips to be 35 mm diameter poles, length as specified in the table to SLW2.W420;
2. Bamboo stakes for light standard, standard trees, palms and conifers (up to 2.5 m overall height) to be 50 mm diameter poles, length as specified in the table to SLW2.W420.

SLW2.M330.9 TIES

Tie as shown on Drawings, to be:

1. Rot-proof rope: 5 mm diameter in dark colour; and/or
2. Plastic coated wire: 3 mm overall diameter in dark colour; and/or
3. Stainless steel braided wire: 3 mm diameter with 20 mm adjustable galvanized steel screw clamp.

SLW2.M340.9 GUYS

Guys as shown on Drawings, to be:

1. Rot-proof rope: 8 mm diameter in dark colour; and/or
2. Plastic coated wire: 4 mm overall diameter in dark colour; and/or
3. Stainless steel braided wire: 4 mm diameter with 20 mm adjustable galvanized steel screw clamp.

SLW2.M350.9 GUYING TURNBUCKLES

Turnbuckles and associated fittings to be stainless steel. Turnbuckles to be not less than 100 mm long. The specified length excludes any attached fittings, or adjusting screws.

SLW2.M360.9 GUYING STAKES

1. Material: galvanized mild steel angle, size: 30 mm x 30 mm x 3.5 mm thick;
2. With 5 mm to 10 mm diameter hole drilled 40-45mm from the top prior to galvanizing.

SLW2.M365.9 UNDERGROUND GUYING SYSTEM

Underground Guying System (Option 1), to be:

1. Flexible nylon straps with ratchet tensioner: not less than 50mm width in dark colour, with 3 – 5mm dia. stainless steel anchor ring and galvanized steel ratchet tensioner;
2. Stainless steel cables: not less than 5mm diameter and 20mm adjustable galvanized steel screw clamp or stainless steel anchor ring;
3. Timber deadman: not less than 1000mm x 150mm x 50mm.

Underground Guying System (Option 2), to be:

1. Flexible nylon straps: not less than 50mm width in dark colour, with 3 – 5mm dia. stainless steel anchor ring attached to straps at both ends;
2. Stainless steel cables: not less than 5mm diameter and 20mm adjustable galvanized steel screw clamp or stainless steel anchor ring;
3. Stainless steel turnbuckle: as SLW2.M350;
4. Timber deadman: not less than 1000mm x 150mm x 50mm.

SLW2.M370.9 TRUNK PROTECTION

Trunk protection as shown on Drawings, to be:

1. Hosing: clear unplasticised polyvinyl chloride (uPVC) plastic hosing, 10 mm diameter; and/or
2. Rubber: 2 mm thick 150 mm wide rubber pad, long enough to wrap twice round the trunk.

SLW2.M380.9 EYE BOLTS

Eye bolts to be stainless steel with:

1. 70 mm overall length;
2. Threaded shank;
3. 15 mm diameter eye.

SLW2.M390.9 ROOT BARRIERS AROUND TREE PITS

Root barriers to be 5 mm thick copper lined root resistant bitumen membrane, or Approved proprietary type:

1. Depth: depth of tree pit below paving level less 100 mm;
2. Diameter: as for tree pit.

LABELS

SLW2.M410.9 LABELS FOR USE

Labels to be as SLW1.M410 for each type of tree.

SLW2.M420.9 LABELS FOR STOCK

Supply additional labels to the housing manager, totalling 30% of those provided above and name on a pro-rata basis.

SLW2.M430.9 SECURING TREES IN PLANTERS WITH CONCRETE BASES

1. Guy each tree with 4 No. guys, as SLW2.M340, fixed to tree trunk immediately above the lowest branch;
2. Tie each guy through an eye bolt, as SLW2.M380, drilled and plugged into the inner face of the planter walls 100mm below coping and tighten each end with a galvanized fastener;
3. Tension guys with turnbuckles, as SLW.2.M350, inserted 200mm from the eye bolt;
4. Ensure all guys are of an equal angle to the horizontal, sufficient to hold the tree firm.

WORKMANSHIP

GENERAL

SLW2.W010.9 GENERAL PLANTING REQUIREMENTS

Read this Worskection in conjunction with the appropriate clauses in Worksection SLW1.

NOTCH PLANTING

SLW2.W110.9 SEEDLING TREES

1. Form notch, using a hand held pick or spade, deep enough to accommodate the root of the plant;
2. Place the plant upright in the notch and take care to keep the soil and root intact;
3. Firm the plant in the ground with the shoot upright.

SLW2.W120.9 WHIPS

Unless specified otherwise on the Drawings or plant schedule:

1. Form notch, using a hand held pick or spade, deep enough to accommodate the root of the plant;
2. Place the plant upright in the notch and take care to keep the soil and root intact;
3. Firm the plant in the ground with the shoot upright.

PIT PLANTING

SLW2.W210.9 LIGHT STANDARD, STANDARD AND HEAVY STANDARD TREES, CONIFERS AND PALMS

Plant light standard, standard and heavy standard trees, conifers and palms in accordance with the following procedure and sequence:

1. Dig tree pit to size specified in SLW2.W250;
2. Soak rootball;
3. Fork over base of tree pit to a depth of 150 mm;
4. Prepare backfill material, adding and mixing in fertilizer as SLW2.W310, backfill base in layers and firm in to adjust planting depth;
5. Remove rootball covering, place tree, adjust orientation of the crown and check planting depth, adjusting as necessary;
6. Fix vertical stakes as SLW2.W420;
7. Tie tree to stakes;
8. Backfill in layers, firming in each layer with heel and water thoroughly;
9. Adjust tree ties;
10. Water again and continue to water as required.

SLW2.W220.9 SEMI-MATURE TREES

Plant semi-mature trees in accordance with the following procedure and sequence:

1. Dig tree pit to size specified in SLW2.W250;
2. Soak rootball;
3. Fork over base of tree pit to a depth of 150 mm;
4. Prepare backfill material, adding and mixing in fertilizer as SLW2.W310, backfill base in layers and firm in to adjust planting depth;
5. Remove rootball covering, place tree, adjust orientation of the crown and check planting depth, adjusting as necessary;
6. Fix guying stakes as SLW2.W420;
7. Secure trees with guys as SLW2.W420;
8. Backfill in layers, firming in each layer with heel and water thoroughly;
9. Water again and continue to water as required.

SLW2.W230.9 PLANTING IN PAVED AREAS

Where trees are planted in paved areas, carefully lift any tree grilles, lay them aside and:

1. Excavate tree pit, 900 mm deep, to the full area of the tree grille and expose the surface of aggregate layer over existing land drain at the base;
2. Carry out a water percolation test to check the functioning of the subsoil drain by filling the pit fully with water. If water does not drain away immediately or within 1 working day inform the CM;
3. Complete planting operations specified in this Worksection appropriate to the tree being planted and compact backfill to finish 75 mm below adjacent paving level;
4. Place a filter layer, as EXT13.M110, over the entire pit area tucking all edges into the soil;
5. Lay 50 mm of gravel, as SLW1.M440;
6. Transport from store on the estate, if necessary, and carefully replace tree grilles previously set aside, flush with the surrounding kerb or paving;
7. Fill the interstices and around the base of the trunk as shown on Drawings, with pea gravel, as SLW1.M430, or gravel as SLW1.M440.

SLW2.W240.9 BACKFILLING WITH DG

Where excavated soil is DG as Worksection EXT12, mix it with soil conditioner to form fabricated soil as EXT12.M310.

SLW2.W250.9 TREE PIT DIMENSIONS

Plant trees in pits 300 mm larger than the rootball or in accordance with the following table whichever is the greater except where planted in tree grilles (see SLW2.W230).

Type of tree	Size of Pit
Light Standard, Standard, Conifers and Palms	750 mm diameter x 600 mm deep
Heavy Standard	900 mm diameter x 750 mm deep
Semi-mature	1500 mm diameter x 900 mm deep

SLW2.W260.9 FIXING ROOT BARRIERS

Where indicated on Drawings fix root barrier, as SLW2.M390, in tree pits so that top edge finishes at underside of paving or tree grille level and bottom edge finishes 100 mm above bottom drainage layer of tree pit. Before fixing fully bond 100 mm minimum side laps by torching in accordance with manufacturer's instructions.

FERTILIZING

SLW2.W310.9 APPLICATION OF FERTILIZER

1. Apply slow release fertilizer, as SLW1.M110, in accordance with the following table:

Type of tree	Amount per tree	Application
Seedling trees	25 gm	Spread around each notch.
Small Conifers and Palms	50 gm	Mix with the backfilling soil.
Whips	50 gm	Mix with the backfilling soil or around the notch.
Light Standard trees	Note 1	Mix with the backfilling soil.
Standard trees, Medium Conifers and Palms	Note 1	Mix with the backfilling soil.
Heavy Standard trees, Large Conifers and Palms	Note 1	Mix with the backfilling soil.
Semi-mature trees	Note 1	Mix with the backfilling soil.

Note 1: Mix 0.5 kg of fertilizer with every m^3 of backfilling soil.

2. Application of spent mushroom compost (SMC) as fertilizer
   a. Apply SMC as fertilizer, as SLW1.M135, in accordance with the following dosage:
      i. Add and mix SMC at a dose of 2% by volume to the top 30mm soil depth.

SUPPORTING TREES

SLW2.W410.9 STAKES

Drive vertical stakes firmly into the base of the pit prior to planting the tree; after planting fit protective caps as SLW2.M310 (5) on top of metal stakes.

SLW2.W420.9 SECURING TREES - GENERAL

Secure trees in accordance with the following table, passing ties and guys through trunk protection as SLW2.M370 to prevent trunk and branches being chafed or cut:

Type of tree	No. of stakes	Type of support	Method of fixing
Whips	1	Bamboo stake as SLW2.M320	Two-thirds the height of the plant. When driven into the ground one-third of its height

Light Standard and Standard Trees; Palms and Conifers (up to 2.5 m high)	2	Metal stake as SLW2.M310	1800 mm long, 300 mm from either side of the trunk. Drive into the ground to a depth of 900 mm with the point of the 'V' toward the tree. Stakes angled out at the top by approx. 15°. Ties as SLW2.M330.
	3	Bamboo stake as SLW2.M320	1500 mm long, securely tied with 'scaffold tie' to form a tripod not exceeding 60% of the overall height of the plant.
Heavy Standard Trees; Palms and Conifers (over 2.5 m high)	3	Metal stake as SLW2.M310	As for Standard etc. but 2000 m long, 600 mm from either side of the trunk. Drive into the ground to a depth of 1100 mm
Semi-mature Trees	3	Guys as SLW2.M340; Guying turn buckles as SLW2.M350; Guying stakes as SLW2.M360	Drive 900 mm long guying stakes 750 mm into the ground fix guys with turnbuckles to tree trunk immediately above the lowest branch and tie to each guying stake

SLW2.W430.9 SECURING TREES IN PLANTERS WITH CONCRETE BASES

1. Guy each tree with 4 No. guys, as SLW2.M340, fixed to tree trunk immediately above the lowest branch;
2. Tie each guy through an eye bolt, as SLW2.M380, drilled and plugged into the inner face of the planter walls 100 mm below coping and tighten each end with a galvanized fastener;
3. Tension guys with turnbuckles, as SLW2.M350, inserted 200 mm from the eye bolt;
4. Ensure all guys are of an equal angle to the horizontal, sufficient to hold the tree firm.

SLW2.W440.9 SECURING HEAVY STANDARD AND SEMI-MATURE TREES IN PAVED AREAS AND PODIUM PLANTERS

Submit detailed proposals and shop drawings for underground guying (Option 1 or 2) for Approval.

LABELLING

SLW2.W510.9 FIXING LABELS

1. Attach one label to each tree of Light Standard size and above at a height of 1500 mm above ground level;
2. Attach one label to each separate species in each plant bed for seedlings and whips;
3. Attach labels with dark coloured plastic coated wire and stainless steel coil spring protected with plastic covering;
4. Do not injure the tree.

SLW3 GROUND COVER, SHRUBS, CLIMBERS AND BAMBOOS

MATERIALS

GENERAL

SLW3.M010.9 GENERAL PLANTING REQUIREMENTS

Read this Worksection in conjunction with the appropriate clauses in Worksection SLW1.

PLANTS

SLW3.M110.9 SPECIES

Plant species are as shown or scheduled on the Drawings.

SLW3.M120.9 GROUND COVER PLANTS

Ground cover plants to exhibit all the following characteristics:

1. Well developed vigorous shoots, no fewer in number than specified on the Drawings or plant schedules;
2. A well-developed vigorous root system;
3. Minimum dimensions not less than those specified on the Drawings or plant schedule +50 mm, -0 mm;
4. Grown in a container not less than 125 mm in diameter and 150 mm deep.

SLW3.M130.9 SMALL SHRUBS

Small shrubs to be seedlings or rooted cuttings exhibiting all the following characteristics:

1. A minimum of three, one year old vigorous shoots with a well balanced shape;
2. A well-developed, vigorous root system;
3. Minimum dimensions not less than those specified on the Drawings or plant schedule +100 mm, -0 mm;
4. Grown in a container not less than 125 mm in diameter and 150 mm deep.

SLW3.M140.9 LARGE SHRUBS

Large shrubs to be transplanted seedlings or rooted cuttings exhibiting all the following characteristics:

1. Pruned to encourage bushiness with a minimum of three vigorous, one year old shoots, well furnished to produce a diameter two thirds that of the height;
2. A well-developed, vigorous root system;
3. Minimum dimensions not less than those specified on the Drawings or plant schedule +200 mm, -0 mm;
4. Grown in a container not less than 200 mm in diameter and 250 mm deep.

SLW3.M150.9 CLIMBERS

Climbers to exhibit all the following characteristics:

1. A minimum of four vigorous shoots not less than 600 mm long, except when specified otherwise on the Drawings or plant schedule;
2. A well developed vigorous root system;
3. Grown in a container not less than 125 mm in diameter and 150 mm deep.

SLW3.M160.9 BAMBOOS

Bamboos to exhibit all the following characteristics:

1. A minimum of four 1200 mm +150 mm, -0 mm high main shoots sprouting from the base unless specified otherwise on the Drawings or plant schedule;
2. A well developed, vigorous root system;
3. Grown in a container not less than 450 mm in diameter and 450 mm deep.

SUPPORTS

SLW3.M210.9 STAKES

Stakes to be bamboo poles:

1. For general use:
   a. Diameter: 15 mm;
   b. Length: height of plant to be supported +50% in the ground.
2. As intermediate fixings where non self-clinging climbers are placed between columns of pergolas:
   a. Diameter: 25 mm;
   b. Length: height of pergola above ground +300 mm.

SLW3.M220.9 TIES

1. Ties to be either:
   a. 3 mm diameter, bitumen impregnated, rot-proof string; or
   b. 2 mm diameter, dark coloured plastic coated wire.
2. Do not use nylon string or plastic strapping.

SLW3.M230.9 CLIMBER WIRES

Climber wires to be 3 mm diameter, braided, stainless steel wire, with a clear plastic coating and galvanized clamps.

SLW3.M240.9 TURNBUCKLES

Turnbuckles and associated fittings to be stainless steel. Turnbuckles to be not less than 80 mm long. The specified length excludes any attached fittings, or adjusting screws.

SLW3.M250.9 TRUNK PROTECTION

Trunk protection to comprise 10 mm diameter clear unplasticized polyvinyl chloride (uPVC) hosing.

SLW3.M260.9 GUYING STAKES

1. Material: galvanized mild steel angle;
2. Size: 25 mm x 25 mm x 5 mm thick and 900 mm long;
3. With 5 mm to 10 mm diameter hole drilled 30 mm from top prior to galvanizing.

SLW3.M270.9 HORSESHOE NAILS

Horseshoe nails to be 25 mm long, galvanized, mild steel nails, horseshoe shaped and pointed at both ends, suitable for hammering into timber.

SLW3.M280.9 EYE BOLTS

Eye bolts to be stainless steel with:

1. 70 mm overall length;
2. Threaded shank;
3. 15 mm diameter eye.

LABELS

SLW3.M310.9 LABELS FOR USE

Provide plant labels as SLW1.M410, one label per species per plant or one label per 50 m² of planting as Instructed.

SLW3.M320.9 LABELS FOR STOCK

Supply additional labels to the housing manager, totalling 30% of those provided above and name on a pro-rata basis.

WORKMANSHIP

PLANTING GENERALLY

SLW3.W010.9 SEQUENCE AND GENERAL PROCEDURE

1. Prepare plants in the nursery and plant beds just prior to planting in accordance with Worksection SLW1;
2. Soak rootball;
3. Set out the plant spacing in accordance with the plant schedule or drawing;
4. Excavate the planting hole to the dimensions given at SLW3.W020;
5. With the exception of climbing plants and other plants tied to climber wires or columns, as SLW3.W110 to SLW3.W130, drive in a single support stake so as to leave two thirds of its height above finished ground level;
6. Remove the plant from its container and place it in the hole, spreading the roots as necessary and checking and adjusting the planting depth if required;
7. Tie the plant to its support stake, if one has been provided;
8. Backfill the hole and firm in the plant;
9. Thoroughly water in the plant and mulch to the depths specified at SLW3.W310;
10. Continue watering as SLW1.W520.

SLW3.W020.9 PLANTING HOLE SIZES

Excavate hole to the same depth as the rootball and:

1. For ground cover, small shrubs and climbers, to a diameter 100 mm greater than that of the rootball;
2. For large shrubs and bamboos, to a diameter 150 mm greater than that of the rootball.

SLW3.W030.9 CLIMBERS

Plant as SLW3.W010, at a distance of 150 mm from the structure which is to lend support.

SLW3.W040.9 BARE ROOTED PLANTS

Plant generally as SLW3.W010 but spread out the roots evenly and, as backfilling proceeds, lightly shake the plant to ensure that the soil penetrates between the roots.

SLW3.W050.9 PLANTING IN GRASS AREAS (EXISTING OR NEW)

Plant as SLW3.W010 to SLW3.W040 except:

1. Fork over base of hole in existing grass areas; and
2. Finish top of mulch level with soil level of surrounding grass.

SLW3.W060.9 PLANTING SHRUBS AND GROUND COVERS

Plant generally as SLW3.W010 but in staggered pattern, or as specified in Plant Schedule.

Option 1

SUPPORTING PLANTS OTHER THAN CLIMBERS

SLW3.W105.9 NON-CLIMBER SUPPORTS

Support plants whose natural habit is to be upright and cannot initially stand upright or which may be blown down by strong winds with a single bamboo stake as SLW3.M210 (1). Drive support into the ground so as to leave two thirds of its height above finished ground level and loosely attach the plant to the stake with ties as SLW3.M220.

SUPPORTING NON-SELF-CLINGING CLIMBERS

SLW3.W110.9 FIXING TO WALLS

For each support:

1. Fix the top of each of 3 no. of the climbing wires, 150 mm apart with a galvanized screw clamp to an eye bolt, plugged and screwed securely into the wall at a height of 3000 mm above the soil level, unless otherwise Instructed;
2. Secure the bottom of each wire via a turnbuckle:
    a. To either an eyebolt plugged and screwed securely into the wall at a height of 200 mm above soil level;
    b. To the hole at the top of a guying stake driven firmly 450 mm into the ground at a distance of 300 mm from the wall.
3. Use 20 mm screw clamps for all fixings;
4. Tension wires by adjusting the turnbuckle;
5. After planting the climber, remove all nursery restraining ties and carefully turn the plant around the wire supports with the leading shoots trained upwards;
6. Loosely attach the climber to the supports with ties, as SLW3.M220.

SLW3.W120.9 FIXING TO PERGOLA COLUMNS

Where columns are in or immediately adjacent the plant bed, loosely attach the climber to the column with ties as SLW3.M220.

SLW3.W130.9 FIXING TO WIRE SUPPORTS ON PERGOLAS

For each support:

1. Securely fix the top of each of 3 no. of the climbing wires to the top of the timber slats, using horseshoe nails;
2. Secure the bottom of each wire via a turnbuckle:
    a. To either an eyebolt screwed into the support column of the pergola 200 mm above soil level; or
    b. To the hole at the top of a guying stake driven firmly 450 mm into the ground, in an adjoining planter, as close to the pergola as possible;
3. After planting the climber, remove all nursery restraining ties and carefully turn the plant around the wire supports with the leading shoots trained upwards;
4. Loosely attach the climber to the supports with ties, as SLW3.M220.

SLW3.W140.9 FIXING TO BAMBOO STAKES

1. Drive bamboo stakes, as SLW3.M210 (2), 300 mm into the ground and tie against the top of the pergola;
2. After planting the climber, remove any nursery retaining ties and carefully turn the plant around the bamboo stake with the leading shoots trained upwards;
3. Loosely attach the climber to the wire supports with ties as SLW3.M220.

FERTILIZING

SLW3.W210.9 RATES OF APPLICATION

Thoroughly mix fertilizer, as SLW1.M110, into the backfilling soil, at the following rates:

1. 50 g per plant for shrubs, climbers, and bamboos;
2. 20g per ground cover plant

Option 1

1. Rates of Application of spent mushroom compost (smc)
   a. Apply SMC as fertilizer, as SLW1.M135, in accordance with the following dosage:
      i. Add and mix SMC at a dose of 2% by volume to the top 30mm soil depth.

MULCHING

SLW3.W310.9 MULCHING DEPTHS

Apply mulch immediately after watering in, to the following depths:

1. 25 mm on all planting areas, except grassed area.

LABELLING

SLW3.W410.9 FIXING LABELS

1. Use one label, as SLW1.M410, per species per plant bed, or one label per 50 m² of species planting as Instructed;
2. Attach each label with 1 mm diameter, dark coloured, plastic coated wire 50 mm from the top of a 25 mm diameter bamboo pole, of the following lengths applicable to plant type:

Plant Type	Length of Pole	Height above Soil Level
Ground cover	300 mm	150 mm
Small shrub	500 mm	300 mm
Large shrub	800 mm	500 mm
Bamboo	800 mm	500 mm

3. Attach labels direct to climbers.

SLW4 HERBACEOUS PLANTS

MATERIALS

PLANTS AND SEEDS

SLW4.M010.9 SPECIES

Species are as shown or scheduled on the Drawings.

SLW4.M020.9 DEFINITIONS

1. Bulbs: modified shoot consisting of a small fleshy disk-like stem bearing a spherical mass of fleshy leaves above the developing adventitious root system;
2. Corms: solid swollen part of the stem at or near ground level that produces a bud at its apex;
3. Tuber: swollen underground branch, roundish in shape with buds or 'eyes' from which new plants are produced.

SLW4.M030.9 BULBS

Bulbs to be firm with good vigorous root system and free from rot.

SLW4.M040.9 CORMS

Corms to be firm with strong healthy bud, vigorous root system and free from rot.

SLW4.M050.9 TUBERS

Tubers to be firm with six 'eyes' minimum, strong root system and free from rot.

SLW4.M060.9 HERBACEOUS PLANTS

Herbaceous plants to exhibit all the following characteristics:

1. Number of shoots as specified on the Drawings or plant schedule;
2. Strong vigorous growth;
3. Strong vigorous root system;
4. Not pot bound;
5. Grown in pots, minimum size 150 mm diameter x 100 mm deep;
6. Size(s): as shown on Drawings or plant schedule +150 mm -0 mm.

STAKE TIES

SLW4.M110.9 TIES

Ties to be bitumen impregnated jute string:

1. Type: as Approved;
2. Colour: dark colour.

WORKMANSHIP

GENERAL

SLW4.W010.9 GENERAL PLANTING REQUIREMENTS

Read this Worksection in conjunction with the appropriate clauses in Worksection SLW1.

SLW4.W020.9 PLANTING PROGRAMME

Sow or plant herbaceous plants during the appropriate season for the species specified whether during the Planting or Establishment Periods as applicable.

SLW4.W030.9 PLANTING IN SHRUB BEDS

Plant herbaceous plants after shrubs ensuring shrubs are not disturbed or damaged during herbaceous planting operations.

SLW4.W040.9 PLANTING IN GRASSED AREAS

Plant herbaceous plants either:

1. Before grassed area is sown; or
2. After a suitable sward has been established.

SOWING SEEDS

SLW4.W110.9 BROADCAST SOWING

Broadcast seeds evenly at the rate of 30 gm/m² over the areas shown on the Drawings.

PLANTING

SLW4.W210.9 BULBS, CORMS AND TUBERS

1. Randomly scatter bulbs, corms or tubers by hand over previously prepared soil in locations shown on the Drawings;
2. Dig holes where bulbs, corms or tubers have landed between 50 mm and 100 mm deep, depending on species being planted, and 100 mm in diameter;
3. Place bulb, corm or tuber the right way up on the bottom of the hole and backfill with previously excavated soil.

SLW4.W220.9 HERBACEOUS PLANTS

1. Plant herbaceous plants in holes in previously prepared soil;
2. Dig holes to depth of rootball, or root system if bare-rooted and to a diameter 100 mm greater than rootball diameter or root spread;
3. Secure to stakes, as SLW3.M210, where necessary with tie;
4. Place plants on the bottom of the hole and spread roots where bare without damage and backfill with previously excavated soil.

SLW5 AQUATIC PLANTS

MATERIALS

AQUATIC PLANTS

SLW5.M010.9 PLANTS

Plant species as shown or scheduled on the Drawings and exhibiting all the following characteristics:

1. Grown in pots but not pot bound;
2. Strong vigorous growth;
3. Be capable of maintaining strong vigorous growth for twelve months before requiring repotting or potting on;
4. Tolerance on size(s) shown on Drawings: +150 mm, -0 mm.

PLANTING MATERIALS

SLW5.M110.9 PLANTING MEDIUM

Planting medium comprises DG, as EXT12.M120, with a high plastic clay content thoroughly mixed with:

1. 20% by volume of animal manure compost as, EXT12.M240; and
2. 50% bone-meal to 50% dried blood mix fertilizer added at a rate of 250 g/m³ of planting medium.

SLW5.M120.9 GRASS SODS

Grass sods to be 20 mm thick x 200 mm square with a well developed fibrous root system.

SLW5.M130.9 HESSIAN

Natural woven jute, brown in colour and of a type used in the manufacture of sacks.

CONTAINERS AND SUPPORTS

SLW5.M210.9 UNGLAZED FIRECLAY CONTAINERS

1. Sound and free from cracks, chips etc.;
2. Of matching colour, preferably natural;
3. With adequate drainage holes in base;
4. With a depth to diameter ratio appropriate for plant species to be contained and as follows, in all situations pot depth to be greater than diameter.

Species	Pot dimensions
Cyperus alternifolius	300 mm dia. x 350 mm minimum depth
Nelumbo nucifera	450 mm dia. x 500 mm minimum depth

Nymphaea Spp.	450 mm dia. x 500 mm minimum depth
Other species as shown on drawing	As shown on drawing

SLW5.M220.9 PLASTICS MESH CONTAINERS

1. Open mesh, bread and laundry basket pattern;
2. Colour: dark colour;
3. Shape: rectangular, circular or oval;
4. Minimum size: suitable for the species and plant size being contained but not less than:
    a. 450 mm diameter x 300 mm deep for circular containers;
    b. 500 mm x 400 mm x 300 mm deep for rectangular and oval containers.

SLW5.M230.9 WIRE MESH CAGES

Wire mesh cages to be made from galvanized mild steel expanded metal, not more than 2 mm thick with 10 mm x 10 mm or 5 mm x 20 mm slot pattern.

SLW5.M240.9 CONTAINER SUPPORTS

Container supports to be either:

1. Upturned fireclay pots of same diameter as containers being supported; or
2. Precast concrete blocks of same size as containers being supported.

ANCILLARY MATERIALS

SLW5.M310.9 BALLAST

Ballast to be clean rounded stone, evenly graded in the size range 30 - 75 mm diameter.

SLW5.M320.9 TIES

Ties to be bitumen impregnated jute string:

1. Type: as Approved;
2. Colour: dark colour.

WORKMANSHIP

GENERAL

SLW5.W010.9 GENERAL PLANTING REQUIREMENTS

Read this Worksection in conjunction with the appropriate clauses in Worksection SLW1.

SLW5.W020.9 PLANTING PROGRAMME

Plant no more than two days prior to pool being filled with water.

SLW5.W030.9 SOAKING PLANTS

Keep plants thoroughly soaked at all time prior to being submerged or placed in the pool.

PLANTING, SUPPORT AND PROTECTION

SLW5.W110.9 PLANT BOX FILLING

Fill in-situ plant boxes with planting medium as SLW5.M110, to a depth of 50 mm below lip of box.

SLW5.W120.9 PLANTING IN PLANT BOXES

Plant into in-situ plant boxes while the pool is empty. Remove plants from their pots and plant as follows:

1. In holes previously prepared in planting medium to a depth of the rootball. Diameter to be 100 mm greater than rootball diameter;
2. Place plants the right way up on the bottom of the hole and spread roots, where bare, without damaging and backfill with previously excavated soil;
3. Secure to stake, as SLW3.M210, where necessary with tie.

SLW5.W130.9 PLANTING IN FIRECLAY CONTAINERS

1. Place a broken rock or flat stone over drainage hole in base of container;
2. Place a layer of planting medium, as SLW5.M110, over base;
3. Position plant centrally in container and backfill with planting medium, as SLW5.M110 firmed down around plant;
4. Fill to a depth 50 mm below container lip;
5. Secure to a stake, as SLW3.M210, where necessary with a tie, as SLW5.M320.

SLW5.W140.9 PLANTING IN PLASTICS MESH CONTAINERS

1. Line container with a double layer of hessian, as SLW5.M130, folding the top level with basket lip and overlapping by 75 mm;
2. Place grass sods, as SLW5.M120, tightly around the base and sides of baskets with grass facing inwards;
3. Place a layer of planting medium over base of container;

4. Position plant centrally in container and backfill with planting medium firmed down around plant;
5. Fill to a depth 50 mm below basket lip after settlement;
6. Secure to a stake, as SLW3.M210, where necessary with a tie, as SLW5.M320.

SLW5.W150.9 PLACING CONTAINERS

Place containers on supports, as SLW5.M240, at a level to ensure tops of containers are at the depths below water level as follows:

Species	Depth below water level (mm)
Cyperus alternifolius	at water level
Nelumbo nucifera	50 - 100 mm
Nymphaea Spp.	300 - 500 mm
Other species as shown on drawing	As shown on drawing

SLW5.W160.9 BALLAST COVER

After planting and before filling the pool with water, cover all planting medium with a 50 mm deep layer of ballast as SLW5.M310. Take care not to damage plants.

SLW5.W170.9 WIRE MESH CAGES

After placing containers in final positions and filling the pool with water surround each group of containers or large individual containers with a wire mesh cage, as SLW5.M230, that:

1. Is constructed to form a circle or oval shape as appropriate with ends lapped by 50 mm and securely fastened together with galvanized wire;
2. Protrudes a minimum of 50 mm above water level and is bent through 90° at the base to form a 100 mm plinth;
3. Is a distance from the plant to permit development and floating leaves to fully expand as follows:

Species	Distance from Container Edge to Edge of Cage
Cyperus alternifolius	300 mm
Nelumbo nucifera	300 mm
Nymphaea Spp.	1000 mm - 1500 mm
Other species as shown on drawing	As shown on drawing

SLW6 INDOOR PLANTS

MATERIALS

GENERAL

SLW6.M010.9 GENERAL PLANTING REQUIREMENTS

Read this Worksection in conjunction with the appropriate clauses in Worksection SLW1.

PLANTS

SLW6.M110.9 GENERAL

Plants must exhibit the following characteristics:

1. Not pot bound;
2. Capable of at least 12 months healthy, vigorous growth before requiring repotting or potting on.

SLW6.M120.9 ARTIFICIAL PLANTS

Obtain artificial plants from an Approved supplier subject to individual Approval and exhibiting the following characteristics:

1. Man-made, densely leafed with flowers and foliage of colour-fast silk or polyester appearing in colour, texture, form and habit like a real version of the species stated on the Drawings or plant schedule;
2. With real, preserved trunks and stems, free from insects and fungus;
3. Multi-stemmed when appropriate to the species stated on the Drawings or plant schedule;
4. With all leaves, flowers, stems, trunks and branches securely fixed;
5. Set in appropriately sized pots, entirely filled with dark brown coloured concrete, or an Approved equivalent without leaving a protruding lip.

POTS

SLW6.M210.9 PLAIN EARTHENWARE

Plain earthenware pots to be unglazed fireclay:

1. Sound and free from cracks, chips etc.;
2. Of matching colour;
3. With adequate drainage holes in the base;
4. With a depth to diameter ratio, appropriate to the plant it is intended to contain, but in any case greater than 1.

SLW6.M220.9 DRAGON POTS

Dragon pots used for individual feature plants to be:

1. True to type and of matching design;
2. Sound and free from cracks, chips etc.;
3. Colour: brown;
4. With adequate drainage holes in the base;
5. Size: 500 mm high x 510 mm diameter.

PLANTING MATERIALS

SLW6.M310.9 POTTING COMPOST

An Approved proprietary potting compost suitable for the species concerned.

SLW6.M320.9 POT DRAINAGE LAYER

Any of the following:

1. Clean pea gravel, as SLW1.M430;
2. Broken fireclay;
3. An Approved equivalent.

SLW6.M330.9 PLANT BOX DRAINAGE LAYER

Aggregate, as EXT13.M010.

SLW6.M340.9 FILTER LAYER

As EXT13.M110.

ANCILLARY MATERIALS

SLW6.M420.9 WIRE NETTING

Galvanized steel with a mesh size of 25 mm.

SLW6.M430.9 WOOD CHIP MULCH

As SLW1.M310.

SLW6.M440.9 SURFACE COVER

To artificial plant beds:

1. Type: wood chip mulch as SLW1.M310;
2. Thickness: 100 mm ±5 mm.

WORKMANSHIP

POTTING

SLW6.W010.9 GENERAL

Cultivate indoor plants in potting compost appropriate to the species concerned.

SLW6.W020.9 DRAINAGE LAYER

Lay a drainage layer, as SLW6.M320, in each pot to the following depths.

Diameter of Pot (mm)	Depth of Drainage Layer (mm)
75 - 150	15
175 - 300	25
Over 300	35

SLW6.W030.9 PLANTING

Fill pot to level of the base of the rootball with compost, place the plant and fill the remainder of the pot with compost to within 15 mm of the rim, firming as necessary.

PLANTING IN PLANT BOXES

SLW6.W110.9 DRAINAGE LAYER

Lay aggregate, as SLW6.M330 to a depth of 100 mm in each plant box and cover with filter layer.

SLW6.W120.9 SOILING

Fill planting boxes with fabricated soil, as EXT12.M310, to a level 75 mm below the top of the box.

SLW6.W130.9 PLANTING

As shown on Drawing, place all plants in the planters in their pots, keeping the rim of each pot level with the soil surface in the plant box, and/or remove plants from pots and place in holes of appropriate size excavated in the plant box filling, ensuring that the soil level adjacent to the plant remains unchanged.

SLW6.W140.9 FERTILIZING

Apply fertilizer, as SLW1.M110, at the following rates (±5%):

Type of Plant	Rate of Application
Ground Cover and Herbaceous Plants	15 g per plant
Shrubs, Climbers and Bamboos	20 g per plant
Conifers and Whips	20 g per tree
Light Standard Trees	80 g per tree
Standard Trees and Palms	100 g per tree

Option

1. Fertilizing with spent mushroom compost (SMC)
    a. Apply SMC as fertilizer, as SLW1.M135, in accordance with the following dosage:
        i. Add and mix SMC at a dose of 2% by volume to the top 30mm soil depth.

SLW6.W160.9 MULCHING

Apply wood chip mulch, as SLW1.M310, to a depth of 50 mm ±5 mm.

ARTIFICIAL PLANTS

SLW6.W210.9 PLANT BEDS

1. Place plant pots securely in beds and fill to a level 125 mm below the top with aggregate, as EXT13.M010;
2. Where the depth of the plant bed is greater than that of the plant pot, adjust the height by placing the pot on appropriately sized, upturned empty pots before placing the aggregate.

SLW6.W220.9 SECURING PLANTS

1. Cover the surface of the aggregate with wire mesh and tuck down the sides of the planter to secure the mesh in place;
2. Place artificial plants through cross-cuts in the mesh and retie the mesh securely around the stem to prevent theft.

SLW6.W230.9 SURFACE COVER

Cover the surface of plant beds with cover, as SLW6.M440.

SLW7 GRASSING

MATERIALS

SPRIGS

SLW7.M010.9 SPRIGS

Stoloniferous grass with sward / stolen / rhizome at lease 150 mm long and some fibrous roots attached.

SLW7.M020.9 SPRIG SPECIES

One or a mixture of the following species unless otherwise specified:

Scientific Name	Chinese Name	English Name
Cynodon dactylon	百慕達草	Bermuda grass
Cynodon dactylon x C. transvaalensis cv. Tifway	雜交百慕達草 (Tifway)	Hybrid Bermuda grass (Tifway)
Eremochloa ophiuroides	假儉草	Centipede grass
Paspalum conjugatum	雙耳草	Hilo grass
Paspalum varginatum	海濱雀稗	Seashore Paspalum
Zoysia japonica	朝鮮草	Korean grass
Zoysia matrella	馬尼拉草	Manila grass
Chrysopogon aciculatus	竹節草	Wild Oat Grass
Other species as shown on Drawings	-	-

TURVES AND FIXINGS

SLW7.M110.9 TURVES

1. Grass of even density, capable of healthy growth and free from weeds, impurities, pests, fungi and disease;
2. With a sufficiently stolen / rhizome / root system to hold together when handled;
3. Minimum 300 x 800 x 25mm thick;
4. For area specified as “Sand Based Lawn”, the turves used shall be free of soil, either by:
   a. washed; or
   b. produced from sand based turf farm.
5. Certificate of sand composition used in sand base turf farm shall be provided;

6. Hybrid Bermuda grass cultivar such as Tifway; Improved Seashore Paspalum cultivars such as Salam, SeaIsles 1, 2000, Supreme and Sea Star shall be procured from certified turf farm with appropriate certificate issued by authorized representative from International Turfgrass Genetic Assurance Program (ITGAP) or equivalent.

SLW7.M120.9 TURVES SPECIES

Any of the following grass species:

Scientific Name	Chinese Name	English Name
Axonopus compressus	地毯草 (大葉草)	Carpet grass
Cynodon dactylon	百慕達草	Bermuda grass
Cynodon dactylon x C. transvaalensis cv. Tifway	雜交百慕達草 (Tifway)	Hybrid Bermuda grass (Tifway)
Paspalum conjugatum	雙耳草	Hilo grass
Paspalum vaginatum	海濱雀稗	Seashore Paspalum
Paspalum vaginatum (Cultivars)	雜交海濱雀稗	Seashore Paspalum cultivars, e.g. Salam, SeaIsle series and SeaStar, etc.
Eremochloa ophiuroides	假儉草	Centipede grass
Zoysia japonica	朝鮮草	Korean grass
Zoysia matrella	馬尼拉草	Manila grass
Chrysopogon aciculatus	竹節草	Wild Oat Grass

SLW7.M130.9 TURF PINS

8 Standard Wire Gauge (SWG) galvanized wire bent to hairpin shape not less than 200 mm long.

SLW7.M140.9 SECURING PEGS

5 mm diameter, stainless steel rod, 450 mm long, with top bent over to form a 50 mm diameter loop.

GRASS SEED

SLW7.M210.9 GRASS SEED MIX

Consisting of the following species and proportions:

Scientific Name	English Name	% by weight
Cynodon dactylon	Bermuda grass	30
Paspalum notatum	Bahia grass	60
Zoysia japonica	Korean lawngrass	10

SLW7.M220.9 GERMINATION

Germination capacity of each constituent of the grass seed mix to be at least 80%.

SLW7.M230.9 PURITY

Purity of each constituent of the grass seed mix to be greater than 90%. Total pernicious weed seed content to be less than 0.5% and total content of other crop seeds to be less than 1.0%.

SLW7.M240.9 CERTIFICATION

Submit a certificate of testing for each species of grass seed, not less than 14 days before sowing, stating:

1. Grass species, both Botanic and Chinese names;
2. Date of tests (not more than 6 months prior to sowing);
3. Percentage germination;
4. Percentage purity.

SLW7.M270.9 GRASS SEED MIX FOR USE IN GRASS PAVING SYSTEM

In the locations as shown on Drawings, the grass seed mix for use in grass paving system shall comprise of the following species and proportions at a rate of 1 kg/m³, incorporated with soil mix and other constituents as per EXT12.M330:

Mix 1		
Scientific Name	English Name	% by weight
Cynodon dactylon	Bermuda grass	66
Eragrostis curvula	Weeping lovegrass	34

Mix 2		
Scientific Name	English Name	% by weight
Cynodon dactylon	Bermuda grass	33
Paspalum notatum	Bahia grass	33
Eragrostis curvula	Weeping lovegrass	34

ANCILLARY MATERIALS

SLW7.M310.9 PRE-SEEDING FERTILIZER

Pre-seeding fertilizer to be quick release fertilizer, as SLW1.M130.

SLW7.M330.9 SAND FOR TOP-DRESSING OR INFILLING

Sand for top-dressing and infilling to be graded sand, as EXT12.M235.

SLW7.M340.9 WEED-KILLER

Weed-killer, as SLW1.M220.

SLW7.M350.9 MACHINERY AND TOOLS

For areas specified as "Sand Based Lawn", provide the following machinery and tools for both planting and establishment operation as specified in this Specification:

1. Mowing Machine

   Reel / cylinder or rotary type of mowing machine with height of cut adjustable between 25mm to 75mm in maximum 12.5mm increments; width of cut between 400mm to 600mm.

2. Aerator

   Aerator with coring / spiking width tines 75mm to 100mm apart; coring / spiking depth between 75mm to 150mm; coring / spiking with adjustable solid / hollow tines between 10mm to 20mm in diameter or otherwise specified.

3. Turf Roller

   Pull-behind or ride-on turf rolling machine designed specific for turf with minimum 750mm rolling width; minimum 450kg in full weight. Heavier roller with vibration shall be needed when instructed by the CM.

4. Verticutting Machine

   Walk behind verticutting machine or verticutting unit attached on reel type mowing machine with minimum 25mm working width; adjustable cutting depth between 10 to 50mm.

5. Spiker

   Walk behind or hand Spiker designed specific for turf with minimum 350-400mm working width and tines 75-100mm apart.

6. Spreader

   Rotary broadcast spreader designed specific for turf with minimum 350mm working width.

WORKMANSHIP

GENERAL

SLW7.W010.9 PROGRAMME

Where trees or shrubs are planted in grass areas, carry out all tree or shrub planting prior to any grassing operations.

PREPARATION

SLW7.W110.9 CULTIVATION

1. Prior to cultivation, remove all pernicious and perennial weeds, including complete root system;
2. When instructed by the CM, apply weed-killer in accordance with the manufacturer's recommendation;
3. Cultivate areas less steep than 1:2 to a depth of 150mm and bring to a 25mm deep fine tilth by hand ranking or Approved mechanical means;
4. If necessary, carry out regrading of the surface to conform to the prescribed finished levels and create free flowing contours free from humps and water collecting hollows;
5. Final level: 25 mm above any adjacent hard surfaces.

SLW7.W120.9 CULTIVATION ON EMBANKMENTS

On embankments with slopes of 1:2 or steeper, do not cultivate the existing soil, so that the slope remains stable and erosion is prevented.

SLW7.W130.9 STONE PICKING

Remove all stones larger than 30 mm in any dimension, except on embankments of a gradient of 1:2 or greater.

SLW7.W140.9 FINISHED LEVELS

Finish levels to those indicated on the Drawings, creating free flowing contours, free from water collecting hollows and level with (+25 mm, -0 mm) adjoining hard surfaces.

SPRIGGING

SLW7.W210.9 PROGRAMME

Plant sprigs in their final positions within 48 hours of lifting.

SLW7.W220.9 CULTIVATION

Cultivate all areas, as SLW7.W110 and SLW7.W120, as appropriate. Scarify embankments, with a gradient of 1:2 or greater, to a depth of 5 mm with a hand rake to break up the surface.

SLW7.W230.9 APPLYING PRE-SPRIGGING FERTILIZER

Four to seven days prior to sprigging apply quick release fertilizer, as SLW1.M130, evenly at a rate of 40 g/m² and lightly rake into the soil.

SLW7.W240.9 WATERING

Thoroughly moisten the previously prepared soil immediately prior to sprigging using a fine spray hose attachment to avoid soil erosion and run off.

SLW7.W250.9 SPRIGGING

1. Lay the sprigs evenly at rates of not less than 15 bushels/100m² (approx. 27kg/100m²) on the surface until the entire area is covered;
2. Sprigs shall be laid flat on the surface and avoid protruding out;
3. Apply thin layer of top-dressing, as SLW7.M330 to cover the sprigged area; alternatively, use a disc-roller (cutting blade interval of 100mm) to roll over and press the sprigs down to the rootzone at 50-75mm deep;
4. Roll the top-dressed or roll-planted area with a flat rollers, as SLW7.M350;
5. Apply a compound fertilizer, as SLW1.M110 evenly at a rate of 20g/m²;
6. Water the sprigged area thoroughly and then cover with protective fabric as, EXT14.M240; the protective cover should be made of bio-degradable materials;
7. All sprigs delivered on Site shall be kept moist before sprigging.

SLW7.W260.9 POST-SPRIGGING OPERATION

1. Water the sprigged area three times per day or more depending on weather condition;
2. Remove protective fabric when new leaf blades were found emerging from the surface;
3. Fence off the sprigged area until further instruction by the CM.

SLW7.W270.9 RE-SPRIGGING

Where grassed areas do not show a 90% coverage 28 days after sprigging, immediately recultivate and re-sprig the areas, whether this date occurs in the Planting Period or Establishment Period.

TURFING

SLW7.W310.9 PROGRAMME

Lay turves in their final positions within 48 hours of lifting.

SLW7.W320.9 CULTIVATION

Cultivate all areas for turfing as SLW7.W110 and SLW7.W120 as appropriate. Scarify embankments, with a gradient of 1:2 or greater, to a depth of 5 mm with a hand rake to break up the surface.

SLW7.W330.9 APPLYING PRE-TURFING FERTILIZER

Four to seven days prior to turfing, apply quick-release fertilizer, as SLW1.M130 evenly at a rate of 40g/m² and lightly rake into the soil.

SLW7.W340.9 WATERING

Thoroughly moisten the previously prepared soil immediately prior to turfing using a fine spray hose attachment to avoid erosion and run off.

SLW7.W350.9 DELIVERY AND STACKING

Carefully unload turves and:

1. Store on cleared ground;
2. Stack not more than 1000 mm high unless palletted;
3. Do not allow turves to dry out.

SLW7.W360.9 PLANKED SUPPORTS

Transport turves from stacks to laying areas along planks laid closely side by side. Provide sufficient planks and always use to support workmen and barrows, and for access and laying.

SLW7.W370.9 TURF LAYING

Lay turves:

1. Working off planks;
2. In consecutive rows in stretcher bond to correct levels starting at near side of the area so that work proceeds over turf already laid;
3. Where necessary, lightly and evenly firm turves with approved wooden beaters, the bottom of the beaters being frequently scraped clean of accumulated soil or mud;
4. After laying, fill any gaps with top dressing, as SLW7.M330 well brush in to fill all joints;
5. Use rollers, as SLW7.M350 to roll the surface immediately after laying;
6. Water the grassed area thoroughly;
7. All turves delivered on Site shall be laid within 48 hours and keep moist before laying.

SLW7.W380.9 SLOPES EXCEEDING 1:2

1. Provide sufficient planks and ladders to ensure safe and efficient working;
2. Lay turves to the areas shown on the Drawings in consecutive rows either diagonally or horizontally, in stretcher bond with closely butted joints;
3. Firm as previously specified and secure each turf with one turf peg or turf pin, as appropriate, to provide a firm fixing, properly driven home, just below the surface.

SLW7.W390.9 UNEVENNESS OF FINISHED LEVEL

Adjust any unevenness in the finished level of turf as the work proceeds by lifting, raking out or infilling with graded sand as per EXT12.M330 and replacing and refirming the turf.

SLW7.W400.9 ROLLERS

When instructed by the CM, use rollers as per SLW7.M350 to roll the surface again until it reach an even surface to the satisfaction of the CM.

SLW7.W410.9 PERIMETERS

Use whole turves only and trim to clean, straight lines or regular curves as shown on Drawings.

SLW7.W420.9 TURF JOINTS

When instructed by the CM, refill the gaps with top dressing, as SLW7.M330 well brush in to level the surface to the satisfaction of the CM and water in carefully with a fine spray hose.

SLW7.W430.9 SHRINKAGE

Should shrinkage occur, fill the open joints with graded sand, as EXT12.M330 brush in and well water.

SLW7.W440.9 APPLYING POST-TURFING FERTILIZER

30 days after turfing apply slow release fertilizer, as SLW1.M110 evenly at a rate of 20 g/m².

SLW7.W450.9 TURFING TAKE

Where bare patches still occur 21 days after laying, remove the whole turf, recultivate the soil and returf the patch.

SLW7.W460.9 LAYING TURF IN GRASS PAVING SYSTEM

In the locations as shown on Drawings, lay turf to grass paving system as follows:

1. Apply soil filling mix, as EXT12.M330 to the openings of the grass paving system and water lightly prior to laying turf;
2. Prepare turf for use by cutting to an appropriate size and shape to fit the openings in the grass paving system in use;
3. Lay the cut turf in each of the openings of the grass paving system with closely butted joints and firm the turf by lightly and evenly beating with approved wooden beaters. The bottom of the beaters being frequently scraped clean of accumulated soil or mud;
4. After laying, fill any gaps with top dressing, as SLW7.M330 and brush in well to fill all joints and water carefully using a fine spray hose attachment;
5. Should shrinkage occur, refer to SLW7.W430;
6. Apply post-turfing fertilizers, as SLW7.W440;
7. Where bare patches within the turfed portions of the grass paving system still occur 21 days after laying, carry out turfing take, as SLW7.W450.

SEEDING

SLW7.W510.9 STORING SEED

Store seed on boards off the ground, in a clean dry place, free from vermin.

SLW7.W520.9 APPLYING PRE-SEEDING FERTILIZER

Four to seven days prior to broadcast sowing apply quick release fertilizer, as SLW1.M130, evenly at a rate of 40 g/m² (±5%) and lightly rake into the soil.

SLW7.W530.9 BROADCAST SOWING

1. Evenly broadcast grass seed mix, SLW7.M210, over areas shown on the Drawings by sowing at half the rate specified below in two equal sowings at right angles to each other, either by hand or by an Approved mechanical drill;
2. Rate of sowing: 30 g/m².

SLW7.W540.9 RAKING, HARROWING AND ROLLING

1. Lightly rake or harrow in the seed;
2. Roll and cross-roll with a lightweight roller.

SLW7.W550.9 APPLYING WEED-KILLER

Apply weed-killer evenly to newly seeded areas, as SLW1.W720.

SLW7.W560.9 TURF EDGING TO SEEDED AREAS

Edge seeded areas with turf 300 mm wide where shown on the Drawings. Adjust soil level to receive turf and marry-in surface of seed bed to surface of turf.

SLW7.W570.9 EDGE TRIMMING TO SEEDED AREAS

Trim edges of seeded areas which have not been edged with turf when sufficiently established to clean, straight lines or regular curves as shown on Drawings.

SLW7.W580.9 APPLYING POST-SEEDING FERTILIZER

Ten days after broadcast sowing, apply slow release fertilizer, as SLW1.M110 evenly at a rate of 20g/m².

SLW7.W590.9 GERMINATION OF BROADCAST SOWN SEED

Where grass areas do not show 90% cover over any 10 m² area, 28 days after sowing immediately re-cultivate and re-sow the area, whether this date occurs in the Planting Period or the Establishment Period.

SLW7.W592.9 APPLICATION OF GRASS SEED AND SOIL FILLING MIXTURE IN GRASS PAVING SYSTEM

In the locations as shown on Drawings, apply grass seed and soil filling mixture to grass paving system as follows:

1. Thoroughly mix grass seed, as SLW7.M270 and soil filling, as EXT12.M330 to form grass seed and soil filling mixture;
2. Apply grass seed and soil filling mixture to the openings of the grass paving system;
3. Lightly compact, and finish flush with the adjoining surfaces;
4. Water immediately and continue to water, as SLW1.W520 using a fine spray hose attachment to avoid erosion and run off;
5. Apply weed-killer evenly to newly seeded areas in accordance with the manufacturer's recommendation;
6. Apply post-seeding fertilizer, as SLW7.W580;
7. Re-sow, as SLW7.W590;
8. Carry out post-planting cutting, as SLW7.W630;
9. After germination and throughout the Planting Period and Establishment Period, ensure that the soil surface within the seeded areas of the grass paving system remain flush with the surrounding surfaces by supplementing top dressing, as SLW7.M330 and seed mixture, as SLW7.M270. Water in carefully using a fine spray hose attachment.

POST PLANTING OPERATIONS

SLW7.W610.9 WATERING

Water immediately after laying and continue to water, as SLW1.W520 using a fine spray hose attachment to avoid erosion and run off.

SLW7.W620.9 ROLLING OF GRASSED AREAS

When instructed by the CM, roll the grassed area with rollers, as SLW7.M350 to increase contact between the turves or sprigs and the rootzone medium.

SLW7.W630.9 CUTTING

1. Make the first cut when the grass sward is 75 mm high and reduce the sward to 25 mm high;
2. Make subsequent cuts as soon as the grass sward is 50 mm high and reduce the sward to 25 mm high;
3. Trim edges after cutting.

SLW7.W640.9 MOWING

1. Use mowing machine, as SLW7.M350;
2. Make the first mowing when the turf is at 50mm high and reduce the turf to 35mm high;
3. Make subsequent mowing as soon as the turf is at 40mm high and reduce the turf to 32 - 37mm high, depends on the season, as SLW9.W640;
4. Trim edges after cutting;
5. Rake up and remove all cuttings from Site within 24 hours after mowing;
6. Do not remove more than one-third of the height of the turf at each time.

SLW8 TREE SURGERY WORKS

MATERIALS

GENERAL

SLW8.M010.9 SCOPE OF WORK

The scope of the Works comprises the removal of dead, dying and diseased branches and stumps, cleaning out cavities, raising and thinning the crown, for transplanting purposes as Worksection EXT11 and generally improving the shape of existing trees, as scheduled and shown on the Drawings or as Instructed.

1. These works shall include those trees and palms transplanted to the Site by the Employer's Direct Contractor, as refer to PRE.B2.010 for relevance.

WORKMANSHIP

TREE SURGERY

SLW8.W010.9 STANDARD

Carry out works in accordance with BS 3998:2010 "Recommendations for Tree Work" and “General Guidelines on Tree Pruning” posted as website:

http://www.trees.gov.hk.

SLW8.W020.9 PRUNING TECHNIQUES

1. Cut back dead branches to living tissue/growing point;
2. Where removal of a whole lateral branch is required, do not cut flush to the main trunk or leaving a stub. Apply under cut technique to prevent tearing the bark and cut limbs in two operations. Cut initially from the underside close to the trunk or parent limb, without cutting into the branch bark ridge or collar. Make the second cut from above at a point 25 mm further away from the trunk;
3. Cut all limbs sloping away from the main trunk at an angle of approximately 60° from the horizontal on a line above the branch bark ridge and the branch collar without leaving a stub, in accordance with BS 3998:1989; figure 1;
4. Long and heavy branches should be cut in sequence of section by section. Carefully lower all cut branches to the ground to prevent any damage to limbs being retained;
5. Keep the crown in a well-balanced form and natural shape after pruning. Do not remove more than one quarter of the original crown coverage in each pruning operation.

SLW8.W030.9 CUTTING BACK BARK

Cleanly cut back loose, dead or damaged bark to firm healthy bark, and trim to leave rounded edges.

SLW8.W040.9 TIMING OF PRUNING

Carry out pruning of evergreen trees just before spring. For deciduous trees, pruning after shedding leaves in winter when trees are dormant is preferred. Avoid pruning prior to flowering seasons of the trees.

SLW8.W050.9 CAVITY TREATMENT

Cut out rotten wood from cavities, without exposing clean healthy wood.

SLW8.W060.9 ADDITIONAL DAMAGE

Repair any additional damage to existing trees, caused by tree surgery operations or any other cause during the Contract Period, as Instructed.

SLW8.W070.9 TOOLS AND EQUIPMENT

Use the tools and equipment recommended by and in accordance with BS 3998: 2010.

SLW9 ESTABLISHMENT WORKS

WORKMANSHIP

DEFINITIONS

SLW9.W010.9 ESTABLISHMENT WORKS

Establishment Works (EW) is the works as defined in the Preliminaries Worksection to be carried out during the Establishment Period (EP) to establish the soft landscaping.

1. These works shall include those trees and palms transplanted to the Site by the Employer's Direct Contractor, as refer to PRE.B2.010 for relevance.

SLW9.W020.9 ESTABLISHMENT PERIOD

Establishment Period (EP) is the 24 month period, commencing the day after the certified date for Completion of Section A - Planting Works, during which the EW are to be carried out.

GENERAL

SLW9.W100.9 TREE INVENTORY REPORT

1. No later than three(3) months from the certified date of completion of Section A, provide written Tree Inventory Report with information of all existing and newly planted trees, palms and conifers as indicated on Drawings and Plant Schedules for preparation of record plan of soft landscape works. In particular, attention is drawn to the following requirements:
    a. To provide tree information including location with Geographic Information System (GIS) technology, dimensions including trunk girth at 1.3m above ground level, crown spread, overall height, current conditions of tree such as form and health, and tree identification number to trees of size of light-standard and above, palms and conifers;
    b. To install tag to individual tree, palm or conifer with the tree identification (ID) number based on the tree layout plan. Format of the tree tag and the numbering system to be approved by the CM;
    c. To take and complete the tree inventory record for each tree, palm or conifer with a photo showing the whole tree, palm or conifer.
2. No later than two (2) months before the date for completion of Section B, replace missing tree tag(s), update and submit the Tree Inventory Report to the CM.

SLW9.W110.9 VANDALISM DAMAGE TO PLANTING

The Authority will accept responsibility for replacing dead or damaged stock resulting from vandalism only when the Contractor

1. Proves that such death or damage was caused by circumstances outside his control; and
2. Submits written claims to the CM within three working days of the event happening.

SLW9.W120.9 TYPHOON DAMAGE

1. Within 48 hours of Typhoon Signal No. 8 or above being lowered:
   a. Make a photographic record and detailed report of all plant damage;
   b. Replant all plants blown over and firm up all other plants.
2. Within five days of Typhoon Signal No. 8 or above being lowered:
   a. Remove dead plants and clear the Site of all debris;
   b. Provide the above photographic record and report to the CM.
3. The Authority will accept responsibility for plants recorded as dead or dying after, and as a result of, the typhoon only when:
   a. The CM is notified within one month of the end of the typhoon; and
   b. Replanting works are carried out satisfactorily as specified and thorough watering is carried out each day.

SLW9.W130.9 REPLACEMENT PLANTING

Replace any plant during the EP which is, in the opinion of the CM, dead, dying, ailing or no longer conforming to this Specification within two weeks of identification. Carry out replacement planting in accordance with this Specification. Bear all costs of replacement unless due to extreme weather conditions, vandalism, or typhoons as SLW9.W110 and SLW9.W120.

1. Those trees and palms transplanted to the Site by the Employer's Direct contractor are excepted, as refer to PRE.B2.010 for relevance.

SLW9.W140.9 PLANT DIVISION

Where the CM considers ground cover and herbaceous planting to be overcrowded, divide and transplant as Instructed and in accordance with the following:

1. Dig up at an appropriate season;
2. Divide by teasing the roots apart by hand or using two forks back to back taking care to maintain an adequate root system with each divided part;
3. Replant one part in the original location and carry the other parts to another part of the estate as Instructed;
4. Replant in agreed positions, fertilize and water, all in accordance with this Specification.

SLW9.W150.9 THINNING

Where Instructed reduce the number of plants due to overcrowding as

1. Dig up plants, transport and replant in locations as directed; or
2. Dig up plants, transport and replant in locations within a 20 km round trip of the original location as directed; or
3. Remove from site;
4. Fertilize and water all in accordance with this Specification.

SLW9.W160.9 PARASITIC PLANTS

Parasitic plants, as defined as SLW1.M070, which become evident during the first four months of the EP are deemed to have been brought in on plants or soil delivered to the Site. Treat these parasitic plants as SLW1.W610 to SLW1.W650.

SLW9.W170.9 RECORDS

1. Ensure that the Approved Foreman reports to the Estate's Housing Manager's office before and after carrying out each day's establishment work and makes a signed record each day:
   a. Stating the work carried out;
   b. Indicating the percentage completed for each day's operation on the standard form (DLAP-F005) provided for the purpose.
2. Obtain countersignatures from the CM's site staff and keep the records available for inspection in the Estate Housing Manager's office.

SLW9.W180.9 WATER SUPPLY

See clauses PRE.B10.1210 and PRE.B10.1220.

SCHEDULES OF ESTABLISHMENT WORKS OPERATIONS

SLW9.W210.9 GENERAL

In the event of the scheduled operations requiring amendment due to the site and weather conditions prevailing during the EP, seek Approval, at least four weeks before the operation on site, with full justification to exceed the numbers specified.

SLW9.W220.A FIRST TWELVE MONTHS OF ESTABLISHMENT PERIOD

During the first twelve months of EP, carry out the operations as scheduled below as applicable to the Soft Landscaping Works in accordance with this Specification and shown or scheduled on the Drawings:

Operation	Anticipated No.	Timing
Watering (in open air) (under cover)	300 180	As specified. As specified.
Weeding	12	As specified.
Fertilizing	1	Early Summer, or otherwise Instructed.
Soil aeration	1	Immediately after fertilizer application.
Mulch application	1	Immediately after aeration operation.
Firming up	Min. 3	Immediately after strong wind and/or every four months.
Checking and adjusting tree ties	6	Check every two months; adjust/replace as necessary.
Tying climbers to supports and climber wires	As required	Check monthly, tie as necessary.
Climber wires	6	Check every two months; adjust/replace as necessary.
Pruning	Varies according to species	As scheduled in clause SLW9.W240.
Grass cutting	12	As specified.

Pesticide	As required	Check monthly; treat immediately.
Fungicide	As required	Check monthly; treat immediately.
Cleaning indoor plants	12	1 per month.
Checking and making good artificial plants	12	1 per month.
Checking and repairing protective fencing	Continuous	Check weekly: repair immediately.
Typhoon damage; assessment and repair	As required	As specified.
Gravel mulch topping up to tree grilles	4	Three monthly intervals.
Clearance of existing vegetated areas	Min. 2	Check every three months and treat as necessary.
Hessian binding removal		Remove from transplanted trees when instructed

SLW9.W230.A SECOND TWELVE MONTHS OF ESTABLISHMENT PERIOD

During the second twelve months of EP, carry out the operations as scheduled below as applicable to the Soft Landscaping Works in accordance with this Specification and shown or scheduled on the Drawings:

Operation	Anticipated No.	Timing
Watering (in open air) (under cover)	280 180	As specified. As specified.
Weeding	9	As specified.
Fertilizing	2	Early Spring and Late Summer, or otherwise Instructed.
Soil aeration	2	a. Immediately after first fertilizer application; b. Immediately after second fertilizer application.
Mulch application	2	a. Immediately after first aeration operation; b. Immediately after second aeration operation.
Firming up	Min. 3	Immediately after strong wind and/or every four months.
Checking and adjusting tree ties	6	Check every two months; adjust/replace as necessary.
Tying climbers to supports and climber wires	As required	Check monthly; tie as necessary.
Climber wires	6	Check every 2 months; adjust/replace as necessary.

Pruning	Varies according to species	As scheduled in clause SLW9.W240.
Grass cutting	12	As specified.
Pesticide	As required	Check monthly; treat immediately.
Fungicide	As required	Check monthly; treat immediately.
Cleaning indoor plants	12	1 per month.
Checking and making good artificial plants	12	1 per month.
Checking and repairing protective fencing	Continuous	Check weekly: repair immediately.
Stakes	1	Remove as necessary.
Typhoon damage; assessment and repair	As required	As specified.
Gravel mulch topping up to tree grilles	4	Three monthly intervals.
Clearance of existing vegetated areas	Min. 2	Check every three months and treat as necessary.

SLW9.W240.9 PRUNING SCHEDULE

Carry out pruning operations as schedule below as applicable to the Soft Landscaping Works:

Timing	Plant Species	Pruning Requirement
January	Palms:	
	All	Remove dead fronds.
	Small Shrub:	
	Nandina spp.	Remove dead leaves.
	Climbers:	
	Antigonon leptopus	Moderate pruning after flowering.
	Pyrostegia ignea	Moderate pruning after flowering.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
February	Conifers:	
	Casuarina spp.	As hedge: heavy pruning to shape as specified.
	Palms:	
	All	Remove dead fronds.
	Ground Cover:	
	Tradescantia fluminensis	Prune hard back to 100 mm.

	Zebrina pendula	Prune hard back to 100 mm.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
End of February	Large Shrubs:	
	Acalypha spp. (except A.hispida)	Prune hard back to 300 mm to remove previous year's growth.
	Barleria cristata	Prune hard back to 300 mm.
	Lagerstroemia spp.	Prune to 900 mm.
	Manihot spp.	Prune back to 300 mm.
	Mussaenda spp.	Prune to 600 mm.
	Tecoma stans	As mass planting: prune 900 mm. As feature plant: no pruning.
	Thunbergia erecta	Light pruning to remove dense overcrowded crossing branches. Shorten branches by one half. Prune as necessary to encourage even, natural free form habit.
	Small Shrubs:	
	Allamanda nerifolia	Prune hard back to 300 mm.
	Jasminum sambac	Prune hard back to 300 mm.
	Jasminum mesnyi	Thin out stems.
	Nandina spp.	Remove dead leaves.
	Ground Cover:	
	Catharanthus roseus	Prune hard back to 300 mm.

Timing	Plant Species	Pruning Requirement
March	Trees:	
	All	Remove dead wood and crossing branches. Clear trunks of adventitious budding.
	Conifers:	
	All	Remove dead branches.
	Palms:	
	All	Remove dead fronds.
	Large Shrubs:	
	All	Remove dead wood
	Ervatamia divaricata	Prune to 750 mm to encourage dense bushy growth of a natural form.
	Rhodomyrtus spp.	Prune to 900 mm maintaining a natural free branching form.

	Tecomaria spp.	As hedge: prune to shape as specified. As shrub: prune to 600 mm.
	Small Shrubs:	
	All	Remove dead wood.
	Cuphea hyssopifolia	Prune to 200 mm.
	Eranthemum spp.	Prune to 450 mm to encourage dense, basal branching.
	Nandina spp.	Remove dead leaves.
	Ground Cover:	
	All	Remove dead shoots and wood.
	Lantana montevidensis	After flowering prune back as necessary to maintain a tight cushion form or tight overhanging form if planted in balcony planters.
	Climbers:	
	All	Remove dead wood and withered leaves. Thin out when overcrowded.
	Allamanda cathartica	Prune hard back to 600 mm
	Bougainvillea spp.	Moderate pruning to remove old wood.
	Malvaviscus arboreus	Prune hard back to 900 mm.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
April	Trees:	
	Callistemon spp.	Light pruning.
	Eucalyptus spp.	Light pruning.
	Palms:	
	All	Remove dead fronds.
	Bamboos:	
	All	Remove dead wood.
	Large Shrubs:	
	Agave spp.	Remove lower dead leaves.
	Cordyline spp.	Remove dead leaves.
	Duranta spp.	As hedge: prune to shape as specified. As shrub: remove dead wood.
	Hibiscus spp.	Prune hard back to 900 mm.
	Ligustrum sinense	As hedge: prune to shape as specified.
	Malvaviscus spp.	As hedge: prune to shape as specified. As shrub: prune to 900 mm.

	Schefflera arboricola	Shorten leggy branched by ½ to ⅓. Light pruning to encourage dense, balanced, bushy, natural growth form.
	Thevetia spp.	Prune to 900 mm.
	Small Shrubs:	
	Eranthemum spp.	Prune to 450 mm to encourage dense, basal branching.
	Nandina spp.	Remove dead leaves
	Ground Cover:	
	Wedelia trilobata	Prune hard back to prevent Wedelia from climbing over other plants. At edge of planter, cut back to 100 mm overhang.
	Aquatic:	
	All	Remove dead leaves and stems

Timing	Plant Species	Pruning Requirement
May	Palms:	
	All	Remove dead fronds.
	Large Shrubs:	
	Brunfelsia calycina	Prune hard back to 300 mm, after flowering.
	Melastoma spp.	Light pruning.
	Murraya spp.	Light pruning to remove rough foliage.
	Nerium spp.	Prune to 900 mm.
	Small Shrubs:	
	Nandina spp.	Remove dead leaves.
	Ground Cover:	
	Lantana montevidensis	Light pruning to maintain tight balanced form.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
June	Palms:	
	All	Remove dead fronds.
	Small Shrubs:	
	Nandina spp.	Remove dead leaves.
	Ground Cover:	
	Wedelia trilobata	Prune hard back to prevent Wedelia from climbing over other plants. At edge of planter, cut back to 100 mm overhang.
	Aquatic:	

	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
July	Palms:	
	All	Remove dead fronds.
	Large Shrubs:	
	Agave spp.	Remove lower dead leaves.
	Small Shrubs:	
	Nandina spp.	Remove dead leaves.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
August	Palms:	
	All	Remove dead fronds.
	Large Shrubs:	
	Acalypha spp. (except A.hispida)	Prune to reduce height to 500 mm.
	Cordyline spp.	Remove dead leaves.
	Small Shrubs:	
	Allamanda nerifolia	Prune hard back to 300 mm.
	Nandina spp.	Remove dead leaves.
	Ground Cover:	
	Gerbera jamesonii	Prune hard back to soil level
	Lantana montevidensis	Moderate pruning to maintain tight balanced form.
	Liriope spicata	Remove dead foliage.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
September	Palms:	
	All	Remove dead fronds.
	Large Shrubs:	
	Dichroa febrifuga	Prune to 500 mm to encourage dense basal branching but maintain a natural free branching form.
	Schefflera arboricola	Shorten leggy branches by 1/2 or 1/3.
	Small Shrubs:	

	Nandina spp.	Light pruning to encourage dense, balanced, bushy, natural growth form. Remove dead leaves.
	Ground Cover:	
	Wedelia trilobata	Prune hard back to prevent Wedelia from climbing over other plants. At edge of planter, cut back to 100 mm overhang.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
October	Trees:	
	All	Remove dead wood and crossing branches. Clear trunks of adventitious budding.
	Conifers:	
	All	Remove dead branches.
	Palms:	
	All	Remove dead fronds.
	Large Shrubs:	
	All	Remove dead wood.
	Agave spp.	Remove lower dead leaves.
	Small Shrubs:	
	All	Remove dead wood.
	Nandina spp.	Remove dead leaves
	Ground Cover:	
	All	Remove dead shoots and wood.
	Climbers:	
	All	Remove dead wood, and withered leaves. Thin out when overcrowded.

Timing	Plant Species	Pruning Requirement
November	Palms:	
	All	Remove dead fronds.
	Large Shrubs:	
	Calliandra spp.	Prune to 750 mm after flowering.
	Small Shrubs:	
	Nandina spp.	Remove dead leaves.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
December	Palms:	
	All	Remove dead fronds.
	Livistona spp.	Remove old fruit branches.
	Phoenix spp.	Remove old fruit branches.
	Large Shrubs:	
	Cordyline spp.	Remove dead leaves.
	Small Shrubs:	
	Nandina spp.	Remove dead leaves.
	Aquatic:	
	All	Remove dead leaves and stems.

Timing	Plant Species	Pruning Requirement
As and when required	Herbaceous:	
	All	Cut back to ground level immediately after plant dies back for dormant period.

ESTABLISHMENT OPERATIONS

SLW9.W300.9 MAKING GOOD ERODED SEEDED AREAS

Make good any erosion of seeded, or hydroseeded, areas by broadcast sowing as SLW7.W530 or hydroseeding as EXT14.W310 as appropriate and carry out post application operations as specified.

SLW9.W310.9 WATERING

Water all planted areas so as to maintain a moist soil through the depth of the fabricated soil profile adequate to ensure satisfactory establishment and as a minimum:

1. For plants exposed to natural rainfall:
    a. Water during the first 12 months of EP, on every day that the rainfall is less than 5 mm per day except on the day following a day that rainfall exceeded 20 mm per day or when the fabricated soil profile is saturated;
    b. Water during the second 12 months of EP on every day that the rainfall is less than 2 mm per day except on the day following a day that rainfall exceeded 15 mm per day or when the fabricated soil profile is moist.
2. For plants NOT exposed to natural rainfall:

    Water every two to three days irrespective of the weather conditions during the whole EP.

Carry out watering either early mornings or late afternoon or both.

SLW9.W320.9 WEEDING

Keep all planted areas weed-free and:

1. During the first twelve months of EP, undertake a weeding operation at least once every three weeks during the wet season, and at least once every two months during the dry season;
2. During the second twelve months of EP, undertake a weeding operation at least once every month during the wet season, and at least once every two months during the dry season;
3. Replace any mulch or soil disturbed or removed during this process;
4. Maintain a circle of bare soil, 200 mm diameter greater than that of the tree trunk or plant stem, around all plant bases in grassed areas;
5. Collect all arisings resulting from these operations and remove from the Site to a properly designated tip.

SLW9.W330.A FERTILIZING

1. During the first twelve months of the EP, carry out one applications of fertilizer during early summer, as SLW1.M110, at the following rates (±5%):
   a. 200 gm per semi-mature tree;
   b. 150 gm per heavy standard tree, large palm and large conifer;
   c. 100 gm per standard tree, light standard tree, medium size palm and medium size conifer;
   d. 50 gm per seedling tree, whip, small palm (up to 2000 mm high), small conifer;
   e. 30 gm for shrub, climbing plant and bamboo;
   f. 5 gm per ground cover and herbaceous plant;
   g. 25 gm/m² for grass area.
2. During the second twelve months of the EP, carry out two applications of fertilizer, one during early spring and one during later summer as SLW1.M110, at the following rates (±5%):
   a. 200 gm per semi-mature tree;
   b. 150 gm per heavy standard tree, large palm and large conifer;
   c. 100 gm per standard and light standard tree, medium size palm and medium size conifer;
   d. 50 gm per seedling tree, whip, small palm, small conifer;
   e. 10 gm for shrub, climbing plant and bamboo;
   f. 5 gm per ground cover and herbaceous plant;
   g. 25 gm/m² for grass areas.
3. For the purpose of this clause the following definitions apply:

	Conifer height (mm)	Palm height (mm)
Large:	Above 3000	Above 4000
Medium:	Above 1200 but not above 3000	Above 2000 but not above 4000
Small:	Not above 1200	Not above 2000

4. These works shall include those trees and palms transplanted to the Site by the Employer's Direct Contractor, as refer to PRE.B2.010 where relevant.

Option

5. Fertilizing with spent mushroom compost (SMC)

a. During the EP, carry out one application of SMC fertilizer every 6 months, as SLW1.M135, at the following dosage: Add SMC at a dose of 2% by volume by layering on the top soil;

b. These works shall include those trees and palms transplanted to the Site by the Employer's Direct Contractor, as refer to PRE.B2.010 where relevant.

SLW9.W340.9 TOP DRESSING TO GRASSED AREAS

Immediately after fertilizing, top dress all grass areas with top dressing, as specified at SLW7.M330, to smooth out minor depressions.

SLW9.W350.9 AERATION

1. Shrub areas, including bamboos, climbers and herbaceous plants: immediately after fertilizing, cultivate the soil by hand using a fork to a depth of 100 mm;
2. Ground cover areas: immediately after fertilizing lightly break up the soil by hand using a fork to a depth of 75 mm;
3. Grass areas: immediately before fertilizing aerate the soil by inserting a tine or fork to a depth of 100 mm at 200 mm centres.

SLW9.W360.9 MULCHING

Immediately after aeration, top up all shrub and ground cover areas, by adding mulch to match existing to the following minimum depths:

1. Shrubs, bamboo, climber and herbaceous plants: 25 mm;
2. Ground cover plants: restore to the original depth;
3. Plants in grassed areas: 25 mm in mulched circle.

SLW9.W370.9 AERATION AND MULCHING

Do not undertake aeration or mulching to ground cover areas once ground cover plants have successfully established and there are not visible bare areas of soil.

SLW9.W380.9 TOPPING UP GRAVEL MULCH TO TREE GRILLES

At three monthly intervals top-up gravel to match existing to fill the interstices of the tree grilles.

SLW9.W390.9 FIRMING UP

Firm up plants and tree stakes from time to time during the EP and particularly after heavy rain or wind.

SLW9.W400.9 TREE SUPPORTS

1. Tighten, slacken or replace tree ties, as SLW2.M330, as necessary for the healthy growth of the tree, and adjust or replace the trunk protection, as SLW2.M370 as necessary to prevent chafing of the bark;
2. Adjust guying turnbuckles as necessary to ensure guys are taut.

SLW9.W410.9 GRASS CUTTING

Cut grass by hand or machine, as SLW7.W630 and EXT14.W350 or otherwise instructed. These works shall include those existing grassed / hydroseeded area on Site:

1. During the main growing period (April to October): at least once per month at 100mm height;
2. During the dry season (November to March): at least twice at equal intervals at 100mm height;
3. Rake up and remove all cuttings from site to a properly designated tip within 24 hours after cut.

SLW9.W420.9 PRUNING PROGRAMME

Carry out pruning:

1. At the appropriate time of year for each species as scheduled in SLW9.W240;
2. Once each year of the EP, except when otherwise specified.

SLW9.W430.9 PRUNING PROCEDURES

Carry out pruning using sharp tools to give a clean cut, free from ragged edges and:

1. Ensure cuts are immediately above buds or branches and slope away from an outward facing bud;
2. Prune back branches, to the main stem to encourage bushy growth and improve flowering;
3. Remove dead, damaged or crossing branches and dead flower heads;
4. Retain the individual habit and shape of the plant, unless otherwise directed or the intention of the design is to form a clipped hedge;
5. Prune flowering shrubs by removing the shoots bearing the dead flower heads and/or the new growth dependant on species.

SLW9.W440.9 TREATMENT OF PESTS AND FUNGAL GROWTH

1. Regularly check all plant and grass areas for signs of insect attack or fungal infestation, whether or not the insects or fungi are injurious to the plants or only cause a nuisance. Pay particularly attention during known periods of activity;
2. Report immediately to the CM any signs of insect attack or fungal infestation, and carry on to identify, monitor, and assess the insect attack or fungal infestation and propose remedial measures according to prevailing guidelines on pest control laid down by AFCD and Guidelines on Occupational Safety and Health for Pest Control Operators laid down by Food and Environmental Hygiene Department (FEHD);
3. Post warning notices (e.g. poison, no-entry, name of pesticide, date and time of application, re-entry time etc.) at conspicuous locations to avoid the public from entering the area under treatment before and after spraying of pesticide. Inform Estate Management to notify residents on the application and on spray drift risks;
4. Effect remedial measures by applying pesticides approved by the CM in strict accordance with the manufacturer's recommendations and labelling instructions, and carry out associated arboriculture works to the infected and/or infested areas in the manner as stated in PRE.B8.1260 sub-clauses (5)(a) and (5)(c) to (g);
5. Take due care and have regard to the safety and convenience of the general public and carefully control the spraying of the chemical pesticide to avoid unnecessary dispersion;
6. Plant parts pruned from diseased plants shall not be stockpiled anywhere on the Site and shall be disposed of from the Site.

SLW9.W445.9 CLEARANCE OF EXISTING VEGETATED AREAS

Keep existing vegetated areas clear as EXT11.W110.

SLW9.W450.9 CARE OF INDOOR PLANTS

Clean the leaves of all indoor plants at least once a month, and fertilize as SLW9.W330.

SLW9.W460.9 CARE OF ARTIFICIAL PLANTS

Maintain artificial plants as follows:

1. Clean each leaf and keep tidy once per month;
2. Replace leaves when they are loose or missing.

SLW9.W470.9 MAINTENANCE OF PROTECTIVE FENCING

Regularly check protective fencing and immediately carry out all necessary repairs to ensure that fencing is maintained in good condition at all times.

SLW9.W480.9 REMOVAL OF PROTECTIVE FENCING

Remove temporary protective fencing during or at the end of the EP as Instructed.

SLW9.W490.9 REMOVAL OF STAKES

Remove stakes when the plant root system is sufficiently developed to support the plant at the end of the EP unless otherwise instructed.

SLW9.W500.9 REMOVAL OF HESSIAN BINDING TO TRANSPLANTED TREES

Remove hessian binding from trunk and large branches of transplanted trees as soon as satisfactory growth has occurred as Instructed.

SLW9.W510.9 FINAL INSPECTION

1. In the presence of the CM carry out an inspection and formal check of the Works at the end of the EP;
2. Carry out the last of the operations scheduled immediately prior to the final handover inspection;
3. On satisfactory completion of any outstanding defective and replacement work, a completion Certificate will be issued in accordance with Clause 53 of the "said Conditions"

MAINTENANCE FOR SAND BASED LAWN

SLW9.W610.9 GENERAL

Maintenance operations listed in SLW9.W620 to SLW9.W680 only apply to areas specified as “Sand Based Lawn”.

SLW9.W620.9 CONTROL USAGE

Control the usage with fence for turf establishment or recovery when instructed by the CM.

SLW9.W630.9 OVERSEED DURING DRY SEASON

Overseed with dry season grass seeds by hand / overseeding machine during onset of cooler months when instructed by the CM.

SLW9.W640.9 TURF MOWING

Mow the turf by machine, as SLW7.M350:

1. During the main growing period: mow at 32 mm once per week;
2. During the dry season: mow at 37 mm once per week;
3. Rake up and remove all cuttings from site within 24 hours after cut.

SLW9.W650.9 TOPDRESSING

Apply 6mm thick topdressing by spreader as per SLW7.M350 2 times per year and any additional operation when instructed by the CM with graded sand as per EXT12.M235.

SLW9.W660.9 DETHATCHING

Remove the thatch layer by following operation:

1. Verti-cutting: 1-2 times per year and any additional operation when instructed by the CM by machine as per SLW7.M350. The depth of the cutting should be set at about 25mm below the thatch layer;
2. Hollow-tine coring: once per year with aerator installed with 12mm diameter hallow tine;
3. Solid-tine coring: once every 2 months with aerator installed with 6mm diameter solid tine.

SLW9.W670.9 SPIKING

Spike the grassed area with hand spiker, as SLW7.M350 once every 2 months and any additional operation when instructed by the CM.

SLW9.W680.9 FERTILIZATION

Apply compound fertilizer as per SLW1.M110 monthly.

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Building Services Installation Works Specification

ELE ELECTRICAL INSTALLATION

ELE1 GENERAL REQUIREMENTS

ELE1.1 APPLICATION OF SPECIFICATION 3
ELE1.1.010.9 PRELIMINARIES 3
ELE1.1.020.9 APPLICATION TO SYSTEMS 3

ELE1.2 THE WORKS 4
ELE1.2.010.9 SITE OF THE WORKS 4
ELE1.2.020.9 SCOPE OF THE WORKS 4

ELE1.3 CONTRACT DOCUMENTATION 5
ELE1.3.010.9 DRAWINGS AND DOCUMENTS 5
ELE1.3.020.9 TECHNICAL INFORMATION SUPPLIED WITH TENDER AND SUB-CONTRACTOR'S RESPONSIBILITY 5
ELE1.3.030.9 DEFINITIONS AND ABBREVIATIONS 5
ELE1.3.040.9 SINGULAR AND PLURAL 6

ELE1.4 COMPLIANCE WITH REGULATIONS AND STANDARDS 7
ELE1.4.010.B STATUTORY REGULATIONS 7
ELE1.4.020.9 STANDARDS 8
ELE1.4.030.9 PRECEDENCE 8
ELE1.4.040.9 APPLICATION OF BRITISH STANDARDS/INTERNATIONAL OR NATIONAL STANDARDS / CODE OF PRACTICE 9
ELE1.4.050.9 OTHER INTERNATIONAL OR NATIONAL STANDARD SPECIFICATIONS 9
ELE1.4.060.9 TESTING AND CERTIFICATION 9
ELE1.4.085.9 CODE OF PRACTICE FOR ENERGY EFFICIENCY OF BUILDING SERVICES INSTALLATION 10

ELE1.5 CONDITIONS OF SUPPLY 11
ELE1.5.010.9 ELECTRICITY SUPPLY 11
ELE1.5.020.9 SERVICE CONDITIONS 11

ELE1.6 MATERIALS AND EQUIPMENT 12
ELE1.6.010.9 METRIC UNITS 12
ELE1.6.020.9 SUBMISSIONS FOR APPROVAL 12
ELE1.6.030.9 SELECTION OF EQUIPMENT 12
ELE1.6.040.9 EQUIPMENT CATALOGUES AND MANUFACTURER'S SPECIFICATIONS 12
ELE1.6.050.9 CONSISTENCY 12
ELE1.6.060.9 RESTRICTED USE OF ASBESTOS PRODUCTS 12

ELE1.7 WORKMANSHIP 13
ELE1.7.010.9 TRADESMEN 13
ELE1.7.020.9 TOOLS AND INSTRUMENTS 13
ELE1.7.030.9 SAFETY ON SITE 13
ELE1.7.040.9 GUARD AND RAILING FOR MOVING OR ROTATING PARTS OF EQUIPMENT 13
ELE1.7.050.9 IDENTIFICATION OF CABLES AND CONDUITS 13
ELE1.7.060.9 SAMPLE FLATS AND SAMPLE WING 14

ELE1.8 SITE MANAGEMENT 15

ELE1.8.010.9 APPOINTMENT OF SUPERVISING ENGINEERS, SITE SUPERVISORS AND BLOCK FOREMEN 15
ELE1.8.020.9 SUPERVISING ENGINEERS 15
ELE1.8.030.9 SITE SUPERVISORS 16
ELE1.8.035.9 BLOCK FOREMEN 16
ELE1.8.040.9 BUILDING SERVICES PERFORMANCE ASSESSMENT SCORING SYSTEM 16
ELE1.8.050.9 COORDINATION WITH MAIN CONTRACTOR ON INTENDED CONSTRUCTION METHOD FOR INTERNAL PARTITION WALLS (PANEL WALLS) IN DOMESTIC FLATS, PRECAST CONCRETE WALL & PRECAST FACADE PANEL 17
ELE1.8.060.9 MODIFICATION WORKS IN NON-DOMESTIC PREMISES DURING MAINTENANCE PERIOD 17
ELE1.8.070.9 NOTICES AND FEES 17

ELE1.9 SITE SECURITY 18

ELE1.9.010.9 SUB-CONTRACTOR'S STORE ROOMS 18
ELE1.9.020.9 BURGLAR ALARM SYSTEM FOR SUB-CONTRACTOR'S STORE ROOMS 18
ELE1.9.030.9 MARKING OF RESIDUAL CURRENT CIRCUIT BREAKERS (RCCB) 20

ELE1.10 RECORD DOCUMENTATION 21

ELE1.10.010.9 REQUIREMENTS FOR SUB-CONTRACTOR'S DRAWINGS 21
ELE1.10.020.9 CONDUIT RUN DRAWINGS 22
ELE1.10.030.9 WORKING DRAWINGS AND AS-FITTED DRAWINGS 22
ELE1.10.040.9 DOCUMENTS AND TECHNICAL LITERATURE TO BE SUBMITTED AFTER COMPLETION 23

ELE1.1 APPLICATION OF SPECIFICATION

ELE1.1.010.9 PRELIMINARIES

This Specification and this Worksection ELE1 in particular should be read in conjunction with Preliminaries for Building Services Sub-contracts.

ELE1.1.020.9 APPLICATION TO SYSTEMS

1. This Worksection ELE1 of this Specification is applicable to the whole of the Sub-contract Works while the other Worksections are applicable to the Systems described in the respective Worksection;
2. Worksection ELE2, which specifies general system requirements should be read in conjunction with subsequent Worksections of this Specification which are reference Worksections and define details of installations.

ELE1.2 THE WORKS

ELE1.2.010.9 SITE OF THE WORKS

The site of the Works is given in the Project Specific Specification.

ELE1.2.020.9 SCOPE OF THE WORKS

The scope of the works is given in the Project Specific Specification.

ELE1.3 CONTRACT DOCUMENTATION

ELE1.3.010.9 DRAWINGS AND DOCUMENTS

1. A Schedule of the Sub-contract Drawings is included in Appendix 'P';
2. The tenderer's attention is also drawn to the latest revision of the Standard Lighting Fitting Schedule issued by the Housing Department;
3. The Schedule is available for inspection at the Building Services Section, Housing Department during normal office hours upon application to the Contract Manager;
4. The Sub-contract Drawings and the Schedule shall hereinafter be referred to as the Drawings.

ELE1.3.020.9 TECHNICAL INFORMATION SUPPLIED WITH TENDER AND SUB-CONTRACTOR'S RESPONSIBILITY

1. All technical information supplied with the tender, including the tenderer's proposed design and the materials offered, is for tender assessment only;
2. Acceptance of the tender will not relieve the Sub-contractor of his responsibility for the proper working of the installation to meet the specified requirements in compliance with the Sub-contract documents to the entire satisfaction of the Contract Manager;
3. In the event of the installation being, in the opinion of the Contract Manager, not in compliance with the specified requirements, the Sub-contractor shall modify his design, replace any unsatisfactory materials and do everything necessary for compliance with the specified requirements at his own cost.

ELE1.3.030.9 DEFINITIONS AND ABBREVIATIONS

In this Specification the word "shall" is mandatory, the word "will" is informative, the word "should" is advisory and the word "provide" means supply and fix, or supply and install. In addition the following words shall have meanings herein assigned:

1. "Authority"

   means Hong Kong Housing Authority.

2. "Indicated"

   means indicated elsewhere in the Specification or on the Drawings.

3. "or Equal" or "or Similar"

   means having similar characteristics and Specification, as regards type of construction, performance, general appearance and standard of quality of manufacture.

4. "Drawing"

   means the drawings referred to in the Specification and any modification of such drawings Approved by the Contract Manager and such other drawings as may be, from time to time, furnished or Approved.

5. "Standard Drawings"

   means the drawings prepared by the Authority to show detailed arrangements of the common standard installations.

6. "EMSD"

   means the Electrical and Mechanical Services Department.

7. "WSD"

   means the Water Supplies Department.

8. "FSD"

   means the Fire Services Department.

9. "IET"

   means the Institution of Engineering and Technology UK.

10. "CSA"

    means the conductor cross-sectional area.

11. "BSI"

    means the British Standards Institution.

12. "BS"

    means British Standards, including British Standard Specifications and British Standard Codes of Practice published by the British Standards Institution.

13. "EN"

    means European Standard.

14. "ISO"

    means International Organization for Standardization Publications.

15. "IEC"

    means International Electrotechnical Commission Publications.

16. "BS EN"

    means European Standard adopted by the British Standards Institution to replace any relevant British Standard.

17. "ASTM"

    means American Society for Testing and Materials.

18. "ANSI"

    means American National Standards Institution.

19. "PASS"

    means Performance Assessment Scoring System.

20. "BSPASS"

    means Building Services Performance Assessment Scoring System.

ELE1.3.040.9 SINGULAR AND PLURAL

Words importing the singular only also include the plural vice versa where the context requires.

ELE1.4 COMPLIANCE WITH REGULATIONS AND STANDARDS

ELE1.4.010.B STATUTORY REGULATIONS

The Sub-contractor shall comply with the latest edition of all relevant Ordinances and Regulations together with any amendments made thereto, Laws of Hong Kong and shall be responsible for giving notifications to the appropriate authorities and paying all fees in accordance with the Sub-contract.

The following are particularly relevant:

1. Electricity Ordinance Chapter 406, and other subsidiary legislation made under the Ordinance;
2. Regulations of the Telecommunication Authority, Government of Hong Kong;
3. Buildings Energy Efficiency Ordinance (Cap. 610);
4. Energy Efficiency (Labelling of Products) Ordinance Chapter 598;
5. Fire Safety (Commercial Premises) Ordinance and Fire Safety (Buildings) Ordinance;
6. Dangerous Goods Ordinance and Dangerous Goods (General) Regulations;
7. Occupational Safety and Health Ordinance, Chapter 509, and other subsidiary legislation made under the Ordinance;
8. Factories and Industrial Undertakings Ordinance, Chapter 59, and other subsidiary legislation made under the Ordinance;
9. Construction Site (Safety) Regulations;
10. Construction Site Safety Manual issued by the Development Bureau, the Government of the HKSAR;
11. All regulations, code of practices and guidelines on safety issued by the Labour Department from time to time;
12. Other relevant Ordinances and Regulations, Laws of Hong Kong;
13. Code of Practice for the Electricity (Wiring) Regulations (hereinafter referred to as the Electrical CoP);
14. Guidance Notes for the Electrical Products (Safety) Regulation (hereinafter referred to as the Electrical Product Guidance Notes), which applies to all electrical products designed for household use and supplied in Hong Kong;
15. Codes of Practice for minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment, and Circular Letters issued by the Fire Services Department (hereinafter referred to as Fire Services COP);
16. Code of Practice for Energy Efficiency of Building Services Installation, issued by the Electrical and Mechanical Services Department (hereinafter referred to as the BEC);
17. Code of Practice on Energy Labelling of Products, issued by the Electrical and Mechanical Services Department (hereinafter referred to as the MEELS).

ELE1.4.020.9 STANDARDS

All materials and workmanship shall comply, where applicable, with all relevant sections, together with any revisions or amendments made thereto, of the following:

1. The Supply Rules issued by the respective Supply Company currently in operation in Hong Kong (hereinafter referred to as the Supply Rules);
2. 17th Edition of the Regulations for Electrical Installations, issued by the IET (hereinafter referred to as the 17th Edition IEE Wiring Regulations). The 17th Edition IEE Regulations was jointly published by the BSI and the IET as BS 7671(hereinafter referred to as BS 7671) and is the general standard now referred to in this Specification. Reference is also made to Guidance Notes published by the IET for use in conjunction with BS 7671;
3. Appropriate British Standards / International or National Standards / Code of Practice subject to clause ELE1.4.040. When a British Standard quoted in this Specification has been wholly or partially superseded by another equivalent or similar British Standard, the Sub-contractor is allowed to offer material in compliance with the latter in lieu for the Contract Manager's Approval;
4. Relevant parts of the HKHA Specification Library for Building Works (hereinafter referred to as the HKHA Building Works Specification) which may be viewed during normal office hours in the Authority's offices upon application to the Contract Manager;
5. General Technical Specifications for Monochrome and Colour Closed Circuit Television Systems (Specification No. ESG 14 March 2017 Edition) issued by the Electronic & Data Communication Division, Electrical and Mechanical Services Department, Hong Kong;
6. General Specification for Public Address System (Specification No. ESG11 Issue No. 5 October 2016 and Amendment 4 October 2016) issued by the Projects Division, Electrical and Mechanical Service Department, Hong Kong (hereinafter referred to as the General PA Specification);
7. Other International or National Standard Specifications as detailed in ELE1.4.050 (hereinafter referred to as Equivalent Standards).

ELE1.4.030.9 PRECEDENCE

In case of conflict between the requirements among the publications referred to in ELE1.4.010 and ELE1.4.020, interpretation shall be in accordance with the following order of preference unless otherwise specified or directed by the Contract Manager:

1. Ordinances and subsidiary legislations, Regulations, Laws of Hong Kong;
2. The Project Specific Specification and / or the contract documents for a particular project;
3. The Specification and/or the Drawings;
4. The Electrical CoP;
5. Electrical Product Guidance Notes;
6. Supply Rules;
7. BS 7671 when specified;
8. British Standard Specifications and Codes of Practice;
9. Equivalent standard;
10. HKHA Building Works Specification.

ELE1.4.040.9 APPLICATION OF BRITISH STANDARDS/INTERNATIONAL OR NATIONAL STANDARDS / CODE OF PRACTICE

1. The date/year of British Standards (BS)/International or National Standards / Codes of Practice (CP) shall be referred to Appendix 1 of the Specification. Where it is not specified in the Specification, it shall be deemed to refer to any valid or latest version, and any applicable amendments to that version;
2. Where the date/year is specified, due to intended purposes, the specified version and any amendments to that version shall be compiled with unless otherwise approved by Contract Manager;
3. "Head standards" (HS) are not dated because they do not contain any technical content. However reference to a head standard invokes all relevant extant "parts" of that standard which are themselves dated. Reference to head standards is a practicable method of using a general BS reference in situations where detailed reference to each part would be cumbersome.

ELE1.4.050.9 OTHER INTERNATIONAL OR NATIONAL STANDARD SPECIFICATIONS

Materials or equipment manufactured to other International or National Standard Specifications (Equivalent Standard) may be considered for acceptance provided that:

1. The Equivalent Standard shall be no less stringent than the corresponding BS; and
2. The materials or equipment shall be compatible, in all respects, with and comply with the corresponding BS; and
3. The following documents shall be produced when required:
    a. An English translation of the Equivalent Standard, certified true by the Equivalent Standard issuing organization or an acceptable authority;
    b. A comparison table highlighting the differences between the Equivalent Standard and the corresponding BS.

ELE1.4.060.9 TESTING AND CERTIFICATION

1. Unless otherwise specified, equipment shall be type-tested in accordance with the testing requirements as stipulated in the appropriate recognised standard as stipulated in the Electrical CoP;
2. Test certificates for each type test complete with reports and drawings, where applicable, shall be produced when required, to prove to the satisfaction of the Contract Manager of the compliance with the recognised standard. If the original documents are not produced in English, an English translation of the documents, certified true by the issuing organisation or an acceptable authority, shall be produced when required;
3. For the purpose of product testing and certification, the following interpretation shall apply:
    a. "Independent" shall mean not owned, managed or operated, either in whole or in part, by the manufacturer or its agents;
    b. "Accredited Laboratory" shall mean a laboratory accredited to carry out the specified tests by:
        i. IECEE (IEC System for Conformity Testing to Standards for Safety of Electrical Equipment) CB Scheme; or
        ii. Hong Kong Accreditation Service (HKAS) or Hong Kong Laboratory Accreditation Scheme (HOKLAS); or

iii. Other equivalent national laboratory accreditation schemes which have mutual recognition agreements with HKAS/HOKLAS as stipulated in the Electrical CoP.

c. "Short Circuit Testing Organisation" shall mean:

i. The Association of Short Circuit Testing Authorities (ASTA); or

ii. NV tot Keuring van Elektrotechnische Materialen (KEMA); or

iii. Association des Stations d'Essais Francaises d'Appareillage (ASEFA); or

iv. An Accredited Laboratory; or

v. Other short-circuit testing authorities internationally recognized as having equal standing as ASTA.

d. "Equivalent Quality Surveillance Scheme" shall mean equivalent quality surveillance schemes internationally recognized as having equal standing as the specified scheme(s).

ELE1.4.085.9 CODE OF PRACTICE FOR ENERGY EFFICIENCY OF BUILDING SERVICES INSTALLATION

1. All materials and workmanship, where specified, shall comply with the BEC;
2. The Sub-contractor shall provide all necessary information and document to the CM for Registered Energy Assessor’s preparation of all relevant submission as required under the Buildings Energy Efficiency Ordinance (Cap. 610);
3. Attend and provide necessary equipment for random check and site check upon requested by the CM.

ELE1.5 CONDITIONS OF SUPPLY

ELE1.5.010.9 ELECTRICITY SUPPLY

Unless otherwise specified, the complete electrical installation shall be suitable for operation under the supply system with a nominal frequency of 50 Hz and nominal voltage of 380V, 3-phase and 220V, single phase within the variation limits as declared by the local Supply Companies.

ELE1.5.020.9 SERVICE CONDITIONS

The complete electrical installation shall be suitable for use under Hong Kong climatic conditions with relative humidity and ambient temperature as shown below:

1. Relative Humidity: up to 0.99 saturation;
2. Ambient Temperature: peak from minus 5°C to plus 40°C for 4 hours continuously with an average from 0°C to plus 35°C over only 24 hours period.

ELE1.6 MATERIALS AND EQUIPMENT

ELE1.6.010.9 METRIC UNITS

Materials shall be of metric unit.

ELE1.6.020.9 SUBMISSIONS FOR APPROVAL

1. The Sub-contractor shall submit catalogues, technical information, certificate of safety compliance and samples of the materials proposed for Approval as required by the Contract Manager. The Sub-contractor shall also read in conjunction with the associated requirements stipulated at Preliminaries for Building Services Sub-contracts;
2. The Sub-contractor shall ensure the availability of the certificate of safety compliance for all proposed household products, prior to the submission for approval;
3. Approval of equipment will not be considered until and unless proper rating/type of sample complete with detailed information/technical data such as equipment catalogue, manufacturer's specification and certificates, when required are submitted for examination.

ELE1.6.030.9 SELECTION OF EQUIPMENT

1. Selection of equipment shall be based on this Specification and technical data contained on the Drawings for a particular installation;
2. Where items of equipment are interconnected to form an integral part of the complete electrical installation, their characteristics of performance and capacities shall be so matched as to give efficient, economical, safe and reliable operation of the complete electrical installation.

ELE1.6.040.9 EQUIPMENT CATALOGUES AND MANUFACTURER'S SPECIFICATIONS

1. Equipment Catalogues and manufacturers' Specification related to the proposed equipment shall be in the English language, specific and shall include all information necessary for the Contract Manager to ascertain that the equipment complies with this Specification and Drawings. Data and sales catalogue of a general nature will not normally be accepted;
2. Equipment catalogues and manufacturers' specifications must be submitted for the examination by and Approval of the Contract Manager before any equipment is to be ordered.

ELE1.6.050.9 CONSISTENCY

All equipment of the same category shall be the product of the same manufacturer and shall preferably be of the same colour scheme throughout.

ELE1.6.060.9 RESTRICTED USE OF ASBESTOS PRODUCTS

Asbestos or products containing asbestos shall not be used without prior Approval.

ELE1.7 WORKMANSHIP

ELE1.7.010.9 TRADESMEN

All tradesmen must be experienced in the trade and the works carried out shall be consistent with good practice in Hong Kong and to the satisfaction of the Contract Manager.

ELE1.7.020.9 TOOLS AND INSTRUMENTS

1. Proper tools shall be used to carry out the electrical installations;
2. Adequate and accurate testing/measuring instruments shall also be used to demonstrate compliance of the electrical installations with the relevant specifications and regulations;
3. The Contract Manager has the right to stop any work on which the correct tools and/or instruments are not being used;
4. Instruments used for acceptance test shall be calibrated at appropriate intervals and/or as specified in Project Specific Specification.

ELE1.7.030.9 SAFETY ON SITE

All works shall be carried out in such a manner as to comply with all regulations together with any amendments made thereto on safety aspects. These include but are not limited to the following:

1. Construction Sites (Safety) Regulations;
2. Factories & Industries Undertakings Electricity Regulations;
3. Electricity Ordinance, Chapter 406;
4. IEC 60364-7-704: Construction and Demolition Site Installation.

ELE1.7.040.9 GUARD AND RAILING FOR MOVING OR ROTATING PARTS OF EQUIPMENT

1. All moving or rotating parts of equipment shall be provided with an Approved guard and railing complying with the Factories & Industrial Undertakings (Guarding and Operation of Machinery) Regulations, published by the Labour Department, together with any amendments made thereto;
2. Guards shall be rigid and of substantial construction and shall consist of heavy mild steel angle frames, hinged and latched with either heavy galvanized mild steel wire crimped mesh securely fastened to frames or galvanised sheet metal of 1.2 mm minimum thickness;
3. All apertures shall be such that finger access to dangerous parts is not possible.
4. All sections shall be bolted or riveted;
5. Railings shall be 32 mm galvanized mild steel pipe and rail fittings.

ELE1.7.050.9 IDENTIFICATION OF CABLES AND CONDUITS

1. Cables for control circuits, inter-communication circuits, signalling circuits, and bell wiring shall be identified as required for each particular circumstance. Cables for power and lighting circuits shall be identified in accordance with the Electrical CoP Code 13D;

2. Electrical conduits, where required to be distinguished from pipelines of other services, shall use orange as the basic identification colour in compliance with BS 1710.

ELE1.7.060.9 SAMPLE FLATS AND SAMPLE WING

During the construction for domestic building blocks, a specified sample flats and wing located on a typical floor and construction mock-up will be required to be completed by the Main Contractor including the flats, the corridor, the flights of common staircase leading to the floors immediately above and below the sample wing and the lift lobby etc. If necessary, flats at the adjacent wing may also be selected. The Sub-contractor shall complete the electrical installations in the specified sample flats, sample wing and construction mock-up in coordination with the Main Contractor to cope with the construction programme. The proposed samples and details of electrical installations in the sample flats and the sample wing shall be submitted to the CM for approval prior to commencement of works. The Sub-contractor shall be responsible to replace any electrical installations which are found damaged or deformed and to carry out the necessary adjustments to restore to as-new condition before building completion.

ELE1.8 SITE MANAGEMENT

ELE1.8.010.9 APPOINTMENT OF SUPERVISING ENGINEERS, SITE SUPERVISORS AND BLOCK FOREMEN

1. Immediately upon the award of the Sub-contract, the Sub-contractor shall appoint Supervising Engineer(s) and Site Supervisor(s) specified in ELE1.8.020 and ELE1.8.030 who shall be both English and Cantonese speaking and in the Sub-contractor's full-time employment for the supervision of the Sub-contract Works to the satisfaction of the Contract Manager;
2. The Sub-contractor shall also identify Block Foremen as in ELE1.8.035;
3. Immediately after the award of the Sub-contract, the name, qualifications and curriculum vitae of the Supervising Engineer(s) and Site Supervisor(s) shall be submitted for Approval to the satisfaction of the Contract Manager;
4. None of the Supervising Engineer(s) and Site Supervisor(s) shall be removed from their respective duties without prior Approval;
5. In the event of any of them being unsatisfactory, in the opinion of the Contract Manager, or misconducting themselves, they shall be removed forthwith and be replaced by suitable substitutes to the Contract Manager's satisfaction within seven days from the Contract Manager's instruction in writing.

ELE1.8.020.9 SUPERVISING ENGINEERS

1. Unless otherwise specified, the Sub-contractor is to employ for the supervision of all works on Site, at least one qualified Supervising Engineer. The Supervising Engineer shall generally represent the Sub-contractor in all respects of the Sub-contract and assume the following duties:
    a. Coordinate and supervise the work in the Sub-contractor's office and the Site;
    b. Develop, in conjunction with the Main Contractor, schedules of installation drawings, builder's work drawings, material submission and delivery, statutory submissions, the programme of works and testing and commissioning programme, for approval by the CM;
    c. Liaison with the CM and other parties;
    d. Attend at the office of the CM for the finalisation of drawings and equipment selection;
    e. Attend progress meetings and coordination meetings;
    f. Monitor and supervise installation drawings submission, builder's work drawings submission, material submission and delivery, statutory submissions in accordance with the respective submission schedules. Submit progress reports to the CM monthly or at shorter intervals when such requested by the CM;
    g. Check and confirm the installation drawings, builder's work drawings and material submissions are suitable for the installation works and in compliance with the requirements of the Sub-contract;
    h. Examine, verify and confirm in writing to the CM on a monthly basis that the material delivered to the Site under the Sub-contract has been approved by the CM;
    i. Certify all material delivery vouchers in accordance with PRE.B12.280 of the Main Contract;

j. Prepare, in conjunction with the Main contractor, the delivery method statements for delivery of plant and equipment;

k. Undertake all site test and commissioning of the Sub-contract Works and endorse the test and commissioning reports to confirm that he is satisfied with the completeness, workmanship and performance of the installations which comply fully with the Sub-contract requirements, prior to submission to the CM.

2. Qualification requirements:

   At least one year of proven post qualification at supervisory level on electrical installations in buildings with the following qualification:

   a. Registered Professional Engineer (Electrical or BS Discipline) under the Engineers Registration Ordinance; or

   b. Member of the Hong Kong Institution of Engineers (Electrical or BS Discipline) elected after 5 December 1975; or

   c. Member (Electrical or BS Discipline) of an overseas engineering institution which has signed agreements for the mutual recognition of qualifications with the Hong Kong Institution of Engineers.

3. The Supervising Engineer(s) shall be highly competent and experienced, and shall be given a high level of delegated authority such that they can take decisions, including those involving expenditure.

ELE1.8.030.9 SITE SUPERVISORS

1. Unless otherwise specified, the Sub-contractor is to employ at least one qualified Site Supervisor. The Site Supervisor(s) shall be stationed on site;

2. Qualifications requirements:

   Registered Electrical Worker Grade B(2) or above registered under the Electricity Ordinance.

ELE1.8.035.9 BLOCK FOREMEN

The Sub-contractor is to identify from time to time one Block Foreman per block who shall be answerable to the Contract Manager for the quality and progress of works for the block. The Block Foreman shall be stationed on Site. This Block Foreman and the Site Supervisor shall not be the same person.

ELE1.8.040.9 BUILDING SERVICES PERFORMANCE ASSESSMENT SCORING SYSTEM

1. The Housing Authority has adopted a Building Services Performance Assessment Scoring System (BSPASS) to assess the performance of building services Nominated Sub-contractors undertaking works for the Authority;

2. BSPASS will be operated in this Sub-contract and assessments by Building Services PASS Assessment Team (BSPAT) or other staff of the HA will be conducted at quarterly intervals or other intervals as required by the Contract Manager;

3. Upon the Contract Manager's notification, the Sub-contractor's authorised representative shall attend all such assessments;

4. The Sub-contractor shall provide all necessary attendance, and all necessary measuring instruments, in addition to those specified in PRE.BS1.630, etc. to facilitate the BSPASS assessment as stipulated in the relevant BSPASS manuals;

5. In addition, the Sub-contractor shall also provide labours for the opening up and re-fixing of the works, the operation of the equipment and the testing, etc. as required by the assessment.

ELE1.8.050.9 COORDINATION WITH MAIN CONTRACTOR ON INTENDED CONSTRUCTION METHOD FOR INTERNAL PARTITION WALLS (PANEL WALLS) IN DOMESTIC FLATS, PRECAST CONCRETE WALL & PRECAST FACADE PANEL

The internal partition walls (panel walls) in the domestic flats, precast concrete walls and the precast facade panel are of prefabricated panel wall construction. The Sub-contractor shall coordinate with the Main Contractor on their intended panel wall construction method and makes necessary allowance for the conduit installation work. The provision and installation of GI / PVC conduits and conduit fittings on internal partition walls (panel walls), precast concrete walls and precast facade panel should be carried out by Main Contractor and the proposed installation details are shown on Drawings. The Sub-contractor should ensure that all the conduit systems are in compliance with the Specification & Drawings.

ELE1.8.060.9 MODIFICATION WORKS IN NON-DOMESTIC PREMISES DURING MAINTENANCE PERIOD

1. During the Maintenance Period, the Employer may employ other workmen or contractors to carry out modification works pertaining to the installation to suit the fitting out works of the tenants;
2. The Sub-contractor shall provide the necessary attendance, including operation of the installation, as instructed by the Contract Manager to facilitate such modification works;
3. The costs of the attendance will be determined by a fair valuation made by the Contract Manager in conjunction with the Sub-contractor and paid for separately;
4. The employment of other workmen or contractors by the Employer for the modification of the installation shall not in any way relieve the Sub-contractor of his responsibilities for the maintenance and defects of the Works, other than those parts which have been modified by others, in accordance with the Contract.

ELE1.8.070.9 NOTICES AND FEES

The Sub-contractor shall comply with the regulations and requirements of all relevant Authorities such as Fire Services Department, the Building Authority, the Telecommunications Authority, the Electrical and Mechanical Services Department, Utility Companies, etc and shall be responsible for giving notifications to the appropriate Authorities and for paying all fees levied; such fees shall be included in the Tender Price, and also for collecting all necessary certificates and licenses for the installation.

ELE1.9 SITE SECURITY

ELE1.9.010.9 SUB-CONTRACTOR'S STORE ROOMS

1. In addition to the storage shed to be constructed by the Main Contractor as required under PRE.BS1.380 of the Preliminaries for Building Services Sub-contracts, the Main Contractor will also hand over to the Sub-contractor the switchroom of each building six months after the concreting of the structural frame and ceiling slab of the respective main switchroom, or four months before the completion of each building, whichever is the earlier;
2. The Sub-contractor may make use of the rooms for storage of materials, subject to the progress of the Works not being affected. The Sub-contractor shall make available to the Contractor the builder's work drawings and programme in good time to enable the Contractor to complete his works necessary for the handover of the rooms;
3. Immediately after the handover of the rooms, the Sub-contractor shall lock the doors with a good quality padlock. The padlock shall have proven reliability and in-service records for the Housing Authority projects. The Sub-contractor shall also provide and maintain in good operating conditions a burglar alarm system as specified in ELE1.9.020;
4. The Sub-contractor shall remove the padlocks and burglar alarm system upon completion of the respective building and upon Approval by the Contract Manager.

ELE1.9.020.9 BURGLAR ALARM SYSTEM FOR SUB-CONTRACTOR'S STORE ROOMS

The Sub-contractor shall provide the following whole burglar alarm system for each Electrical Sub-contractor's store room during the period as specified in ELE1.9.010:

1. System description

   The system shall consist of:

   a. Volumetric motion detector;

   b. Magnetic door contacts;

   c. Burglar alarm panel;

   d. Self activated bell;

   e. Dedicated-line remote alarm transmission circuit.

2. Volumetric motion detector

   a. Volumetric detectors used shall make use of dual technology, including passive infra red and microwave/ultrasonic wave, such that the possibility of false alarm will be reduced to the minimum;

   b. There shall be at least one detector installed facing each cable trench or any other weak points or openings.

3. Magnetic door contact

   Surface-mounted magnetic door contacts shall be installed on the inner door frame. It will be used to detect door open.

4. Control panel

The control panel shall be installed inside the protected room. It shall be powered by AC mains and backed up by stand-by battery sufficient for 8 hours. The control panel shall have real time clock display and alarm latching display. The panel shall be able to be armed or disarmed by mechanical key or by keying in secret code via the panel keypad. The panel shall also be built-in with entry and exit delay timer, such that the timer will be triggered by the entry, exit route sensors.

5. Alarm annunciator

   a. Self-activated alarm bell shall be installed on outstanding location on the outer wall of the protected room. The bell shall be housed in strong steel housing with anti-corrosion finishing and are tamper protect against removal of the lid, the bolt or attempted removal of the housing from the wall. The bell shall be self-powered by rechargeable battery. If input circuit is cut off, it shall give out annunciation. Upon activation it shall give out alarm sound level not less than 100 db at 1 metre distance. There shall also be a strobe light on the bell to provide visual warning;

   b. A cut off timer adjustable from 1 minute to 15 minutes shall be provided. Should the bell ring for the pre-set period, it shall be cut off by the timer. However, the strobe light shall remain flashing. Should the built-in battery voltage goes below the threshold limit, the bell shall give intermittent audio and visual warning to signify the need for battery replacement.

6. Dedicated line remote alarm transmission

   a. Alarm signal shall be transmitted to a remote central station. The signal shall be transmitted through dedicated lease-line. The alarm transmission line shall also be supervised, such that communication failure can be detected from the central station;

   b. The transmitter used shall have identity signals sent back to the central station such that compromising by direct swapping of transmitter shall not be possible. Communication data shall also be encrypted to deter compromising;

   c. The alarm signal shall be terminated in the central station which shall be manned by at least 2 persons any time. The central station shall enforce stringent security measures and meeting BS 5979 is preferred. The central station shall be operated by a well established and reputable security service company, the name of which shall be submitted to the Contract Manager for Approval;

   d. In the central station, there shall be records of telephone numbers of site guard post and keyholders. Should there by any alarm received by the central station, its operator shall call site guard and the keyholder. Upon notification, the keyholder shall return to the protected premises to investigate and reset the control panel. Should there be any suspected theft or burglary, the operator shall call the police. All telephone conversations with central station must be recorded and kept for at least 30 days for later reference.

7. Operating cost

   All operating costs for the burglar alarm system, including the rental charges for the lease-line, the charges for the remote central station etc. shall be borne by the Sub-contractor.

ELE1.9.030.9 MARKING OF RESIDUAL CURRENT CIRCUIT BREAKERS (RCCB)

The name of the estate and the phase number (e.g. LOK FU 5), or the suitable description of the contract, shall be indelibly marked on an external surface of the enclosure of the RCCB in capital letters of not less than 3 mm high. The marking shall not affect the appearance and performance of the RCCB. A sample of the marked RCCB shall be submitted to the Contract Manager for Approval prior to installation.

ELE1.10 RECORD DOCUMENTATION

ELE1.10.010.9 REQUIREMENTS FOR SUB-CONTRACTOR'S DRAWINGS

1. Size of drawings

   Drawings submitted by the Sub-contractor shall be of a standard size from A0 to A4 in accordance with BS EN ISO 5457. "As-fitted" drawings shall be of A0 or A1 size only.

2. Installation drawings

   The Installation Drawings shall detail and dimension the following, where relevant and also read in conjunction with Preliminaries for Building Services Sub-contracts:

   a. Site distribution, cable and busduct routes;

   b. General layout drawings giving accurate and dimensioned locations of all plant and equipment included in the Sub-contract;

   c. Schematic diagrams for main and sub-main distribution;

   d. Main switchboard details, including schematic diagram, component layout, busbar arrangement, compartmentation, conductor sizes, cabling arrangement, termination details, control diagram;

   e. Details of distribution boards and consumer units, including types and rating of protective devices, sizes and types of incoming and outgoing cables, circuit description;

   f. Busduct installation details showing connections, mounting details and setting out of all components including straight runs elbows, offsets, tap-off units, etc.;

   g. Prefabricated Branch Cables installation details showing connections, mounting details and setting out of all components including straight runs elbows, offsets, tap-off units, etc.;

   h. Lighting layouts for normal and emergency fittings, detailing positions, mounting methods, types of luminaires, switch positions and wiring connections;

   i. Conduit routes with conduit sizes, showing adaptable boxes, details of cables and circuit references (see ELE1.10.020);

   j. Trunking and cable tray routes with details of sizes, fixings, cables carried;

   k. Generator installation details, showing plant layout and sections, exhaust pipe details, fuel system details, acoustic treatment, control equipment;

   l. Earthing and equipotential bonding system with details of conductor sizes and routing, bonding arrangement;

   m. Lightning protection system with details of air terminations, down conductors and bonding;

   n. CABD, Security, CCTV, EAS, PA and carpark control systems, whichever included in the Sub-contract, with schematics, equipment details, cable routes, termination details, fixing details, etc.;

   o. Label schedules, showing wording and formats for the labelling of equipment and distribution board circuits;

   Operating and maintenance clearances for the equipment and their static and dynamic structural loading shall be shown on the installation drawings wherever necessary.

3. "As-fitted" drawings

   The "as-fitted" drawings shall be based on the full set of Approved Installation Drawings updated to show the actual positions and arrangement of all items installed. Any additional drawings which are considered necessary by the Contract Manager for showing the complete installation shall be included. The Drawings shall be drawn in black-ink lines on transparent linen or other Approved materials, suitable for reproduction of prints.

ELE1.10.020.9 CONDUIT RUN DRAWINGS

The Sub-contractor shall submit detailed conduit layout drawings for Approval prior to commencement of the installation. The Sub-contractor shall supply to the Contract Manager eight (8) sets of conduit run drawings after Approval.

ELE1.10.030.9 WORKING DRAWINGS AND AS-FITTED DRAWINGS

1. The Sub-contractor's attention is drawn to Preliminaries for Building Services Sub-contracts for installation drawings and ELE1.10.020 above;
2. Schematic wiring diagrams for the electrical installation of each building shall be provided and fixed properly to the satisfaction of the Contract Manager, in the locations hereunder. The diagrams shall be of A1 size minimum and each diagram shall be treated with acrylic varnish to prevent deterioration and mounted in an anodised aluminium frame with transparent plastic front plate of 3 mm minimum thickness and wooden backing board of 5 mm minimum thickness;

System	Location of diagram
Electrical power distribution and associated systems	Main switchroom and near other main switches as required in compliance with the Electrical CoP
Security system	Meter room accommodating the main control equipment
Public address system	Adjacent to the main system amplifier

3. The complete set of as-fitted drawings shall consist of each of the drawings, which shall include but not be limited to the following:
   a. Site plan and underground cable route of telecommunication lines, supply company cables, road lighting layout plan;
   b. Schematic wiring diagrams;
   c. Electrical floor layout plans;
   d. Typical domestic flat layout plans;
   e. Schematic wiring diagram of public lighting;
   f. Public lighting layout plans;
   g. External lighting layout plans;
   h. Transformer room, main switch room and meter room layout plans;
   i. Installation details - lateral main, trunking and mounting methods;
   j. Lightning protection system;
   k. Schematic diagram for doorphone system;
   l. Control block diagram for doorphone system;

m. Security system – schematic diagram for all sub-systems (showing the type of integrated circuits transistors, diodes and other semiconductor devices, voltage rating and values of all passive components etc), one to one scale printed board layout and the arrangement of components on the circuit boards;

n. CCTV installation layout plan;

o. Security alarm installation;

p. Public address system;

q. CABD system - site layout plan (showing antenna position and direction) and signal field strength.

ELE1.10.040.9 DOCUMENTS AND TECHNICAL LITERATURE TO BE SUBMITTED AFTER COMPLETION

The Sub-contractor shall submit the following documents and technical literature to the Contract Manager for the whole installation and equipment provided under this Sub-contract which shall include, but not be limited to the following:

1. User manual consisting of:

   a. Information (catalogue, manual, instruction etc.) on special precautions/procedures/methods required on the use, operation, cleaning, servicing, maintenance, repair and replacement of all proprietary material and equipment installed such as air circuit breaker(s)/moulded case circuit breaker(s) including protection and instrumentation devices, lighting fittings, amplifiers and cameras. Requirements on proper use and operation for durability, safety and statutory consideration shall be clearly stated;

   b. A list of recommended spare parts;

   c. Testing and commissioning reports on the system and equipment installed (electronic copy in PDF format stored on recordable compact disc shall be provided in addition to hard copies).

2. Original certificate of warranty for any material, equipment and installation with warranty period last beyond Maintenance Period; and

3. Other items as required by the Contract Manager.

For public address system, apart from the documents stipulated above, three sets of operation and maintenance manuals with detailed circuit diagrams and descriptions shall be submitted to the Contract Manager one month before the commissioning of the installation.

ELE2 SYSTEM REQUIREMENTS

ELE2.1 DOMESTIC BLOCKS 4

ELE2.1.1 APPLICATION 4
ELE2.1.1.010.9 BLOCKS 4
ELE2.1.1.020.9 REFERENCE DOCUMENTS 4

ELE2.1.2 MAINS SUPPLY 4
ELE2.1.2.010.9 PROVISION BY SUPPLY COMPANY 4
ELE2.1.2.020.9 ATTENDANCE BY SUB-CONTRACTOR 4

ELE2.1.3 MAIN CUBICLE SWITCHBOARD 4
ELE2.1.3.010.9 PROVISION OF DETAILS 4
ELE2.1.3.020.9 INSTALLATION OF SUPPLY COMPANY'S ELECTRICITY METERS 4
ELE2.1.3.030.9 OFF-SITE INSPECTION 5
ELE2.1.3.040.9 TESTS 5
ELE2.1.3.050.9 SUPPLY FEEDING FROM HEC 5
ELE2.1.3.060.9 POWER FACTOR CORRECTION EQUIPMENT 5
ELE2.1.3.070.9 PAINTING SWITCHGEAR 5

ELE2.1.4 RISING MAINS AND SUB-MAINS DISTRIBUTION SYSTEMS . 5
ELE2.1.4.010.9 SCOPE OF WORK 5
ELE2.1.4.020.9 BUSBAR/PRE-FABRICATED BRANCH CABLE RISING MAINS 5
ELE2.1.4.030.9 BUSBAR/PRE-FABRICATED BRANCH CABLE RISERS 6
ELE2.1.4.040.9 FIXING ARMOURED CABLES 6
ELE2.1.4.050.9 PAINTING SWITCHGEAR 6

ELE2.1.5 BRANCH-OFF CIRCUITS FROM RISING MAINS 6
ELE2.1.5.010.9 SCOPE OF WORK 6

ELE2.1.6 RADIAL MAINS TO DOMESTIC UNITS 6
ELE2.1.6.010.9 THE INSTALLATION 6
ELE2.1.6.020.9 METER CONNECTION AND ENERGISATION FOR DOMESTIC FLATS 7

ELE2.1.7 INSTALLATION FOR DOMESTIC UNITS IN RENTAL BLOCKS 7
ELE2.1.7.010.9 SCOPE OF INSTALLATION 7
ELE2.1.7.020.9 WIRING SYSTEM 8
ELE2.1.7.050.9 ACCESSORIES 8
ELE2.1.7.060.9 CONSUMER UNIT 8
ELE2.1.7.070.A CONDUIT FOR COMMUNICATIONS INSTALLATIONS 8
ELE2.1.7.080.9 EQUIPOTENTIAL BONDING - GENERAL 8
ELE2.1.7.085.9 MAIN EQUIPOTENTIAL BONDING 8
ELE2.1.7.090.9 LOCAL SUPPLEMENTARY BONDING 9

ELE2.1.12 PUBLIC LIGHTING AND POWER 10
ELE2.1.12.010.9 SCOPE OF INSTALLATION 10
ELE2.1.12.020.9 ESSENTIAL LIGHTING 10
ELE2.1.12.030.A LIGHTING CONTROLS 10
ELE2.1.12.050.9 EXIT SIGNS 10
ELE2.1.12.060.9 MCB UNIT 11

ELE2.1.13 LIFT SUPPLY 11
ELE2.1.13.010.9 SCOPE OF INSTALLATION 11
ELE2.1.13.020.9 INSTALLATION CABLES 11
ELE2.1.13.030.9 CONDUIT FOR LIFT ALARM BELLS 11
ELE2.1.13.040.9 TRIPPING OF POWER CIRCUITS FOR AFTER HOMING 11

ELE2.1.14 PUMP SUPPLY 11
ELE2.1.14.010.9 SCOPE OF INSTALLATION 11
ELE2.1.14.020.9 FACILITIES PROVIDED BY OTHERS 11

ELE2.1.14.030.9 INSTALLATION OF CABLES 12
ELE2.1.14.040.9 CONDUIT FOR PUMP SUPPLY 12

ELE2.1.15 PUMP, LIFT MACHINE, GENERATOR ROOMS, REFUSE STORAGE & MATERIAL RECOVERY CHAMBERS, REFUSE STORAGE & MATERIAL RECOVERY ROOMS AND REFUSE COLLECTION POINT/JUNK COLLECTION POINT 12
ELE2.1.15.010.9 SCOPE OF INSTALLATION 12
ELE2.1.15.025.9 SCOPE AND REQUIREMENTS OF MECHANICAL VENTILATION SYSTEM 12
ELE2.1.15.030.9 EXECUTION OF WORK FOR MECHANICAL VENTILATION SYSTEM 13
ELE2.1.15.040.9 EXTRACTION SYSTEM FOR VEHICLE EXHAUST 13
ELE2.1.15.050.9 FILTERS FOR MECHANICAL VENTILATION SYSTEM 13

ELE2.1.16 TRANSFORMER ROOMS/H.V. SWITCH ROOMS 13
ELE2.1.16.010.9 SCOPE OF INSTALLATION FOR POWER SUPPLY FROM CLP 13
ELE2.1.16.015.9 SCOPE OF INSTALLATION FOR POWER SUPPLY FROM HEC 13
ELE2.1.16.020.9 SUPPLY 13
ELE2.1.16.030.9 FANS FOR CLP TRANSFORMER ROOM 13
ELE2.1.16.035.9 FANS FOR HEC TRANSFORMER ROOM 13
ELE2.1.16.040.9 AIR TRUNKING 13
ELE2.1.16.050.9 EQUIPOTENTIAL BONDING 14

ELE2.1.17 PROVISION FOR FIXED TELECOMMUNICATION NETWORK SYSTEM (FTNS) INSTALLATION 14
ELE2.1.17.010.9 CONDUIT AND TRUNKING 14
ELE2.1.17.020.9 EARTHING 14
ELE2.1.17.030.9 LIGHTING IN TBE ROOMS 14
ELE2.1.17.040.9 TBE ROOM SUPPLY 14

ELE2.1.18 PROVISION FOR SECURITY SYSTEM (SE) INSTALLATION 14
ELE2.1.18.010.9 PROVISION OF SYSTEM / INSTALLATION 14
ELE2.1.18.020.9 PROVISION OF POWER SUPPLY AND CONDUIT 15

ELE2.1.19 PROVISION FOR COMMUNAL AERIAL BROADCASTING DISTRIBUTION (CABD) INSTALLATION 15
ELE2.1.19.010.A CONDUIT AND TRUNKING 15
ELE2.1.19.020.X DELETED 15

ELE2.1.20 EARTHING AND FAULT PROTECTION 15
ELE2.1.20.010.9 GENERAL 15
ELE2.1.20.020.9 EARTHING TERMINALS 15
ELE2.1.20.030.9 EARTH ELECTRODE 15
ELE2.1.20.040.9 EARTHING SYSTEM FOR TBE ROOM 16
ELE2.1.20.050.9 CIRCUIT PROTECTIVE CONDUCTOR 16
ELE2.1.20.060.9 EQUIPOTENTIAL BONDING FOR EXTRANEOUS CONDUCTIVE PARTS IN COMMUNAL AREA OF BUILDING 16

ELE2.1.21 LIGHTNING PROTECTION SYSTEM 16
ELE2.1.21.010.9 STANDARD 16
ELE2.1.21.020.9 CONSTRUCTION 16
ELE2.1.21.030.9 EQUIPOTENTIAL BONDING 17
ELE2.1.21.040.9 RESISTANCE 17

ELE2.1.22 STANDBY DIESEL GENERATING SET(S) 17
ELE2.1.22.010.9 APPLICATION 17

ELE2.1.23 PROVISION FOR TOWNGAS AUTOMATIC METER READING (AMR) SYSTEM INSTALLATION 17
ELE2.1.23.010.9 CONDUIT AND TRUNKING 17

ELE2.1.24 COMMUNAL AERIAL BROADCAST DISTRIBUTION SYSTEM 17
ELE2.1.24.010.9 PROVISION OF SYSTEM / INSTALLATION....17
ELE2.1.24.020.9 SPECIAL REQUIREMENTS....17
ELE2.1.25 PUBLIC ADDRESS SYSTEM....17
ELE2.1.25.010.9 PROVISION OF SYSTEM / INSTALLATION....17
ELE2.1.26 SMART METER MONITORING AND ENERGY INFORMATION DISPLAY SYSTEM....18
ELE2.1.26.010.9 SCOPE OF INSTALLATION....18
ELE2.1.27 AUTOMATIC METER READING (AMR) OUTSTATION FOR WATER SUPPLIES 18
ELE2.1.27.010.9 PROVISION OF SYSTEM / INSTALLATION....18
ELE2.1.27.020.9 CONDUIT AND TRUNKING....18
ELE2.2 EXTERNAL PUBLIC LIGHTING....19
ELE2.2.010.9 SCOPE....19
ELE2.2.020.9 INSTALLATION....19
ELE2.2.030.9 SWITCH CONTROL....19
ELE2.2.040.9 FLOODLIGHTING FITTINGS....19

ELE2.1 DOMESTIC BLOCKS

ELE2.1.1 APPLICATION

ELE2.1.1.010.9 BLOCKS

ELE2.1 applies to the domestic blocks covered by this Sub-contract unless otherwise specified in Project Specific Specification or Drawings.

ELE2.1.1.020.9 REFERENCE DOCUMENTS

The Sub-contractor shall provide the whole of the electrical installation in each of the blocks/buildings as detailed on the Drawings and in this Specification including Project Specific Specification. This section of the Specification should be read in conjunction with other Worksections.

ELE2.1.2 MAINS SUPPLY

ELE2.1.2.010.9 PROVISION BY SUPPLY COMPANY

1. The Supply Company will provide an independent 380V, 3-phase, 4-wire, TT system supply to each block/building;
2. The Sub-contractor shall provide durable labels at the main incoming circuit breakers and along the risers at all floor levels to indicate the source transformers as per the power supply company's requirements and as otherwise specified in Project Specific Specification.

ELE2.1.2.020.9 ATTENDANCE BY SUB-CONTRACTOR

The Sub-contractor shall provide all necessary attendance, complete with all necessary work, and enforce all safety measures required for the connection of supply.

ELE2.1.3 MAIN CUBICLE SWITCHBOARD

ELE2.1.3.010.9 PROVISION OF DETAILS

The main cubicle switchboard shall be provided as shown on the Drawings. The Sub-contractor shall submit a set of detailed installation drawings showing the proposed layout, positioning and construction of the cubicle switchboard for Approval prior to assembly. The proposal shall take into account the actual site conditions and Supply Company's requirements with regard to incoming supply termination, clearance space for installation, operation and maintenance, incoming cable/bars and outgoing cable routing, supporting framework, etc.

ELE2.1.3.020.9 INSTALLATION OF SUPPLY COMPANY'S ELECTRICITY METERS

The Sub-contractor shall apply, collect and install the Supply Company's electricity meters, and liaise with the Supply Company to ensure that the provisions for termination of the incoming supply cables/busbars and installation of the electricity meters are suitable and meet the Supply Company's requirements.

ELE2.1.3.030.9 OFF-SITE INSPECTION

Inspection of the cubicle switchboard may be carried out by the Contract Manager or his representative at the manufacturer's works during the construction stage.

ELE2.1.3.040.9 TESTS

Tests shall be carried out by the Sub-contractor upon completion in the presence of the Contract Manager or his representative prior to acceptance and delivery to Site.

ELE2.1.3.050.9 SUPPLY FEEDING FROM HEC

1. Unless otherwise specified on Drawings, the Sub-contractor shall supply and install the LV transit blocks and single cores XLPE/PVCI/PVCS power supply cables connecting to the incoming air circuit breakers;
2. For design using busbar trunking system, the Sub-contractor shall supply and install the LV transit blocks and busbar trunking system connecting to the incoming air circuit breakers;
3. The busbar trunking system shall comply with IEC 61439-1 and shall be assembled by the same manufacturer of the main cubicle switchboard;
4. The copper busbars shall be of 2500A TP and full neutral and housed in an enclosure of IP 31. The system and its installation details shall be submitted for Approval prior to installation.

ELE2.1.3.060.9 POWER FACTOR CORRECTION EQUIPMENT

1. When power factor correction equipment is required, a separate floor-standing cubicle housing the power factor correction capacitor bank and the associated equipment shall be provided within the main switch room as shown on the Drawings;
2. The power factor correction cubicle shall be manufactured/assembled by the same manufacturer of the main cubicle switchboard;
3. The Sub-contractor shall submit a set of detailed installation drawings showing the proposed layout, positioning and construction of the power factor correction cubicle for Approval prior to assembly.

ELE2.1.3.070.9 PAINTING SWITCHGEAR

All the switchgears fed from essential supply circuitry shall be painted in red.

ELE2.1.4 RISING MAINS AND SUB-MAINS DISTRIBUTION SYSTEMS

ELE2.1.4.010.9 SCOPE OF WORK

The Sub-contractor shall supply, install and connect rising mains and sub-mains distribution systems comprising cables, busbar/pre-fabricated branch cable risers, conduit and accessories, MCB distribution boards, busbar chambers, etc as shown on the Drawings and otherwise as specified in Project Specific Specification.

ELE2.1.4.020.9 BUSBAR/PRE-FABRICATED BRANCH CABLE RISING MAINS

The busbar/pre-fabricated branch cable rising mains shall be manufactured and designed for the particular job with all purpose-made fittings and accessories.

ELE2.1.4.030.9 BUSBAR/PRE-FABRICATED BRANCH CABLE RISERS

1. The Sub-contractor shall submit the manufacturer's drawings showing the details of the busbar/pre-fabricated branch cable risers to the Contract Manager or his representative for Approval prior to manufacture;
2. The busbar risers shall be securely fixed on the surface of the wall and shall be straight from the bottom to the top;
3. When the gap between a riser and wall is considerable due to uneven plastering or concrete at fixing point, the Sub-contractor shall install suitable packing or Approved galvanized steel brackets to which the trunking shall be fixed;
4. The minimum distance between the trunking case and the wall shall be 25 mm.

ELE2.1.4.040.9 FIXING ARMOURED CABLES

All armoured cables run on walls shall be fixed by cable cleats of the following types:

Cable Diameter (mm)	Type of Cable Cleat
dia. ≤ 50	1-bolt Fixing Type
dia. > 50	2-bolt Fixing Type

Also, the cables shall be fixed on wall by means of angle iron support or metal framework depending on actual site conditions.

ELE2.1.4.050.9 PAINTING SWITCHGEAR

All the switchgears fed from essential supply circuitry shall be painted in red.

ELE2.1.5 BRANCH-OFF CIRCUITS FROM RISING MAINS

ELE2.1.5.010.9 SCOPE OF WORK

The Sub-contractor shall supply, install and connect the TP & N branch-off circuits from the busbar/pre-fabricated branch cable rising mains comprising cables, TP & N fuse combination unit and MCB distribution board etc. in the meter rooms of each domestic floor and at other locations as shown on the Drawings and otherwise as specified in Project Specific Specification.

ELE2.1.6 RADIAL MAINS TO DOMESTIC UNITS

ELE2.1.6.010.9 THE INSTALLATION

1. The mains supply to each domestic unit on one floor shall be fed from the appropriate MCB distribution board in the meter room on the same floor or the other floor as shown on the Drawings;
2. Each circuit commencing from the respective double pole MCB shall be fed via the Supply Company's electricity meter to each individual domestic unit by PVC insulated cable in a cable containment system such as surface steel conduit/PVC conduit/trunking system as shown on the Drawings inside the meter room(s), and in concealed PVC conduit system from the meter room(s) to the consumer unit in each domestic unit;
3. The meter board for the installation of Supply Company's meter shall be provided and installed by the Sub-contractor;

4. The Supply Company's meters will be supplied and installed on the meter board in Meter Rooms at each floor by the Supply Company as shown on the Drawings. The Sub-contractor shall be responsible for providing connection and fixing facilities, at the position and ready for installing Supply Company's meter. The Sub-contractor shall check and ensure everything of the circuit is in an orderly manner before meter connection by the Supply Company.

ELE2.1.6.020.9 METER CONNECTION AND ENERGISATION FOR DOMESTIC FLATS

1. Before the installation and connection of the meters by Supply Company for the flats, the Sub-contractor shall switch off all the control switches i.e. the DP MCBs in the meter rooms and shall insulate properly any exposed conductors of the meter tails to the satisfaction of the Contract Manager;

2. The Sub-contractor shall also switch off all the main switches of consumer units in the flats and provide, next to each main switch, a temporary label/notice, in English and Chinese, as follows

   "Danger : Do not switch on the main switch unless the meter is connected and the electricity supply to this flat is ready. (Please check with the Management Office for the readiness of supply)."

   危險 : 在本單位電錶安裝和電源接駁妥當前切勿閉合(開)電源總掣 (有關電錶 / 電源接駁時間，請與管理處聯絡)

   The label/notice shall be legible and reasonably durable. Sample shall be submitted for Approval.

3. The Supply Company, before connecting the meters, will inspect and test the installation of the flats. The Sub-contractor shall provide all necessary attendance for such inspection and testing carried out within the Maintenance Period and shall pay all fees levied on retesting;

4. The Sub-contractor shall be responsible for switching on the supply circuits to individual flats subsequent to the installation of meters by the Supply Company. Immediately before switching on the supply to each flat, the Sub-contractor shall check to ensure that the switching will not cause any danger to other persons and the installation;

5. The Sub-contractor shall liaise with the Supply Co. and the Management Office for programming the meter connection and the switching operation before and within the Maintenance Period. The Sub-contractor shall complete the switching operation within 12 hours after collecting the daily return from the Management Office for those flats with the meter connected or upon notification by the Management Office. After the switching, the Sub-contractor shall return the record of flats energised to the Management Office immediately.

ELE2.1.7 INSTALLATION FOR DOMESTIC UNITS IN RENTAL BLOCKS

ELE2.1.7.010.9 SCOPE OF INSTALLATION

Each installation shall comprise a door bell and push, 13A 3-pin single and twin sockets, 20A DP switches, connection units, lampholders, lighting switches etc, to complete as shown on the Drawings and otherwise as specified in Project Specific Specification.

ELE2.1.7.020.9 WIRING SYSTEM

The Sub-contractor shall supply, install and connect a concealed PVC conduit wiring system for lighting and power points in each domestic unit, commencing from the surface mounted consumer unit as shown on the Drawings.

ELE2.1.7.050.9 ACCESSORIES

1. All electrical accessories shall be of flush type;
2. Inscription is not required on front plate of control switches feeding fixed electrical appliances in domestic blocks;
3. The door bell shall operate at extra-low voltage, comprising double wound transformer, bell and push etc. Sample of the door bell shall be submitted for Approval prior to ordering of material.

ELE2.1.7.060.9 CONSUMER UNIT

1. A plastic label to indicate the on and off of the main switch and the function of each MCB and spare way shall be provided in accordance with Worksection ELE28.1;
2. The range of instantaneous tripping current for MCB for the A/C unit shall be in accordance with IEC 60898-1 or BS EN 60898-1 - type C tripping characteristics;
3. The range of instantaneous tripping current for MCB for lighting and power shall be in accordance with IEC 60898-1 or BS EN 60898-1 – type B tripping characteristics;
4. The earthing terminal of the consumer unit shall be connected by protective conductor of adequate size PVC insulated cable as shown on the Drawings to the proper earthing terminal of the incoming supply system.

ELE2.1.7.070.A CONDUIT FOR COMMUNICATIONS INSTALLATIONS

1. A concealed PVC conduit system complete with draw wire and accessories shall be provided by the Sub-contractor for the Fixed Telecommunication Network Services (FTNS), Communal Aerial Broadcasting Distribution (CABD) installation, Towngas Automatic Meter Reading (AMR) system and security system installation as shown on the Drawings;
2. The Sub-contractor shall take the roles of coordinating other neighbouring services and determine the exact concealed conduit routes for communications installations while those given on the Drawings are for indicative and tendering purposes.

ELE2.1.7.080.9 EQUIPOTENTIAL BONDING - GENERAL

1. The Sub-contractor shall provide a system of main equipotential bonding and local supplementary bonding for all exposed and extraneous conductive parts for each domestic unit in accordance with the Electrical CoP, BS 7671, Supply Rules and ELE17;
2. The Sub-contractor shall ensure the bonding for extraneous conductive parts is sound and the result complies with the Electrical CoP and BS 7671 by proper measurement with records at good time. For those parts of equipotential bonding system found not electrical conductive, the Main Contractor and the Sub-contractor shall be responsible for rectification of their own works as early as possible.

ELE2.1.7.085.9 MAIN EQUIPOTENTIAL BONDING

The water and gas main incoming pipes inside the domestic flat shall be bonded at their point of entry to the flat to the earth terminal of the consumer unit by cables in concealed PVC conduit system and surface wires as shown on the Drawings.

ELE2.1.7.090.9 LOCAL SUPPLEMENTARY BONDING

1. Local supplementary bonding shall also be provided for the exposed metal cold/hot water pipes and/or gas pipes in the flats, when they are not connected to the main pipes by reliable metal-to-metal joints of negligible impedance. Local supplementary bonding for these pipes inside pipe duct, under sink, cooking bench or below bath tub may be by surface wiring;
2. The Sub-contractor shall provide, local supplementary bonding for the following extraneous conductive parts, which are not exhaustive in the domestic flat as shown on the Drawings:
    a. Sink/combined unit/cooking bench;
    b. Windows;
    c. Louvers;
    d. Bathroom fittings.
3. Supplementary Bonding
    a. For sink/combined unit/cooking bench
        i. The Main Contractor will provide a 1.5 mm thick stainless steel earthing lug with a 5 mm diameter hole welded to each sink/combined unit/cooking bench;
        ii. The Sub-contractor shall provide the supplementary bonding for the sink/combined unit/cooking bench by surface wiring to the earthing terminal of the nearby extraneous/exposed conductive parts or BS 4662 or IEC 60670-1 box or the nearby fused connection unit via concealed PVC conduit to the BS 4662 or IEC 60670-1 box. For the former case, the bonding conductor shall be fixed by a 4 mm diameter stainless steel screw, washer and nut to the earthing lug.
    b. For windows and louvers
        i. The Main Contractor will provide at each of the extraneous conductive parts, a 20 mm wide, 1.5 mm thick hot-dip galvanized steel earthing lug one end of which will be fixed to the extraneous conductive part by 2 nos. M4 self-tapping stainless steel screws at 60 mm c/c and the other end with a 5 mm diameter hole provided, for the termination of the bonding conductor, will be extended to the nearby BS 4662 or IEC 60670-1 box via a recess slot;
        ii. The Sub-contractor shall provide the bonding conductor which shall be fixed to the earthing lug by a 4 mm diameter stainless steel screw, washer and nut and to the earthing terminal of the nearby [BS 4662 or IEC 60670-1 box]/[lighting point or connection unit];
        iii. The recess slot will be provided and backfilled after the fixing of the earthing lug by the Main Contractor;
        iv. The Sub-contractor shall advise the Main Contractor of the location of the recess slot in conjunction with the layout of the BS 4662 or IEC 60670-1 box for equipotential bonding.
    c. For bathroom fittings
        i. The Main Contractor will provide a concealed 30 mm wide, 1.5 mm thick hot-dip galvanized steel metal strip for equipotential bonding of the extraneous conductive parts as shown on the Drawings;

ii. The Main Contractor will fix one end of the hot-dip galvanized steel metal strip to the extraneous conductive part and the other end with a 5 mm diameter hole provided, for the termination of the bonding conductor in the nearby BS 4662 or IEC 60670-1 box as shown on the Drawings;

iii. The Sub-contractor shall provide the bonding conductor which shall be fixed to the metal strip by a 4 mm diameter stainless steel screw, washer and nut and to the earthing terminal of the nearby [BS 4662 or IEC 60670-1 box]/[lighting point or connection unit];

The Sub-contractor shall advise the Main Contractor of the location of the BS 4662 or IEC 60670-1 box for equipotential bonding.

ELE2.1.12 PUBLIC LIGHTING AND POWER

ELE2.1.12.010.9 SCOPE OF INSTALLATION

The Sub-contractor shall supply, install and connect concealed PVC conduit wiring systems for the electrical installations at all public areas and plant rooms, comprising conduits and fittings, cables, lighting fittings, switches, MCB boards, sockets, etc to complete as shown on the Drawings.

ELE2.1.12.020.9 ESSENTIAL LIGHTING

Part of the public lighting is essential lighting fed from the essential supply board as shown on the Drawings.

ELE2.1.12.030.A LIGHTING CONTROLS

1. The public lighting shall be controlled by 24 hours time switches / photocells complete with metal box as shown on the Drawings;
2. A by-pass switch with “ON” and “OFF” indication shall be provided for each time switch to control the operation manually;
3. A notification label should be provided next to the by-pass switch and coloured in white with red lettering in both English and Chinese denoting,

   "ONLY AUTHORISED MAINTENANCE PERSONNEL IS PERMITTED TO OPERATE THE BYPASS SWITCH FOR EMERGENCY OPERATION.

   PLEASE ENSURE THAT THIS SWITCH IS RESUMED TO THE "OFF" POSITION AFTER USE.

   只允許授權維修人員操作此旁路掣以進行緊急操作

   請確保此掣在使用後恢復到“關閉”位置"
4. The time switch / photocell shall be submitted for Approval before installation;
5. The control of the lightings on roof is timer controlled and interconnected with the fire alarm installation and door contacts for operation as shown on the Drawings and as otherwise specified in Project Specific Specification;
6. The public lighting main switch and MCB distribution boards shall be installed in switch / meter rooms at various floors and blocks as shown on the Drawings.

ELE2.1.12.050.9 EXIT SIGNS

The Sub-contractor shall supply and install the exit signs as shown on the Drawings.

ELE2.1.12.060.9 MCB UNIT

Unless otherwise specified, the range of instantaneous tripping current for MCB unit for lighting and power circuitry shall be in accordance with IEC 60898 or BS EN 60898-1 type B tripping characteristics.

ELE2.1.13 LIFT SUPPLY

ELE2.1.13.010.9 SCOPE OF INSTALLATION

1. The Sub-contractor shall supply, install and connect lift power supply system consisting of multi-core fire resistant armoured cables, floor mounted L.V. cubicle switchboard, isolator, changeover contactor, fuse combination units, busbar chamber, MCB distribution boards, etc, as shown on the Drawings and otherwise as specified in Project Specific Specification;
2. The L.V. cubicle switchboard shall be provided as shown on the Drawings. The Sub-contractor shall submit a set of detailed installation drawings showing the proposed layout, position and construction of the cubicle switchboard for approval prior to assembly.

ELE2.1.13.020.9 INSTALLATION CABLES

The cables shall be installed with a minimum horizontal or vertical separation distance of 75 mm with other circuits.

ELE2.1.13.030.9 CONDUIT FOR LIFT ALARM BELLS

Except for surface mounted conduit which shall be of G. I. type, a system of concealed PVC conduit completed with draw wire and accessories reserved for lift alarm bells at ground floor and central lift alarm indication system shall be carried out by the Sub-contractor as shown on the Drawings.

ELE2.1.13.040.9 TRIPPING OF POWER CIRCUITS FOR AFTER HOMING

The Lift Sub-contractor shall provide a homing signal to the Sub-Contractor, in form of a pair of normally open dry contacts, for each non-fireman's lift after completion of homing. Upon receiving the homing signal, the power supply of the corresponding sub-distribution board serving the lighting and small power of that lift shall be tripped off automatically. The power supply shall resume normal after the homing signal is removed. The Sub-Contractor shall supply and install all necessary contactors and control circuits to perform the above function.

ELE2.1.14 PUMP SUPPLY

ELE2.1.14.010.9 SCOPE OF INSTALLATION

The Sub-contractor shall supply, install and connect the pump power supply system consisting of multi-core armoured cable, switchgears, busbar chambers, MCB distribution board, etc inside the fire services pump rooms, and water pump room, as shown on the Drawings and otherwise as specified in Project Specific Specification.

ELE2.1.14.020.9 FACILITIES PROVIDED BY OTHERS

All water pumps including fire pumps, starters, control panel, control wiring and accessories up to the roof tank will be provided by others.

ELE2.1.14.030.9 INSTALLATION OF CABLES

The circuit for fire pump supply shall be at a horizontal or vertical separation distance of 75 mm with other circuits.

ELE2.1.14.040.9 CONDUIT FOR PUMP SUPPLY

Except for surface mounted conduit which shall be of G. I. type, a system of concealed PVC conduits completed with draw wires and accessories, etc from the roof tanks down to the pump rooms for the pump control circuit, shall be carried out by the Sub-contractor as shown on the Drawings.

ELE2.1.15 PUMP, LIFT MACHINE, GENERATOR ROOMS, REFUSE STORAGE & MATERIAL RECOVERY CHAMBERS, REFUSE STORAGE & MATERIAL RECOVERY ROOMS AND REFUSE COLLECTION POINT/JUNK COLLECTION POINT

ELE2.1.15.010.9 SCOPE OF INSTALLATION

1. The Sub-contractor shall supply, install and connect in surface steel conduit wiring system for the electrical installation in all lift machine rooms, FS pump rooms, water pump rooms and generator rooms as shown on the Drawings and otherwise as specified in the Project Specific Specification, whereas for refuse storage & material recovery chambers, refuse storage & material recovery rooms and refuse collection point/junk collection point, concealed PVC conduit system shall be used;
2. The Sub-contractor shall supply and install mechanical ventilation systems for the refuse collection point/junk collection point, refuse storage & material recovery chambers, refuse storage & material recovery rooms, refuse chutes, pump rooms, lift machine rooms, generator rooms and other rooms all as shown on the Drawings and otherwise as specified in the Project Specific Specification and ELE31.

ELE2.1.15.025.9 SCOPE AND REQUIREMENTS OF MECHANICAL VENTILATION SYSTEM

1. The Sub-contractor shall supply, install, commission, test and maintain the mechanical ventilation systems all as shown on the Drawings and as specified in this Specification;
2. The sections in ELE31 stipulate the performance specification to be supplied and installed by the Sub-contractor and set out in general the design criteria, minimum requirements, types and standards of the relevant equipment and materials to be provided. The Sub-contractor shall be fully responsible for the comprehensive application design, manufacture, supply, installation, testing and commissioning to meet the project requirements, whether or not installation details are indicated in the Specification and / or on the Drawings;
3. The system installation shall comply with this Specification, latest edition of General Specification for Air conditioning, Refrigeration, Ventilation and Central Monitoring & Control System Installation in Government Buildings of the Hong Kong Special Administrative Region issued by Architectural Services Department, Hong Kong (hereinafter referred to as "General AC Specification") and latest edition of Code of Practice for Energy Efficiency of Building Services Installation issued by Electrical and Mechanical Services Department, Hong Kong.

ELE2.1.15.030.9 EXECUTION OF WORK FOR MECHANICAL VENTILATION SYSTEM

The Sub-contractor shall employ a registered ventilation contractor to supply, install, commission, test and maintain the complete systems and to issue ventilation certificates to the Contract Manager during the Maintenance Period where required by Building (Ventilating Systems) Regulations.

ELE2.1.15.040.9 EXTRACTION SYSTEM FOR VEHICLE EXHAUST

Extraction system for vehicle exhaust shall be provided for the refuse collection point when specified in the Project Specific Specification and shown on the Drawings.

ELE2.1.15.050.9 FILTERS FOR MECHANICAL VENTILATION SYSTEM

Outdoor air shall be filtered by washable panel filter when shown on the Drawings to improve indoor air quality and protect equipment before it enters the mechanical ventilation system.

ELE2.1.16 TRANSFORMER ROOMS/H.V. SWITCH ROOMS

ELE2.1.16.010.9 SCOPE OF INSTALLATION FOR POWER SUPPLY FROM CLP

The Sub-contractor shall supply, install and connect the electrical installation comprising surface steel conduits and accessories, cables, MCB distribution board, switches, socket-outlets, lighting fittings, cable tray, etc to complete as shown on the Drawings and otherwise as specified in the Project Specific Specification.

ELE2.1.16.015.9 SCOPE OF INSTALLATION FOR POWER SUPPLY FROM HEC

The Sub-contractor shall supply, install and connect the electrical installation comprising surface steel conduits and accessories, cable, MCB distribution board, switches, socket-outlets, lighting fittings, etc to complete as shown on the Drawings and otherwise as specified in the Project Specific Specification.

ELE2.1.16.020.9 SUPPLY

The supply to the MCB distribution board will be provided by the Supply Company.

ELE2.1.16.030.9 FANS FOR CLP TRANSFORMER ROOM

1. The exhaust fan and the temperature control panel will be provided by the Supply Company but shall be collected and installed by the Sub-contractor;
2. The mounting diaphragm and flexible connection for exhaust fan shall be supplied and installed by the Sub-contractor.

ELE2.1.16.035.9 FANS FOR HEC TRANSFORMER ROOM

1. The axial flow fan and silencer will be supplied by the Supply Company and will be installed by the Main Contractor;
2. The fan control cubicle will be supplied by the Supply Company and shall be installed by the Sub-contractor.

ELE2.1.16.040.9 AIR TRUNKING

The air trunking inside the transformer rooms/switch rooms will be provided and installed by the Main Contractor.

ELE2.1.16.050.9 EQUIPOTENTIAL BONDING

The Sub-contractor shall also provide the equipotential bonding for the air trunking, steel door, etc to the earthing terminal of the MCB distribution board as shown on the Drawings.

ELE2.1.17 PROVISION FOR FIXED TELECOMMUNICATION NETWORK SYSTEM (FTNS) INSTALLATION

ELE2.1.17.010.9 CONDUIT AND TRUNKING

Except for the surface mounted conduit which shall be of G. I. type, a system of concealed PVC conduit and steel trunking together with accessories only for fixed telecommunication network system (FTNS) installation shall be provided by the Sub-contractor as shown on the Drawings.

ELE2.1.17.020.9 EARTHING

An earthing terminal for the FTNS equipment shall be provided by the Sub-contractor at the location as shown on the Drawings.

ELE2.1.17.030.9 LIGHTING IN TBE ROOMS

The Sub-contractor shall supply and install lighting fittings and switches in TBE rooms in concealed PVC conduit system as shown on the Drawings.

ELE2.1.17.040.9 TBE ROOM SUPPLY

The Sub-contractor shall supply, install and connect power supply system for FTNS installation consisting of switchgear, MCB board, trunking and cables in TBE room as shown on the Drawings.

ELE2.1.18 PROVISION FOR SECURITY SYSTEM (SE) INSTALLATION

ELE2.1.18.010.9 PROVISION OF SYSTEM / INSTALLATION

The Sub-contractor shall supply, install and connect the SE installation as shown on the Drawings and otherwise as specified in the Project Specific Specification and ELE24.

The detail of the building to be provided with a separate security system is specified in the Project Specific Specification.

The provision of Security System, unless otherwise stated in the Project Specific Specification or the Drawings, shall consist of the following:

1. A complete doorphone system with doorphone panel in main entrance or other entrances as indicated on the Drawings for every domestic block;
2. A complete local CCTV monitoring system for lifts and entrances at every domestic block;
3. A complete local alarm and door monitoring system at every domestic block;
4. A complete central alarm and door monitoring system;
5. A complete central CCTV system for entrances and guard counter;
6. Telephone at guard counter and in Estate Office.

ELE2.1.18.020.9 PROVISION OF POWER SUPPLY AND CONDUIT

1. The Sub-contractor shall provide the power supply and surface steel conduit/trunking system inside the meter/service room for SE installation;
2. A system of concealed PVC conduit together with accessories from the meter/service rooms to the domestic units and roof shall be provided as shown on the Drawings and otherwise as specified in the Project Specific Specification.

ELE2.1.19 PROVISION FOR COMMUNAL AERIAL BROADCASTING DISTRIBUTION (CABD) INSTALLATION

ELE2.1.19.010.A CONDUIT AND TRUNKING

1. Except for surface mounted conduit which shall be of G.I. type, a system consisting of concealed PVC conduit and steel trunking together with accessories only for CABD installations shall be provided by the Sub-contractor as shown on the Drawings;
2. The Sub-contractor shall take the roles of coordinating other neighbouring services and determine the exact concealed conduit routes for communications installations while those given on the Drawings are for indicative and tendering purposes;
3. The Sub-contractor shall check and locate the exact location of the antenna in preparing the conduit run drawing from the meter / service room on the top floor to the roof and submit to the CM for Approval as this portion of conduit routing has not been shown on the Drawings;
4. The coordinated conduit layout for the entire CABD shall be submitted to the CM for approval prior to the commencement of works.

ELE2.1.19.020.X DELETED

ELE2.1.20 EARTHING AND FAULT PROTECTION

ELE2.1.20.010.9 GENERAL

This section should be read in conjunction with other Worksections relating to earthing and fault protection.

ELE2.1.20.020.9 EARTHING TERMINALS

1. An earthing terminal bonded to the reinforcement or steel piles of the building in each main switchroom will be provided by the Main Contractor as shown on the Drawings;
2. The Sub-contractor shall supervise the work and label the terminal and connect it up with copper tapes to the main earthing terminal in accordance with the Drawings;
3. The Sub-contractor shall follow Power Company Code of Practice 101 / Guide to Connection of Supply to provide bonding terminal and connection to the main earthing terminal as shown on the Drawings for bonding to the earthed point of transformer.

ELE2.1.20.030.9 EARTH ELECTRODE

The earth electrode shall be of rod electrode.

ELE2.1.20.040.9 EARTHING SYSTEM FOR TBE ROOM

In addition to earthing provided for exposed conductive parts of electrical installations in TBE room, a separate earthing system consisting of earth electrode(s), earthing conductor and earthing terminal shall be provided for telecommunication equipment as shown on the Drawings.

ELE2.1.20.050.9 CIRCUIT PROTECTIVE CONDUCTOR

1. For distribution boards supplying circuits for both sockets and fixed equipment, the Sub-contractor shall also check, in accordance with the offered equipment, and ensure that the impedance of the protective conductor between the exposed conductive parts and the point at which the protective conductor is connected to the main equipotential bonding of an installation does not exceed 50Zs/Uo ohms, where Zs is the earth fault loop impedance corresponding to a disconnection time of 5 sec. and Uo is the nominal voltage equivalent to 220V, failing which the Sub-contractor shall provide CPC with larger cross-sectional area wherever necessary;
2. For circuits supplying only fixed equipment within the equipotential zone, the earth fault loop impedance at every point of utilisation is such that disconnection occurs within 0.4 second or 5 seconds in accordance with Code 11B(b) (ii) of the Electrical CoP;
3. For circuits supplying fixed equipment outside the equipotential zone, the earth fault loop impedance at every point of utilisation is such that disconnection occurs within 0.2 second or 0.4 second in accordance with Code 11B(b) (iii) of the Electrical CoP.

ELE2.1.20.060.9 EQUIPOTENTIAL BONDING FOR EXTRANEOUS CONDUCTIVE PARTS IN COMMUNAL AREA OF BUILDING

1. Notwithstanding the provisions of the following specification on workmanship and materials for installation of cast iron piping system by Main Contractor, the Sub-contractor has the responsibility to verify that the resistance of installed cast iron pipes to main earth is not less than 45,000 Ohm even under the worst conditions (e.g. high moisture) in accordance with the Electrical CoP and if otherwise and necessary to provide the equipotential bonding in accordance with the requirements of the Electrical CoP:
    a. Use cold caulking compound for jointing of cast iron pipes and fittings in accordance with manufacturer's instruction;
    b. The pipe brackets for mounting cast iron pipe shall be lined with resilient plastic at pipe clamp;
    c. Paint cast iron pipes/fittings with at least 2 finish coats of bitumen to BS 3416 after installation.

ELE2.1.21 LIGHTNING PROTECTION SYSTEM

ELE2.1.21.010.9 STANDARD

The Sub-contractor shall supply, install and connect a lightning protection system at the roof top of Domestic Blocks as shown on the Drawings.

ELE2.1.21.020.9 CONSTRUCTION

The lightning protection system comprising aluminium tapes shall be complete with fixing saddles bonded to the structure as shown on the Drawings.

ELE2.1.21.030.9 EQUIPOTENTIAL BONDING

The Sub-contractor shall also provide equipotential bonding of the lightning protection system to the electrical system in accordance with the Electrical CoP.

ELE2.1.21.040.9 RESISTANCE

After the completion of the lightning protection system installation, the Sub-contractor shall measure the resistance of the down conductors between the air termination on roof and the structural earth terminal in the main switch room and report the measured results to the Contract Manager for checking purpose.

ELE2.1.22 STANDBY DIESEL GENERATING SET(S)

ELE2.1.22.010.9 APPLICATION

A standby diesel generating set shall be provided as an emergency supply to comply with the Fire Services Department requirements as shown on the Drawings.

ELE2.1.23 PROVISION FOR TOWNGAS AUTOMATIC METER READING (AMR) SYSTEM INSTALLATION

ELE2.1.23.010.9 CONDUIT AND TRUNKING

Except for surface mounted conduit which shall be of G.I. type, a system of consisting of concealed PVC conduit and steel trunking together with accessories for AMR system installation shall be provided as shown on the Drawings.

ELE2.1.24 COMMUNAL AERIAL BROADCAST DISTRIBUTION SYSTEM

ELE2.1.24.010.9 PROVISION OF SYSTEM / INSTALLATION

A complete communal aerial broadcast distribution system shall be provided as shown on the Drawings and otherwise as specified in the Project Specific Specification and ELE23.

ELE2.1.24.020.9 SPECIAL REQUIREMENTS

The special requirements are specified in the Project Specific Specification.

ELE2.1.25 PUBLIC ADDRESS SYSTEM

ELE2.1.25.010.9 PROVISION OF SYSTEM / INSTALLATION

Complete public address systems shall be provided as shown on the Drawings and otherwise as specified in the Project Specific Specification and ELE25.

ELE2.1.26 SMART METER MONITORING AND ENERGY INFORMATION DISPLAY SYSTEM

ELE2.1.26.010.9 SCOPE OF INSTALLATION

The Sub-contractor shall design, supply and install a smart meter monitoring and energy information display system as shown on the Drawings and as specified in ELE35. The Sub-contractor shall supply and install a central monitoring and management workstation in the security control room at the Estate Management Office for central data processing, and which shall be connected to the local energy information display system in each domestic block as specified and shown on the Drawings. The central monitoring and management workstation shall oversee the local systems in all domestic blocks.

The Sub-contractor shall supply and install local energy information display system at the ground floor main entrance lobby of each domestic block and the associated data gathering units and equipment for displaying the information as described in ELE35. The complete display system shall include a LED TV display panel, integrated stereo speakers, display interfacing units and all peripheral devices and connections as specified and shown on Drawings.

The Sub-contract shall supply and install the complete communication network and cabling system including all connection cables and all associated interfaces and accessories between the central monitoring and management station at the EMO and all associated domestic blocks.

ELE2.1.27 AUTOMATIC METER READING (AMR) OUTSTATION FOR WATER SUPPLIES

ELE2.1.27.010.9 PROVISION OF SYSTEM / INSTALLATION

The Sub-contractor shall design, supply and install AMR outstation for water supplies as shown on the Drawings and as Specification in ELE36.

ELE2.1.27.020.9 CONDUIT AND TRUNKING

Except for surface mounted conduit which shall be of G.I. type, a system consisting of concealed PVC conduit and steel trunking together with accessories for AMR outstation for water supplies shall be provided as shown on the Drawings.

ELE2.2 EXTERNAL PUBLIC LIGHTING

ELE2.2.010.9 SCOPE

The Sub-contractor shall supply, install and connect the complete external public lighting system as shown on the Drawings and otherwise as specified in the Project Specific Specification.

ELE2.2.020.9 INSTALLATION

1. Where the lighting fittings are mounted on the periphery of the block, they shall be wired in concealed conduits;
2. Power supply to each circuit of lighting fitting(s) shall be fed from MCB unit via individual residual current devices or RCBO unit;
3. The Sub-contractor shall provide all necessary fixing facilities and accessories as recommended by manufacturers for installation of external lighting fittings as shown on the Drawings;
4. Provision of ducts, excavation, concrete foundation necessary for installation of external lighting fittings and the cement/soil filling will be carried out by the Main Contractor;
5. The Sub-contractor shall coordinate with the Main Contractor and submit drawings showing details of all builder's works requirements necessary to complete installation of external public lighting to the Main Contractor for subsequent transmission to and Approval by Contract Manager.

ELE2.2.030.9 SWITCH CONTROL

The public lighting shall be controlled by 24 hours time switches/photocell as shown on the Drawings.

ELE2.2.040.9 FLOODLIGHTING FITTINGS

The Sub-contractor shall also be responsible for adjusting the mounting heights and aiming angles of the flood lighting fittings (if any) for the ball courts, playgrounds, etc. This may be carried out at night when required.

ELE3 LOW VOLTAGE SWITCHGEAR AND ASSOCIATED EQUIPMENT

ELE3.1 GENERAL 6
ELE3.1.010.9 SCOPE 6
ELE3.1.020.9 SERVICE CONDITIONS 6
ELE3.1.030.9 SHORT-CIRCUIT RATING AND CONTINUOUS CURRENT RATING 6
ELE3.1.040.9 VOLTAGE RATING 6
ELE3.1.050.9 DEGREE OF PROTECTION FOR ENCLOSURE 7
ELE3.1.060.9 MATERIALS 7
ELE3.1.070.9 ON AND OFF INDICATION 7
ELE3.1.080.9 IDENTIFICATION OF CIRCUIT 7

ELE3.2 SURFACE MOUNTED FUSE COMBINATION UNITS AND SWITCH-DISCONNECTORS 8
ELE3.2.1 GENERAL 8
ELE3.2.1.010.9 TYPE AND STANDARD 8
ELE3.2.1.020.9 ARRANGEMENT 8
ELE3.2.1.030.9 CLASS AND RATING 8
ELE3.2.1.040.9 IN-SERVICE RECORDS 8
ELE3.2.2 TYPE-TEST 9
ELE3.2.2.010.9 TEST STANDARDS 9
ELE3.2.2.020.9 TYPE-TESTING 9
ELE3.2.3 CONSTRUCTION AND DESIGN 9
ELE3.2.3.010.9 TYPE 9
ELE3.2.3.020.9 CURRENT RATINGS ABOVE 100A 9
ELE3.2.3.030.9 CURRENT RATINGS OF 100A AND BELOW 9
ELE3.2.3.040.9 CURRENT CARRYING MATERIAL 9
ELE3.2.3.050.9 ENCLOSURE 9
ELE3.2.3.060.9 FRONT COVER 10
ELE3.2.3.070.9 DEGREE OF PROTECTION 10
ELE3.2.3.080.9 SPACE IN TERMINAL ENCLOSURE 10
ELE3.2.3.090.9 FUSE COMBINATION UNITS 10
ELE3.2.3.100.9 EARTHING TERMINAL 10
ELE3.2.4 OPERATION 10
ELE3.2.4.010.9 DESCRIPTION 10
ELE3.2.4.020.9 PERFORMANCE 10
ELE3.2.4.030.9 SECURITY 11

ELE3.3 CIRCUIT BREAKER - GENERAL 12
ELE3.3.010.9 SCOPE OF CIRCUIT BREAKER 12
ELE3.3.020.9 NUMBER OF POLES 12
ELE3.3.030.9 OPERATING MECHANISM 12
ELE3.3.040.9 CASING 12
ELE3.3.050.9 CURRENT RATING 12

ELE3.4 MOULDED CASE CIRCUIT BREAKERS (MCCB) 13
ELE3.4.1 GENERAL 13
ELE3.4.1.010.9 STANDARD 13
ELE3.4.1.020.9 CLASS AND RATING 13
ELE3.4.1.030.9 IN-SERVICE RECORDS 13
ELE3.4.2 CONSTRUCTION AND DESIGN 13
ELE3.4.2.010.9 MCCB 13
ELE3.4.2.020.9 ENCLOSURES FOR SURFACE-MOUNTED MCCB 13

ELE3.4.3 OPERATION 14
ELE3.4.3.010.9 OPERATING CHARACTERISTICS 14
ELE3.4.3.020.9 OPERATING MECHANISM AND INDICATIONS 14
ELE3.4.3.030.9 TYPE-TEST 15

ELE3.5 MINIATURE CIRCUIT BREAKERS (MCB) 16
ELE3.5.010.9 GENERAL 16
ELE3.5.020.9 CATEGORY OF DUTY 16
ELE3.5.030.9 TYPE 16
ELE3.5.040.9 CABLE TERMINALS 16
ELE3.5.050.9 CONTACTS 16
ELE3.5.060.9 TRIPPING MECHANISM, ISOLATION AND SWITCHING 16
ELE3.5.070.9 OPERATING MECHANISM 16
ELE3.5.080.9 TYPE-TEST 17

ELE3.6 RESIDUAL CURRENT OPERATED CIRCUIT BREAKERS (RCCB) 18
ELE3.6.010.9 PERFORMANCE 18
ELE3.6.020.9 TYPE-TEST CERTIFICATES 18
ELE3.6.030.9 CIRCUIT FAULT CURRENT TEST 18
ELE3.6.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 18

ELE3.7 RESIDUAL CURRENT-OPERATED CIRCUIT BREAKERS WITH INTEGRAL OVERCURRENT PROTECTION (RCBO) 19
ELE3.7.010.9 GENERAL 19
ELE3.7.020.9 CATEGORY OF DUTY 19
ELE3.7.030.9 PERFORMANCE 19
ELE3.7.040.9 TYPE-TEST CERTIFICATES 19
ELE3.7.050.9 CIRCUIT FAULT CURRENT TEST 19
ELE3.7.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 20

ELE3.8 DOUBLE POLE SWITCH-DISCONNECTORS 21
ELE3.8.010.9 PERFORMANCE 21
ELE3.8.020.9 TYPE-TEST REPORTS 21

ELE3.9 DISTRIBUTION BOARDS - GENERAL 22
ELE3.9.010.9 SCOPE OF DISTRIBUTION BOARDS 22
ELE3.9.020.9 CONSTRUCTION OF ENCLOSURE 22
ELE3.9.030.9 ARRANGEMENT OF COMPONENT PARTS 22
ELE3.9.040.9 BUSBARS 22
ELE3.9.050.9 EARTHING TERMINALS 22
ELE3.9.060.9 PROVISION OF SPARE WAYS 22
ELE3.9.070.9 SHROUDING OF LIVE PARTS 23

ELE3.10 MOULDED CASE CIRCUIT BREAKER (MCCB) DISTRIBUTION BOARDS 24
ELE3.10.010.9 GENERAL 24
ELE3.10.020.9 TYPE OF MCCB DISTRIBUTION BOARD 24
ELE3.10.030.9 BUSBARS 24

ELE3.10.040.9 ASSISTIVE DEVICE FOR LOCKING OF MCCB UNIT USING PADLOCK 24

ELE3.11 MINIATURE CIRCUIT BREAKER (MCB) DISTRIBUTION BOARDS 25

ELE3.11.1 GENERAL 25
ELE3.11.1.010.9 TYPE 25
ELE3.11.1.020.9 GUARANTEE OF TYPE TEST EQUIVALENCE 25
ELE3.11.1.030.9 IN-SERVICE RECORDS 25

ELE3.11.2 PERFORMANCE 25
ELE3.11.2.010.9 CLASS AND RATING 25

ELE3.11.3 ENCLOSURE 25
ELE3.11.3.010.9 CONSTRUCTION 25
ELE3.11.3.020.9 FINISH 26
ELE3.11.3.030.9 KNOCKOUTS 26
ELE3.11.3.040.9 FASTENING DEVICE 26
ELE3.11.3.050.9 DEGREE OF PROTECTION 26
ELE3.11.3.060.9 DANGER LABEL 26

ELE3.11.4 COMPONENTS AND ARRANGEMENT 26
ELE3.11.4.010.9 SPECIFICATION 26
ELE3.11.4.020.9 MOUNTING ARRANGEMENT 27
ELE3.11.4.030.9 MAIN BUSBARS 27
ELE3.11.4.040.9 NEUTRAL TERMINAL BLOCK 27
ELE3.11.4.050.9 EARTHING TERMINAL BLOCK 27
ELE3.11.4.060.9 SPACING 27
ELE3.11.4.070.9 MOUNTING 27
ELE3.11.4.080.9 REMOVAL 27
ELE3.11.4.090.9 STEEL SCREWS 27
ELE3.11.4.100.9 IDENTIFICATION 27
ELE3.11.4.110.9 CIRCUITRY 27
ELE3.11.4.120.9 ASSISTIVE DEVICE FOR LOCKING OF MCB UNIT AND RCBO UNIT USING PADLOCK 28

ELE3.11.5 TYPE-TEST 28
ELE3.11.5.010.9 STANDARD 28
ELE3.11.5.020.9 VERIFICATION 28
ELE3.11.5.030.A SHORT-CIRCUIT 28

ELE3.12 CONSUMER UNITS 29

ELE3.12.1 GENERAL 29
ELE3.12.1.010.9 STANDARD 29
ELE3.12.1.020.9 GUARANTEE OF TYPE-TEST EQUIVALENCE 29
ELE3.12.1.030.9 IN-SERVICE RECORDS 29

ELE3.12.2 ENCLOSURE 29
ELE3.12.2.010.9 CONSTRUCTION 29
ELE3.12.2.020.9 FINISH 29
ELE3.12.2.030.9 KNOCKOUTS 29
ELE3.12.2.040.9 FASTENING DEVICE 30
ELE3.12.2.050.9 DEGREE OF PROTECTION 30

ELE3.12.3 COMPONENTS AND ARRANGEMENT 30
ELE3.12.3.010.9 COMPONENTS 30
ELE3.12.3.020.9 CIRCUITRY 30
ELE3.12.3.030.9 SPECIFICATION 30

ELE3.12.3.040.9 MOUNTING ARRANGEMENTS 31
ELE3.12.3.050.9 SPACING 31
ELE3.12.3.060.9 MOUNTING 31
ELE3.12.3.070.9 MULTI-TERMINAL BARS 31
ELE3.12.3.080.9 STEEL SCREWS 31
ELE3.12.3.090.9 ASSISTIVE DEVICE FOR LOCKING OF MCB UNIT USING PADLOCK 31

ELE3.12.4 TYPE-TEST 32
ELE3.12.4.010.9 STANDARD 32
ELE3.12.4.020.9 VERIFICATION 32

ELE3.13 FUSES 33
ELE3.13.010.9 GENERAL 33
ELE3.13.020.9 FUSES TO BS 88:SECTION 2.2 33
ELE3.13.030.9 FUSES TO BS 88:PART 6 34

ELE3.15 CONTACTORS 35

ELE3.15.1 GENERAL APPLICATION 35
ELE3.15.1.010.9 STANDARD 35
ELE3.15.1.020.9 RATINGS 35
ELE3.15.1.030.9 CONSTRUCTION AND DESIGN 35
ELE3.15.1.040.9 OPERATION 35
ELE3.15.1.050.9 UTILISATION CATEGORY 35
ELE3.15.1.060.9 TYPE TESTS 36

ELE3.15.2 SPECIAL APPLICATIONS 36
ELE3.15.2.010.9 CHANGEOVER CONTACTORS FOR CUBICLE TYPE SWITCHBOARD 36
ELE3.15.2.020.9 CONTROL CONTACTORS FOR POWER FACTOR CORRECTION EQUIPMENT 36
ELE3.15.2.030.9 CONTACTORS FOR MOTOR STARTER 36
ELE3.15.2.040.9 CONTROL CONTACTORS FOR DISCHARGE LAMPS 36
ELE3.15.2.050.9 CONTROL CONTACTORS FOR HERMETIC REFRIGERANT COMPRESSOR MOTORS 36

ELE3.16 STARTERS 37
ELE3.16.010.9 GENERAL 37
ELE3.16.020.9 UTILISATION CATEGORY 37
ELE3.16.030.9 MECHANICAL AND ELECTRICAL ENDURANCE 37
ELE3.16.040.9 THERMAL OVERLOAD RELAY 37
ELE3.16.050.9 AUXILIARIES 37

ELE3.17 TIME SWITCHES 38
ELE3.17.010.9 OPERATION 38
ELE3.17.020.9 MOUNTING/HOUSING 38
ELE3.17.030.9 RATING 38
ELE3.17.040.9 FEATURES 38

ELE3.18 MEASURING INSTRUMENTS 39
ELE3.18.010.9 KILOWATT-HOUR METERS 39
ELE3.18.020.9 AMMETERS AND VOLTMETERS 39
ELE3.18.030.9 CURRENT TRANSFORMERS 40
ELE3.18.040.9 SELECTOR SWITCH FOR AMMETER 40

ELE3.18.050.9 SELECTOR SWITCH FOR VOLTMETERS 40
ELE3.18.060.9 MOUNTING POSITION OF SELECTOR SWITCHES 40
ELE3.18.070.9 METER CHAMBERS 40
ELE3.18.080.9 MOUNTING OF CURRENT TRANSFORMERS ASSOCIATED WITH A WATT-HOUR METER 41
ELE3.18.090.9 IDENTIFICATION OF INSTRUMENTS 41

ELE3.19 SITE BUILT ASSEMBLIES 42
ELE3.19.010.9 SITE BUILT ASSEMBLIES 42

ELE3.20 FIREMAN'S EMERGENCY SWITCH 43
ELE3.20.010.9 GENERAL 43

ELE3.1 GENERAL

ELE3.1.010.9 SCOPE

1. This section specifies the general requirements of low voltage switchgear and associated equipments which are intended for assembly on site from individual items of components. Additional and specific requirements for factory built assemblies of switchgear and controlgear are given in ELE4, the Drawings, other documents issued by the Contract Manager or Project Specific Specification;
2. The component equipments covered in this Section shall include the following:
    a. Fuse combination units and switch disconnectors;
    b. Circuit-breakers comprising moulded case circuit-breakers (MCCBs), miniature circuit breakers (MCBs), residual current-operated circuit-breakers (RCCBs) and residual current-operated circuit-breakers with integral overcurrent protection (RCBOs);
    c. Double-pole switch disconnectors;
    d. Fuses;
    e. Distribution boards including consumer units;
    f. Starters and contactors;
    g. Time switches;
    h. Measuring instrument;
    i. Site built assemblies.
3. The general requirements specified in ELE3.1.020 to ELE3.1.080 both inclusive shall apply to all items of switchgear and associated equipment where applicable unless explicitly mentioned otherwise.

ELE3.1.020.9 SERVICE CONDITIONS

The following conditions shall apply:

1. Ambient temperature: peak from minus 5°C to plus 40°C for 4 hours continuously with an average from 0°C to plus 35°C over only 24 hour period;
2. Relative humidity: up to 0.99 saturation.

ELE3.1.030.9 SHORT-CIRCUIT RATING AND CONTINUOUS CURRENT RATING

1. Low voltage switchgear shall be suitably rated for the specified prospective short-circuit current which can occur at the point of its installation. It shall also be rated for uninterrupted duty when carrying continuously the specified full load current. For non-automatic switching devices the rated short-time withstanding current shall be at least 12 times the continuous current rating for 1 second;
2. Where equipment components are installed in enclosures, they shall be suitable for operation at the actual maximum temperatures which will be reached within the enclosures under normal loaded conditions when the ambient temperature is 40ºC.

ELE3.1.040.9 VOLTAGE RATING

Low voltage switchgear and associated equipment shall be suitable for use on 220V (single phase) or 380V (3 phase) 50Hz supply.

ELE3.1.050.9 DEGREE OF PROTECTION FOR ENCLOSURE

Enclosures for low voltage switchgear and associated equipment shall have an index of protection, in accordance with IEC 60529 of at least IP 30 for indoor applications and of at least IP 54 for outdoor applications.

ELE3.1.060.9 MATERIALS

1. Unless otherwise specified, low voltage switchgear and associated equipment except MCCBs, MCBs and RCBOs shall be metalclad. All ferrous metal parts shall be galvanised or chrome plated unless the final finish has been painted or enamelled in the manufacturer's factory;
2. All extraneous conductive parts shall be electrically continuous.

ELE3.1.070.9 ON AND OFF INDICATION

1. The design of a switching device shall incorporate some positive means to indicate clearly and reliably the ON (or CLOSE) and the OFF (or OPEN) positions of the contacts. Indication of either position shall only occur when the ON or OFF position on every pole has been attained. Such indication shall be provided on the outside of the device and shall be prominently visible to an operator when the device is installed in the normal manner;
2. When the switching device is also used for isolation purpose, then an indication of the OFF position shall occur only when all contacts are also in the OFF position and the isolating distance between contacts in every pole has attained a clearance not less than those specified in the respective equipment standards.

ELE3.1.080.9 IDENTIFICATION OF CIRCUIT

1. Labels or other means of identification shall be provided for every item of switchgear and associated equipment to indicate the purpose of the item. The labels shall either be fixed at the front cover or at the inside surface of the hinged front cover;
2. For a split-busbar consumer unit, the labels shall identify all outgoing MCBs which are protected by an RCCB from those which are not.

ELE3.2 SURFACE MOUNTED FUSE COMBINATION UNITS AND SWITCH-DISCONNECTORS

ELE3.2.1 GENERAL

ELE3.2.1.010.9 TYPE AND STANDARD

Surface mounted switch-disconnector fuses, fuse-switch disconnectors and switch-disconnectors (hereinafter referred to as "switching device" or "switching devices") shall be air-break, metalclad type and shall comply with IEC 60947-3.

ELE3.2.1.020.9 ARRANGEMENT

The switch-disconnector fuses or fuse-switch disconnectors shall be a combination of a switch-disconnector and one or more fuses in a composite unit.

ELE3.2.1.030.9 CLASS AND RATING

	Class	Rating
1.	Rated operational voltage	380/220V (min.)
2.	Rated frequency	50Hz
3.	Rated insulation voltage	415V (min.)
4.	Rated impulse withstand voltage	6 kV (min.)
5.	Conventional enclosed thermal current and rated operational current/power for uninterrupted duty	As shown on the drawings
6.	Utilization category	AC22B unless otherwise specified.
7.	Rated short-time withstand current (for switch-disconnectors protected by air circuit breakers/moulded case circuit breakers)	At least twelve times the maximum rated operational current for one second.
8.	Rated short-circuit current (for switch-disconnectors protected by bolt-type fuses as specified in ELE3.13.010 and for switch-disconnector fuses / fuse-switch disconnectors)	40 kA

ELE3.2.1.040.9 IN-SERVICE RECORDS

Prior to the time of material submission for Approval, the equipment shall have proven record of reliability in local application for a minimum continuous period of 12 months to the satisfaction of the Contract Manager.

ELE3.2.2 TYPE-TEST

ELE3.2.2.010.9 TEST STANDARDS

Switch-disconnector fuses, fuse-switch disconnectors and switch-disconnectors shall be type-tested in accordance with Clause 8.2 and Clause 8.3 of IEC 60947-3. For switch-disconnectors to be used in circuits protected by fuses, test sequence III of Clause 8.3.5 is not required, but test sequence IV of Clause 8.3.6 shall be performed to such switch-disconnectors connected in series with bolt-type fuse links as specified in ELE3.13.010 of the corresponding rated maximum current.

ELE3.2.2.020.9 TYPE-TESTING

The following test sequences of IEC 60947-3 shall be carried out by a Short Circuit Testing Organisation.

1. For fuse combination units – test sequences I & IV;
2. For switch-disconnectors – test sequences I & III.

Switch disconnectors converted from type-tested switch-disconnector fuses/fuse-switch disconnectors by replacing the fuse links with copper short links for a rated operational current not greater than the maximum rated operational current for the original switch-disconnector fuses/fuse-switch disconnectors and are installed in circuits protected by bolt-type fuses as specified in ELE3.13.010 are also acceptable.

ELE3.2.3 CONSTRUCTION AND DESIGN

ELE3.2.3.010.9 TYPE

Switch-disconnector fuses, fuse-switch disconnectors and switch-disconnectors shall be triple or single pole as shown on the Drawings, with detachable fully rated front accessible neutral link, or 4-pole as shown on the Drawings.

ELE3.2.3.020.9 CURRENT RATINGS ABOVE 100A

For fuse combination units with current ratings above 100A, the switching devices shall make and break on both the incoming supply side and the outgoing load side.

ELE3.2.3.030.9 CURRENT RATINGS OF 100A AND BELOW

For fuse combination units with current ratings of 100A and below, fuse bases and carriers shall be provided for housing the fuse links if the switching device are not making and breaking on both the incoming supply side and the outgoing load side.

ELE3.2.3.040.9 CURRENT CARRYING MATERIAL

The current carrying parts shall be made of hard drawn, high conductivity copper to BS EN 13601.

ELE3.2.3.050.9 ENCLOSURE

The enclosure shall be made of sheet steel of thickness not less than 1.6 mm for current ratings above 32A and not less than 1.2 mm for 32A and below, complete with stoved epoxy powder paint, or equal and Approved finish of a gloss light colour.

ELE3.2.3.060.9 FRONT COVER

The front cover of switching devices shall be hinged or of an equal and Approved construction, to enable easy access to the interior for replacement of fuse links. Gland plates shall be provided for top and bottom cable entry for switching devices of current ratings above 32A.

ELE3.2.3.070.9 DEGREE OF PROTECTION

1. Under normal service conditions, the enclosure shall be of totally enclosed type with a degree of protection against ingress of foreign solid bodies and liquids of at least IP41 as per IEC 60529 for the top surface and IP31 for the other surfaces of the enclosures. With the front-hinged door open and in replacing fuse links, the degree of protection to the live parts shall be at least IP2X. If the degree of protection to the neutral conductor of the live part cannot comply with this requirement, a warning label shall be provided next to the neutral conductor;
2. The switching devices shall be suitable for installation under environmental condition of pollution degree 3 unless otherwise specified.

ELE3.2.3.080.9 SPACE IN TERMINAL ENCLOSURE

1. Terminal connections shall be by means of screws so to ensure that the necessary contact pressure is maintained;
2. The terminal enclosure shall have sufficient space for accommodating cable lugs for the largest cables which the switching device is designed to receive, and also for proper cable termination with cable bending radius in accordance with the Electrical CoP otherwise proper extension cable terminals and/or cable boxes shall be provided. The palm width of the cable lugs shall comply with BS 91.

ELE3.2.3.090.9 FUSE COMBINATION UNITS

For switch-disconnector fuses or fuse-switch disconnectors, the fuse holders shall be capable of accepting any fuse links of physical dimension complying with the minimum and maximum limits of the respective fuse reference tabulated in the Specification for fuses (i.e. ELE3.13).

ELE3.2.3.100.9 EARTHING TERMINAL

An external accessible earthing terminal shall be provided at the side panel of the enclosure.

ELE3.2.4 OPERATION

ELE3.2.4.010.9 DESCRIPTION

The switching devices shall be independent manual operated and shall have mechanical interlock to prevent access to the interior except when the switching devices are in the OFF position, and to prevent the contacts from being switched to close when the door is open.

ELE3.2.4.020.9 PERFORMANCE

The latter interlock shall be able to be defeated by trained personnel for maintenance when necessary.

ELE3.2.4.030.9 SECURITY

A facility shall be provided for padlocking the switching devices in the OFF position.

ELE3.3 CIRCUIT BREAKER - GENERAL

ELE3.3.010.9 SCOPE OF CIRCUIT BREAKER

This Sub-section covers the general requirements of ACBs, MCCBs, MCBs, RCCBs and RCBOs. Additional requirements relevant to particular types of circuit-breakers shall be given in ELE3.4 to ELE3.7 both inclusive.

ELE3.3.020.9 NUMBER OF POLES

Circuit-breakers shall be of four-pole, three-pole, double-pole or single-pole, as specified and shall have air-break contacts.

ELE3.3.030.9 OPERATING MECHANISM

1. The operating mechanism of a circuit-breaker shall be trip-free;
2. When an MCCB or MCB or RCCB or RCBO trips and opens its contacts, the operating toggle shall automatically resume the OFF or TRIPPED position.

ELE3.3.040.9 CASING

The casing of an MCCB, an MCB, an RCCB, an RCBO shall be formed from an insulating material. The construction shall be capable of withstanding the appropriate rated short circuit current and reasonably rough use without fracture or distortion.

ELE3.3.050.9 CURRENT RATING

The rated current of a circuit-breaker shall be taken as that rated continuous current when the circuit-breaker is installed in the enclosure together with other equipment, if any, under normal operating conditions as shown on the Drawings.

ELE3.4 MOULDED CASE CIRCUIT BREAKERS (MCCB)

ELE3.4.1 GENERAL

ELE3.4.1.010.9 STANDARD

Moulded Case Circuit Breakers (MCCB) shall comply with IEC 60947-2.

ELE3.4.1.020.9 CLASS AND RATING

	Class	Rating
a.	Rated operation voltage:	220/380V
b.	Rated insulation voltage:	415V
c.	Rated frequency:	50Hz
d.	Rated ultimate short-circuit breaking capacity:	40 kA unless otherwise specified
e.	Rated uninterrupted current:	As shown on the Drawings

ELE3.4.1.030.9 IN-SERVICE RECORDS

Prior to the time of material submission for Approval, the equipment shall have proven record of reliability in local application for a minimum continuous period of 12 months to the satisfaction of the Contract Manager.

ELE3.4.2 CONSTRUCTION AND DESIGN

ELE3.4.2.010.9 MCCB

1. MCCB shall be triple, double or single pole complete with overcurrent and/or earth leakage tripping device as shown on the Drawings, and suitable for direct mounting inside a metal enclosure or a cubicle switchboard. Both triple and single pole MCCB shall be provided with detachable, fully rated, front accessible neutral copper link mounted inside the enclosure;
2.
    a. For surface mounted MCCB cable terminals shall be at the top and bottom with access from the front;
    b. For MCCB housed in switchboard cubicles, the cable terminals shall be suitable for busbar connection;
    c. Interphase barriers shall be provided when necessary to maintain safe electrical clearance.
3. MCCB shall be type-tested and comply with the additional requirements for circuit breakers suitable for isolation in accordance with Clause 7.1.2 of IEC 60947-2.

ELE3.4.2.020.9 ENCLOSURES FOR SURFACE-MOUNTED MCCB

1.

a. The enclosure shall be of totally enclosed type with a degree of protection against ingress of foreign solid bodies and liquids of at least IP41 as per IEC 60529, for the top surface, and IP31 for the other surfaces of the enclosures;

b. The enclosure shall conform to the type-tested standard or as recommended by the manufacturer. The front cover of the enclosure shall be hinged or equal and approved. With the front-hinged cover opened, all live parts shall be protected to IP20. If the degree of protection to the neutral conductor of the live part cannot comply with this requirement, a warning label shall be provided next to the neutral conductor;

c. The enclosure shall have sufficient space for accommodating cable lugs for the largest cables which the MCCB is designed to receive;

d. The palm width of the cable lugs shall comply with BS 91;

e. There shall also be sufficient space for proper cable termination with cable bending radius in accordance with the Electrical CoP, otherwise proper extension cable terminals and/or cable box shall be provided.

2. An external accessible earthing terminal shall be provided at the side panel of the enclosure. The enclosure shall be formed from sheet steel 1.6 mm thick;

3. All inside and outside surfaces of the enclosures shall be treated with either anti-rust protective coating followed by two stoved coats of gloss paint of contrasting colours, or an alternative acceptable finish such as phosphate treatment followed by epoxy powder paint. The finishing colour shall be approved by the Contract Manager.

ELE3.4.3 OPERATION

ELE3.4.3.010.9 OPERATING CHARACTERISTICS

1. MCCB shall have inverse time delay and instantaneous tripping time-current characteristic which cannot be inadvertently adjusted. The operating characteristic shall be such that:

   a. The time delay on overload tripping shall be inversely proportional to the overcurrent up to a threshold value of approximately 7 times the rated current or as otherwise specified;

   b. There shall be no intentional time-delay on overcurrent tripping due to short-circuit or heavy overcurrent exceeding the threshold value.

2. The operating characteristic shall be calibrated at 40°C. For earth leakage protection, the tripping current shall be as shown on the Drawings. The earth leakage relay and the zero-sequence current transformer, if any, shall comply with the relevant British Standard.

ELE3.4.3.020.9 OPERATING MECHANISM AND INDICATIONS

1. The operating mechanism shall be independent manual and trip-free. Indication of OFF position shall occur only when the specified isolation distance on each pole has been attained. Reliable visual indication of ON and OFF position and trip indication shall be provided;

2. MCCBs shall be equipped with lockable function such that they can be locked off and only be able to be unlocked by the use of keys or tools used to lock off these devices. Additional proprietary assistive devices shall be provided where necessary to facilitate the lockable function using padlocks. In case of no supply of proprietary assistive devices from the MCCB manufacturer or in case of provision of assistive devices for existing MCCBs in existing buildings, alternative made may be proposed and shall be demonstrated by the Sub-contractor that the proposed devices are suitable for the MCCBs to facilitate the lockable function using padlocks.

ELE3.4.3.030.9 TYPE-TEST

MCCB shall be type-tested to IEC 60947-2. Verification of short-circuit making and breaking capacity shall be carried out by a Short-Circuit Testing Organization.

ELE3.5 MINIATURE CIRCUIT BREAKERS (MCB)

ELE3.5.010.9 GENERAL

Miniature Circuit Breakers (MCBs) shall comply with IEC 60898-1 or BS EN 60898-1, suitable for 220/380V supply operation with rated current and number of poles as shown on the Drawings.

ELE3.5.020.9 CATEGORY OF DUTY

MCBs shall have a standard value of rated short-circuit capacity of not less than 4500A.

ELE3.5.030.9 TYPE

Unless otherwise specified or shown on the Drawings, MCBs shall have an instantaneous tripping operation of type B or type C in accordance with IEC 60898-1 or BS EN 60898-1.

ELE3.5.040.9 CABLE TERMINALS

Terminals suitable for terminating appropriate size of solid or stranded conductors shall be provided for the outgoing cables. The terminals shall be accessible from the front for easy cable termination.

ELE3.5.050.9 CONTACTS

Contacts shall be non-weld type.

ELE3.5.060.9 TRIPPING MECHANISM, ISOLATION AND SWITCHING

1. Tripping elements shall be thermal magnetic type with instantaneous tripping characteristic under short-circuit conditions and inverse time delay tripping characteristic under overload conditions;
2. For domestic buildings, the double pole MCBs providing supply to domestic units before the power company's meters shall be capable of both isolating and switching the full load current of the respective circuits;
3. MCBs shall be equipped with lockable function such that they can be locked off and only be able to be unlocked by the use of keys or tools used to lock off these devices. Additional proprietary assistive devices shall be provided where necessary to facilitate the lockable function using padlocks. In case of no supply of proprietary assistive devices from the MCB manufacturer or in case of provision of assistive devices for existing MCBs in existing buildings, alternative made may be proposed and shall be demonstrated by the Sub-contractor that the proposed devices are suitable for the MCBs to facilitate the lockable function using padlocks.

ELE3.5.070.9 OPERATING MECHANISM

Operating mechanism shall be quick break, trip free type. Where the handle is used to indicate the position of the contacts, the handle, when released, shall automatically take up the position corresponding to that of the moving contacts; in this case, the handle shall have two distinct rest positions corresponding to the position of the contacts but, for automatic opening, a third distinct position of the handle may be provided.

ELE3.5.080.9 TYPE-TEST

Full type-test certificates to Section 9 of BS EN 60898-1 or Section 9 of IEC 60898-1 shall be produced to the satisfaction of the Contract Manager. In addition, type-test to test sequences C, D and E of IEC 60898-1 or BS EN 60898-1 shall be carried out by a Short Circuit Testing Organization.

ELE3.6 RESIDUAL CURRENT OPERATED CIRCUIT BREAKERS (RCCB)

ELE3.6.010.9 PERFORMANCE

1. Residual current operated circuit breakers (RCCBs) shall comply with IEC 61008-1, and shall be suitable for 220/380V supply operation with rated current and number of poles as indicated on the Drawings. The rated residual operating current of RCCBs shall be 30 mA unless otherwise specified. RCCBs shall not require any auxiliary source for operation. However, 2-pole RCCB requiring an integral auxiliary source for operation will still be acceptable provided that in the event of failure of integral auxiliary source through the loss of neutral, it shall either still function as a RCCB or open automatically without delay;
2. The RCCBs shall be the following types for earth leakage protection:
    a. Circuits serving electric vehicles charging facilities: Type B;
    b. Other circuits: Type AC (General type).

ELE3.6.020.9 TYPE-TEST CERTIFICATES

Full type-test certificates to Section 9 of IEC 61008-1 shall be produced to the satisfaction of the Contract Manager.

ELE3.6.030.9 CIRCUIT FAULT CURRENT TEST

1. The short circuit tests as specified in Clause 9.11 of IEC 61008-1 shall be carried out by a Short-circuit Testing Organisation;
2. For RCCBs which form part of consumer units or miniature circuit breaker distribution boards which have been satisfactorily tested in accordance with ELE3.12.4 or ELE3.11.5 respectively, the short circuit tests as specified in Clause 9.11 of IEC 61008-1 will not be required.

ELE3.6.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences as PRE.BS1.205 to verify the country / place of manufacture and authenticity of RCCBs delivered to Site or installed.

ELE3.7 RESIDUAL CURRENT-OPERATED CIRCUIT BREAKERS WITH INTEGRAL OVERCURRENT PROTECTION (RCBO)

ELE3.7.010.9 GENERAL

Residual current operated circuit breaker with integral overcurrent protection (RCBO) shall comply with IEC 61009-1 or BS EN 61009-1, and shall be suitable for 220/380V supply operation with rated current and number of poles as indicated on the Drawings. The rated residual operating current of RCBOs shall be 30mA unless otherwise specified.

ELE3.7.020.9 CATEGORY OF DUTY

RCBOs shall have a standard value of rated short-circuit capacity of not less than 4500A.

ELE3.7.030.9 PERFORMANCE

1. RCBOs shall not require any auxiliary source for operation;
2. The RCBOs shall comply with the following types for earth leakage protection:
   a. Circuits serving electric vehicles charging facilities: Type B;
   b. Other circuits: Type AC (General type).
3. Unless otherwise specified or shown on the Drawings, RCBOs shall also have an overcurrent instantaneous tripping operation of type B or type C in accordance with IEC 61009-1 or BS EN 61009-1;
4. Cable Terminals and contacts shall be as specified in ELE3.5.040 and ELE3.5.050 respectively;
5. Tripping mechanism shall be as specified in ELE3.5.060 Sub-clause (1);
6. RCBOs shall be equipped with lockable function such that they can be locked off and only be able to be unlocked by the use of keys or tools used to lock off these devices. Additional proprietary assistive devices shall be provided where necessary to facilitate the lockable function using padlocks. In case of no supply of proprietary assistive devices from the RCBO manufacturer, alternative made may be proposed and shall be demonstrated by the Sub-contractor that the proposed devices are suitable for the RCBOs to facilitate the lockable function using padlocks;
7. Operating mechanism shall be as specified in ELE3.5.070.

ELE3.7.040.9 TYPE-TEST CERTIFICATES

Full type-test certificates to Section 9 of IEC 61009-1 or BS EN 61009-1 shall be produced to the satisfaction of the Contract Manager. In addition, type-test to test sequences C, E_1, F_0 and F_1 of IEC 61009-1 or BS EN 61009-1 shall be carried out by a Short-circuit Testing Organisation.

ELE3.7.050.9 CIRCUIT FAULT CURRENT TEST

1. The short circuit tests as specified in Clause 9.12 of IEC 61009-1 or BS EN 61009-1 shall be carried out by a Short-circuit Testing Organisation;

2. For RCBOs which form part of miniature circuit breaker distribution boards which have been satisfactorily tested in accordance with ELE3.11.5, the short circuit tests as specified in Clause 9.12 of IEC 61009-1 or BS EN 61009-1 will not be required.

ELE3.7.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences as PRE.BS1.205 to verify the country / place of manufacture and authenticity of RCBOs delivered to Site or installed.

ELE3.8 DOUBLE POLE SWITCH-DISCONNECTORS

ELE3.8.010.9 PERFORMANCE

1. Double Pole Switch-disconnectors shall comply with IEC 60947-3, suitable for 220V supply operation with rated current as indicated on the Drawings;
2. They shall have Utilization Category AC22A and shall be provided with facility for padlocking the switch disconnectors in the isolated position;
3. Incoming terminal shall be protected against direct contact to IP2X.

ELE3.8.020.9 TYPE-TEST REPORTS

Full type-test report to Clause 8.1.2 of IEC 60947-3 shall be produced to the satisfaction of the Contract Manager.

ELE3.9 DISTRIBUTION BOARDS - GENERAL

ELE3.9.010.9 SCOPE OF DISTRIBUTION BOARDS

This sub-section covers the general requirements of MCCB distribution boards. Additional requirements relevant to a particular type of MCCB distribution board shall be given in ELE3.10.

ELE3.9.020.9 CONSTRUCTION OF ENCLOSURE

1. The enclosure of a distribution board shall be constructed from sheet steel, rust proofed and baked enamelled or stove epoxy powder painted;
2. The construction shall be of robust design, capable of withstanding the mechanical, electrical and thermal stresses under all working conditions, including fault conditions.

ELE3.9.030.9 ARRANGEMENT OF COMPONENT PARTS

1. Distribution boards shall include all necessary components and accessories to form a complete assembly;
2. Components and accessories shall be firmly fixed in position in the distribution board, and shall be assembled in such a way that it shall be possible to remove or replace any component parts and to carry out cable connections from the front;
3. Ample space shall be allowed for cabling;
4. MCCBs shall be arranged neatly in a row or rows;
5. All components shall be totally concealed: only the toggles of the MCCBs shall protrude through the cover plate of the distribution board.

ELE3.9.040.9 BUSBARS

All busbars shall be of hard drawn copper having ratings as specified and shall be electro-tinned. Neutral busbars shall be of the same CSA as the phase busbars, and shall have adequate number of terminals for all outgoing circuits including spare ways.

ELE3.9.050.9 EARTHING TERMINALS

1. Every distribution board shall be provided with an external earthing terminal for connection to the main earthing terminal. In addition, a multi-terminal connector shall be provided within the distribution board for connection of protective conductors of all outgoing circuits including spare ways;
2. Both the external earthing terminal and the multi-terminal connector for protective conductor shall be of hard drawn electro-tinned copper and shall be labelled in accordance with the requirements of IEC 60439-1.

ELE3.9.060.9 PROVISION OF SPARE WAYS

Each distribution board shall be provided with spare ways for future expansion. For new installations, the number of spare ways shall not be less than 20% of the total number of outgoing ways in the distribution board. Each spare way shall be blanked off with a suitable blanking plate having a finish comparable to that of the distribution board.

ELE3.9.070.9 SHROUDING OF LIVE PARTS

1. All conductive parts shall be properly shrouded against accidental contact by means of rigid barriers, partitions of insulating materials such that accidental contact can be prevented during operation of component replacement or cable connection;
2. All conductive structural parts of the distribution boards shall comply with the protective circuit requirements of IEC 60439-1.

ELE3.10 MOULDED CASE CIRCUIT BREAKER (MCCB) DISTRIBUTION BOARDS

ELE3.10.010.9 GENERAL

1. The enclosure of an MCCB distribution board shall be constructed from sheet steel having a thickness of not less than 1.5 mm, and shall be designed for general commercial and light industrial applications;
2. The design, construction and testing specifications of the distribution boards shall comply with IEC 61439-1 and IEC 61439-2, or IEC 60439-1.

ELE3.10.020.9 TYPE OF MCCB DISTRIBUTION BOARD

1. MCCB distribution boards shall be of two types, viz. Type A and Type B. Type A MCCB distribution board shall be suitable for accommodating, in any combination, the double-pole and triple-pole MCCBs of 100A frame size. Type B MCCB distribution boards shall be suitable for accommodating triple-pole MCCBs of 225A framesize;
2. All MCCB distribution boards shall each be provided with a moulded-case isolating switch having a current rating not less than that of the supply side protective device. The moulded-case isolating switch shall meet the relevant requirements of ELE3.1 and ELE3.2.

ELE3.10.030.9 BUSBARS

1. MCCB distribution boards shall be provided with vertical triple-pole and neutral copper busbars of rating not less than that of the supply side protective device subject to a minimum of 250A;
2. The configuration of the busbars, busbar supports and busbar mounting arrangement shall be type-tested to a short-time withstanding current of not less than 14 kA in the case of type A boards or 22 kA in the case of type B boards for 0.2 seconds at a voltage of not less than 380V;
3. Outgoing MCCBs shall be mounted horizontally on both sides of the vertical busbars. The connection between the MCCBs and the phase busbars shall be by means of copper tapes and bolted joints. Plug-in type of current carrying contacts shall not be accepted.

ELE3.10.040.9 ASSISTIVE DEVICE FOR LOCKING OF MCCB UNIT USING PADLOCK

1. For the MCCB distribution board fitted with MCCBs that cannot be locked by directly application of padlocks, two (2) assistive devices shall be provided for each MCCB distribution board irrespective of the number of outgoing ways to facilitate the locking of MCCBs using padlocks for isolation purpose during maintenance;
2. The assistive devices for all MCCB distribution boards installed within the electrical meter room shall be collectively housed inside a cabinet suitably wall mounted at a location within the electrical meter room;
3. The cabinet shall be made of sheet steel with finishing in baked enamelled or stove epoxy powder painted. The cabinet shall be suitably sized, fitted with front-hinged door and equipped inside with suitable hooks of sufficient numbers for hanging of all assistive devices.

ELE3.11 MINIATURE CIRCUIT BREAKER (MCB) DISTRIBUTION BOARDS

ELE3.11.1 GENERAL

ELE3.11.1.010.9 TYPE

Miniature Circuit Breaker Distribution Boards (MCB boards) shall be of surface mounted and enclosed type, and shall comply with IEC 60439-3 or BS EN 60439-3.

ELE3.11.1.020.9 GUARANTEE OF TYPE TEST EQUIVALENCE

In cases where miniature circuit breaker distribution boards are manufactured under licence from a Principal Company, letters of guarantee for products manufactured by the licensee from the Principal Company shall be produced to prove that such products are equivalent, in every respect, to the type-tested products.

ELE3.11.1.030.9 IN-SERVICE RECORDS

Prior to the time of material submission for Approval, the equipment including its major components shall have proven record of reliability in local application for a minimum continuous period of 12 months to the satisfaction of the Contract Manager.

ELE3.11.2 PERFORMANCE

ELE3.11.2.010.9 CLASS AND RATING

Class	Rating
1. Rated operational voltage:	220/380V (min)
2. Rated frequency:	50Hz
3. Rated insulated voltage:	415V (min)
4. Rated current:	a. MCB boards without integral incoming switch-disconnector: 200A; b. MCB boards with integral incoming switch-disconnector: not less than the current rating of the integral incoming switch-disconnector, subject to a minimum of 100A.
5. Rated conditional short-circuit current:	24 kA when backed up by 160A fuse as specified in ELE3.13.010.

ELE3.11.3 ENCLOSURE

ELE3.11.3.010.9 CONSTRUCTION

MCB boards shall be fabricated from sheet steel with a thickness of not less than 1.2 mm. They shall be robustly constructed and rustproof.

ELE3.11.3.020.9 FINISH

All inside and outside surfaces of the enclosure shall be treated with either anti-rust protective coating followed by two stoved coats of gloss paint of contrasting colours or an alternative acceptable finish such as phosphate treatment followed by stove epoxy powder paint. The finishing coat shall be approved by the Contract Manager.

ELE3.11.3.030.9 KNOCKOUTS

Knockouts of appropriate size shall be provided on the top and bottom of the enclosure.

ELE3.11.3.040.9 FASTENING DEVICE

The fastening device (e.g. screws) for fixing the cover to the enclosure shall be captive and shall not cause damage to the enclosure during fastening and loosening.

ELE3.11.3.050.9 DEGREE OF PROTECTION

1. The degree of protection for the enclosure with all functional units and blanking plates fitted shall be at least IP41 and IP 31 for the top surface and other surfaces respectively;
2. If any cover or blanking plate can be removed without a tool, the degree of protection against direct contact with live parts shall be at least IP 2X with the cover or blanking plate removed;
3. Insulated tooth covers should be provided and inserted to cover the exposed live parts protruding from the main busbar reserved for future connection of MCB units and RCBO units;
4. With the front cover removed or in replacing the MCB unit or RCBO unit, any live parts which cannot be isolated by the MCB board's integral incoming switch-disconnector shall be provided with barrier or other means affording a degree of protection at least IP 2X. If the degree of protection to the neutral conductor of the live part cannot comply with this requirement, a warning label bearing "DANGER - 危險" in red legible letters and characters each not less than 10 mm high shall be provided next to the neutral conductor. And, if the MCB board is not provided with an integral incoming switch disconnector, a warning notice shall be placed in such a position that any person gaining access to live parts will be warned of the need to use the appropriate isolating device.

ELE3.11.3.060.9 DANGER LABEL

A label bearing "DANGER - 危險" in red legible letters and characters each not less than 10 mm high shall also be provided on the cover.

ELE3.11.4 COMPONENTS AND ARRANGEMENT

ELE3.11.4.010.9 SPECIFICATION

The functional units such as MCBs, RCCBs, RCBOs, switch-disconnectors etc. shall comply with the relevant BS EN/BS/IEC and the relevant sections in this Specification.

ELE3.11.4.020.9 MOUNTING ARRANGEMENT

All the MCBs, RCCB, RCBO (if provided) and switch-disconnectors (if provided) shall be mounted in a straight line manner and fixed firmly in position. The toggles of all devices shall be projected through the front panel of the MCB board. The on and off identifications for all these devices shall be clearly visible such that the close or open state of the devices shall be easily distinguished when they are mounted in the normal service position.

ELE3.11.4.030.9 MAIN BUSBARS

The main busbars shall be copper to BS EN 13601 and be completely tinned. Fixing of busbars shall not rely on any functional unit.

ELE3.11.4.040.9 NEUTRAL TERMINAL BLOCK

The neutral terminal block, where specified, shall allow the connection of copper conductors having current carrying capacity of the phase conductor. The number of outgoing terminals in the neutral blocks shall not be less than the maximum number of outgoing circuits.

ELE3.11.4.050.9 EARTHING TERMINAL BLOCK

The earthing terminal block shall be provided with sufficient terminals for the incoming and maximum number of outgoing circuits.

ELE3.11.4.060.9 SPACING

Sufficient space shall be provided for wiring and termination after all the functional units are fixed in position.

ELE3.11.4.070.9 MOUNTING

The functional units, terminal blocks, busbars, incoming switch-disconnector, etc. shall be mounted as skeleton units or on a backplate. The skeleton units shall not be disintegrated for the removal or replacement of any functional unit.

ELE3.11.4.080.9 REMOVAL

Removal of any skeleton unit or the backplate, replacement of MCB or RCBO, or termination of cable shall not disturb or loosen the other components or wiring.

ELE3.11.4.090.9 STEEL SCREWS

All steel screws shall be zinc plated or chromate coated. Self tapping screws are not acceptable.

ELE3.11.4.100.9 IDENTIFICATION

1. For MCB board designed to incorporate both multi-pole and single pole MCBs/RCBOs, phase and neutral colour identification shall be provided adjacent to each MCB/RCBO outgoing way and neutral connection;
2. Ferrules shall be provided for wires, including earthing, phase and neutral conductor, throughout the distribution board internally for circuit identification.

ELE3.11.4.110.9 CIRCUITRY

The circuitry of the MCB board shall be as shown on the Drawings.

ELE3.11.4.120.9 ASSISTIVE DEVICE FOR LOCKING OF MCB UNIT AND RCBO UNIT USING PADLOCK

1. Two (2) assistive devices shall be provided for each MCB board irrespective of the number of outgoing ways to facilitate the locking of MCBs and RCBOs using padlocks for isolation purpose during maintenance;
2. The assistive devices for all MCB boards installed within the electrical meter room shall be collectively housed inside a cabinet suitably wall mounted at a location within the electrical meter room;
3. The cabinet shall be made of sheet steel with finishing in baked enamelled or stove epoxy powder painted. The cabinet shall be suitably sized, fitted with front-hinged door and equipped inside with suitable hooks of sufficient numbers for hanging of all assistive devices.

ELE3.11.5 TYPE-TEST

ELE3.11.5.010.9 STANDARD

MCB boards shall be type-tested to Clause 8 of BS EN 60439-3 or IEC 60439-3. Partially type-tested assemblies (PTTA) will only be accepted provided that the non-type-tested arrangements are derived from and have been verified to comply with the standard of the type-tested ones and/or been tested to the satisfaction of the Contract Manager. PTTA shall be verified and substantiated by test certificates/reports and/or graphs, calculations, etc. together with the details of the type-tested arrangement from which the PTTA is derived.

ELE3.11.5.020.9 VERIFICATION

The short-circuit strength of the MCB board shall be type-tested and verified by a Short Circuit Testing Organization with the conditional short-circuit current specified in ELE3.11.2.

ELE3.11.5.030.A SHORT-CIRCUIT

The short-circuit shall be made as follows:

1. For MCB boards designed to incorporate single pole MCBs/RCBOs only: across the phase and neutral;
2. For MCB boards designed to incorporate DP MCBs/DP RCBOs: across each phase and neutral. If the busbars in all phases are equally constructed and subject to the Approval of the Contract Manager, partially type tested assembly (PTTA) will be acceptable;
3. For MCB boards designed to incorporate TP and/or SP MCBs and SP RCBOs: across the three phases. Where a neutral bar exists, it shall be subjected to one test to prove its short-circuit withstand strength in relation to the nearest phase bar for the conditional short-circuit current specified in ELE3.11.2;
4. The bolted short-circuit connection shall be provided immediately at the terminals of the outgoing functional unit. The prospective short-circuit current shall pass through the integral incoming switch-disconnector (if provided), the main busbars, the neutral busbar (if provided), RCCB (if provided), SP, DP or TP MCBs, and SP or DP RCBOs, as appropriate, located at the farthest position from the incoming supply point.

ELE3.12 CONSUMER UNITS

ELE3.12.1 GENERAL

ELE3.12.1.010.9 STANDARD

Consumer units shall comply with IEC 60439-3 or BS EN 60439-3 and shall be tropicalised for use in Hong Kong.

ELE3.12.1.020.9 GUARANTEE OF TYPE-TEST EQUIVALENCE

In case where consumer units are manufactured under licence from a Principal Company, a letter of guarantee for products manufactured by the licencee from the Principal Company shall be produced to prove that such products are equivalent, in every respect, to the type-tested standard products.

ELE3.12.1.030.9 IN-SERVICE RECORDS

Prior to the time of material submission for Approval, the equipment including its major components shall have proven record of reliability in local application for a minimum continuous period of 12 months to the satisfaction of the Contract Manager.

ELE3.12.2 ENCLOSURE

ELE3.12.2.010.9 CONSTRUCTION

Consumer units shall be fabricated from sheet steel with a thickness of not less than 1.2 mm for the enclosures, cover plates and hinged covers. They shall be robustly constructed and rustproof. The hinged covers shall be capable of covering up all functional units including labels fitted on the consumer units. The hinged covers together with hinges shall be so designed and fixed to the enclosures to enable their easy removal when and where required without causing any damage to the finish or impairing the integrity and the specified IP of the cover plates and enclosures.

ELE3.12.2.020.9 FINISH

1. All inside and outside surfaces of the enclosure, cover plate and hinged cover shall be treated with, either anti-rust protective coating followed by two stoved coats of gloss paint of contrasting colours, or an alternative acceptable finish such as phosphate treatment, followed by two stoved coats of gloss paint of contrasting colours, or an alternative acceptable finish such as phosphate treatment followed by stoved epoxy powder paint;
2. The finishing colour shall be the manufacturer's standard colour or a standard alternative light gray colour RAL 9002 according to the Classic RAL System, subject to the approval of the Contract Manager.

ELE3.12.2.030.9 KNOCKOUTS

Knockouts of appropriate size on the top and rear of the enclosure shall be provided.

ELE3.12.2.040.9 FASTENING DEVICE

The fastening device (e.g. screws) for fixing the cover plate/cover to the enclosure shall not cause damage to the enclosure during fastening and loosening. Hinges and screwed connections shall be properly designed and fixed to ensure permanent good conductivity between the enclosure, cover plates and hinged covers.

ELE3.12.2.050.9 DEGREE OF PROTECTION

1. The degree of protection for the enclosure shall be at least IP 41 with all the functional units and blanking plates fitted;
2. If any cover or blanking plate can be removed without a tool, the degree of protection against direct contact with live parts shall be at least IP 2X with the cover or blanking plate removed;
3. Insulated tooth covers should be provided and inserted to cover the exposed live parts protruding from the main busbar reserved for future connection of MCB units.

ELE3.12.3 COMPONENTS AND ARRANGEMENT

ELE3.12.3.010.9 COMPONENTS

Each consumer unit shall comprise, but not be limited to, the following items:

1. Tinned main copper busbars to BS EN 13601;
2. A double pole switch-disconnector;
3. A residual current operated circuit breaker (RCCB);
4. An assembly of miniature circuit breakers (MCBs);
5. Multi-terminal bar(s) for neutral conductors with one hole and screw of suitable size for each way; the bar(s) shall be properly supported to and insulated from the backplate or enclosure;
6. A multi-terminal bar for circuit protective conductors with one hole and screw of suitable size for each way, earthing lead and two bonding conductors;
7. Rigidly fixed but removable metal backplate or mounting rail assembly;
8. Plastic labels for incoming and outgoing circuits and RCCB on the cover;
9. Rigid blanking plates; and
10. Interconnecting tinned copper bars of appropriate rating to BS EN 13601 or copper cables of appropriate rating to BS EN 50525-2-31.

ELE3.12.3.020.9 CIRCUITRY

The circuitry of the consumer unit shall be as shown on the Drawings.

ELE3.12.3.030.9 SPECIFICATION

The functional units such as MCBs, RCCB, switch-disconnector, etc. shall comply with the relevant BS/BS EN/IEC and the relevant sections in this Specification.

ELE3.12.3.040.9 MOUNTING ARRANGEMENTS

All the MCBs, RCCB and switch-disconnector shall be mounted in a straight line manner and fixed firmly in position so as not to allow any lateral movement. Except for rotary type, the toggles of all devices shall be operated in the same direction and projected through the front panel of the unit. The on and off identifications for all these devices shall be clearly visible such that the close or open state of the devices shall be easily distinguished when they are mounted in the normal service position.

ELE3.12.3.050.9 SPACING

Sufficient space shall be provided for wiring and termination after all the circuit breakers are mounted in position.

ELE3.12.3.060.9 MOUNTING

All the MCBs, RCCB, switch-disconnector, main busbars and the interconnecting copper bars or cables shall form an integral assembly on the metal backplate or mounting rail in such a way that it can be easily removed from the enclosure without disintegration.

ELE3.12.3.070.9 MULTI-TERMINAL BARS

The multi-terminal bars for neutral and circuit protective conductors shall be fixed securely and held captive so that they cannot be rotated. These bars shall be of copper to BS EN 13601.

ELE3.12.3.080.9 STEEL SCREWS

All steel screws within the unit shall be zinc plated or chromate coated.

ELE3.12.3.090.9 ASSISTIVE DEVICE FOR LOCKING OF MCB UNIT USING PADLOCK

1. For Public Rental Housing (PRH) development:

    a. A total of fifty (50) assistive devices shall be provided for each domestic block of any size to facilitate the locking of MCBs using padlocks for isolation purpose during maintenance;

    b. Twenty (20) assistive devices shall be collectively housed inside a cabinet suitably wall mounted at a location near guard counter of each domestic block. The cabinet shall be made of sheet steel with finishing in baked enamelled or stove epoxy powder painted or fabricated in other material as specified by the CM. The cabinet shall be suitably sized, fitted with front-hinged door with lock using key for access and equipped inside with suitable hooks of sufficient numbers for hanging of all assistive devices;

    c. The rest thirty (30) assistive devices shall be collectively housed inside a cabinet suitably wall mounted at a location within the main switch room. The cabinet shall be made of sheet steel with finishing in baked enamelled or stove epoxy powder painted. The cabinet shall be suitably sized, fitted with front-hinged door and equipped inside with suitable hooks of sufficient numbers for hanging of all assistive devices; and

    d. A label of durable material shall be provided with prominent red wordings on white ground with a size of not less than 100 x 50 mm inscribed in English and Chinese characters as follows:

REW MAY BORROW ASSISTIVE DEVICE(S)
FOR LOCKING OFF MCB UNITS FROM
GUARD COUNTER

電業工程人員可於大堂櫃位借取微型斷路器的
上鎖輔助器

Lettering shall be at least 5 mm high. The notice shall be securely affixed by adhesive means inside the cover of consumer unit.

2. For Subsidised Sale Flats (SSF) development:

   a. Two (2) assistive devices shall be provided for each consumer unit irrespective of the number of outgoing ways to facilitate the locking of MCBs using padlocks for isolation purpose during maintenance; and

   b. The assistive devices for all consumer units shall be handed over to the CM at contract completion.

ELE3.12.4 TYPE-TEST

ELE3.12.4.010.9 STANDARD

Consumer units shall be type-tested to Clause 8 of BS EN 60439-3 or IEC 60439-3. Partially type-tested assemblies (PTTA) will only be accepted provided that the non-type-tested arrangements are derived from and have been verified to comply with the standard of the type-tested ones and/or been tested to the satisfaction of the Contract Manager. PTTA shall be verified and substantiated by test certificates/reports and/or graphs, calculations, etc. together with the details of the type-tested arrangement from which the PTTA is derived.

ELE3.12.4.020.9 VERIFICATION

The short-circuit strength of the consumer unit shall be type-tested and verified by a Short Circuit Testing Organization in accordance with Annex ZA to BS EN 60439-3 or IEC 60439-3 at 16 kA minimum.

ELE3.13 FUSES

ELE3.13.010.9 GENERAL

1. Fuses shall comply with IEC 60269-1, IEC 60269-2 and BS 88:Section 2.2 or BS 88-2;
2. Fuses of compact dimensions to BS 88:Part 6 or BS 88-2 are only acceptable for metering circuits and/or control circuits provided that the rated breaking capacity of the fuse shall exceed the prospective short-circuit current at the point where the fuse is installed;
3. All fuses shall be of a.c. rating and their current ratings shall be as shown on the Drawings;
4. Fuse links shall be certified to use and shall bear the marking of "ASTA 20 CERT" or a similar and Approved Equivalent Quality Surveillance Scheme;
5. Unless otherwise specified, fuse links shall be of current limiting type with full-range breaking capacity for general application (i.e. Utilization Category "gG"). Fuse links shall have conventional fusing current not more than 1.45 times the rated current under the intended service conditions;
6. Fuse links other than those to be used in fuse combination units shall be provided with fuse holders. The maximum power dissipation of the fuse link shall not exceed the maximum rated power acceptance of the fuse holder under the intended service conditions;
7. When fuse holders are specified, the degree of protection against electric shock for the complete fuse shall be IP3X under normal service conditions. When replacing the fuse link or removing the fuse carrier, the degree of protection against electric shock shall be at least IP2X;
8. Type-test certificates and reports, time/current characteristics, cut-off characteristics, pre-arcing and operating $I^2 t$ characteristics and Letter of Authorisation to use "ASTA 20 CERT" endorsement or similar documents shall be submitted for reference and examination if required.

ELE3.13.020.9 FUSES TO BS 88:SECTION 2.2

1. Fuses shall comply with IEC 60269-1, IEC 60269-2 and BS 88:Section 2.2 or BS 88-2;
2. When the fuse link is to be used in a fuse combination unit, its rated power dissipating shall not exceed that of the fuse link used in carrying out the temperature-rise type test of the unit;
3. The physical dimensions of the fuse links shall be as shown in the following table:

Current rating of fuse link (I)	Dimension as fuse reference of BS 88:Section 2.2 or BS 88-2
32 > or = I	A2
32 < I < or = 63	A3
63 < I < or = 100	A4 or B1
100 < I < or = 200	B2
200 < I < or = 315	B3
315< I < or = 400	B4 or C1

400 < I < or = 630	C2
630< I < or = 800	C3

For fuse links rated at or below 100A mounted in cubicle switchboard, the physical dimensions of the fuse links as shown in Fig. 1 of BS 88:Section 2.2 or Figure 501 of BS 88-2 are also acceptable;

4. Fuses shall be type-tested to IEC, 60269-1, IEC 60269-2 and BS 88:Section 2.2 or BS 88-2. Type-test of 'Verification of Breaking Capacity' shall be carried out by a Short-Circuit Testing Organisation.

ELE3.13.030.9 FUSES TO BS 88:PART 6

1. Fuses of compact dimensions shall comply with IEC 60269-1 and BS 88:Part 6 or BS 88-2;

2. Fuses shall be type-tested to IEC 60269-1 and BS 88:Part 6 or BS 88-2. Type test of 'Verification of Breaking Capacity' shall be carried out by a Short-Circuit Testing Organisation.

ELE3.15 CONTACTORS

ELE3.15.1 GENERAL APPLICATION

ELE3.15.1.010.9 STANDARD

Contactors shall comply with IEC 60947-4-1.

ELE3.15.1.020.9 RATINGS

1.	Rated operational voltage:	380/220V
2.	Rated insulation voltage:	415V
3.	Rated frequency:	50Hz
4.	Pollution degree:	3
5.	Conventional enclosed thermal current:	As shown on the drawings
6.	Rated operational current/power and duty:	As shown on the drawings

ELE3.15.1.030.9 CONSTRUCTION AND DESIGN

1. Contactors shall be four-pole, triple-pole, double-pole or single-pole as shown on the Drawings;
2. The mechanical endurance of the contactors shall not be less than 3 million no-load operating cycles;
3. Unless otherwise specified, the number of on-load operating cycles for category AC-3 shall not be less than 1/20 of the number of no-load operating cycles corresponding to the mechanical endurance of the contactor;
4. Contactors shall be silver or silver-faced;
5. Insulation shall be of class B of IEC 60085.

ELE3.15.1.040.9 OPERATION

Contactors shall be electro-magnetically controlled, double air-break type. The rated control circuit voltage shall be the same as that of the main circuit; otherwise it shall be 24V, 30V or 110V d.c. as specified.

ELE3.15.1.050.9 UTILISATION CATEGORY

1. Unless otherwise specified, contactors shall be of utilisation category AC-2 for general application;
2. For special applications described in clause ELE3.15.2, the utilisation categories of the contactors used shall comply with the correspondent requirements accordingly. Contactors with utilisation category other than the stipulated categories are acceptable provided that the test currents, voltages, power factors or time constants, number of operating cycles, the on and off times given in the Tables 7 and 8 of IEC 60947-4-1 and the test circuit for the assigned utilisation categories are not more severe than those of the contactor has been tested and the temperature rise has been verified at a current not less than the highest assigned rated operational current in continuous duty.

ELE3.15.1.060.9 TYPE TESTS

Contactors shall be type-tested to IEC 60947-1 and IEC 60947-4-1. Full type-test certificates shall be produced to the satisfaction of the Contract Manager.

ELE3.15.2 SPECIAL APPLICATIONS

ELE3.15.2.010.9 CHANGEOVER CONTACTORS FOR CUBICLE TYPE SWITCHBOARD

1. Two identical contactors, mechanically and electrically interlocked such that only one of them can be closed at any one time, shall be used;
2. Each changeover contactor shall be enclosed in a separate and segregated compartment with a hinged front door as specified in ELE4.2.050. The contactor shall be provided with phase barriers and arcing chutes where applicable. At least one "a" contact and one "b" contact shall be provided for each contactor;
3. Contactors shall be rated for AC-3 utilisation category and intermittent duty of Class 30. When the main contacts of a contactor remain closed at either the main supply side or the essential supply side, the contactor shall be suitably rated for the specified current for uninterrupted duty;
4. Prior to the time of material submission for approval, the equipment shall have proven record of reliability in local application for a minimum continuous period of 12 months to the satisfaction of the Contract Manager.

ELE3.15.2.020.9 CONTROL CONTACTORS FOR POWER FACTOR CORRECTION EQUIPMENT

1. The contacts shall be of quick break and have a high arc resistance during switching operation;
2. Contactors shall be of utilisation category AC-6b and specifically designed for switching direct connected capacitor banks with intermittent duty of Class 30.

ELE3.15.2.030.9 CONTACTORS FOR MOTOR STARTER

1. Contactors for star/delta starting or reversing contactors shall be fitted with the necessary mechanical and electrical interlocks;
2. Contactors shall be of utilisation category AC-3 for general motor circuits and AC-4 for motor circuits with plugging or inching facilities. Contactors for motor starters of AC-3 utilisation category shall be of uninterrupted duty and intermittent duty Class 12, 60% on-load factor; and contactors for AC-4 category shall be of intermittent duty Class 30, 60% on-load factor.

ELE3.15.2.040.9 CONTROL CONTACTORS FOR DISCHARGE LAMPS

Contactors shall be of utilisation category AC-5a for electric discharge lamps. Also it shall be specifically designed for switching operations of the lamps with intermittent duty of Class 30.

ELE3.15.2.050.9 CONTROL CONTACTORS FOR HERMETIC REFRIGERANT COMPRESSOR MOTORS

Contactors shall be of utilisation category AC-8a for hermetic refrigerant compressor motors with manual reset of overload releases and AC-8b for the one with automatic reset of overload releases. Also it shall be specifically designed for switching operations of these items with intermittent duty of Class 30.

ELE3.16 STARTERS

ELE3.16.010.9 GENERAL

Starters shall be air-break triple pole electromagnetic contractor type and shall comply with and be tested to IEC 60947-4-1 or EN 60947-4-1. Unless otherwise specified, each starter shall comprise an isolating device, a thermal overload protective device, main and auxiliary contacts, on/off controls and indications.

ELE3.16.020.9 UTILISATION CATEGORY

Starters shall be of utilisation categories AC-3 for general motor circuits and AC-4 for motor circuits with plugging or inching facilities. Motor starters for AC-3 utilisation category shall be of both uninterrupted duty and intermittent duty Class 0.1 60% on-load factor. Starters of category AC-4 shall be of intermittent duty Class 0.3 60% on-load factor.

ELE3.16.030.9 MECHANICAL AND ELECTRICAL ENDURANCE

1. The mechanical and electrical endurance of the starters shall be tested in accordance with IEC 60947-4-1 or EN 60947-4-1;
2. The mechanical endurance of the starters shall not be less than 0.1 million no-load operating cycles for category AC-3 starters and 0.3 million no-load operating cycles for AC-4 starters;
3. The number of on-load operating cycles for category AC-3 starters shall not be less than 1/20 of the number of no-load operating cycles corresponding to the mechanical endurance of the starters.

ELE3.16.040.9 THERMAL OVERLOAD RELAY

Thermal overload relay shall be Type B compensated for ambient temperature of 40°C and have a setting range of 50% - 150% rated operational current.

ELE3.16.050.9 AUXILIARIES

For assisted start starters, timers shall be solid state plug-in type with 0 - 15 seconds setting. For star/delta and reversing starters, mechanical and electrical interlocks shall be fitted with the contactors.

ELE3.17 TIME SWITCHES

ELE3.17.010.9 OPERATION

Time switches shall be self-starting and driven by synchronous motor or an electronic operated clock.

ELE3.17.020.9 MOUNTING/HOUSING

Time switches shall be suitable for either flush, surface or panel mounting as specified in ELE2 and shall be housed in metal or robust moulded plastic enclosure with a removable clear plastic front cover.

ELE3.17.030.9 RATING

The time switches shall be rated at 15A (Resistive load) unless otherwise specified. The time accuracy shall be within ±1 second per day.

ELE3.17.040.9 FEATURES

1. An automatic rewind spring reserve or lithium/NiMH battery backup, of not less than 72 hours, to drive the mechanism during power interruption;
2. A 24-hour dial with at least 2 "ON-OFF" operation cycles everyday;
3. An on/off or test switch to enable the circuit to be controlled at will without affecting the normal dial operation;
4. A minimum time setting period of 15 minutes shall be achievable.

ELE3.18 MEASURING INSTRUMENTS

ELE3.18.010.9 KILOWATT-HOUR METERS

1. Kilowatt-hour meters shall be of a digital display type suitable for small rating circuits and have rated current not less than the rating of the circuit protection MCBs at the upstream of the corresponding circuits, single-phase or three-phase, as shown on the Drawings;
2. The meters shall comply with IEC 62053-21 or BS EN 62053-21, with IP51 in protective enclosure for indoor meters;
3. The meters shall be of direct connection type or connection with external measuring current transformers (MCTs) as appropriate to suit the rating of measured circuits;
4. The meters shall be mounted on a DIN rail and housed inside a metal enclosure with the display exposed to view on the front cover;
5. The display of the meter shall show the accumulative reading in kilowatt-hour and have minimum 4 digits. The reading shall be maintained even under power interruption and be continued upon power resumption;
6. The accuracy of the meters shall not be less than Class 1 according to IEC 62053-21 or BS EN 62053-21. The manufacturer shall issue a calibration certificate for every batch of meters at time of production and the calibration certificate shall be submitted to the Contract Manager. Such calibration shall be conducted by the manufacturer within one year prior to delivery of the meter on site. The manufacturer shall also declare in writing that the meter shall require no re-calibration for a minimum of 10 years from the time of issue of calibration certificate. A label marking the manufacturer's calibration date shall be fixed adjacent to the meter;
7. The meters shall comply with the Electromagnetic Compatibility (EMC) requirements in accordance with IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4 and IEC 61000-4-5 standards.

ELE3.18.020.9 AMMETERS AND VOLTMETERS

1.
   a. Ammeters and voltmeters shall be of moving iron type or moving magnet type or moving coil with transducer type, complying with IEC 60051-1 and IEC 60051-2;
   b. The accuracy class shall be "2.5" or better in accordance with IEC 60051-1 and IEC 60051-2;
   c. The dial shall have a nominal diameter of approximate 75 mm and shall have a minimum scale deflection of 90°.
2.
   a. An ammeter for any circuit of rating up to 60A may be connected directly in series with the circuit, so that the full circuit current passes through the instrument;
   b. For a circuit of rating exceeding 60A, the ammeter shall be fed through the secondary winding of a current transformer, and shall give a scale deflection with a secondary current of 5A.

ELE3.18.030.9 CURRENT TRANSFORMERS

Current transformers for use with measuring instruments shall comply with IEC 61869-2 or BS EN 61869-2 having rated secondary current of 5A and rated output suitably matched with the burden of the measuring instrument.

ELE3.18.040.9 SELECTOR SWITCH FOR AMMETER

1. Where a single ammeter is used to measure the current in each phase, or the neutral of a three phase circuit, the ammeter shall be connected to a selector switch which shall enable the ammeter to be inserted in series with each phase and the neutral in turn;
2. When the ammeter is connected to the secondary windings of the measuring current transformers, the selector switch shall have facilities to prevent the current transformers from being open circuited during change-over and at OFF position.

ELE3.18.050.9 SELECTOR SWITCH FOR VOLTMETERS

1. In three phase circuits, in which a single voltmeter is used to measure the voltage, the voltmeter shall be provided with a selector switch to enable the following voltages to be measured:
    a. Voltage between each phase to neutral;
    b. Voltage between any two phases.
2. The selector switch shall also have an OFF position.

ELE3.18.060.9 MOUNTING POSITION OF SELECTOR SWITCHES

Selector switches for ammeters or voltmeters shall be mounted immediately below the meters with which they are associated.

ELE3.18.070.9 METER CHAMBERS

1. Construction:
    a. Meter chambers for housing kilowatt-hour meters shall be made of galvanised steel not less than 1.6 mm thick and shall be of ample size to accommodate the required number of kilowatt-hour meters and meter cables;
    b. Provision shall be made to enable the kilowatt-hour meters to be fixed inside the chamber without removing the chamber from the wall or other supports;
    c. Meter fixing screws shall not project through the back of the chamber.
2. Front covers:
    a. When a meter chamber is installed indoors, it shall be fitted with a hinged metal front cover;
    b. Meter chambers installed outdoors shall be weatherproof, with screw-on type front covers;
    c. The degree of protection in the latter case shall be of at least IP54 in accordance with IEC 60529.
3. Windows:
    a. Glass windows shall be provided in the front covers of meter chambers to enable the registers of the kilowatt-hour meters to be read easily;
    b. A window shall be provided for each meter, and the size of the window shall be large enough to enable the serial number of the meter and the register to be clearly visible.

ELE3.18.080.9 MOUNTING OF CURRENT TRANSFORMERS ASSOCIATED WITH A WATT-HOUR METER

1. Current transformers, if required in association with a watt-hour meter, may be mounted inside the meter chamber, or in a separate current transformer chamber, as dictated by the circumstances of each particular job;
2. When current transformers are mounted in the meter chamber, the front cover shall be arranged so that the opening or removal of the front cover to gain access to the meters will not expose the current transformers;
3. A separate cover giving access to the current transformers compartment shall be provided;
4. Suitable engraved labels shall be fixed on the covers to identify the installed equipment therein.

ELE3.18.090.9 IDENTIFICATION OF INSTRUMENTS

Each measuring instrument shall be identified by means of a label fitted under the associated instrument. This label shall denote the function of the circuit connected to the meter.

ELE3.19 SITE BUILT ASSEMBLIES

ELE3.19.010.9 SITE BUILT ASSEMBLIES

Site built assemblies of switchgear and controlgear shall be constructed, assembled and installed in accordance with ELE2 or the Drawings. They shall also comply with and be tested to the relevant BS EN/BS/IEC Specifications.

ELE3.20 FIREMAN'S EMERGENCY SWITCH

ELE3.20.010.9 GENERAL

1. The fireman's emergency switch shall comply with IEC 60947-3;
2. The fireman's emergency switch shall be coloured red with aluminium enclosure. The switch shall be weatherproof with ingress protection of at least IP65 to BS EN 60529 or IEC 60529;
3. The fireman's emergency switch shall have its 'ON' and 'OFF' positions clearly indicated by lettering legible to a person standing on the ground at the intended site, with the 'OFF position at the top;
4. The fireman's emergency switch shall be provided with a device with interlocking mechanism to prevent the switch being inadvertently returned to the 'ON' position;
5. The fireman's emergency switch shall be provided with an operating handle which is designed in such a way that a fireman-hook or axe can be used to switch off the switch.

ELE4 CUBICLE TYPE SWITCHBOARDS

ELE4.1 GENERAL 4

ELE4.1.005.9 STANDARDS 4
ELE4.1.015.A SWITCHBOARDS 4
ELE4.1.025.A DESIGN VERIFICATION 4
ELE4.1.028.N MODIFICATIONS MADE TO A VERIFIED (TYPE TESTED) ASSEMBLY 5
ELE4.1.035.A SHORT-CIRCUIT WITHSTAND STRENGTH VERIFICATION 5

ELE4.2 ASSEMBLIES - DESIGN AND CONSTRUCTION 7

ELE4.2.015.9 GENERAL ARRANGEMENT 7
ELE4.2.020.A MECHANICAL DESIGN 7
ELE4.2.035.A PROTECTION AGAINST ELECTRIC SHOCK AND EXTERNAL INFLUENCES 7
ELE4.2.040.9 FINISH 8
ELE4.2.055.A COMPARTMENTATION 8

ELE4.3 ASSEMBLIES - COMPONENTS AND AUXILIARIES 10

ELE4.3.1 BUSBARS AND BUSBAR CONNECTIONS 10
ELE4.3.1.015.9 STANDARD 10
ELE4.3.1.025.A RATING 10
ELE4.3.1.035.A BUSBARS 10
ELE4.3.1.040.9 ARRANGEMENT OF BUSBARS AND CONNECTIONS 10
ELE4.3.1.055.9 BUSBAR IDENTIFICATION 11
ELE4.3.1.065.9 BUSBAR JOINTING AND SUPPORT 11
ELE4.3.1.075.9 PROTECTIVE CONDUCTORS 11
ELE4.3.1.080.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 11

ELE4.3.2 AUXILIARY CIRCUITS 12
ELE4.3.2.010.9 WIRING 12
ELE4.3.2.020.9 MARKING 12
ELE4.3.2.030.9 TERMINATION 12

ELE4.3.3 AIR CIRCUIT BREAKERS 13
ELE4.3.3.015.9 STANDARDS 13
ELE4.3.3.025.A RATING 13
ELE4.3.3.035.A CIRCUIT BREAKER 13
ELE4.3.3.040.9 MECHANICAL INTERLOCKS 14
ELE4.3.3.050.9 CIRCUIT BREAKER COMPARTMENT/INTERLOCK 15
ELE4.3.3.060.9 SAFETY SHUTTERS 15
ELE4.3.3.070.A AUXILIARY CONTACTS, CONTROL CONTACTS AND AUXILIARY SWITCHES 15

ELE4.3.4 FUSE COMBINATION UNITS AND SWITCH-DISCONNECTORS 15
ELE4.3.4.010.9 COMPLIANCE WITH SPECIFICATION 15
ELE4.3.4.025.9 ASSEMBLY 16
ELE4.3.4.035.9 SWITCHING DEVICE 16
ELE4.3.4.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 16

ELE4.3.5 CHANGEOVER CONTACTORS 16
ELE4.3.5.010.9 COMPLIANCE WITH SPECIFICATION 16
ELE4.3.5.025.9 INSTALLATION 16
ELE4.3.5.030.9 SHORT-CIRCUIT WITHSTAND CAPACITY 16

ELE4.3.5.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 16
ELE4.3.6 CABLE TERMINATION 16
ELE4.3.6.015.9 INCOMING/OUTGOING CABLES 16
ELE4.3.6.020.9 CABLE GLAND PLATES 17
ELE4.3.6.030.9 CABLE SUPPORTS 17
ELE4.3.7 SUPPLY COMPANY'S METERING EQUIPMENT 17
ELE4.3.7.010.9 METERING COMPARTMENTS 17
ELE4.3.7.020.9 METERING EQUIPMENT 17
ELE4.3.8 MOULDED CASE CIRCUIT BREAKERS (MCCB) 17
ELE4.3.8.010.9 COMPLIANCE WITH SPECIFICATION 17
ELE4.3.8.025.9 INSTALLATION 17
ELE4.3.8.030.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 18
ELE4.3.9 POWER FACTOR CORRECTION EQUIPMENT 18
ELE4.3.9.010.9 COMPLIANCE WITH SPECIFICATION 18

ELE4.4 PROTECTION AND INSTRUMENTATION 19

ELE4.4.1 CIRCUIT BREAKER PROTECTION 19
ELE4.4.1.015.9 COMPLIANCE WITH SPECIFICATION 19
ELE4.4.1.020.9 PROTECTION SCHEME WITH EXTERNAL D.C. SOURCE FOR TRIPPING 19
ELE4.4.1.035.A BATTERY SET AND CHARGER 19
ELE4.4.1.040.9 ELECTROMECHANICAL TYPE PROTECTION RELAY 20
ELE4.4.1.050.9 ELECTRONIC TYPE PROTECTION RELAYS 20
ELE4.4.1.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY FOR ELECTROMECHANICAL AND ELECTRONIC TYPE PROTECTION RELAY 21
ELE4.4.3 FUSE PROTECTION 22
ELE4.4.3.010.9 METHOD OF PROTECTION 22
ELE4.4.3.020.9 COMPLIANCE WITH SPECIFICATION 22
ELE4.4.4 CURRENT TRANSFORMERS 22
ELE4.4.4.010.A STANDARD AND TYPE 22
ELE4.4.4.020.9 MEASURING CURRENT TRANSFORMERS 22
ELE4.4.4.030.A PROTECTION CURRENT TRANSFORMERS 22
ELE4.4.4.040.9 FITTING 22
ELE4.4.5 INDICATING METERS 22
ELE4.4.5.010.9 STANDARD 22
ELE4.4.5.020.9 MOUNTING 22
ELE4.4.5.030.9 MONITORING 23
ELE4.4.5.040.A MULTI-FUNCTION ELECTRONIC METERS 23
ELE4.4.6 VOLTAGE SENSING RELAYS 24
ELE4.4.6.010.A GENERAL 24
ELE4.4.6.025.9 FEATURES 24
ELE4.4.6.030.A FACTORY TESTING 25
ELE4.4.7 BATTERY SET AND CHARGER FOR CONTROL CIRCUIT ... 25
ELE4.4.7.015.9 BATTERY SET AND CHARGER 25
ELE4.4.8 INDICATING LIGHTS 26
ELE4.4.8.010.9 INDICATING LIGHTS ON FRONT PANEL OF ASSEMBLY 26

ELE4.5 MISCELLANEOUS 27

ELE4.5.1 INFORMATION, MARKING AND LABELLING 27
ELE4.5.1.015.A INFORMATION TO BE GIVEN 27
ELE4.5.1.020.A LABELS AND MARKINGS 27
ELE4.5.2 VERIFICATION AND TESTING 28
ELE4.5.2.015.9 VERIFICATION 28
ELE4.5.2.025.A WORKSHOP TESTS (FACTORY ACCEPTANCE TEST) 28
ELE4.5.2.030.A SITE ACCEPTANCE TESTS 29
ELE4.5.2.040.9 COMMISSIONING TESTS 29
ELE4.5.3 AUXILIARY EQUIPMENT 29
ELE4.5.3.010.9 COMPLETENESS 29

ELE4.1 GENERAL

ELE4.1.005.9 STANDARDS

Switchboards shall be constructed to fully comply with IEC 61439-1 and IEC 61439-2 standards.

ELE4.1.015.A SWITCHBOARDS

1. Switchboards shall be low-voltage switchgear and controlgear assemblies (hereinafter referred to as "ASSEMBLY" or "ASSEMBLIES") in full compliance with IEC 61439-1 and IEC 61439-2. They shall be of the enclosed, stationary, floor-standing, multi-cubicle type ASSEMBLIES for indoor use;
2. The manufacturer shall operate quality management system including design, manufacture, installation and maintenance of the ASSEMBLIES conforming to ISO 9001 and be certified by a certification body which is accredited by one of the following accreditation bodies:
    a. Hong Kong Accreditation Services (HKAS);
    b. An accreditation body considered as having equivalent standard by the Development Bureau.
3. In the case where the ASSEMBLIES are manufactured under licence from a Principal Company, a letter of guarantee from the Principal Company shall be produced to prove that the products manufactured by the licences are equivalent, in every respect, to those verified standard products;
4. Prior to delivery to Site, the ASSEMBLIES shall have satisfactory proven record of reliability in local application for a minimum period of 12 months which shall be established after the satisfactory completion of the original design verification in compliance with IEC 61439-1 and IEC 61439-2;
5. All materials and components used in the ASSEMBLIES shall be of the same make and brand of the verified ones. Alternative materials or components will not be accepted without prior Approval;
6. The ASSEMBLIES shall adopt the full compliance of IEC 61439-1 and IEC 61439-2 as a whole.

ELE4.1.025.A DESIGN VERIFICATION

1. Three different but equivalent types of verification of requirements as stipulated in Annex D of IEC 61439-1 shall be made for the ASSEMBLIES:
    a. Verification testing (type testing);
    b. Verification comparison with a tested reference design;
    c. Verification assessment, i.e. confirmation of the correct application of calculations and design rules, including use of appropriate safety margins.
2. ASSEMBLIES, circuit breakers and fuse combination units shall be verified to comply with IEC 61439-1 and IEC 61439-2, IEC 60947-2 and IEC 60947-3 respectively. They shall be suitable for installation under environment condition of pollution degree 3 unless otherwise specified;

3. Certificates for verification complete with reports and drawings showing enclosures and partitions of the ASSEMBLIES to demonstrate the segregation of circuits, the type and thickness of insulation barriers, details of insulating supports and the clearances of equipment that passed the verification shall be submitted if required by the CM;

4. Verification shall be substantiated by test certificates / reports and / or graphs, calculations, etc. together with the details of the verified arrangement from which is derived.

ELE4.1.028.N MODIFICATIONS MADE TO A VERIFIED (TYPE TESTED) ASSEMBLY

1. If modifications are made to a verified ASSEMBLY, Clause 10 of IEC 61439-1 shall be used to check if these modifications will affect the performance of the ASSEMBLY. New verifications shall be carried out if an adverse effect is likely to occur. Certification bodies recognised by the electrical CoP as shown in Code 4A as Recognised Certification Bodies for testing of low voltage switchgear and control gear assemblies shall be considered eligible to be third party design checker for assessment and verification of ASSEMBLY design employing design calculation approach as allowed in IEC 61439-2;

2. A functional unit (ACB, MCCB, switchfuse, fuseswitch and changeover contactor / switch) in the verified ASSEMBLY may be substituted with a similar device from another series of the same manufacturer to that used in the original verification, provided that:

   a. The power loss and terminal temperature rise of the device, when tested in accordance with its product standard, is the same or lower;

   b. The physical arrangement within the functional unit and the rating of the functional unit shall be maintained;

   c. Other requirements are considered including the short-circuit requirements according to Table 13 of IEC 61439-1.

3. The configuration of the busbar and functional unit assembly contained in the ASSEMBLY shall be the same as shown on the verification test drawings. Modifications are only allowed if these modifications will not affect the performance of the ASSEMBLY. As far as temperature-rise matters are concerned, any change in the configuration shall not have any adverse thermal influences of the adjacent units and shall be substantiated in accordance with ELE4.1.028 (2a) and further verified by temperature rise limits test in accordance with ELE4.5.2.025 (1g). Any change of configurations which may introduce negative impact to the short-circuit performance of the ASSEMBLY will require separate test certificates issued by certification bodies unless verification in accordance with all the criteria specified in Table 13 of IEC 61439-1 is submitted by the Sub-contractor and approved by the CM.

ELE4.1.035.A SHORT-CIRCUIT WITHSTAND STRENGTH VERIFICATION

1. ASSEMBLIES:

   The following short-circuit withstand strength verification on the main circuits of ASSEMBLIES shall be carried out by a Short Circuit Testing Organization in compliance with IEC 61439-1 and IEC 61439-2 at the value of short circuit currents specified below:

Circuit	Test Current

a. Busbars connected to the outgoing terminals of the outgoing functional unit in accordance with Clause10.11.5.3.2 of IEC 61439-1	50kA for 1 second when outgoing functional unit is an air circuit breaker; Prospective short-circuit current of 50kA to flow until it is broken when the outgoing functional unit is a fuse combination unit or MCCB unit.
b. Main busbars including riser / droppers and the busbars connected to the outgoing terminals of the mains incoming circuit breaker in accordance with Clause 10.11.5.3.3 of IEC 61439-1	50kA for 1 second
c. Neutral busbars of the above circuits in accordance with Clause 10.11.5.3.5 of IEC 61439-1	30kA for 1 second
d. Separate protective conductors and the terminals for the outgoing protective conductor in accordance with Clause 10.11.5.6 of IEC 61439-1	30kA for 1 second at main earth bar; Prospective short-circuit current of 30kA to flow until it is broken at outgoing protective conductor in each modular section.

2. Circuit breakers and fuse combination units:

   The following short-circuit type-test on the circuit breakers and fuse combination units shall also be carried out by a Short Circuit Testing Organization in accordance with IEC 60947-2 and IEC 60947-3 respectively:

Switchgear	Test Current
a. Air Circuit Breakers:	
i. Rated service short-circuit breaking capacities:	50kA
ii. Rated short-circuit making capacity:	105kA at 0.25p.f.
iii. Rated short-time withstand current:	50kA for 1 second
b. MCCBs:	
Rated ultimate short-circuit breaking capacity:	50kA
c. Fuse Combination Units:	
Rated fused short-circuit current:	50kA

ELE4.2 ASSEMBLIES - DESIGN AND CONSTRUCTION

ELE4.2.015.9 GENERAL ARRANGEMENT

1. ASSEMBLIES shall be formed from one or more modular sections (vertical-panel), each with a maximum width not exceeding 1000 mm and shall not accommodate more than two fuse combination units or two MCCB units in the same row. They shall be fitted together to form a flush front continuous board of uniform height and depth front-to-back and be suitable for floor mounting without any mounting structure. ASSEMBLIES shall be pleasing in appearance and shall be extensible at both ends;
2. ASSEMBLIES shall be of totally enclosed type with openings only for ventilating purposes. Ventilating grills or louvres located on top of the board shall be protected against ingress of condensate water (see also ELE4.2.035). In no case shall ventilating louvres be located at the front of ASSEMBLIES;
3. No forced ventilation to any components of ASSEMBLIES is allowed.

ELE4.2.020.A MECHANICAL DESIGN

1. The construction of the ASSEMBLIES shall be structurally, mechanically and electrically sound and shall be of steel construction, self supporting, with the enclosures, covers, removable covers and cover plates made of sheet steel of not less than 2 mm thick. All removable covers and doors shall be notched and all joints shall be machined to give a rigid, robust and smooth appearance to the satisfaction of the CM;
2. Marks of welding shall not be visible from the external surface of panels;
3. Detachable hinges shall be provided for the doors. Exposed hinges shall be bright cadmium or nickel chromium plated;
4. Gaskets shall be fitted on doors and removable covers and shall be continuous, without joints around corners, and suitably arranged to minimize the transmission of vibration, and to prevent the entry of dust.

ELE4.2.035.A PROTECTION AGAINST ELECTRIC SHOCK AND EXTERNAL INFLUENCES

1. Basic protection (protection against direct contact) shall be by means of barriers of enclosures in accordance with IEC 61439-1 and IEC 61439-2;
2. All external surfaces of an ASSEMBLY shall have a degree of protection against ingress of solid foreign bodies and liquid of at least IP31 in the normal service condition in accordance with IEC 61439-1 and IEC 61439-2;
3. With the front-hinged door of the functional units open and in replacing the fuse links, the degree of protection to the live part shall be at least IP2X. If the degree of protection to the neutral conductor of the live part cannot comply with this requirement, a warning label shall be provided next to the neutral conductor;
4. The bottom of the ASSEMBLY shall be closed and made vermin-proof by means of barriers cut away, where required, to fit the cables passing through. The barriers in the cable compartment shall be made of phenolic resin bonded paper laminate sheet of a minimum thickness of 6 mm;

5. The construction of the enclosure shall be the same for ASSEMBLIES under all types of verification, and be checked by visual inspection and standard test finger, if necessary, as specified in IEC 60529;
6. Fault protection (protection against indirect contact) shall be by means of protective circuits in accordance with IEC 61439-1 and IEC 61439-2. The size and installation of the protective conductors in an ASSEMBLY shall be in accordance with ELE4.3.1.075.

ELE4.2.040.9 FINISH

1. Before untreated steel work is painted, it shall be thoroughly cleaned by an Approved method, such as grit-blasting or chemical pickling and an Approved rust inhibitive priming coat applied. Treated steelwork e.g. zintec, shall be suitably cleaned and degreased;
2. Surfaces shall then have not less than two coats of stoved finish paint of contrasting colours; the finishing colour, both interior and exterior shall be equivalent to colour code 00A01 of BS 4800 (light grey) or lighter;
3. Care shall be taken to ensure that edges of metalwork have an adequate dry film thickness of paint and that paint build-up does not occur at edges;
4. Alternative finishing processes such as phosphate treatment followed by stoved epoxy powder paint conforming to BS EN 12476 will also be accepted.

ELE4.2.055.A COMPARTMENTATION

1. Internal separation of an ASSEMBLY shall be provided by means of barriers or partitions made of sheet steel or non-hygroscopic and flame retardant insulating materials rigidly fixed;
2. The size and construction of the compartments shall be the same as the type-tested ones;
3. Openings necessary for interconnection, control or ventilation shall be at least IP2X for protection against contact with live parts in the adjacent compartments, and be such that exhaust outlets of functional units shall not discharge directly to the live parts in adjacent compartments;
4. The ASSEMBLY shall be capable of withstanding any external fault. In the event of any internal arcing fault on a functional unit, the damage shall be confined to that unit so that the busbar and all other functional units remain fit for further service;
5. The internal separation shall be of Form 3b in accordance with IEC 61439-2. Further compartmentation shall also be provided for each of the following equipment:
    a. Incoming power supply cables, conductors and connections to the incoming supply side terminals of each incoming circuit breakers;
    b. Protective relays and terminal blocks;
    c. Batteries and Battery Charger;
    d. Supply Company's meter;
    e. Supply Company's CT;
    f. Capacitor bank;
    g. Fuse combination unit for capacitor bank;
    h. Control gears and relays for capacitor bank;
    i. Each section (vertical-panel) except the horizontal busbar compartments;

j. Cable terminals for outgoing functional units.

6. Front doors shall be provided for items given in sub-clauses (5)(b), (5)(c), (5)(d), (5)(e), (5)(g) and (5)(h) above and each outgoing functional units;

7. Removal back covers shall be completed with pair of handles for easy fixing and removal and provided for items given in sub-clauses (5)(a), (5)(f) and (5)(i) above;

8. Voltmeters, ammeters, multi-function electronic meters together with associated switches and indication lamps are allowed to be mounted on the front cover/door of the respective functional unit, provided that they do not obstruct the operation of the unit, are suitably protected against direct contact of live parts of at least IP2X, even when the door is open and, are properly earthed.

ELE4.3 ASSEMBLIES - COMPONENTS AND AUXILIARIES

ELE4.3.1 BUSBARS AND BUSBAR CONNECTIONS

ELE4.3.1.015.9 STANDARD

Assembly: IEC 61439-1 and IEC 61439-2.

ELE4.3.1.025.A RATING

1. Rated insulation voltage:	415V minimum
2. Rated operational voltage:	380/220V
3. Rated current:	100A, 200A, 400A, 800A, 1200A, 1600A, 2500A, 3200A as shown on the drawings
4. Rated frequency:	50Hz
5. Rated short-time withstand current:	as specified in ELE4.1.035

ELE4.3.1.035.A BUSBARS

1. Busbars shall be three phase and full rating neutral busbar made of hard drawn, high conductivity, bare solid copper bars to BS EN 13601 with electrotinned finish. The temperature-rise verification with rated current on each busbar section shall be witnessed by an acceptable third-party;
2. Main busbars shall run horizontally and conform to the verification arrangement;
3. A vertical busbar riser / dropper shall be required for each section of the ASSEMBLY where switchgears are arranged in multi-tier, with a cross-section capable of carrying either the total rated current of all outgoing functional units including spare outgoing functional units connected to it or the current rating of the upstream protective device protecting it, whichever is the less, without undue temperature-rise in accordance with Clause 10.10 of IEC 61439-1 and IEC 61439-2;
4. Busbars connecting the riser / dropper to the supply side of outgoing functional unit shall be with adequate insulation or shrouding;
5. Busbars shall be provided to connect between functional units and to extend each outgoing terminal of the functional units to the cabling compartment;
6. Where connection by busbars from busbar riser / dropper to the supply terminals of those outgoing functional units of small rating are not possible, appropriate functional units with suitable frame size shall be selected instead such that the connection by busbars could be maintained throughout the entire ASSEMBLY.

ELE4.3.1.040.9 ARRANGEMENT OF BUSBARS AND CONNECTIONS

1. In the incoming terminal compartment, the busbars shall be arranged in a manner that the provision and arrangement for the cable/busbar terminations shall comply with the Supply Company's requirement;
2. Unless otherwise specified, busbars and main connections which are generally in one plane shall be arranged in the order of L1-L2-L3 phases as follows:

a. If the run of the conductors is horizontal, the L1 phase shall be the top, or the left or farthest away as viewed from the front of the ASSEMBLY;

b. If the run of the conductor is vertical, the L1 phase shall be the left or farthest away as viewed from the front of the ASSEMBLY.

3. The busbars from the incoming supply connections through the incomer circuit breaker to the nearest main horizontal busbars, which follow the phase notation of the Supply Company's incoming terminals, shall also be acceptable;

4. The neutral shall occupy the outer position and shall be clearly marked.

ELE4.3.1.055.9 BUSBAR IDENTIFICATION

Each busbar and protective conductor shall be identified by colours in accordance with the Electrical CoP. The terminals for external protective conductors shall be marked in accordance with IEC 61439-1 and IEC 61439-2.

ELE4.3.1.065.9 BUSBAR JOINTING AND SUPPORT

1. Jointing of sections of busbars shall be made by bolts and nuts or clamps. Soldered, welded or riveted joints shall not be used;

2. Bolts for jointing busbars shall be of steel, either hot-dip galvanized or heavily eletroplated with zinc or cadmium, to guard against corrosion;

3. Conductors shall be supported on insulators of non-hygroscopic and non-deteriorating materials as verification;

4. The method and materials used in jointing and support shall conform to the verification arrangement.

ELE4.3.1.075.9 PROTECTIVE CONDUCTORS

1. Protective conductors shall be of size in accordance with IEC 61439-1 and IEC 61439-2;

2. The cross sectional area and the installation of the protective conductor shall be so selected and designed to eliminate the possibility of the fault current in the protective conductor causing a temperature rise that may damage the conductor or impair its electrical continuity before the operation of the protective device, for a duration that may last up to 5 seconds;

3. A continuous tinned copper bar of size satisfying the above requirement and in any case not less than 150 mm² shall be fixed at the rear interior bottom portion throughout the length of the ASSEMBLY, bonding the frame-work of all modular sections, terminals for the outgoing protective conductor(s) of each circuit, the circuit breaker's earthing terminal and finally connected to the earthing terminals on the external surface at the extreme ends of the ASSEMBLY.

ELE4.3.1.080.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of busbars delivered to Site or installed.

ELE4.3.2 AUXILIARY CIRCUITS

ELE4.3.2.010.9 WIRING

1. All auxiliary circuits shall be wired in PVC insulated copper cables to type CK of BS 6231 of not less than 2.5 mm² conductor;
2. All wiring shall be clipped in a neat and tidy manner by nylon type cable ties or installed in plastic wiring channels;
3. Wiring from the fixed part of the ASSEMBLY to equipment mounted on the hinged door shall be enclosed by a flexible PVC tubing.

ELE4.3.2.020.9 MARKING

1. Sleeve type cable markers shall be fitted to both ends of each length of cable to denote its function; the function letter shall be followed by a number identifying the individual wire;
2. Each branch of any connection shall bear the same identification mark. Where it is necessary to identify branches which are common, different identification marks for the branches shall be employed only if they are common through links or are connected to separate terminals which are then common by removable connections;
3. Numbering shall read from the terminals outwards on all wires;
4. Circuit function letters and wire numbers shall be in accordance with the following table:

Circuit		Test Current
C	Current transformers for over-current protection (including combined earth-fault protection) and instruments	10 - 29 : L1 phase 30 - 49 : L2 phase 50 - 69 : L3 phase 70 - 89 : residual circuit and neutral current transformer
D	Current transformers for metering and voltage control	90 : circuit protective conductors directly connected to the earthing bar
J	D.C. and d.c. supply	1 - 69
H	A.C. and a.c. supply	1 - 69
K	Closing and tripping control circuit	any number from 1 upwards
L	Alarms and indications initiated by auxiliary switches and relay contacts	any number from 1 upwards

ELE4.3.2.030.9 TERMINATION

1. Wiring from one section to another section of an ASSEMBLY shall feed through terminal blocks;
2. Except for the Supply Company's metering, test/disconnect terminal blocks shall be provided for each measurement and protection current transformer. The terminal blocks shall be housed in the same relay compartment with hinged front door;
3. All terminal blocks shall be feed-through terminal blocks with screw clamp connections and conforming to the following requirements:
    a. Electrical and mechanical characteristics to be type tested to IEC 60947-7-1;

b. Voltage rating 750V;

c. Moulding material to be melamine with low flammability as certified to UL94-V0(5V);

d. Designed to be mounted directly on assembly rail to BS 5825;

e. All current carrying parts to be copper coated with tin lead alloy. Clamping yokes and screw to be zinc plated steel with additional protection by a chromate layer.

In addition, test/disconnect terminal blocks complete with plugs and test sockets for tapping off/disconnection shall be provided for test and measurement circuits.

4. The terminal blocks shall be provided with manufacturer's standard assembly rails, end section, partition, bracket, cross connection plug, jumper bar, warning sign, plastic screw, marking tags, disconnect plugs, test plug bolt, test plug, etc.;

5. Only one cable shall be terminated in each terminal, where necessary, jumper bars or cross connecting plugs shall be used;

6. Terminal blocks for the live conductor shall be indicated with a warning sign and separated from other terminal blocks by partitions.

ELE4.3.3 AIR CIRCUIT BREAKERS

ELE4.3.3.015.9 STANDARDS

1. Circuit Breaker: IEC 60947-2;

2. Assembly: IEC 61439-1 and IEC 61439-2.

ELE4.3.3.025.A RATING

1. Rated operational voltage:	380V
2. Rated insulation voltage:	415V minimum
3. Rated frequency:	50Hz
4. Rated service short-circuit breaking capacity:	as specified in ELE4.1.035
5. Rated short-time withstand current:	as specified in ELE4.1.035
6. Rated-uninterrupted current:	800A, 1200A, 1600A, 2500A and 3200A as shown on the drawings

ELE4.3.3.035.A CIRCUIT BREAKER

1. The circuit breaker shall be triple pole or four pole as specified on the Drawings, air break and of metalclad, horizontal withdrawable type, fitted with a shunt trip coil and / or overcurrent release, depending on the type of protection scheme used, as specified in ELE4.4.1 and shown on the Drawings;

2. The circuit breaker shall be housed in a separate and segregated circuit breaker compartment as specified in ELE4.2.055. Each circuit breaker of triple pole type shall be complete with an accessible bolted type neutral link in accordance with the type-tested designs;

3. The circuit breaker shall have independent manual closing with stored energy or spring assisted mechanism, unless otherwise specified. Neutral link / pole shall be easily accessible for inspection and maintenance even after cabling;

4. Unless otherwise specified, opening and closing of incoming and bus-section ACB shall be capable of being remote controlled repeatedly by the integrally mounted shunt trip coil and shunt close coil respectively and shall be provided with on and off or "1" and "0" mechanical indicators on the front panel of the circuit breaker. The closing operation of the ACB shall be operable either by a solenoid coil or by a motorized mechanism;
5. For circuit breaker with mechanism controlled by a solenoid coil, the closing mechanism shall be controlled by the solenoid coil which replaces the standard closing spring. The a.c. supply to the rectifier for the solenoid coil shall be taken from the "Live" side of the circuit breaker. The closing contactor, rectifier and anti-hunting relay shall all be integrally mounted on the circuit breaker;
6. For circuit breaker with motorized mechanism, the closing spring shall be capable of being released electrically or manually and shall automatically be recharged upon each release operation with indication showing the mechanism is fully charged;
7. A push button shall be mounted on the front door of the circuit breaker to enable local closing for normal operation;
8. The remote closing and tripping function shall be designed to be operated through a pair of voltage free contacts on a remote operating device. A female 3-pin receptacle without the remote operating device shall be provided inside the IDMT Relay / Fuse chamber of the cubicle. The receptacle shall be of rating 250V 10A, a.c. to IEC 60320 or equivalent and approved standard. One number remote operating device shall be provided with each ASSEMBLY. The connection of the receptacle shall be as follows:
    a. Earth: common;
    b. Live: for remote closing;
    c. Neutral: for remote tripping.
9. The circuit breaker shall be of horizontal withdrawable type with 'connected', 'test' and 'isolated' positions, fitted with mechanical position indicators and pad-locking facilities in each of the positions;
10. The circuit breaker shall be type-tested and comply with the additional requirements for circuit breakers suitable for isolation in accordance with Clause 7.1.2 of IEC 60947-2.

ELE4.3.3.040.9 MECHANICAL INTERLOCKS

The circuit breaker shall be provided with the following mechanical interlocks:

1. Circuit breaker cannot be racked in or withdrawn when in closed position;
2. Circuit breaker can be closed only when the main circuit connection is fully connected. When circuit breaker is racked out to a position at test or completed isolated or a position in between the two, the breaker can also be closed for testing purpose as long as the main circuit connection is already fully opened;
3. With hand charged spring mechanism, initiation of the closing of the circuit breaker is not possible until the closing mechanism is fully charged;
4. Other mechanical interlocks if specified on the Drawings to facilitate sequential operation of circuit breakers/section switches of the ASSEMBLY incorporating more than one circuit breaker.

ELE4.3.3.050.9 CIRCUIT BREAKER COMPARTMENT/INTERLOCK

The circuit breaker compartment shall maintain a degree of protection against direct contact with live parts of at least IP 2X during normal operation without overriding the interlock. To ensure safety, the circuit breaker compartment shall be provided with the necessary mechanical interlock as follows, or other equal and Approved means of mechanical interlock, so that:

1. If a door is used to enclose the breaker, it can only be opened when the main circuit of the circuit breaker has opened and it shall not be possible to close the circuit breaker while the door is opened, except by overriding the interlock. The interlock shall be restored on reclosing the door; or
2. If a front panel is used to enclose the breaker, the panel shall be fitted to the withdrawable part of the breaker and carried in unity with it in the drawout/rack-in operation. It shall be possible to remove the panel with tools when the circuit breaker is in the 'isolated' position.

ELE4.3.3.060.9 SAFETY SHUTTERS

1. A set of safety shutters shall be provided to cover each three phase or three phase and neutral group of stationary isolating contacts for three pole or four pole circuit breaker respectively;
2. Shutters shall be opened automatically by a positive drive from the circuit breaker moving portion and, when closed, shall prevent access to stationary isolating contacts. When the circuit breaker is withdrawn, shutters shall be capable of being operated and padlocked in the closed position;
3. Each safety shutter shall bear a colour label with 15 mm minimum white lettering as follows:
   a. Incoming supply : red/incomer;
   b. Busbar : yellow/busbar;
   c. Bus section : red/bus section;
   d. Outgoing feeder : yellow/outgoing.

ELE4.3.3.070.A AUXILIARY CONTACTS, CONTROL CONTACTS AND AUXILIARY SWITCHES

1. All the control and instrumentation wiring between the fixing part of the ASSEMBLY and the withdrawable part of the breaker shall through the auxiliary and control contacts. Automatic safety shutters or screens with warning signs shall be provided if they are still live when the circuit breaker is withdrawn;
2. The auxiliary contacts shall engage when the breaker is in the "connected" and "test" positions and disengage when in the "isolated" position;
3. At least one spare a – contact (normally open contact) and one spare b – contact (normally closed contact) shall be provided.

ELE4.3.4 FUSE COMBINATION UNITS AND SWITCH-DISCONNECTORS

ELE4.3.4.010.9 COMPLIANCE WITH SPECIFICATION

Unless otherwise specified, cubicle mounted fuse combination units and switch-disconnectors shall comply with the relevant parts of Specification for surface mounted fuse combination units and switch-disconnector (i.e. ELE3.2).

ELE4.3.4.025.9 ASSEMBLY

The assembly of the switching devices in the ASSEMBLY shall also comply with IEC 61439-1 and IEC 61439-2.

ELE4.3.4.035.9 SWITCHING DEVICE

Each switching device shall be enclosed in a separate and segregated compartment with hinged front door as specified in ELE4.2.055 and flush mounted on the front of the ASSEMBLY.

ELE4.3.4.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of fuse combination units and switch-disconnectors delivered to Site or installed.

ELE4.3.5 CHANGEOVER CONTACTORS

ELE4.3.5.010.9 COMPLIANCE WITH SPECIFICATION

Unless otherwise specified, changeover contactors shall comply with the relevant parts of Specification for contactors. (i.e. ELE3.15).

ELE4.3.5.025.9 INSTALLATION

The installation of the changeover contactors in the ASSEMBLY shall also comply with IEC 61439-1 and IEC 61439-2. The installation such as the ways of mounting, the connection of incoming and outgoing conductors, the clearance and creepage distance, the enclosure, etc. shall be identical to the type-tested one or as recommended by the contactor manufacturers.

ELE4.3.5.030.9 SHORT-CIRCUIT WITHSTAND CAPACITY

For contactors protected by fuse, the short-circuit withstand capacity of the contactors shall be not less than the maximum let-through energy of the respective fuse and be verified by test.

ELE4.3.5.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of changeover contactors delivered to Site or installed.

ELE4.3.6 CABLE TERMINATION

ELE4.3.6.015.9 INCOMING/OUTGOING CABLES

All incoming/outgoing cables, unless otherwise specified, shall be of bottom-entry and incoming/outgoing busbar trunking of top entry and terminated in separate compartments as stated in ELE4.2.055. The cables shall be located at the rear of the ASSEMBLY complete with removable back covers.

ELE4.3.6.020.9 CABLE GLAND PLATES

Cable gland plates made of brass or steel of not less than 2 mm thick shall be provided below the lug termination at a distance not exceeding 600 mm. Adequate space shall be reserved for future cabling for the spare functional units.

ELE4.3.6.030.9 CABLE SUPPORTS

Cable and cable supports shall be suitably installed to prevent terminals or cables being subjected to stresses, which may reduce their normal life or performance.

ELE4.3.7 SUPPLY COMPANY'S METERING EQUIPMENT

ELE4.3.7.010.9 METERING COMPARTMENTS

1. Separate compartments shall be provided for accommodating the Supply Company's meter(s) on the front of the ASSEMBLY and for the corresponding current transformers;
2. The metering compartment shall be complete with a hinged glazed door for meter viewing and suitable support for mounting the meter.

ELE4.3.7.020.9 METERING EQUIPMENT

1. The metering equipment will be supplied and fixed by the Supply Company on site, but the ASSEMBLY shall be complete with fuses for the voltage coil, removable links for mounting the current transformers and the associated wiring to the meter;
2. The fuses shall be of rating according to the requirements of the Supply Company, with provision for sealing to prevent unauthorized removal and the incoming side of the fuseholders bolted to the incoming supply busbar.

ELE4.3.8 MOULDED CASE CIRCUIT BREAKERS (MCCB)

ELE4.3.8.010.9 COMPLIANCE WITH SPECIFICATION

Unless otherwise specified, MCCBs mounted in the ASSEMBLY shall comply with the relevant parts of Specification for MCCB (i.e. ELE3.4). MCCB shall be type-tested and comply with the additional requirements for circuit breakers suitable for isolation in accordance with Clause 7.1.2 of IEC 60947-2.

ELE4.3.8.025.9 INSTALLATION

The installation of MCCBs mounted in the ASSEMBLY shall also comply with IEC 61439-1 and IEC 61439-2. The installation details such as the ways of mounting, mounting plates, termination of incoming and outgoing conductors, clearance and creepage distances, dimensions of enclosure, etc. shall be submitted to verify them in full compliance with the type-tested arrangements and/or the MCCB manufacturers' recommendations.

ELE4.3.8.030.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of MCCBs delivered to Site or installed.

ELE4.3.9 POWER FACTOR CORRECTION EQUIPMENT

ELE4.3.9.010.9 COMPLIANCE WITH SPECIFICATION

Unless otherwise specified, power factor correction equipment mounted on/housed in the ASSEMBLY shall comply with the Specification for Power Factor Correction Equipment (i.e. ELE5).

ELE4.4 PROTECTION AND INSTRUMENTATION

ELE4.4.1 CIRCUIT BREAKER PROTECTION

ELE4.4.1.015.9 COMPLIANCE WITH SPECIFICATION

The protection scheme for circuit breakers shall be in accordance with ELE4.4.1.020 and ELE4.4.1.035 as indicated on the Drawings.

ELE4.4.1.020.9 PROTECTION SCHEME WITH EXTERNAL D.C. SOURCE FOR TRIPPING

For overcurrent or earth fault protection the circuit breaker shall trip by means of shunt trip release operated from the battery set and charger and controlled by protection relays. If electromechanical relays are used, three overcurrent relays, one for each phase, and one earth fault relay shall be provided.

ELE4.4.1.035.A BATTERY SET AND CHARGER

1. General:

   Battery set and charger shall be manufactured by a specialised battery and charger manufacturer and be suitable for use under the intended service conditions. Two sets of battery and charger system shall be separately provided for tripping circuit and changeover / control circuits.

2. Battery / Charger equipment:

   The battery / charger equipment shall be housed in a segregated front accessible compartment as defined in ELE4.2.055. The input voltage of the battery charger shall be 220V a.c., 50Hz and the output voltage of the battery shall be as follows:

   a. 30V d.c for tripping circuits;

   b. 24V d.c. for changeover / control circuits.

3. Batteries:

   a. The batteries shall be sealed nickel cadmium to IEC 61951-1 or nickel-metal hydride to IEC 61951-2, maintenance free type, rated at 5 hours discharge rate. Type test report shall be submitted if required by the CM. Cells shall be of the sealed nickel cadmium sintered plate type or nickel-metal hydride type;

   b. The rated capacity of the battery for switchgear tripping auxiliary supplies shall be sufficient for at least 20 operations without charging and for at least two air circuit breakers tripping simultaneously, and shall be of at least 4 Ampere-hour rating.

4. Battery charger:

   The battery charger shall be automatic trickle-charge type with two rates charging to suit the battery characteristics. The first rate of charging shall be capable of restoring full capacity and second rate shall maintain the batteries in a fully charged condition. The standard charge rate and the float charge rate of the battery charger shall be adjustable to meet requirements of battery rating up to 10 Ampere-hour.

5. Battery re-charging time:

The time required for re-charging batteries from fully discharged to fully charged condition shall be not more than eight hours. Battery over-current protection shall be provided to safeguard the battery under short circuit conditions and facilities shall also be provided to prevent the batteries from being overcharged.

6. Battery charger indication / facilities:

   The battery charger shall be provided with the following indications / facilities which shall be extended and mounted on the front door of the compartment:

   a. Mains On;

   b. Charger Fail;

   c. Voltmeter;

   d. Ammeter;

   e. Test Facilities.

ELE4.4.1.040.9 ELECTROMECHANICAL TYPE PROTECTION RELAY

1. Overcurrent and earth fault protection relays shall be of induction type to BS EN 60255 or IEC 60255 with IDMT characteristics in accordance with the time setting specified below;
2. The relays shall be accommodated in draw-out cases and contacts shall be fitted which shall short-circuit the associated current transformers on withdrawal of the relay. For the overcurrent relays, the three single phase elements shall be arrayed in one horizontal plane and accommodated in a common draw-out case, which shall be flush mounted on the front hinged door of the ASSEMBLY;
3. Operation indicators shall be provided for each protective element and installed within the same relay. They shall have a common hand-reset device operable without opening the relay case. The overcurrent relay shall comprise the following features:

a. Current setting:	50% to 200% of 5A (CT rating), adjustable in 7 equal steps;
b. Time setting:	0.63 second at 10 times current setting (for HEC supply); 1.3 seconds at 10 times current setting (for CLP supply);
c. Burden:	3.5VA maximum at current setting.

4. The earth fault relay shall comprise the following features:

a. Current setting:	10% to 40% of 5A (CT Rating), adjustable in 7 equal steps;
b. Time setting:	1.3 seconds at 10 times current setting;
c. Burden:	3.5VA maximum at current setting.

ELE4.4.1.050.9 ELECTRONIC TYPE PROTECTION RELAYS

1. Electronic type protection relays shall comply with BS EN 60255 or IEC 60255 with choice of the following characteristic curves:

   a. Normal inverse IDMT curve;

   b. Very inverse IDMT curve;

   c. Extremely inverse IDMT curve.

2. The relay shall provide trip contact for overcurrent and earth fault protections, and separate signal contacts for time delayed phase fault, instantaneous high-set phase fault and time delayed earth fault operations;

3. Trip indicators shall be provided which will enable the type of fault condition to be identified. Each indicator shall be capable of being reset by hand without opening the relay case;

4. The relay shall comprise the following features:

   a. Current setting: 0.5 to 2 x In in step of 0.05 x In with instantaneous high-set of 5 to 10 x In for overcurrent protection; 0.1 to 0.4 x In in step of 0.05 x In for earth fault protection;

   b. Time multiplier setting: 0.1 to 1.0 in 0.05 step;

   c. AC burden: less than 0.5VA for 5A relay in any setting.

5. The relay shall be accommodated in a dust-proof case to IP51 and can be easily drawn out on front side in the event that the relay requires replacement. Facility shall be provided for short-circuiting the associated current transformers on withdrawal of the relay. The draw-out case shall be flush mounted on the front-hinged door of the ASSEMBLY. The relay shall be rated for an operating temperature up to 55°C;

6. The relay shall be type-tested for compliance with the following international standards by an Accredited Laboratory:

Standards	Description
BS EN 61000-6-4 or IEC 61000-6-4	Electromagnetic Emission
BS EN 61000-6-2 or IEC 61000-6-2	Electromagnetic Immunity
BS EN 60255-3 or BS EN 60255-151 or IEC 60255-151	Accuracy
BS EN 60255-21-1 or IEC 60255-21-1	Vibration Tests - Class 1
BS EN 60255-21-2 or IEC 60255-21-2	Shock & Bump Tests - Class 1
BS EN 60255-22-2 or IEC 60255-22-2	Electrostatic Discharge Tests - Class 2

7. The relay shall be suitable for operation at 30V d.c. auxiliary power supply and accepts current inputs from standard protection current transformers with rated secondary current of 5A. An exclusive battery set and charger shall be provided for relay operation.

ELE4.4.1.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY FOR ELECTROMECHANICAL AND ELECTRONIC TYPE PROTECTION RELAY

The Sub-contractor shall produce documentary evidences in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of electromechanical and electronic type protection relays delivered to Site or installed.

ELE4.4.3 FUSE PROTECTION

ELE4.4.3.010.9 METHOD OF PROTECTION

All potential auxiliary and control circuits shall be protected by fuses.

ELE4.4.3.020.9 COMPLIANCE WITH SPECIFICATION

All fuses used, including those used in fuse combination units, shall be in compliance with the Specification for Fuses (i.e. ELE3.13).

ELE4.4.4 CURRENT TRANSFORMERS

ELE4.4.4.010.A STANDARD AND TYPE

Current transformers shall comply with IEC 61869-2 and shall be of ring and encapsulated type.

ELE4.4.4.020.9 MEASURING CURRENT TRANSFORMERS

Measuring current transformers shall have a minimum accuracy class of 1. The C.T. ratio for measuring current transformer shall match the corresponding indicating/measuring device.

ELE4.4.4.030.A PROTECTION CURRENT TRANSFORMERS

Protection current transformers (PCT) shall have a minimum accuracy class of 10P. The rating of the current transformer shall match the total burden of the trip circuit including the relays, connection leads and overcurrent release where applicable, to which the current transformer is connected, such that, under the most severe fault conditions, the current transformer does not saturate and is still capable of maintaining its accuracy. The C.T. ratios of all PCTs used in conjunction with mains incoming circuit breakers shall meet the requirements of related power company.

ELE4.4.4.040.9 FITTING

Unless otherwise specified, the protection current transformers shall be fitted on the outgoing side of the respective circuit breaker, whereas for the measuring current transformer, on the outgoing side of the functional unit, removable short links for mounting the current transformer shall be provided to facilitate subsequent easy replacement/maintenance.

ELE4.4.5 INDICATING METERS

ELE4.4.5.010.9 STANDARD

Indicating meters of analogue type shall comply with class 2.5 of BS EN 60051 or IEC 60051. Multi-function electronic meters shall comply with BS EN 61557-12 or IEC 61557-12.

ELE4.4.5.020.9 MOUNTING

Meters of analogue type with approximate 75 mm dial and with an external zero adjustment, and multi-function electronic meters shall be flush mounted on the front cover of the ASSEMBLY.

ELE4.4.5.030.9 MONITORING

Multi-function electronic meters, analogue type ammeters and voltmeters etc. shall be provided as shown on the Drawings. The analogue type ammeters used for monitoring the total current carried by the incoming circuit breaker shall be of the combination type with the thermal demand and the instantaneous values shown. The thermal demand shall indicate the mean r.m.s. current over the past 15 minutes with a slave pointer showing the maximum value reached.

ELE4.4.5.040.A MULTI-FUNCTION ELECTRONIC METERS

1. Multi-function electronic meter shall be of a digital display type to measure the following electrical parameters by means of microprocessor technology:

Function of Measurement	Minimum Accuracy
True Root Mean Square (RMS) Current: per phase & neutral	±0.5%
True RMS Volts: all phase-to-phase & phase-to-neutral	±0.5%
Real Power (kW): per phase & three phase total	±1%
Apparent Power (kVA): per phase & three phase total	±1%
Reactive Power (kVAr): per phase & three phase total	±1%
Total Power Factor: per phase & three phase total	±1%
Frequency (Hz)	±1%
Maximum Demand Current (Id): per phase, present & peak	±1%
Real Power Demand (kWd): three phase total, present & peak	±1%
Apparent Power Demand (kVAd): three phase total, present & peak	±1%
Reactive Power Demand (kVArd): three phase total	±1%
Real Energy (kWh): three phase total	±1%
Total Harmonic Distortion (THD): per phase, voltage & current (at least up to 31st harmonic order)	±2%

2. The meter shall be suitable for operation at 380V/220V, 50Hz and accepts current inputs from standard measuring current transformers with rated secondary current of 5A. The meter shall be rated for an operating temperature up to 50°C and have a minimum overcurrent withstand rating of 100A for 1 second;
3. The meter shall be capable to trend the required parameters as stipulated in the BEC Code at every 15 minutes and include hourly, daily, monthly and annual data. The meter shall be equipped with sufficient built-in memory capable of maintaining all data collected for a minimum of 36 months. The Sub-contractor shall retrieve the data files from all meters and submit to the CM on annual basis or as required by the CM during the Maintenance Period;
4. The meter shall be equipped with a communication port at front panel, using either RS232, RS485, RJ45 or similar socket and plug as Approved, for communication with portable personal computer for energy control and audit purpose. The connection cable with the appropriate plug and a copy of proprietary-made software for data retrieval shall be provided;
5. The meter shall be flush mounted with protection to not less than IP2X at front face. All wiring shall be connected via terminal blocks to allow easy removal of the cable connectors in the event that the meter requires replacement;
6. The meter shall comply with the general electrical safety requirements as specified in IEC 61010-1 and should be suitably suppressed to fall within the limits allowed by BS EN 61000-6-4 or IEC 61000-6-4 and BS EN 61000-6-2 or IEC 61000-6-2 for electromagnetic emission and immunity;

7. The manufacturer shall operate a quality management system conforming to ISO 9001 or other equivalent national / international quality system. The manufacturer shall issue a calibration certificate for every meter at the time of production and the calibration certificate shall be submitted to the CM. Such calibration shall be conducted by the manufacturer within one year prior to delivery of the meter on Site or prior to the date of factory acceptance test if the meter is installed in an ASSEMBLY that factory acceptance test is required. The manufacturer shall also declare in writing that the meter shall require no re-calibration for a minimum of 10 years from the time of issue of calibration certificate. A label marking the manufacturer's calibration date shall be fixed adjacent to the meter;
8. For domestic building with Smart Meter Monitoring System provision:
    a. The meters shall be fully compatible with Smart Meter Monitoring System as stipulated in ELE35 to allow connection for data retrieval by the System. Necessary data cables connections shall be included and wired to the interfacing terminals of the System.

ELE4.4.6 VOLTAGE SENSING RELAYS

ELE4.4.6.010.A GENERAL

1. Two numbers of voltage sensing relays of different brands for monitoring the mains supply conditions shall be provided to control the operation of the automatic changeover contactors / automatic transfer switches and to activate the starting of the standby generating set and alarm indication as shown on the drawings.

ELE4.4.6.025.9 FEATURES

1. The relay shall be suitable for monitoring voltage of 380/220V 3-phase 4-wire system;
2. The relay shall be provided with indication to show its operation status;
3. The voltage sensing elements shall operate from measured phase-to-neutral voltages. When the voltage at either one phase drops below the voltage setting and sustains for a period exceeding the time setting, the relay shall activate the dry contacts to open position. The dry contacts shall be reset to close position automatically when all the measured voltages resume normal;
4. The relay shall operate at 24V d.c. auxiliary power supply. The battery set and charger for the auxiliary power supply shall comply with the requirement as stipulated in ELE4.4.7.015;
5. The relay shall comply with the following requirement:

Description	Requirements
Adjustable voltage monitoring element setting	Undervoltage: 70 – 95%
Adjustable time delay setting	0 – 1 sec.
Expected mechanical life	0.2 million operations
Standard	IEC 60255 or other reputable national/international standards.
Operating temperature	0°C to +50°C

ELE4.4.6.030.A FACTORY TESTING

1. The relay shall be tested on load with a dummy circuit at the ASSEMBLY manufacturer workshop for operation for at least 50 times with each operating voltage and time properly recorded before installed in the ASSEMBLY cubicle. Result shall be incorporated into the test report. The setting shall be properly sealed after the factory test.

ELE4.4.7 BATTERY SET AND CHARGER FOR CONTROL CIRCUIT

ELE4.4.7.015.9 BATTERY SET AND CHARGER

1. General:

   A separate battery and charger system shall be provided for the control circuit. The battery set and charger shall be manufactured by a specialised battery and charger manufacturer and be suitable for use under the intended service conditions;

2. Battery/Charger equipment:

   The battery/charger equipment shall be housed in a segregated front accessible compartment as defined in ELE4.2.055. The input voltage of the battery charger shall be 220V a.c., 50Hz and the output voltage of the battery shall be 24V d.c. for control circuit;

3. Batteries:

   a. The batteries shall be sealed nickel cadmium to IEC 61951-1 or nickel-metal hydride to IEC 61951-2, maintenance free type, rated at 5 hours discharge rate. Cells shall be of the sealed nickel cadmium sintered plate type or nickel-metal hydride type;

   b. The rated capacity of the battery for control circuits shall be sufficient for at least 24 hours operations without charging including at least 10 times change of state of the control relays.

4. Battery charger:

   The battery charger shall be automatic trickle-charge type with two rates charging to suit the batteries characteristics. The first rate of charging shall be capable of restoring full capacity and the second rate shall maintain the batteries in a fully charged condition. The standard charge rate and the float charge rate of the battery charger shall be adjustable to meet requirements of battery rating up to 10 Ampere-hour;

5. Battery re-charging time:

   The time required for re-charging batteries from fully discharged to fully charged condition shall be not more than eight hours. Battery over-current protection shall be provided to safeguard the battery under short circuit conditions and facilities shall also be provided to prevent the batteries from being overcharged;

6. Battery charger indication/facilities:

   The battery charger shall be provided with the following indications/facilities which shall be extended and mounted on the front door of the compartment:

   a. Mains On;

   b. Charger Fail;

   c. Voltmeter;

d. Ammeter;

e. Test Facilities.

ELE4.4.8 INDICATING LIGHTS

ELE4.4.8.010.9 INDICATING LIGHTS ON FRONT PANEL OF ASSEMBLY

1. All indicating lights on the front panels of each ASSEMBLY shall be LED type of diameter minimum 22mm and shall be provided with built-in transformer step down to 6V a.c. or d.c.. The lamp base shall be BA9S type. The service life of indicating light shall be at least 50,000 hours at rated voltage and 25ºC environment;
2. Removal of lamp lenses and bulbs shall be carried out at the front of the unit without the need of any special tool and opening of the panel doors.

ELE4.5 MISCELLANEOUS

ELE4.5.1 INFORMATION, MARKING AND LABELLING

ELE4.5.1.015.A INFORMATION TO BE GIVEN

1. The ASSEMBLIES shall be provided with one or more plates, marked in a durable manner and located in a place such that they are visible and legible when the ASSEMBLIES are installed;
2. The following shall be given on the nameplates:
   a. The manufacturer's name or trade mark;
   b. Type designation or identification number or other means of identification making it possible to obtain relevant information from the manufacturer;
   c. Standard of the ASSEMBLIES (e.g. IEC 61439-1 and IEC 61439-2:2011);
   d. Rated current of the ASSEMBLIES;
   e. Rated operational voltage and frequency;
   f. Rated insulation voltage;
   g. Short-circuit withstand strength;
   h. Degree of protection;
   i. Rating of main busbars.

ELE4.5.1.020.A LABELS AND MARKINGS

1. Each equipment, functional unit and settings of overcurrent and earth fault protection of air circuit breakers and moulded case circuit breakers of the ASSEMBLY shall be marked or labelled in a durable and indelible manner in both English and Chinese for identification;
2. Unless otherwise specified, all warning labels referred to in the previous clauses shall be coloured in red with white lettering in both English and Chinese denoting,

   "DANGER 380/220V

   危險 380/220 伏特"
3. The removable cover of the incoming conductor and connection compartment shall bear a warning label coloured in red with white lettering in both English and Chinese denoting,

   "INCOMING CONNECTION - DANGER - 380/220 V - SWITCH OFF FROM SUPPLY COMPANY'S SIDE BEFORE REMOVING COVER

   電源接點 - 危險 - 380/220V

   開蓋前必須切斷電力公司來電"
4. For other circuits of the ASSEMBLY which may be still live when the incoming circuit breaker(s) are switched off, such as the essential busbars, the circuit for discharging the capacitive electrical energy, etc., the covers shall bear appropriate warning labels (e.g. LIVE BUSBAR 危險 - 帶電電巴) for personnel gaining access to those parts;

5. For each spare protective device with current rating exceeding 200A, a reminding notification label should be provided and coloured in white with red lettering in both English and Chinese denoting,

   "THIS IS SPARE CIRCUIT BREAKER

   WHEN CONNECTING TO THE CIRCUIT, IT MUST BE INSTALLED IN ACCORDANCE WITH THE BUILDING ENERGY EFFICIENCY ORDINANCE AND THE CODE OF PRACTICE FOR ENERGY EFFICIENCY OF BUILDING SERVICES INSTALLATION. METERING AND MONITORING FACILITIES SHOULD BE INSTALLED WHERE APPLICABLE.

   此乃備用斷路器

   接駁電路時須按照《建築物能源效益條例》及《屋宇裝備裝置能源效益實務守則》規定並須適用的情況下安裝計量儀器及監察設施"

ELE4.5.2 VERIFICATION AND TESTING

ELE4.5.2.015.9 VERIFICATION

1. Two sets of shop drawings showing the details of the proposed ASSEMBLY including the front and end elevations, single line busbar diagrams, control wiring diagrams, list of equipment schedule and any other details as required by the Contract Manager, shall be submitted for approval prior to assembly;
2. The drawings shall indicate which portions of the ASSEMBLY are verified by testing, by calculation, measurement or by satisfying design rules if required by the Contract Manager. Documents such as test reports, calculations, etc., to verify the above conformity shall be submitted for examination.

ELE4.5.2.025.A WORKSHOP TESTS (FACTORY ACCEPTANCE TEST)

1. The following tests shall be performed at the manufacturer's workshop during the course of assembly and on completion immediately prior to transportation to Site:
   a. Inspection of the ASSEMBLY including wiring, electrical and mechanical connections, external and internal finish, degree of protection, creepage distance and clearance, etc.;
   b. Mechanical test;
   c. Primary and secondary injection tests to check that all measuring, protection and control circuits and associated components are operative;
   d. Continuity test;
   e. Dielectric properties test and insulation tests;
   f. Functional check, including the shunt trip operation of breakers at 70% and 110% of the rated control supply voltage, if applicable;
   g. Unless ELE4.1.028 (1) or (2) are fully satisfied, temperature rise limits test shall be carried out in accordance with clause 10.10.2.3.5 of IEC 61439-1 if any modifications are made to a verified ASSEMBLY.
2. All the above inspections and tests shall be carried out in accordance with IEC 61439-1 and IEC 61439-2 and IEC 60947-2 and IEC 60947-3 and the standard test report format prepared by the CM;
3. All test results shall be properly recorded with data entries using electronic means (e.g. notebook computer, tablet, etc.) at the time of testing by competent staff. The required electronic devices shall be provided by the manufacturer.

ELE4.5.2.030.A SITE ACCEPTANCE TESTS

1. After the erection of the ASSEMBLY on Site, the following test / inspections shall also be carried out:
   a. General inspection of the ASSEMBLY;
   b. Mechanical tests;
   c. Continuity and insulation resistance tests;
   d. Function checks;
   e. Contact resistance test (testing of a series of joints at one time for horizontal main busbars and vertical busbar riser / droppers; the test shall be recorded in the format approved by the CM);
   f. Secondary injection test to re-calibrate all protection relays or devices function in accordance with their performance curves.
2. All test results shall be properly recorded with data entries using electronic means (e.g. notebook computer, tablet, etc.) at the time of testing by competent staff. The required electronic devices shall be provided by the manufacturer.

ELE4.5.2.040.9 COMMISSIONING TESTS

The following inspections and tests shall be carried out immediately before the ASSEMBLY is put into normal service:

1. Voltage tests between any two combinations of each phase, neutral and earth;
2. Phase sequence tests on each outgoing unit;
3. Functional checks, especially on the controlling devices.

ELE4.5.3 AUXILIARY EQUIPMENT

ELE4.5.3.010.9 COMPLETENESS

Each ASSEMBLY shall be supplied complete with all operating handles, jigs, etc. required for the normal operation and inspection of all circuit breakers and switchgears of the ASSEMBLY.

ELE5 POWER FACTOR CORRECTION EQUIPMENT

ELE5.1 GENERAL ARRANGEMENT 3
ELE5.1.010.9 HOUSING 3
ELE5.1.020.9 CONTROLS 3

ELE5.2 CUBICLE CABINET DESIGN 4
ELE5.2.010.9 CONSTRUCTION 4
ELE5.2.020.9 MOUNTING OF SWITCHES 4
ELE5.2.030.9 DEGREE OF PROTECTION 4
ELE5.2.040.9 POSITION OF MAIN FUSESWITCH 4
ELE5.2.050.9 SPACING 4

ELE5.3 CAPACITORS 5
ELE5.3.010.9 STANDARD 5
ELE5.3.020.9 RATED OUTPUT OF CAPACITOR BANK 5
ELE5.3.030.9 RATED OUTPUT OF CAPACITOR UNIT 5
ELE5.3.040.9 SAFETY FEATURES 5
ELE5.3.050.9 DISCHARGE DEVICE 5
ELE5.3.060.9 LOSSES 6
ELE5.3.070.9 CAPACITANCE TOLERANCES 6

ELE5.4 AUTOMATIC CONTROL EQUIPMENT 7
ELE5.4.010.9 APPLICATION 7
ELE5.4.020.9 OPERATION OF CONTROL SYSTEM 7
ELE5.4.030.9 STEPS 7
ELE5.4.040.9 POWER FACTOR SELECTOR SWITCH 7
ELE5.4.050.9 CONTROL RELAY 7
ELE5.4.060.9 SWITCHING TIME 7
ELE5.4.070.9 PROVISIONS FOR POWER FAILURE 8
ELE5.4.080.9 ACCESS TO CONTROL SWITCHES 8

ELE5.5 MANUAL CONTROL 9
ELE5.5.010.9 SELECTOR SWITCH 9
ELE5.5.020.9 PUSH-BUTTONS 9
ELE5.5.030.9 CAPACITOR CONTROL 9

ELE5.6 ADDITIONAL MANUAL CONTROL 10
ELE5.6.010.9 OVERRIDE SWITCH 10
ELE5.6.020.9 CAPACITOR CONTROL LOCATION 10

ELE5.7 CONTACTORS 11
ELE5.7.010.9 NUMBER 11
ELE5.7.020.9 SPECIFICATION 11

ELE5.8 INDICATING INSTRUMENTS 12
ELE5.8.010.9 LOCATION OF INDICATORS 12
ELE5.8.020.9 INDICATORS FOR RATINGS GREATER THAN 30 KVAR 12
ELE5.8.030.9 INDICATORS FOR RATINGS EQUAL TO 30 KVAR OR LESS 12

ELE5.9 TYPE-TESTS AND ROUTINE TESTS 13
ELE5.9.010.9 TYPE-TESTS 13
ELE5.9.020.9 ROUTINE TESTS 13

ELE5.10 COMMISSIONING AND ACCEPTANCE TESTS 14

ELE5.10.010.9 FACTORY TESTS 14
ELE5.10.020.9 MINIMUM ACCEPTANCE TESTS 14
ELE5.10.030.9 VOLTAGE TEST 14
ELE5.10.040.9 CONTROL SIMULATION TEST 14
ELE5.10.050.9 REPORT FORMATS 14
ELE5.10.060.9 ACCEPTANCE TEST REPORT 14
ELE5.10.070.9 ACCEPTANCE TESTS DURING MAINTENANCE PERIOD 14

ELE5.1 GENERAL ARRANGEMENT

ELE5.1.010.9 HOUSING

The capacitor units shall be housed in a separated compartment to prevent the control equipment from being damaged by the capacitors in case of a fault.

ELE5.1.020.9 CONTROLS

For capacitor installation of ratings equal to 30 kVAr or less, no step-switching mechanism and control relay or regulator will be required. For ratings greater than 30 kVAr, the capacitor installation shall be switchable type complete with switching devices and automatic control relays.

ELE5.2 CUBICLE CABINET DESIGN

ELE5.2.010.9 CONSTRUCTION

The construction of the cabinet and the fixture of the capacitor installation shall be sufficiently rigid to stand the thermal, electrical and mechanical stresses due to short circuit, step-switching and discharging of the capacitor.

ELE5.2.020.9 MOUNTING OF SWITCHES

For switchable type capacitor cabinet, flush mounted indicating devices and selector control switches shall be fitted on the front panel which shall be in the form of a hinged door.

ELE5.2.030.9 DEGREE OF PROTECTION

The cubicle cabinet shall have a degree of protection not less than IP 31 and IP 2X when the cubicle door is in the "close" and "open" position respectively.

ELE5.2.040.9 POSITION OF MAIN FUSESWITCH

The main fuseswitch for the power factor correction equipment shall not be housed within the control cabinet.

ELE5.2.050.9 SPACING

1. Sufficient space shall be allowed between cables connecting distribution fuses to contactors and contactors to capacitor banks for insertion of clamp-on meters for current measurement.
2. The capacitor units shall be spaced to enable access to individual capacitor terminals for on-load electrical tests.

ELE5.3 CAPACITORS

ELE5.3.010.9 STANDARD

1. IEC 60831-1;
2. IEC 60831-2.

ELE5.3.020.9 RATED OUTPUT OF CAPACITOR BANK

The output kVAr rating of capacitor bank shall be provided according to the standard ratings listed below:

20, 25, 30, 40, 50, 60, 90, 120, 150, 180, 200, 240, 280 (subsequent increases in 40 kVAr steps).

ELE5.3.030.9 RATED OUTPUT OF CAPACITOR UNIT

The output kVAr rating of each capacitor unit shall be provided according to the standard ratings listed below (all in kVAr):

20, 25, 30, 40.

ELE5.3.040.9 SAFETY FEATURES

1. All capacitor elements shall be of self-healing type, capable of self-restoration after breakdown of insulation due to momentary over voltage. The self-healing process shall be complete within half-a-cycle and with no significant changes in capacitance and the loss angle;
2. The capacitor elements shall be completely encapsulated in metal or epoxy case and fitted with tear-off fuse or other effective means to minimize overpressure due to internal fault;
3. Capacitors shall be dry type only;
4. PCBs (polychlorinated biphenyls) shall not be used and dielectric shall be environment compatible, i.e. no pollution to environment in case of leakage;
5. All materials used in capacitors except the dielectric shall be non-flammable and self-extinguishing;
6. Fuses having a current rating 1.5 times the capacitor current shall be provided to protect each capacitor unit and shall comply with ELE3.13;
7. A label shall be fixed on the front surface of the cubicle to indicate, in English and Chinese, the operating procedures before accessing the live parts inside the cubicle compartment. The label shall be submitted to Contract Manager for Approval;
8. The metallic container of the capacitor units and also the cubicle cabinet shall be properly earthed by permanent connection.

ELE5.3.050.9 DISCHARGE DEVICE

1. A resistor discharge device of appropriate resistance value shall be provided to reduce the residual voltage to less than 50V within one minute after actuation of the device. The discharge device shall function automatically on loss of supply and the discharge circuit shall be rated to discharge the capacitor bank from the peak of 30% overvoltage;
2. The residual voltage shall be measured across the terminals of the whole capacitor bank, i.e. not across individual capacitor element or unit;

3. The discharge path shall have no disconnecting link, switch, fuse or series capacitor interposed.

ELE5.3.060.9 LOSSES

1. The losses measured under nominal voltage and frequency shall be less than 0.5 W per kVAr. Type test report to the satisfaction of the Contract Manager shall be submitted to verify that this requirement has been met;
2. Puncture of insulation due to momentary overvoltage across electrodes shall not lead to significant increase in losses.

ELE5.3.070.9 CAPACITANCE TOLERANCES

1. The capacitance shall not differ from the rated capacitance by more than:
   a. -5% to 15% for units and banks up to 100 kVar;
   b. 0% to 10% for units and banks above 100 kVar.
2. In three-phase units, the ratio of maximum and minimum value of the capacitance measured between any two-line terminals shall not exceed 1.08;
3. Rating plate bearing the information markings as stipulated in Sections 26 & 27 of IEC 60831-1, shall be provided for each capacitor unit and the capacitor bank.

ELE5.4 AUTOMATIC CONTROL EQUIPMENT

ELE5.4.010.9 APPLICATION

For capacitors of 40 kVAr and above, automatic control relay shall be provided to maintain the power factor at the specified value.

ELE5.4.020.9 OPERATION OF CONTROL SYSTEM

The control system shall continuously detect and measure the power factor and switch-in or switch-out bank(s) of capacitors in steps to maintain the designed power factor. The value of each step is determined as follows:

Total capacitor rating in kVAr	Minimum no. of steps	Maximum of each step
40	2	20 kVAr
50	2	25 kVAr
60	3	20 kVAr
90	3	30 kVAr
120	4	30 kVAr
150	5	30 kVAr
180	6	30 kVAr
200	5	40 kVAr
240	6	40 kVAr
280	7	40 kVAr

ELE5.4.030.9 STEPS

The number of steps shall be programmable within the range of 2 steps to 12 steps using a code switch.

ELE5.4.040.9 POWER FACTOR SELECTOR SWITCH

The power factor selector switch shall be continuously adjustable between 0.85 inductive to 0.95 capacitive.

ELE5.4.050.9 CONTROL RELAY

The control relay shall be designed in such a way that there shall be no relay hunting when the load power fluctuates. A starting reactive current (c/k ratio) setting device shall be provided to allow stepless adjustment between 0.075 to 1.0.

ELE5.4.060.9 SWITCHING TIME

The switching time between each switching stage shall be adjustable from 30 seconds to 60 seconds or above to give a time delay longer than the charging and discharging times of the previous stage so that there shall be no simultaneous charging or discharging of two stages.

ELE5.4.070.9 PROVISIONS FOR POWER FAILURE

In the event of power failure, all the capacitors shall be automatically disconnected and discharged. On restoration of supply, the relay shall, after a waiting time to ensure sufficient discharge of stored energy, commence operation in accordance with the selected switching programme and power factor setting.

ELE5.4.080.9 ACCESS TO CONTROL SWITCHES

Unless otherwise stated, all the control switches shall be front accessible without opening the cabinet door stated in ELE5.2.020.

ELE5.5 MANUAL CONTROL

ELE5.5.010.9 SELECTOR SWITCH

A selector switch for manual or automatic control of the equipment shall be provided inside the cubicle cabinet.

ELE5.5.020.9 PUSH-BUTTONS

Push-buttons shall be provided for steps "switching-in" and "switching-out" in the manual mode with the switching time delay as provided at ELE5.4.060.

ELE5.5.030.9 CAPACITOR CONTROL

The number of capacitors "switching-in" or "switching-out" shall be entirely manually controlled irrespective of the mode of controller output.

ELE5.6 ADDITIONAL MANUAL CONTROL

ELE5.6.010.9 OVERRIDE SWITCH

An additional selector switch to override the automatic control relay in case of its failure shall be provided inside the control cabinet.

ELE5.6.020.9 CAPACITOR CONTROL LOCATION

Under this manual control, the number of capacitors "switching-in" or "switching-out" shall be entirely manually controlled by additional push-buttons inside the control cabinet.

ELE5.7 CONTACTORS

ELE5.7.010.9 NUMBER

The number of contactors shall be determined by the number of switching stages stipulated in ELE5.4.020.

ELE5.7.020.9 SPECIFICATION

Contactors shall be in compliance with ELE3.15.

ELE5.8 INDICATING INSTRUMENTS

ELE5.8.010.9 LOCATION OF INDICATORS

Indicators shall be fitted on the front panel of the cubicle cabinet.

ELE5.8.020.9 INDICATORS FOR RATINGS GREATER THAN 30 KVAR

1. Supply ON/OFF indicator;
2. Power factor meter for inductive/capacitive indication;
3. Indicator showing the number of stages of capacitors being connected;
4. Indicator showing mode of operation, automatic or manual control;
5. Warning plate which reads "WARNING : WAIT 5 MINUTES AFTER ISOLATING SUPPLY BEFORE HANDLING" in both English and Chinese.

ELE5.8.030.9 INDICATORS FOR RATINGS EQUAL TO 30 KVAR OR LESS

1. Warning plate which reads "WARNING : WAIT 5 MINUTES AFTER ISOLATING SUPPLY BEFORE HANDLING" in both English and Chinese;
2. The warning plate specified in sub-clause (1) above shall constitute the minimum requirements and extra indicators relevant to the operation of the control equipment shall be provided to suit the design features of the equipment offered. In particular, the warning plate shall be provided on all access panels or doors;
3. Labels in the cubicle cabinet for indicators and control switches shall be in English or internationally accepted abbreviation.

ELE5.9 TYPE-TESTS AND ROUTINE TESTS

ELE5.9.010.9 TYPE-TESTS

Type-test reports to verify compliance with the specified requirements and details in IEC 60831-1 and IEC 60831-2 shall be submitted to the Contract Manager.

ELE5.9.020.9 ROUTINE TESTS

Routine tests for every capacitor supplied shall be carried out at manufacturer's works and test certificates shall be submitted to the Contract Manager.

ELE5.10 COMMISSIONING AND ACCEPTANCE TESTS

ELE5.10.010.9 FACTORY TESTS

Before putting the equipment into operation, acceptance tests shall be carried out in the manufacturing factory.

ELE5.10.020.9 MINIMUM ACCEPTANCE TESTS

The acceptance tests shall comprise at least the following:

1. Capacitance measurement and output calculation;
2. Measurement of the tangent of the loss angle (tan δ) of the capacitor;
3. Voltage test between terminal and container;
4. Test of the internal discharge device;
5. Control simulation test.

ELE5.10.030.9 VOLTAGE TEST

During voltage test between terminals, self-healing breakdowns will be allowed. However, the capacitance and tangent of the loss angle shall be measured subsequently and no significant changes in value shall be allowed.

ELE5.10.040.9 CONTROL SIMULATION TEST

During control simulation test, adequate temporary facilities, including field testers to simulate the actual load variations for checking the operation of the control relay and the correct functions of the power factor correction equipment, shall be provided.

ELE5.10.050.9 REPORT FORMATS

The report formats for the tests listed in ELE5.10.020 will be provided by the Contract Manager.

ELE5.10.060.9 ACCEPTANCE TEST REPORT

The acceptance test report for each capacitor installation should be submitted to the Contract Manager prior to delivery to Site.

ELE5.10.070.9 ACCEPTANCE TESTS DURING MAINTENANCE PERIOD

At the end of the Maintenance Period, or at any time instructed by the Contract Manager during the Maintenance Period, the Sub-contractor shall carry out the following and shall replace, at his own cost, any capacitor that fails the inspection and test:

1. Visual inspection;
2. Control simulation test;
3. 24-hour continuous measurements on power factor variations.

ELE6 BUSBAR CHAMBERS AND BUSBAR TRUNKING SYSTEMS

ELE6.1 BUSBAR CHAMBERS 2

ELE6.1.010.9 STANDARD 2
ELE6.1.020.9 ENCLOSURE 2
ELE6.1.030.9 FINISH 2
ELE6.1.040.9 BUSBARS 2
ELE6.1.050.9 TAP-OFF DEVICES 2
ELE6.1.060.9 VERIFICATION TESTING 3

ELE6.3 ALL INSULATED BUSBAR TRUNKING SYSTEM (BUSDUCT) 4

ELE6.3.010.9 GENERAL 4
ELE6.3.020.9 DESIGN AND CONSTRUCTION 4
ELE6.3.030.9 BUSDUCT ENCLOSURE 5
ELE6.3.040.9 BUSBARS 5
ELE6.3.050.9 BUSBAR JOINTING 5
ELE6.3.060.9 BUSBAR SUPPORT 6
ELE6.3.070.9 EXPANSION UNIT 6
ELE6.3.080.9 TAP-OFF UNIT 6
ELE6.3.090.9 BUSDUCT FITTINGS AND ACCESSORIES 7
ELE6.3.100.9 LABELS AND WARNING NOTICES 7
ELE6.3.110.9 TESTING AND CERTIFICATION 8
ELE6.3.120.9 IN-SERVICE RECORDS 8

ELE6.1 BUSBAR CHAMBERS

ELE6.1.010.9 STANDARD

Busbar chambers shall comply with and be verification tested to IEC 61439-6 in conjunction with IEC 61439-1.

ELE6.1.020.9 ENCLOSURE

1. The busbar chamber enclosure shall be made of sheet steel not less than 1.5 mm thick for ratings not exceeding 500A, and not less than 2 mm thick for rating above 500A;
2. The enclosure shall be formed in such a way as to give a rigid structure of sufficient strength;
3. The cover shall be provided with rubber gasket and fixed on to the main enclosure at the front by means of heavily electroplated hexagonal headed screws and nuts;
4. Either the screw or the nut shall be permanently fixed on to the main enclosure;
5. The enclosure shall be suitable for surface mounting with a degree of protection against ingress of foreign solid particles and liquids of at least IP31 of IEC 60529 with the cover closed. For application inside plant room where weatherproof requirement is specified in drawing, the degree of protection of the enclosure shall be of at least IP44.

ELE6.1.030.9 FINISH

All steel work shall be treated to prohibit corrosion by hot-dip galvanising or electrolytically coated with zinc. The inside and outside surfaces of the enclosure shall then be coated with not less than two layers of stove enamel finish paint of contrasting colours, or one layer of stoved enamel epoxy powder paint, of an Approved colour.

ELE6.1.040.9 BUSBARS

1. Busbars shall be hard drawn, high conductivity, air insulated, electro-tinned, solid copper bars to BS EN 13601;
2. The neutral busbar shall be of the same rating as the phase busbars;
3. Each busbar shall be marked with the appropriate phase colour at intervals of not more than 600 mm;
4. Busbars shall be mounted on insulators that shall follow the verification tested designs.

ELE6.1.050.9 TAP-OFF DEVICES

Unless otherwise Approved, proper tap-off devices in the form of tap-off clamps and cable lugs, where necessary, shall be provided for the tap-off cables and such devices shall not reduce the effective size or rating of the busbars. Slots through enclosures for tap-off cables shall be sealed with phenolic resin bonded paper laminated sheet not less than 6 mm thick.

ELE6.1.060.9 VERIFICATION TESTING

Busbar chambers shall be verification tested in accordance with Clause 10 of IEC 61439-6 in conjunction with IEC 61439-1. The verification of short-circuit strength shall be carried out by a Short-Circuit Testing Organisation at the value of short circuit current specified below:

	Busbar rating	Test circuit
1.	Not exceeding 500A	*Fused short circuit current of 40kA
2.	Over 500A	a. Short time withstand current of 40kA for one second; b. Peak withstand current of 84kA.

* With the use of fuses to IEC 60269-2 or BS 88-2.

ELE6.3 ALL INSULATED BUSBAR TRUNKING SYSTEM (BUSDUCT)

ELE6.3.010.9 GENERAL

1. This specification covers the all-insulated busbar trunking system including fittings & accessories (hereinafter referred to as "busduct" or "busducts") up to and including 2500A;
2. Busducts shall comply with IEC 60439-2, and meeting all clauses as described in this Specification. Other standards, e.g. National Electrical Manufacturers Association (NEMA) or Underwriters Laboratories Inc. (UL) may be considered as acceptable provided that the standard is not inferior to the relevant IEC standards;
3. All the materials and components use for the busducts shall be of the same make and same country/place of manufacture of the typed-tested ones;
4. The busduct shall be manufactured at the base country/place of the original manufacturer. Licensed to make at other country/place will not be accepted;
5. Busduct current rating indicated on the Schedule of Rates, drawings or the particular specifications is the anticipated full load current (concentrated load) that the busduct must be capable of carrying continuously;
6. If the busduct is installed in flatwise mounting, appropriate de-rating factor as recommended by the manufacturer shall be applied to the busduct;
7. Busducts shall be totally enclosed type with ingress of protection not less than IP55 for indoor installation, including tap-off units, and IP66 for outdoor installation without tap-off units;
8. Unique model numbers shall be used to differentiate busducts with or without tap-off units;
9. Permanent nameplates shall be fixed on each busduct section and fitting. The use of stickers is not considered permanent in these circumstances.

ELE6.3.020.9 DESIGN AND CONSTRUCTION

1. The busducts shall be factory fabricated, fully insulated, totally enclosed, non-ventilated (sandwich) type. The busduct shall be designed to operate under the service conditions as specified in ELE1.5;
2. The busduct shall be of three phases and full size neutral busbar type;
3. Same length of busduct sections shall be interchangeable and polarized for phase relation. Each length of fitting shall bear the manufacturer's name, catalogue no. and rating. Each length or fitting shall bear the manufacturer's name, catalogue no. and rating;
4. All busducts can be mounted either flatwise or edgewise without loss in their mechanical strength and the current carrying capacity;
5. All plug-in sections provided shall be standardised to 1200 mm (4 feet) nominal length.

ELE6.3.030.9 BUSDUCT ENCLOSURE

1. The enclosure of the busducts shall be rigidly constructed from galvanized sheet steel of not less than 1.5 mm thickness or aluminium of minimum 2.5 mm thickness. Where a combination of sheets of these two materials is used as the assembly, no apparent visible stress shall be observed during operation when the busducts are properly supported. However, the thickness of the metal sheets employed shall, in no case, be less than 1.5 mm each;
2. The enclosure shall have one of the following finishes and the colour shall be grey or the manufacturer's colour of standard production:
    a. Stoved enamel paint;
    b. Stoved epoxy powder paint;
    c. Anodic oxidation coatings to Class 25 of EN 12373-1 for aluminum alloy;
    d. Other equivalent finishes approved by the Contract Manager.
3. For plug-in type busduct, the plug-in access opening shall be equipped with a hinged cover which covers the opening when not in use. All openings shall be usable simultaneously, if required.

ELE6.3.040.9 BUSBARS

1. Busbars shall be of hard drawn, high conductivity, solid copper bar to BS EN 13601 or alternatively hard drawn, high conductivity solid copper bars of 97% International Annealed Copper Standard Conductivity;
2. The busbar including all electrical contact surfaces shall be electroplated with silver or tin. The busbars shall be of adequate size to carry the rated current of the busducts continuously without exceeding the temperature rise limits specified in IEC 60439-2 when tested in accordance with sub-clause 8.2.1 of IEC 60439-2 at ambient temperature of 40°C;
3. Each busbar shall be insulated over its entire length except at joints and contact surfaces. The insulation material shall be of at lease class B (130°C);
4. The insulation material shall be of heat-resistant, self-extinguishing, non-hygroscopic and high insulation resistance and mechanical strength to withstand the stresses under all services and fault conditions and it shall be tested in accordance with Clauses 8.2.14 of IEC 60439-2 or to the satisfaction of the CM;
5. The maximum voltage drop value of a three phases and neutral busduct shall be 10 volts per 100 metres run when the busduct is operating at a full rated sinusoidal a.c. current of 50 Hz (concentrated load), at a power factor of 0.85 and at an ambient temperature of 35°C. Use of higher current rating busducts to achieve the above maximum voltage drop value is acceptable subject to the maximum allowable structural opening size shown on the drawings not being exceeded;
6. Drilling of busbars for power take off shall not be permitted, unless otherwise approved by the CM.

ELE6.3.050.9 BUSBAR JOINTING

1. Two sections of busducts shall be joined by connecting the joint-ends of the busbars in an interleaved manner;
2. The joints shall be of bolt-on type. The contact pressure shall be maintained by insulated bolts through the joint with the bolt at earth potential. Soldered, welded or riveted joints shall not be permitted;
3. The bolt shall be torque indicating and be tightened up by means of a torque wrench as recommended by the manufacturer;

4. The joint shall be protected by metal cover plates of same type of material and finish as the busduct casing so that the degree of protection shall not be less than that of an unjoined busduct;
5. The design of jointing shall permit safe, practical checking of joints for tightness without de-energising the busbars, or exposing maintenance personnel to any electrical hazard;
6. It shall be possible to tighten up a joint from one side only of the busducts. The joint shall be so designed and located that removal of any length should not result in the removal of the adjacent lengths.

ELE6.3.060.9 BUSBAR SUPPORT

1. Busducts shall be securely fixed on the building structure by means of hangers and brackets specifically designed and supplied by the same manufacturers;
2. Unless otherwise specified, horizontal run busducts shall be supported by hangers spaced at intervals of not more than 2 meters. Extra number of hanger shall be required for joints. At least one hanger shall be provided for every section of the busducts. Additional supports as recommended by the busduct manufacturer shall be provided;
3. Vertical busducts shall be supported by spring hangers on every floor. The spring hangers shall be properly adjusted such that the loading of vertical busducts is evenly distributed among the supports. Additional guide brackets in intermediate position between two supports shall be provided, if necessary, to balance the offset loading of the tap-off units.

ELE6.3.070.9 EXPANSION UNIT

1. Expansion unit shall be provided where busduct is installed across any structural expansion joint. The expansion unit shall be so constructed that any lateral or axial displacement on both the conductors and the casing caused by any movement of the building joint (in all directions) can be absorbed easily and cause no distortion to the busduct in whatever form;
2. Thermal expansion units, if required, shall be so constructed that any change in length on both the conductors and the casing so caused by thermal expansion and contraction in all direction can be absorbed easily and cause no distortion of the busduct in whatever form;
3. All expansion units shall be protected from water dripping by means of properly fabricated enclosure, details of which shall be submitted for Approval.

ELE6.3.080.9 TAP-OFF UNIT

1. Power tapping-off from the busduct shall be taken by means of specially designed tap-off units. These devices shall be plug-in type units, which shall be held in position by means of wing nuts or other quick fastening and quick release device. Quick fastening device shall mean that no tools are required for the removal of tap-off units. The design and construction of tap-off units shall be such that the electricity supply to other floors will not be interrupted no matter the tap-off units were plugged in or removed;
2. All plug-in access openings shall be equipped with a hinged door which covers the openings when not in use. The plug-in access opening doors can only be opened by tools otherwise the plug-in access opening door should be padlockable. The Sub-contractor shall provide pad-locks to all spare padlockable doors. A master key shall open all pad-locks of the same busduct. Details of the plug-in access opening doors shall be submitted for Approval;

3. The plug-in or the bolt-on type tap-off unit boxes together with the jaws and internal connection terminals shall be of the same manufacturer and country / place of manufacture of the busducts. The Sub-contractor shall propose, with the support of the busduct manufacturer, a type of FCU complying with ELE3.2 for Approval. If any modification to the manufacturer's standard tap-off unit boxes is required to suit the particular type of FCU, such modification shall be designed and carried out by the busduct manufacturer. The manufacturer shall undertake that such modifications are safe and suitable for the intended purpose. No modification by the Sub-contractor on site is allowed. The plug-in box complete with built-in FCU and fuses shall be type tested to IEC 60439-1 & IEC 60439-2. Full fault level, protection coordination and earth fault calculations should be submitted by the Sub-contractor for CM's Approval;
4. The tap-off units shall be equipped with internal barriers so that when the covers of the boxes are removed / opened, a degree of protection of the least IP2X is still maintained. Internal phase barriers shall be provided where necessary;
5. The tap-off unit shall be mechanically inter-locked with the busduct to prevent installation or removal of the unit while the unit is in the ON position. In addition, the cover of the tap-off unit shall have interlocks to prevent the covers from being opened while the tap-off unit is in the ON position. Means shall also be provided to padlock the FCU in its OFF position;
6. Tap-off unit boxes shall make positive earth connection with the earthing conductors before the jaws make contact with the phase busbars. The earthing method shall be such that it cannot be defeated by future painting of the busduct housing;
7. Tap-off unit shall be equipped with means for direct positioning or hanging so that the weight of the unit is borne by the busduct before the plug-in jaws make contact.

ELE6.3.090.9 BUSDUCT FITTINGS AND ACCESSORIES

1. All the busduct fittings, as listed below but not limited to, shall be specifically designed to suit the requirements of the busduct concerned and made by the some manufacturer:
   a. Flanged end;
   b. Flatwise and edgewise elbow;
   c. Combination elbow;
   d. Flatwise and edgewise offset;
   e. End closer;
   f. Tee-joints.

ELE6.3.100.9 LABELS AND WARNING NOTICES

1. All labels and warning notices shall be in both English and Chinese characters. Details shall be submitted to the Contract Manager for Approval;
2. Warning notices shall be provided along the entire busduct with the following wording in both English and Chinese characters:

   "DANGER - LIVE PART"

   "危險 - 帶電部份"
3. The warning notice shall be in the form of durable self-adhesive type label with red lettering on yellow background. The label shall have a minimum size of 150 mm x 75 mm with the lettering not less than 20 mm high;

4. The warning notices shall be located on all visible sides of the busduct, including all fittings, with a maximum spacing of 2 m along each side.

ELE6.3.110.9 TESTING AND CERTIFICATION

1. Short circuit test shall be carried out and certified by a Short Circuit Testing Organisation;
2. Short-circuit test for the busduct shall be carried out in accordance with Clause 8.2.3 of IEC 60439-1 or to the satisfaction of the Contract Manager at the value of short-circuit current specified below:

	Busbar Rating	Test Current
a.	Not exceeding 500A:	* Fused short-time withstand current of 40 kA
b.	Over 500A & below 1600A:	Short-time withstand current of 40 kA minimum for one (1) second.
c.	1600A & above:	Short-time withstanding current of 50kA for one (1) second.

*IEC 60269-1 and IEC 60269-2 and BS 88 : Section 2.2 or BS 88-2.

3. Before energization, the Sub-contractor shall carry out insulation resistance test for whole length of the busway, including feeders, expansion joints, and tap off/plug-in to verify the insulation resistance of the busway between phases and phases to earth to be not less than 10MΩ. For length of the busway exceeding 50 m, it is acceptable to carry out the insulation resistance test in two sections.

ELE6.3.120.9 IN-SERVICE RECORDS

Prior to the time of material submission for Approval, the equipment including its major components shall have proven record of reliability in local application for a minimum continuous period of 12 months to the satisfaction of the Contract Manager.

ELE7 CABLES

ELE7.1 GENERAL REQUIREMENTS 3
ELE7.1.010.9 QUALITY SURVEILLANCE SCHEME 3
ELE7.1.020.9 CABLE COLOURS 4

ELE7.2 WIRING SYSTEM IN CONDUIT 5
ELE7.2.010.9 TYPE OF CABLE 5
ELE7.2.020.9 GRADE OF CABLE 5

ELE7.3 WIRING SYSTEM IN TRUNKING 6
ELE7.3.010.9 TYPE OF CABLE 6
ELE7.3.020.9 GRADE OF CABLE 6

ELE7.4 SURFACE WIRING SYSTEM IN FIXED INSTALLATIONS 7
ELE7.4.010.9 CABLES - GENERAL 7
ELE7.4.020.9 PVC-INSULATED, NON-SHEATHED, GENERAL PURPOSE, SINGLE-CORE CABLES 7
ELE7.4.030.9 XLPE/PVC-INSULATED, PVC-SHEATHED, SINGLE-CORE CABLES 7
ELE7.4.040.9 PVC-INSULATED, PVC-SHEATHED, FLAT TWIN CABLES 8
ELE7.4.060.9 XLPE-INSULATED, PVC-SHEATHED, ARMOURED CABLES 8
ELE7.4.070.9 PVC-INSULATED CABLES FOR SWITCHGEAR AND CONTROLGEAR WIRING 8
ELE7.4.090.9 MINIMUM SIZE OF LIVE CONDUCTOR 8
ELE7.4.100.9 CIRCUIT PROTECTIVE CONDUCTOR (CPC) 8
ELE7.4.120.9 IDENTIFICATION OF CABLE CORE 8

ELE7.5 WIRING SYSTEM USING MINERAL INSULATED CABLE 9
ELE7.5.010.9 TYPES OF CABLE 9
ELE7.5.020.9 GRADE OF CABLE 9
ELE7.5.030.9 LOW SMOKE ZERO HALOGEN (LSOH) OUTER COVERING 9

ELE7.6 POWER DISTRIBUTION CABLES 10
ELE7.6.020.9 XLPE- INSULATED POWER CABLES WITH COPPER CONDUCTORS 10
ELE7.6.040.9 GRADING OF POWER CABLES 10

ELE7.7 CABLE GLANDS 11
ELE7.7.010.9 CONSTRUCTION 11
ELE7.7.020.9 TERMINATION 11
ELE7.7.030.9 ATTACHMENTS 11
ELE7.7.040.9 CERTIFICATION 11

ELE7.8 FIRE-RESISTANT CABLES 12
ELE7.8.010.9 GENERAL REQUIREMENTS 12
ELE7.8.030.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 15

ELE7.9 PREFABRICATED BRANCH CABLES 16
ELE7.9.010.9 GENERAL 16
ELE7.9.020.9 TYPE OF CONDUCTORS 16
ELE7.9.030.9 TYPE OF BRANCH JOINTS 16
ELE7.9.040.9 VOLTAGE RATING 16

ELE7.9.050.9	INSTALLATION OF BRANCH CABLES	16
ELE7.9.060.9	PROTECTION	16
ELE7.9.070.9	TYPE & ROUTINE TESTS	16
ELE7.9.080.9	FACTORY TEST REPORT	17
ELE7.9.090.9	SITE TESTS/INSPECTION	17
ELE7.9.100.9	MANUFACTURERS' RECOMMENDATIONS & SPECIAL TOOLS	18

ELE7.1 GENERAL REQUIREMENTS

ELE7.1.010.9 QUALITY SURVEILLANCE SCHEME

1. Where a national/international product standard exists, cables of the particular type shall be manufactured under BASEC licence or an Equivalent Quality Surveillance Scheme (EQSS) (e.g. HAR scheme recognized by the European Committee for Electrotechnical Standardization, CENELEC, etc.) and bear BASEC marking or the appropriate marking of the EQSS (e.g. 'X' ◁HAR▷, where 'X' is one of the Approval Organizations' designation under CENELEC);
2. The EQSS shall be a System 5 product certification system in accordance with ISO/IEC 17067 for determining the conformity of a product with specified requirements through initial testing of samples of the product, assessment and surveillance of the involved quality system, and surveillance by testing of product samples taken from the manufacturer, the open market or the supply from the Purchasers;
3. The certification body providing the EQSS shall be accredited by Hong Kong Accreditation Services (HKAS) or its Mutual Recognition Agreement (MRA) partners in accordance with this Scheme, ISO/IEC 17065 and its corresponding International Accreditation Forum (IAF) Guidance;
4. The cable manufacturer shall have its own machineries and facilities to make the cables and laboratories to perform routine tests on cables. Cross licence and sub-contracting of cable manufacture can be acceptable subject to the advance approval is obtained from the approved certification body. Cables manufactured under Original Equipment Manufacture (OEM) or private labelling shall not be accepted;
5. The certification body providing the EQSS shall submit complete set of the EQSS document and substantiate with separate information to the satisfaction of the CM that their product certification work and quality surveillance scheme are equivalent to that of BASEC's by making reference and comparison to each of the following:
    a. Each factory location where cable production occurs, and its product, is separately audited / tested and certified;
    b. Audited quality management system requirements include all requirements of ISO 9001;
    c. Audit includes production equipment and processes, and factory in-process and off-line testing equipment, calibration, etc.. Factories must maintain specified minimum suite of laboratory testing equipment;
    d. Three year certification cycle in line with ISO requirements;
    e. Audit / sample pickup frequency at each factory shall be four times per annum with at least one being unannounced. Sample numbers selected shall be up to 150 per annum for building wires / flexes, 50 per annum for armoured and fire performance cables, and 50 per annum for IEC or special types, which the number shall be geared by volume of production. Reduced level of surveillance can be acceptable only if a risk assessment system is established in the scheme and the licensee maintains persistent satisfactory quality results that meet the criteria for reduced surveillance as defined in the risk assessment. In any case, the risk assessment system and acceptable criteria shall not be less stringent than that adopted by BASEC;

f. Alternative to item e above, EQSS having yearly routine surveillance test at each factory plus inspection acceptance tests to be carried out on each batch cables to be supplied for individual project will also be acceptable. The inspection acceptance tests shall be conducted on each size and type of cable and at least include the following:

   i. verify all the results of routine tests conducted by the factory as defined in the corresponding cable standard and carry out supplementary auditing tests if necessary;

   ii. conduct all the Sample Tests (S) as stipulated in the corresponding cable standards on minimum 10% of each size and type of cables reels;

   iii. conduct the following verification tests on all cables:

      - resistance of conductors;
      - absence of faults in insulation (the spark test);
      - voltage test.

      All the tests shall be carried out in an accredited laboratory. Identification of the tested batch of cables such as purchase order number(s) and date(s) shall be submitted for the CM's checking prior to delivery. The purchase order number(s) shall be printed on the cables as one of the markings on the cable.

g. Initial type testing covering all requirements of cable standards and any subsidiary materials, performance and test standards referenced;

h. Surveillance testing covers all type, sample and routine tests on each cable type over the certification cycle;

i. Full traceability maintained from incoming material, through production to factory final test, and for samples onwards from auditor selection of samples through to final test;

j. Minor irregularities of deviations on test results are handled as non-conformities and require root cause analysis, correction and corrective action;

k. In case of serious test failures product recall notices are issued to the manufacturer;

l. Complaints and appeals system in cases of concern, test failure or failure in-use, with range of sanctions applied;

m. Specific assessment criteria of test results for each type of cable;

n. The certified products, together with their links to news of suspensions, recalls, etc, shall be shown on the certification bodies' websites;

o. The surveillance test report shall be submitted to the CM for checking upon requested.

ELE7.1.020.9 CABLE COLOURS

1. The compliance of electric cables with a national / international product standard shall require their design, construction and manufacture to adhere to that particular standard in all aspects except the cable colours that unless otherwise stated, should be in line with the Electrical CoP;

2. For any electrical installation based on the new cable core colour code, the registered electrical workers employed shall have satisfied the Electrical & Mechanical Services Department training requirements for new cable core colour code.

ELE7.2 WIRING SYSTEM IN CONDUIT

ELE7.2.010.9 TYPE OF CABLE

The cable installed in conduits shall be one of the following types with copper conductors unless otherwise stated:

1. Single-core, PVC-insulated cables to BS EN 50525-2-31 or IEC 60227-3;
2. PVC-insulated cables to BS 6231 Table 2;
3. Single-core, non-sheathed, non-armoured, low smoke zero halogen cables to BS EN 50525-3-41;
4. Single-core, non-sheathed, non-armoured, fire-resistant cables;
5. Single-core, sheathed, non-armoured, fire-resistant cables;
6. Multi-core, sheathed, non-armoured, fire-resistant cables.

ELE7.2.020.9 GRADE OF CABLE

The cable installed in conduits shall have the minimum voltage rating given in the table below:

	Type of Cables	Minimum Voltage Rating (V)
1.	Single-core, PVC-insulated cables to BS EN 50525-2-31 or IEC 60227-3	450/750
2.	PVC-insulated cables to BS 6231 Table 2	600/1000
3.	Single-core, non-sheathed, non-armoured, low smoke zero halogen cables to BS EN 50525-3-41	450/750
4.	Single-core, non-sheathed, non-armoured, fire-resistant cables	450/750
5.	Single-core, sheathed, non-armoured, fire-resistant cables	600/1000
6.	Multi-core, sheathed, non-armoured, fire-resistant cables	300/500

ELE7.3 WIRING SYSTEM IN TRUNKING

ELE7.3.010.9 TYPE OF CABLE

The cable installed in trunkings shall be one of the following types with copper conductors unless otherwise stated:

1. Single-core, PVC-insulated cables to BS EN 50525-2-31 or IEC 60227-3;
2. PVC-insulated cables to BS 6231 Table 2;
3. Single-core, non-sheathed, non-armoured, low smoke zero halogen cables to BS EN 50525-3-41;
4. Single-core, non-sheathed, non-armoured, fire-resistant cables;
5. Single-core, sheathed, non-armoured, fire-resistant cables;
6. Multi-core, sheathed, non-armoured, fire-resistant cables.

ELE7.3.020.9 GRADE OF CABLE

The cable installed in trunkings shall have the minimum voltage rating tabulated below:

	Type of Cables	Minimum Voltage Rating (V)
1.	Single-core, PVC-insulated cables to BS EN 50525-2-31 or IEC 60227-3	450/750
2.	PVC-insulated cables to BS 6231 Table 2	600/1000
3.	Single-core, non-sheathed, non-armoured, low smoke zero halogen cables to BS EN 50525-3-41	450/750
4.	Single-core, non-sheathed, non-armoured, fire-resistant cables	450/750
5.	Single-core, sheathed, non-armoured, fire-resistant cables	600/1000
6.	Multi-core, sheathed, non-armoured, fire-resistant cables	300/500

ELE7.4 SURFACE WIRING SYSTEM IN FIXED INSTALLATIONS

ELE7.4.010.9 CABLES - GENERAL

Unless otherwise stated, the cable having copper conductors shall be one of the following types with the respective minimum voltage rating:

	Type of Cables	Minimum Voltage Rating (V)
1.	Single-core, PVC-insulated cables to BS EN 50525-2-31 or IEC 60227-3	450/750
2.	PVC-insulated, PVC-sheathed, non-armoured cables, 35 mm^2 and below, to BS 6004 Tables 3 & 4	300/500
3.	PVC-insulated cables to BS 6231 Table 2	600/1000
4.	XLPE-insulated, PVC-sheathed, non-armoured cables to BS 7889 or IEC 60502-1	600/1000
5.	Flexible cords to BS EN 50525-2-11	300/500
6.	Flexible cords to BS EN 50525-2-21	450/750
7.	XLPE-insulated, PVC-sheathed, armoured cables to BS 5467 or IEC 60502-1	600/1000
8.	Mineral-insulated cables to IEC 60702-1 or BS EN 60702-1	750
9.	Single-core, non-sheathed, non-armoured, low smoke zero halogen cables to BS EN 50525-3-41	450/750
10.	Single-core, flat twin and flat 3-core, sheathed, non-armoured, low smoke zero halogen cables with circuit protective conductor, to BS 7211 Table 5	300/500
11.	XLPE-insulated, low smoke zero halogen compound-sheathed, armoured cables to BS 6724, or IEC 60502-1 and IEC 60332-1-2 and IEC 61034-2 and IEC 60754-1	600/1000
12.	Single-core, non-sheathed, non-armoured, fire-resistant cables	450/750
13.	Single-core, sheathed, non-armoured, fire-resistant cables	600/1000
14.	Multi-core, sheathed, non-armoured, fire-resistant cables	300/500
15.	Multi-core, sheathed, armoured, fire-resistant cables	600/1000

ELE7.4.020.9 PVC-INSULATED, NON-SHEATHED, GENERAL PURPOSE, SINGLE-CORE CABLES

Cables shall comply with BS EN 50525-2-31 or IEC 60227-3.

ELE7.4.030.9 XLPE/PVC-INSULATED, PVC-SHEATHED, SINGLE-CORE CABLES

1. Cables with copper conductor sizes up to and including 35 mm^2 shall comply with BS 6004 Table 3;

2. Single-core cables with copper conductor sizes from 50 mm² to 1000 mm² inclusive shall comply with BS 7889 or IEC 60502-1.

ELE7.4.040.9 PVC-INSULATED, PVC-SHEATHED, FLAT TWIN CABLES

1. Cables with or without integral circuit protective conductor shall comply with BS 6004 Tables 3 & 4;
2. The colour of the PVC sheath shall be white.

ELE7.4.060.9 XLPE-INSULATED, PVC-SHEATHED, ARMOURED CABLES

1. XLPE-insulated, PVC-sheathed, armoured cables shall comply with BS 5467 or IEC 60502-1;
2. The XLPE insulated cable cores shall be sheathed with PVC which serves as bedding for the galvanized steel single-wire armouring of multi-core cables and for the aluminium single-wire armouring of single-core cables;
3. The XLPE insulation shall be able to operate continuously at a conductor operating temperature of 90°C.

ELE7.4.070.9 PVC-INSULATED CABLES FOR SWITCHGEAR AND CONTROLGEAR WIRING

Flexible cables shall comply with BS 6231 Table 2.

ELE7.4.090.9 MINIMUM SIZE OF LIVE CONDUCTOR

1. Cables for circuits of rating not exceeding 10A shall have CSA of not less than 1.5 mm²;
2. Cables for circuits rated at 15A and above shall have CSA of not less than 2.5 mm²;
3. Flexible cables and flexible cords shall have CSA of not less than 0.75 mm².

ELE7.4.100.9 CIRCUIT PROTECTIVE CONDUCTOR (CPC)

1. In installations where cables are clipped direct having CSA up to 16 mm² and below used for single phase circuit shall be twin-core with integral CPC except where:
   a. They are used in earth free situations; or
   b. They are used for extra low voltage circuits; or
   c. The CSA of the integral CPC cannot meet the requirement of the adiabatic equation laid down in BS 7671 or IEC 60364.
2. Separate CPC shall be single-core cables, to BS EN 50525-2-31 or IEC 60227-3;
3. Tee connection in the CPC shall not be allowed;
4. The minimum CSA of a CPC shall be 1.0 mm² if the CPC is incorporated in the same cables as the associated live conductors, otherwise the minimum CSA shall be 4 mm²;
5. CPC shall be sized in accordance with ELE17.

ELE7.4.120.9 IDENTIFICATION OF CABLE CORE

The identification of cable cores shall follow the requirements of the Electrical CoP.

ELE7.5 WIRING SYSTEM USING MINERAL INSULATED CABLE

ELE7.5.010.9 TYPES OF CABLE

All mineral-insulated cables shall be copper sheathed with copper conductors complying with IEC 60702-1 or BS EN 60702-1.

ELE7.5.020.9 GRADE OF CABLE

Unless otherwise specified, all mineral-insulated cables shall be 750V (heavy duty) of IEC 60702-1 or BS EN 60702-1.

ELE7.5.030.9 LOW SMOKE ZERO HALOGEN (LSOH) OUTER COVERING

1. Mineral-insulated cables shall have LSOH thermoplastic outer covering when:
    a. They are exposed to weather;
    b. They are installed in situations where the atmosphere is likely to cause corrosion;
    c. They are laid upon or fixed direct to a concrete or stone surface subject to dampness;
    d. They are laid upon or fixed directly to a zinc coated surface, e.g. a galvanised cable tray or corrugated sheeting, subject to dampness;
    e. They are buried direct in the ground;
    f. They are as specified in ELE2 or the Drawings.
2. LSOH thermoplastic outer covering shall not be used in refrigerated spaces or other situations where the temperature is consistently below 0°C;
3. The LSOH thermoplastic outer covering shall have an orange colour.

ELE7.6 POWER DISTRIBUTION CABLES

ELE7.6.020.9 XLPE- INSULATED POWER CABLES WITH COPPER CONDUCTORS

XLPE insulated PVC-sheathed, armoured cable shall comply with the requirement specified in ELE7.4.060.

ELE7.6.040.9 GRADING OF POWER CABLES

All power cables for electricity supply shall have a grading of 600/1000V.

ELE7.7 CABLE GLANDS

ELE7.7.010.9 CONSTRUCTION

Cable glands shall be mechanical cable glands in compliance with BS 6121:Part 1 or BS EN 50262 and use brass as basic material.

ELE7.7.020.9 TERMINATION

For the termination of steel wire armoured cables of any of the following types, type D1W glands shall be employed for indoor applications while type E1W shall be employed for outdoor applications:

1. Cables to BS 5467 or IEC 60502-1;
2. Cables to BS 6724 or IEC 60502-1;
3. Fire-resistant cables.

ELE7.7.030.9 ATTACHMENTS

1. Each gland shall be provided with locknut and earth bond attachment of appropriate size and same material as the gland body for making electrical connection to the armour of the cable to be terminated;
2. Each gland shall be complete with a shroud made of the following materials according to the types of cables served:

Type of Cable	Material of Shroud
a. Cables to BS 5467 or IEC 60502-1	PVC
b. Cables to BS 6724, or IEC 60502-1 and IEC 60332-1-2 and IEC 61034-2 and IEC 60754-1	Low smoke zero halogen thermosetting or thermoplastic compound
c. Fire-resistant cables to BS 6387	Low smoke zero halogen thermosetting or thermoplastic compound

ELE7.7.040.9 CERTIFICATION

Test certificates giving the results of type-tests shall be produced to verify compliance with the test requirements stipulated in BS 6121: Part 1 or BS EN 50262.

ELE7.8 FIRE-RESISTANT CABLES

ELE7.8.010.9 GENERAL REQUIREMENTS

1. Fire-resistant cables shall be manufactured under licence of LPCB, BASEC or an Equivalent Quality Surveillance Scheme and shall comply, where applicable, the clauses specified in ELE8;
2. Valid approval documents issued by FSD and / or product certification bodies recognized by FSD for the fire-resistant cables shall be submitted to the Contract Manager for approval;
3. Fire-resistant cables and their application shall comply with the requirements stipulated in Fire Services COP, FSD's Circular Letters, and relevant BS or other international standards acceptable to the Director of Fire Services;
4. Fire-resistant cables shall have cross-sectional area of not less than 1.5 mm^2;
5. Non fire-resistant cables wholly installed in embedded concealed conduits complying with FSD's Circular Letters are allowed to apply for EXIT / directional signs and emergency lightings except those of which exposed conduits will be involved. In such cases, fire resistant cables shall be provided. For avoidance of doubt, only fire-resistant cables in concealed or exposed conduits shall be provided for all EXIT / directional signs in the entire domestic block, emergency lightings on ground floor of domestic blocks and all EXIT / directional signs / emergency lightings of which exposed conduits are involved;
6. Save as modified in the above clauses, the minimum fire-resistant cable requirements in respect of various fire service installations are listed below:

Item	Type of Fire Service Installations	Minimum Requirements
1.	Audio / visual advisory system	<u>For standard cables or cable systems as defined in BS 5839-1, they shall comply with</u>: (a) BS EN 50200 (PH30) and Annex E of BS EN 50200 (a duration of survival time of 30 minutes); or (b) BS EN 60702; or (c) BS 7629-1 (Cat. Standard 30); or (d) BS 7846 (Cat. F2 for cables of overall diameter not exceeding 20mm or Cat. F30 for cables of overall diameter exceeding 20mm); or (e) BS 6387 Cat. CWZ; or (f) Other international standards acceptable to the Director of Fire Services <u>For enhanced cables or cable systems as defined in BS 5839-1, they shall comply with</u>: (g) BS EN 50200 (PH120) and BS 8434-2 (a duration of survival time of 120 minutes); or (h) BS EN 60702; or

		(i) BS 7629-1 (Cat. Enhanced 120); or (j) BS 7846 (Cat. F2 for cables of overall diameter not exceeding 20mm or Cat. F120 for cables of overall diameter exceeding 20mm); or (k) BS 6387 Cat. CWZ; or (l) Other international standards acceptable to the Director of Fire Services.
2.	Automatic actuating device	<u>Cables shall comply with:</u> (a) BS 6387 Cat. CWZ; or (b) BS EN 60702; or (c) BS 8491 (minimum fire survival time of 120 minutes); or (d) BS 7629-1 (Cat. Enhanced 120); or (e) BS 7846 (Cat. F2 for cables of overall diameter not exceeding 20mm or Cat. F120 for cables of overall diameter exceeding 20mm); or (f) BS EN 50200 (PH120) and BS 8434-2 (a duration of survival time of 120 minutes); or (g) Other international standards acceptable to the Director of Fire Services.
3.	Automatic fixed installation other than water	
4.	Automatic fixed installation using water (other than sprinkler system)	
5.	Deluge system	
6.	Drencher system	
7.	Fire hydrant / hose reel system	
8.	Fixed foam system	
9.	Pressurization of staircase	
10.	Ring main system with fixed pump(s)	
11.	Smoke extraction system	
12.	Street fire hydrant system	
13.	Water mist system	
14.	Water spray system	
15.	Fire Service water supply system	
16.	Emergency generator	Cables from emergency generator to main essential switchboard(s) for fire service installations shall comply with the same requirements as those for items 2 to 15.
17.	Emergency lighting	<u>For standard cables or cable systems as defined in BS 5266-1, they shall comply with</u>: (a) BS 5266-1; or (b) BS EN 50200 (PH60) and Annex E of BS EN 50200 (a duration of survival time of 30 minutes) and one of following standards:

		(i) BS EN 60702 (ii) BS 7629-1 (Cat. Standard 60) (iii) BS 7846 (Cat. F2 for cables of overall diameter not exceeding 20mm); or (c) BS 6387 Cat. CWZ; or (d) BS 7846 (Cat. F60 for cables of overall diameter exceeding 20mm); or (e) Other international standards acceptable to the Director of Fire Services. <u>For enhanced cables or cable systems as defined in BS 5266-1, they shall comply with</u>: (f) BS 5266-1; or (g) BS EN 50200 (PH120) and BS 8434-2 (a duration of survival time of 120 minutes) and one of the following standards: (i) BS EN 60702 (ii) BS 7846 (Cat. F2 for cables of overall diameter not exceeding 20mm); or (h) BS 7629-1 (Cat. Enhanced 120); or (i) BS 6387 Cat. CWZ; or (j) BS 7846 (Cat. F120 for cables of overall diameter exceeding 20mm); or (k) Other international standards acceptable to the Director of Fire Services.
18.	Exit sign	The same requirements as those for item 17.
19.	Fire alarm system	<u>For standard cables or cable systems as defined in BS 5839-1, they shall comply with</u>: (a) BS 5839-1; or (b) BS EN 50200 (PH30) and Annex E of BS EN 50200 (a duration of survival time of 30 minutes); or (c) BS EN 60702; or (d) BS 7629-1 (Cat. Standard 30); or (e) BS 7846 (Cat. F2 for cables of overall diameter not exceeding 20mm or Cat. F30 for cables of overall diameter exceeding 20mm); or (f) BS 6387 Cat. CWZ; or (g) Other international standards acceptable to the Director of Fire

		Services. For enhanced cables or cable systems as defined in BS 5839-1, they shall comply with: (h) BS EN 50200 (PH120) and BS 8434-2 (a duration of survival time of 120 minutes); or (i) BS EN 60702; or (j) BS 7629-1 (Cat. Enhanced 120); or (k) BS 7846 (Cat. F2 for cables of overall diameter not exceeding 20mm or Cat. F120 for cables of overall diameter exceeding 20mm); or (l) BS 6387 Cat. CWZ; or (m) Other international standards acceptable to the Director of Fire Services.
20.	Fire detection system	The same requirements as those for item 19.
21.	Fireman's lift	Cables from the main essential switchboard for fire service installations to the main switch for lift power circuit, car lighting, etc., in the lift machine room shall comply with the same requirements as those for items 2 to 15.
22.	Sprinkler system	The same requirements as those for items 2 to 15.

ELE7.8.030.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of fire-resistant cables delivered to Site or installed.

ELE7.9 PREFABRICATED BRANCH CABLES

ELE7.9.010.9 GENERAL

1. Being XLPE-insulated, PVC-sheathed type, main and branch cables shall comply with one of the standards below:
    a. BS 7889;
    b. IEC 60502-1.
2. The sizes of main and branch cables shall be in line with those shown on the Drawings.

ELE7.9.020.9 TYPE OF CONDUCTORS

Main and branch cables shall be of copper conductors.

ELE7.9.030.9 TYPE OF BRANCH JOINTS

1. Each branch joint shall take the form of main and branch cables bound together to a compression connector that complies with one of the product standards below:
    a. BS EN 61238-1;
    b. JIS C 2810;
    c. HD 623 S1 or BS EN 50393;
    d. IEC 61238-1.
2. Each branch joint shall be assembled and encapsulated in a thermoplastic moulding, which is compatible with the cable sheath. The entire production process shall be under a quality management system to ISO 9001.

ELE7.9.040.9 VOLTAGE RATING

Prefabricated branch cables shall have a voltage rating of 600/1000V.

ELE7.9.050.9 INSTALLATION OF BRANCH CABLES

Prior to ordering, drawings to show the actual installation details of prefabricated branch cables shall be submitted to the Contract Manager for approval.

ELE7.9.060.9 PROTECTION

Cable ends for main and branch cables shall be sealed at factory before delivery to site.

ELE7.9.070.9 TYPE & ROUTINE TESTS

Prefabricated branch cables shall be assembled under a product specification that establishes at least the following test requirements:

1. Type tests:
    a. Heat cycle test according to the method given in one of the following:
        i. JIS C 2810 Class A;
        ii. HD 623 S1 or BS EN 50393;
        iii. BS EN 61238-1;

iv. Total 125 test cycles undergone - after the 25th cycle, the surface temperature of the thermoplastic moulding shall not exceed 75°C. This temperature shall also not reach more than 8°C plus that at the 25th cycle when measurements are taken at the end of the 50th, 75th, 100th and 125th cycles.

b. Resistance to flame propagation according to one of the standards below:

i. JIS C 3005;

ii. BS 4066-1, or IEC 60332-1-1, or BS EN 60332-1-1 and BS EN 60332-1-2 and BS EN 60332-2-1;

iii. IEC 60332-1-2;

iv. IEC 60332-3 Category C.

c. Insulation resistance test: the cables in water shall have a minimum insulation resistance of 50MΩ;

d. Tensile strength test: the cables shall withstand without breakage twice the specified weight of main and branch cables for the duration of not less than 24 hours.

2. Routine tests:

a. Voltage withstand test: The cables in water shall withstand a minimum voltage of 3.5kV for 1 minute without breakdown;

b. Connector resistance or conductivity test according to the method given in one of the following:

i. JIS C 3005;

ii. The resistance measured between the connector before and after the tensile test mentioned above shall agree to each other within 12%;

iii. $R_1/R_2 \leq 1.2$ where

- R_1 is the cable resistance measured across the connector between the main and one of the branch cables; and
- R_2 is the summation of the resistance of individual cables having the same length of cable up to the connector and conductor sizes as the main and branch cables respectively.

ELE7.9.080.9 FACTORY TEST REPORT

Prefabricated branch cables shall prove to have satisfactorily passed all tests stipulated in the product specification in ELE7.9.070. Prior to delivery to site, a factory test report on routine tests shall be submitted to the Contract Manager for approval.

ELE7.9.090.9 SITE TESTS/INSPECTION

Each prefabricated branch cable shall satisfactorily pass the site inspections/tests below along its entire route once its installation is completed:

1. Visual inspection;
2. Insulation resistance test: the cables in air shall have a minimum insulation resistance of 2MΩ.

ELE7.9.100.9 MANUFACTURERS' RECOMMENDATIONS & SPECIAL TOOLS

Manufacturers' recommendations shall be followed and special tools/accessories shall be used in the installation of prefabricated branch cables on site.

ELE8 INSTALLATION OF POWER CABLES

ELE8.1 GENERAL INSTALLATION REQUIREMENTS 3

ELE8.1.010.9 IDENTIFICATION OF CORE 3
ELE8.1.020.9 IDENTIFICATION AT JOINT OR TERMINATION 3
ELE8.1.030.9 USE OF SINGLE-CORE POWER CABLES WITH STEEL WIRE ARMOURS 3
ELE8.1.040.9 SIZE OF NEUTRAL CONDUCTOR 3
ELE8.1.050.9 BENDING RADIUS OF CABLE 3
ELE8.1.060.9 MINIMUM SIZE OF CABLE CONDUCTOR 3
ELE8.1.070.9 USE OF PVC-INSULATED CABLES AT LOW TEMPERATURE 3
ELE8.1.080.9 TERMINATION OF WIRING CONNECTIONS 3

ELE8.2 PARTICULAR INSTALLATION REQUIREMENTS 4

ELE8.2.010.9 CABLES MOUNTED ON SURFACE 4
ELE8.2.020.9 CABLES LAID IN ENCLOSED TRENCH 4
ELE8.2.030.9 CABLES ENCLOSED IN DUCTS 4
ELE8.2.040.9 CABLES BURIED DIRECT IN GROUND 5
ELE8.2.050.9 CABLE MARKERS 5
ELE8.2.060.9 CABLES CONNECTED TO OR IN CONTACT WITH BARE CONDUCTORS OR BUSBARS 5

ELE8.3 WIRING SYSTEM USING PVC INSULATED AND PVC SHEATHED CABLES 6

ELE8.3.1 WIRING SYSTEM 6
ELE8.3.1.010.9 GENERAL 6
ELE8.3.1.020.9 JOINTS IN CABLES OR CORDS 6

ELE8.3.2 MATERIALS FOR ACCESSORIES 6
ELE8.3.2.010.9 WIRING ACCESSORIES 6
ELE8.3.2.020.9 BOXES OR PATTRESSES 6
ELE8.3.2.030.9 CABLE FIXING CLIPS AND PINS 6
ELE8.3.2.040.9 CABLE FIXING SADDLES AND SCREWS 6

ELE8.3.3 INSTALLATION OF NON-FLEXIBLE CABLES 7
ELE8.3.3.010.9 CABLE ROUTES 7
ELE8.3.3.020.9 PROTECTION TO CABLES SUSCEPTIBLE TO DAMAGE 7
ELE8.3.3.030.9 CABLES PASSING THROUGH A BUILDING STRUCTURE 7
ELE8.3.3.040.9 CABLES CROSSING EXPANSION JOINT 7
ELE8.3.3.050.9 CABLES PASSING THROUGH METAL WORK 7
ELE8.3.3.060.9 SEGREGATION FROM OTHER SERVICES 7
ELE8.3.3.070.9 "LOOPING-IN" WIRING SYSTEM 7
ELE8.3.3.080.9 NEUTRAL CONDUCTOR AT SWITCH POSITION 7
ELE8.3.3.090.9 TERMINATION OF CABLES 8
ELE8.3.3.100.9 BENDING RADII OF CABLES 8
ELE8.3.3.110.9 FIXING OF CABLES 8
ELE8.3.3.120.9 FIXING OF CLIPS 8
ELE8.3.3.130.9 FIXING OF CABLE SADDLES 9
ELE8.3.3.140.9 RATING FACTORS TO CURRENT RATING OF CABLES 9

ELE8.3.4 CORDS INSTALLATION OF FLEXIBLE CABLES AND FLEXIBLE 9
ELE8.3.4.010.9 CONNECTIONS TO PORTABLE EQUIPMENT 9
ELE8.3.4.020.9 CONNECTIONS TO FIXED EQUIPMENT 9
ELE8.3.4.030.9 CONNECTIONS TO LUMINAIRES 9

ELE8.4 WIRING SYSTEM USING MINERAL-INSULATED CABLES..... 10

ELE8.4.1 MATERIALS FOR ACCESSORIES 10
ELE8.4.1.010.9 CABLE SADDLES AND CLIPS 10
ELE8.4.1.020.9 CONDUIT/ADAPTABLE BOXES 10

ELE8.4.2 INSTALLATION OF CABLES 10
ELE8.4.2.010.9 CABLE ROUTES 10
ELE8.4.2.020.9 CABLE SUPPORTS 10
ELE8.4.2.030.9 BENDING RADIUS 10
ELE8.4.2.040.9 CABLE LOOP FOR PREVENTION OF VIBRATION 10
ELE8.4.2.050.9 CABLE TERMINATIONS 10
ELE8.4.2.060.9 INSULATION RESISTANCE 11
ELE8.4.2.070.9 IDENTIFICATION OF CORE 11
ELE8.4.2.080.9 BONDING OF CABLE SHEATH TO METALWORK 12
ELE8.4.2.090.9 USE OF SINGLE-CORE CABLES 12
ELE8.4.2.100.9 PROTECTION FROM MECHANICAL DAMAGE 12
ELE8.4.2.110.9 RESTRICTION OF USE 12

ELE8.4.3 REFERENCE TABLE 12
ELE8.4.3.010.9 MAXIMUM SPACING OF SADDLES FOR MINERAL-INSULATED CABLES 12

ELE8.5 CABLE JOINTS AND TERMINATIONS 14
ELE8.5.010.9 GENERAL 14
ELE8.5.020.9 JOINT BOXES AND TERMINATING BOXES 14
ELE8.5.030.9 USE OF COLD COMPOUND AND PLASTIC SHELLS 14
ELE8.5.040.9 EARTH CONTINUITY ACROSS JOINTS 14
ELE8.5.050.9 STRAIGHT-THROUGH JOINTS FOR COPPER CONDUCTORS 15
ELE8.5.060.9 TEE-JOINTS FOR COPPER CONDUCTORS 15
ELE8.5.100.9 TERMINATION OF XLPE/PVC-INSULATED POWER CABLES WITH COPPER CONDUCTORS 15
ELE8.5.120.9 USE OF HEAT SHRINKABLE TUBING 15
ELE8.5.130.9 OTHER METHODS OF JOINTING AND TERMINATION 15

ELE8.6 REFERENCE TABLES..... 17
ELE8.6.010.9 CORE IDENTIFICATION OF POWER CABLES 17
ELE8.6.020.9 INTERNAL BENDING RADII OF POWER CABLES 17

ELE8.1 GENERAL INSTALLATION REQUIREMENTS

ELE8.1.010.9 IDENTIFICATION OF CORE

Each core of a power cable shall be identified continuously throughout its entire length. The identification shall take the form of appropriate colour or number codes in accordance with ELE8.6.010 or the relevant British Standard specifications.

ELE8.1.020.9 IDENTIFICATION AT JOINT OR TERMINATION

At each joint or termination, a non-ferrous metallic label shall be fixed to the cable giving the size and identification of the cable, e.g. 50 mm² 4-core XLPE/SWA/PVCS copper cable to "Services Block".

ELE8.1.030.9 USE OF SINGLE-CORE POWER CABLES WITH STEEL WIRE ARMOURS

Single-core power cables with steel wire armours shall not be used for a.c. circuits.

ELE8.1.040.9 SIZE OF NEUTRAL CONDUCTOR

The CSA of the neutral conductor shall have the same size as that of the phase conductors, unless otherwise specified.

ELE8.1.050.9 BENDING RADIUS OF CABLE

The internal bending radius of every power cable shall not be less than the appropriate values given in ELE8.6.020.

ELE8.1.060.9 MINIMUM SIZE OF CABLE CONDUCTOR

1. Cables for lighting, bell and control circuits shall have CSA of not less than 1.5 mm², and cables for power circuits shall have CSA of not less than 2.5 mm²;
2. The CSA of any cable shall not be reduced at its point of termination, junction, joints etc.

ELE8.1.070.9 USE OF PVC-INSULATED CABLES AT LOW TEMPERATURE

PVC-insulated cables shall not be installed in refrigerated spaces or other situations where the temperature is consistently below 0ºC.

ELE8.1.080.9 TERMINATION OF WIRING CONNECTIONS

All wiring connections are to be properly terminated.

ELE8.2 PARTICULAR INSTALLATION REQUIREMENTS

ELE8.2.010.9 CABLES MOUNTED ON SURFACE

1. Power cables mounted on the surface of walls or ceilings or other building structures shall either be cleated in position by Approved type cable cleats or cable saddles;
2. Cables cleats or cable saddles shall be provided along the entire cable route at regular intervals and at spacing in accordance with the requirements stipulated in the Electrical CoP unless otherwise specified on the Drawings;
3. Alternatively, the cables shall be supported on cable trays in accordance with the requirements of ELE9;
4. For vertical cable runs exceeding 100 m, tension releasing sections shall be provided in accordance with the recommendation of the cable manufacturer, failing which, a tension releasing section shall be provided for every 100 m vertical run.

ELE8.2.020.9 CABLES LAID IN ENCLOSED TRENCH

When more than one power cable is laid in an enclosed trench, the cables shall be spaced in accordance with BS 7671 or IEC 60364. Correction factors shall be applied to the current ratings as indicated in Table 4B and 4C of the above Standard. For cable sizes not shown in the above-mentioned tables, reference shall be made to the appropriate tables in the ERA Report 69-30 Part III.

ELE8.2.030.9 CABLES ENCLOSED IN DUCTS

1. General:
    a. Power cables installed in ducts shall conform to the provisions of ELE9;
    b. Prior to the drawing-in of the cables, the cylindrical ducts shall be cleaned with a cylindrical brush of appropriate size.
2. Pulling cables through ducts - general:
    a. Attachment to facilitate the pulling of cables through a duct shall be made to the cores, insulation, inner and outer sheath and not to the armour in order to avoid twisting;
    b. Attachment to the armour will only be permitted for small cables with the Approval of the Contract Manager;
    c. When pulling power cables into small ducts, an emulsion of graphite powder and soft soap in water may be used for brushing onto the cable surfaces where they enter the duct to reduce friction during pulling;
    d. The use of "French Chalk" or other methods will not be precluded provided that such materials or methods shall not damage the cables and that the prior Approval of the Contract Manager has been given.
3. Pulling cables through ducts - lead-sheathed insulated:
    a. When pulling-in lead-sheathed insulated power cables, the following stresses shall not be exceeded:
        i. Maximum stress in sheath - 10,000kPa (with stocking pulling grip);

ii. Maximum stress in conductors - 70,000kPa (with pulling eye attached to conductors).

b. When the cables are being drawn into ducts, the maximum pull shall be limited to 220,000 Newtons.

ELE8.2.040.9 CABLES BURIED DIRECT IN GROUND

1. Power cables buried direct in ground shall be armoured;
2. They shall be buried at a depth of not less than 450 mm and shall be protected by means of Approved cable cover tiles;
3. The bottom of the trench shall be covered, to a depth of 100 mm with a bedding layer of sand or fine soil;
4. On top of the cables, a layer of sand or fine soil, also to a depth of 100 mm, shall again be provided;
5. The sand or fine soil shall not be larger than 13 mm sieve;
6. Particular care shall be taken to ensure that there shall be no pebbles or small stones in the bedding layer or after the layer of fine sand or soil;
7. The cables shall then be covered, throughout the entire route, by cable cover tiles which shall be laid on top of the after layer.

ELE8.2.050.9 CABLE MARKERS

1. The route of all power cables buried direct in ground shall be clearly indicated by cable markers laid in the ground;
2. Cable markers shall be placed at regular intervals not exceeding 60 m apart and also at positions where the cable route changes direction;
3. At the position of each underground junction box, a cable marker shall also be installed. Such markers shall be engraved with, in addition to the wordings mentioned above, the appropriate information, such as "3 way Joint Box".

ELE8.2.060.9 CABLES CONNECTED TO OR IN CONTACT WITH BARE CONDUCTORS OR BUSBARS

1. PVC cables for interconnection between busbar risers and their outgoing switchgears, or between busbar chambers and their incoming/outgoing switchgears shall be to type CK of BS 6231 or equal and Approved;
2. Where cables to BS EN 50525-2-31 or BS 5467 or IEC 60502-1 are terminated to bare conductors or busbars of ACBs, MCCBs, fuse combination units or switch-disconnectors in the applications other than those given in sub-clause (1) above, the insulation and sheath of the cables shall be suitable for the maximum temperature of the terminals of the switchgear or equipment.
3. If the Sub-contractor fails to verify the above requirement as given in sub-clause (2) above to the satisfaction of the Contract Manager, the insulation and/or sheath of the cables shall be removed for a distance of 150 mm from the termination and replaced by at least 0.21 mm thick heat-resisting insulating tapes complying with IEC 60454-3-1 and suitable for operating temperatures up to 105°C.

ELE8.3 WIRING SYSTEM USING PVC INSULATED AND PVC SHEATHED CABLES

ELE8.3.1 WIRING SYSTEM

ELE8.3.1.010.9 GENERAL

1. XLPE/PVC insulated and PVC sheathed non-flexible cables shall be used for surface wiring in fixed installations. The cables shall not be buried in concrete or plaster;
2. PVC insulated and PVC sheathed flexible cables or flexible cords shall be used for connection to apparatus, appliances or equipment via an appropriate wiring accessory;
3. Flexible cables or flexible cords shall not be used in a fixed installation, except for final connection to a fixed equipment.

ELE8.3.1.020.9 JOINTS IN CABLES OR CORDS

Joints in cables or cords shall not be allowed unless Approved. In such cases, the joints shall be electrically and mechanically sound and shall be accessible for inspection.

ELE8.3.2 MATERIALS FOR ACCESSORIES

ELE8.3.2.010.9 WIRING ACCESSORIES

Wiring accessories, e.g. switches and socket outlets, shall be of the all-insulated pattern suitable for flush mounting on to a moulded box or pattress. In all other respects, they shall comply with ELE20.

ELE8.3.2.020.9 BOXES OR PATTRESSES

Moulded boxes or pattresses or the enclosure of surface mounted wiring accessories shall be of insulating material and shall comply with BS EN/IEC 60670-1 with dimensions to BS 4662. Each box or pattress shall have a copper earth terminal for the connection of the circuit protective conductors.

ELE8.3.2.030.9 CABLE FIXING CLIPS AND PINS

Buckle clips shall be of heavy gauge, heavily tinned brass with countersunk fixing holes. Fixing pins shall be of copper or brass with a minimum length of 15 mm.

ELE8.3.2.040.9 CABLE FIXING SADDLES AND SCREWS

Saddles shall be of heavy gauge galvanised steel. The fixing screws shall be of non-ferrous metal.

ELE8.3.3 INSTALLATION OF NON-FLEXIBLE CABLES

ELE8.3.3.010.9 CABLE ROUTES

1. All cables shall be run in a vertical or horizontal direction, and shall be secured flat on the surface of walls, columns, partitions or ceilings, etc. throughout the entire route, including at bends. Fixing on to the ceiling shall be avoided unless the cable is required to feed a point on the ceiling;
2. Where required, the cables may be run under floors, between partitions or inside ceiling voids provided that they are enclosed in ducts, conduits or trunking which comply fully with the relevant clauses in ELE9, ELE11, ELE12 and ELE13;
3. When cables are routed along or across steel joints, beams, stanchions, etc. they shall be enclosed in steel trunking/conduit or rigid PVC conduit;
4. Cables shall not be run as a span between beams, trusses, etc. without rigid support throughout their length.

ELE8.3.3.020.9 PROTECTION TO CABLES SUSCEPTIBLE TO DAMAGE

Cables susceptible to damage shall be protected by means of metal channels. Where protection is required for cables running up a wall from the floor, the metal channel shall be fixed to a minimum height of 2 m above finished floor level.

ELE8.3.3.030.9 CABLES PASSING THROUGH A BUILDING STRUCTURE

Where cables pass through a building structure such as a wall or column, the cables shall be drawn through PVC sleeves inserted into the building structure. The size of the PVC sleeves shall be such that the space factor shall not exceed 45%.

ELE8.3.3.040.9 CABLES CROSSING EXPANSION JOINT

Cables passing an expansion joint shall be formed into a loop such that any movement in the joint shall not stress the cables.

ELE8.3.3.050.9 CABLES PASSING THROUGH METAL WORK

Rubber grommets or insulated bushes shall be used to protect the cables passing through metal parts of a distribution board, a luminaires, a metal box or any other metal work.

ELE8.3.3.060.9 SEGREGATION FROM OTHER SERVICES

Cables shall be run at least 150 mm clear of all other non-electrical services.

ELE8.3.3.070.9 "LOOPING-IN" WIRING SYSTEM

The cables shall be wired on the "looping-in" system. Cable joints of any type in cable runs shall not be allowed.

ELE8.3.3.080.9 NEUTRAL CONDUCTOR AT SWITCH POSITION

The neutral conductor of a cable for a lighting final circuit shall be looped through an insulated connector enclosed in the moulded box or pattress housing the switch.

ELE8.3.3.090.9 TERMINATION OF CABLES

1. Cables terminated at a moulded box or pattress, a luminaire or other fittings shall have the overall protective sheaths carried into the moulded box or pattress, luminaire or other fittings for a minimum of 13 mm;
2. The circuit protective conductor shall be terminated at the earth terminal provided in the moulded box or pattress housing the wiring accessories;
3. Where it is not required to terminate the circuit protective conductor in an accessory, the circuit protective conductor shall not be cut back or removed. Instead it shall be coiled away from the live terminals or any bare conductors and shall be insulated and sleeved with a green-and-yellow PVC sleeve.

ELE8.3.3.100.9 BENDING RADII OF CABLES

The internal radii of cables shall not be less than the values given below:

Cable type	Overall diameter of cable, D (mm)	Minimum internal radius of cable
BS EN 50525-2-31 Clause 4.1 and BS 7889 or IEC 60502-1	$D \leq 10$	3 D
	$10 < D \leq 25$	4 D
	$D > 25$	6 D

ELE8.3.3.110.9 FIXING OF CABLES

1. Cables having an overall diameter not exceeding 10 mm shall be fixed by means of buckle clips. Cables of other diameters shall be fixed by means of cable saddles.
2.
   a. Where a number of cables running together on the surface of walls, columns, partitions or ceiling such that their aggregated width exceeds 50 mm, a 13 mm thick hardwood batten of adequate width shall be fixed along the cable route for mounting the cables;
   b. The hardwood batten shall be finished with one coat of Approved priming on front and edges, and treated at the back with waterproof compound;
   c. Lengths of the batten shall be properly fitted together and fixed in position by counter-sunk brass screws in rawplugs.

ELE8.3.3.120.9 FIXING OF CLIPS

1.
   a. Buckle clips shall be fixed to the surface of wall, column, partition or ceiling by pins secured to one plug inserted to a minimum depth of 20 mm;
   b. Where the buckle clips are fixed to plaster, concrete, etc. the plugs shall be made from teak dowelling of parallel length;
   c. The head of every pin shall be level with the surface of the clip so that no damage to the sheath of the fixed cables can occur.
2. Every hole in the buckle clip shall require a fixing pin;
3. A separate buckle clip shall be required for every cable of size above 2.5 mm^2 twin with CPC, or of equivalent size. Not more than two cables shall be allowed in one clip under all circumstances;
4. Buckle clips shall be provided along the entire cable route at regular intervals not exceeding 250 mm on horizontal runs and 400 mm on vertical runs;

5. A clip shall also be provided at a distance not exceeding 75 mm from a termination and from both sides of a bend.

ELE8.3.3.130.9 FIXING OF CABLE SADDLES

Cable saddles shall be securely fixed by fixing screws. Saddles shall be provided along the entire cable route at regular intervals. The spacing between adjacent saddles shall be in accordance with the requirements stipulated in the Electrical CoP unless otherwise specified on the Drawings.

ELE8.3.3.140.9 RATING FACTORS TO CURRENT RATING OF CABLES

There more than two twin cables are fixed together, or when the cables are installed at or in thermally insulated materials, etc., suitable rating factors, as recommended by the electrical CoP or BS 7671 or IEC 60364 shall be applied in determining the size of the cables to be installed.

ELE8.3.4 INSTALLATION OF FLEXIBLE CABLES AND FLEXIBLE CORDS

ELE8.3.4.010.9 CONNECTIONS TO PORTABLE EQUIPMENT

Flexible cables or flexible cords for connections to portable appliances or equipment shall be of suitable length (preferably 1.5 m to 2 m) to avoid undue risk of mechanical damage.

ELE8.3.4.020.9 CONNECTIONS TO FIXED EQUIPMENT

Exposed lengths of flexible cable or flexible cord used for final connections to fixed equipment or appliance shall be as short as possible.

ELE8.3.4.030.9 CONNECTIONS TO LUMINAIRES

Where a flexible cord supports or partly supports a pendant luminaires, the maximum mass acting on the cord shall not exceed 3 kg for flexible cord of 0.75 mm^2, and shall not exceed 5 kg for flexible cord of larger conductor cross sectional area.

ELE8.4 WIRING SYSTEM USING MINERAL-INSULATED CABLES

ELE8.4.1 MATERIALS FOR ACCESSORIES

ELE8.4.1.010.9 CABLE SADDLES AND CLIPS

Saddles and clips for fixing mineral-insulated cables shall be of the type specially made by the cable manufacturer for this purpose. Where the cables are fitted with low smoke zero halogen (LSOH) thermoplastic outer covering, the saddles or clips used shall also have LSOH thermoplastic or thermosetting covering.

ELE8.4.1.020.9 CONDUIT/ADAPTABLE BOXES

Conduit/adaptable boxes shall meet the requirements of ELE11.3.

ELE8.4.2 INSTALLATION OF CABLES

ELE8.4.2.010.9 CABLE ROUTES

Mineral-insulated cables shall be run neatly on the surface of the walls, columns, beams or ceilings in a vertical or horizontal direction, and at least 150 mm clear of all plumbing and mechanical services. The use of conduit and/or cable trunking to enclose such cables shall be kept to the minimum.

ELE8.4.2.020.9 CABLE SUPPORTS

1. Mineral-insulated cables shall be adequately supported by saddles which shall be obtained from the same manufacturer as the cables;
2. Saddles shall be provided through the entire cable route at regular intervals;
3. The spacing between adjacent saddles shall not exceed the values given in ELE8.4.3.010;
4. Saddles shall also be provided at a distance not exceeding 150 mm away from termination and from both sides of a bend.

ELE8.4.2.030.9 BENDING RADIUS

The minimum internal bending radius for mineral-insulated cables shall be 6 times the overall diameter of the cable.

ELE8.4.2.040.9 CABLE LOOP FOR PREVENTION OF VIBRATION

A loop shall be introduced in a cable immediately before its entry into the connected equipment which is subject to vibration or occasional movement. A clear space of at least 10 mm shall be maintained at the point in the loop where the cable passes over itself.

ELE8.4.2.050.9 CABLE TERMINATIONS

1. Cable termination shall generally comply with IEC 60702-2 or BS EN 60702-2;

2. The cable to be terminated shall be cut, screwed, sealed with cold compound and fitted with brass terminating glands, nuts, compression ring, gland body, sealing pot, disc and sleeves. The conductors shall be carried unbroken through the sealing pot to the terminal sockets or clamping screws;
3. The sealing shall be properly carried out to protect the cable ends from moisture and the insulation shall be thoroughly dry before the sealing is applied. The sealing material and any material used to insulate the conductors when they emerge from the insulation shall have adequate insulating and moisture proofing properties and shall retain these properties throughout the range of temperature they may be subjected to in service;
4. Where a mineral insulated cable is terminated at an insulating casing or enamelled/painted metal casing, the sealing pot shall be provided with a copper circuit protective conductor, complying with the requirements of BS EN 60228 and of an appropriate size in accordance with IEC 60702-2 or BS EN 60702-2;
5. Where more than one cable terminates at a galvanised or zinc coated enclosure the gland plate shall be of brass or insulating materials;
6. LSOH thermoplastic or thermosetting shrouded terminating glands shall be used when the cables are fitted with LSOH thermoplastic outer covering;
7. Only tools recommended by the manufacturer of the cables shall be used and the manufacturer's recommended methods of cable termination shall be adopted in all cases.

ELE8.4.2.060.9 INSULATION RESISTANCE

1. The insulation resistance between the cores and between each core and the sheath shall be measured before the cable end is sealed;
2. The measured insulation resistance, RI dependent on its length, l, on a 500V insulation resistance tester shall be given as follows:

Length, l (km)	Requirements on insulation resistance, R_I
$l < 0.1$	$R_I \geq 10{,}000\text{M}\Omega$
$l = 0.1$	$R_I \geq 10{,}000\text{M}\Omega$
$l > 0.1$	$l\,R_I \geq 1{,}000\text{M}\Omega$ km

3. If the reading is less than the values given above, the cable shall be heated by means of a blow lamp or similar device so that moisture is driven out to the open end of the cable and evaporated there;
4. Heating shall be continued until the measured insulation resistance reaches the values given above and the sealing shall be applied without delay;
5. The insulation resistance shall be measured when the cable end has been sealed, and shall meet the values given above;
6. For mineral-insulated cable with LSOH thermoplastic outer covering, adequate length of the LSOH thermoplastic outer covering shall be cut out in the event of low insulation resistance to achieve the required insulation resistance.

ELE8.4.2.070.9 IDENTIFICATION OF CORE

1. The cores of the mineral-insulated cables shall be identifiable at their termination by the application of sleeves or discs of appropriate colours as prescribed below:

Type	**Colour**
Single-phase circuit	Brown

Phase L1 of 3-phase circuit	Brown
Phase L2 of 3-phase circuit	Black
Phase L3 of 3-phase circuit	Grey
Neutral conductor of a circuit	Blue
Protective conductor	Green & Yellow

2. Identification sleeves shall comply with BS 3858 Type 3 where appropriate and shall have temperature rating similar to that of the seals.

ELE8.4.2.080.9 BONDING OF CABLE SHEATH TO METALWORK

Where a mineral-insulated cable passes through or makes contact with any metal, the metal and cable sheath shall be effectively bonded together.

ELE8.4.2.090.9 USE OF SINGLE-CORE CABLES

Single-core mineral-insulated cables running together shall be laid with the cable sheaths in contact. Mineral-insulated cables for 3-phase circuits shall be laid in trefoil formation. Where the cables used are rated at 100A or above, gland plates of apparatus shall be of brass.

ELE8.4.2.100.9 PROTECTION FROM MECHANICAL DAMAGE

The mineral-insulated cables shall be protected by steel conduits or steel sheathings where the cables are exposed in vulnerable positions. Where cables pass through floors, ceilings and walls, the holes shall be made good with cement or other non-combustible material and where cables pass through steelwork, the holes must be bushed.

ELE8.4.2.110.9 RESTRICTION OF USE

Mineral-insulated cables shall not be used:

1. In discharged lighting circuits unless suitable Approved precautions have been taken to avoid excessive voltage; or
2. For earthed concentric wiring system.

ELE8.4.3 REFERENCE TABLE

ELE8.4.3.010.9 MAXIMUM SPACING OF SADDLES FOR MINERAL-INSULATED CABLES

1. The spacing between adjacent saddles shall not exceed the values given in the table below:

Maximum Spacing of Saddles for Mineral-Insulated Cables		
Overall Diameter of Cable, D (mm)	Maximum Spacing (mm)	
	Horizontal Run †	Vertical Run †
$D \leq 9$	600	800
$9 < D \leq 15$	900	1200
$15 < D$	1500	2000

† The spacing stated for horizontal runs may be applied also to runs at an angle of more than 30° from the vertical. For runs at an angle of 30° or less from the vertical, the vertical spacing is applicable.

2. Saddles shall be provided at a distance not exceeding 150 mm away from a termination and away from both sides of a bend.

ELE8.5 CABLE JOINTS AND TERMINATIONS

ELE8.5.010.9 GENERAL

1. Joints and terminations of all power cables shall be made by skilled cable jointers who shall be approved by the Contract Manager before work commences;
2. No reduction in the number of strands of a cable core shall be allowed at a cable joint or termination;
3. Ferrules, compression connectors and bare portions of cable core resulting from a jointing or terminating process shall be insulated with an Approved type insulating tape or heat shrinkable tubing after completion of the process. Such insulating tape or heat shrinkable tubing shall have equal or better electrical and mechanical properties than those of the original insulation removed, and shall be adhered to the cores etc. securely and permanently. The final thickness shall be in a smooth contour throughout the whole length;
4. Every compression joint shall be of a type which has been the subject of a test certificate as described in BS 4579 or IEC 61238-1. When a compression joint is made, the appropriate tools specified by the manufacturer of the joint connectors shall be used.

ELE8.5.020.9 JOINT BOXES AND TERMINATING BOXES

1. Boxes for joints in all power cables shall be of cast-iron, compound filled and of adequate size;
2. The boxes shall be fitted with suitable armouring clamps and glands;
3. The armouring of the cables shall be terminated at the armouring clamps and the inner sheath shall pass through the gland;
4. The box shall be warmed thoroughly before the compound is poured to allow total adhesion between the compound and the box. The compound shall then be allowed to cool and tapped up before the box is closed. No air locks shall be formed within the box.

ELE8.5.030.9 USE OF COLD COMPOUND AND PLASTIC SHELLS

With the consent of the Contract Manager, plastic shells fitted with suitably sized armour bond and filled with Approved type cold pouring encapsulating compound may be used as an alternative to the compound filled cast iron joint boxes for jointing XLPE/PVC-insulated power cables. In such cases, the complete jointing kit, including plastic shell, compound, insulating tape etc., shall be from the same proprietary manufacturer who is specialised in manufacturing products for this purpose. The jointing method and procedure shall be in strict accordance with the manufacturer's recommendations.

ELE8.5.040.9 EARTH CONTINUITY ACROSS JOINTS

A circuit protective conductor having adequate CSA and of same material as the phase conductors shall be installed and connected to maintain the effectiveness of the earth continuity across every cable joint.

ELE8.5.050.9 STRAIGHT-THROUGH JOINTS FOR COPPER CONDUCTORS

1. In a straight-through joint for copper conductors, the two conductors shall be butted together after the strands have been soldered solid and shall be jointed by means of a weak back ferrule, soldered to the cores. Soldering shall be carried out by pouring tinman's solder over the cores and weak back ferrule. In no circumstances shall direct flame from a blowlamp be used for soldering;
2. As an alternative, conductors may be jointed by Approved type compression connectors using appropriate tools and connectors.

ELE8.5.060.9 TEE-JOINTS FOR COPPER CONDUCTORS

When two cables with copper conductors are tee-jointed, the branch conductor shall be connected to the main conductor by means of claw type or weak back ferrules. The strands in both branch and main conductors are to be sweated solid before sweating to the ferrule. Soldering shall be carried out as detailed in ELE8.5.050.

ELE8.5.100.9 TERMINATION OF XLPE/PVC-INSULATED POWER CABLES WITH COPPER CONDUCTORS

1. XLPE/PVC-insulated power cables shall be terminated in a gland fitted with an armour clamp;
2. Provision shall be arranged to enable a watertight seal to be made between the gland and the inner PVC or low smoke zero halogen sheath;.
3. The gland body shall be provided with an internal conical seating to receive the armour clamping cone and a clamping nut which shall secure the armour clamping cone firmly to the armour wires ensuring that the armour wires are tightly clamped between the armour cone and conical armour seating;
4. The spigot on the gland body shall be threaded to suit standard conduit accessories;
5. A shroud shall be fitted to cover the body of the gland and the exposed armour wires.

ELE8.5.120.9 USE OF HEAT SHRINKABLE TUBING

1. With the consent of the Contract Manager, heat shrinkable tubing and accessories may be used for cable joints or terminations. All tubing and accessories shall be specially designed for this purpose and shall be suitable for use with the type and construction of cable to be jointed or terminated;
2. The heat shrinkable materials shall have electrical and mechanical properties equal to or better than those of the cable insulation and sheath, where applicable. After the application of the heat, the heat shrinkable materials shall seal the interfaces between the heat shrinkable materials or between the heat shrinkable materials and the cable surfaces;
3. Whenever heat shrinkable tubing and accessories are used, the complete kit shall be from the same proprietary manufacturer who is specialised in manufacturing products for this purpose. The method and procedures adopted shall be strictly as those laid down by the manufacturer.

ELE8.5.130.9 OTHER METHODS OF JOINTING AND TERMINATION

Methods for jointing or terminating a power cable, other than those specified in the Section, will not be precluded provided that:

1. The method used shall be proven to be capable of affording the degree of safety and efficiency not less than that achieved by those specified in this Section;

2. The method used shall satisfy the requirements of the BS 7671 or IEC 60364;
3. The prior Approval of the Contract Manager has been obtained.

ELE8.6 REFERENCE TABLES

ELE8.6.010.9 CORE IDENTIFICATION OF POWER CABLES

Function of core	Colour code	Number code
Phase conductor of a single phase circuit	Brown	L
Phase conductor of a three-phase circuit	Phase L1: Brown Phase L2: Black Phase L3: Grey	L1 or L2 or L3 according to the phase concerned
Neutral conductor	Blue	N

Note: Cores used as protective conductors shall have an exclusive colour identification of green-and-yellow, unless otherwise stated.

ELE8.6.020.9 INTERNAL BENDING RADII OF POWER CABLES

Type of cables	Minimum radii
1. XLPE-insulated cables to BS 5467 or IEC 60502-1 or BS 6724 with copper conductors	6 D
2. Multi-core, sheathed, armoured, fire-resistant cables to BS 7846	8 D
3. Single-core, sheathed, non-armoured, fire-resistant cables	
4. Multi-core, sheathed, non-armoured, fire-resistant cables not covered by BS 7629:Part 1	
5. Multi-core, sheathed, non-armoured, fire-resistant cables to BS 7629:Part 1	6 D

Where D is the overall diameter of the cable.

ELE9 CABLE DUCTS AND CABLE TRAYS

ELE9.1 CABLE DUCTS 2

ELE9.1.010.9 MATERIALS FOR DUCTS 2
ELE9.1.020.9 METALLIC DUCTING 2
ELE9.1.030.9 CONCRETE DUCTS CAST IN-SITU 2
ELE9.1.040.9 CABLES IN CONCRETE DUCTS 2
ELE9.1.050.9 CABLES IN WOOD DUCTS 2
ELE9.1.060.9 CABLES IN UNDERGROUND DUCTS 2
ELE9.1.070.9 INTERNAL BARRIERS 2
ELE9.1.080.9 FIRE BARRIERS 2
ELE9.1.090.9 ACCESSORIES FASTENED TO DUCT COVER 2
ELE9.1.100.9 STEEL CONDUITS TERMINATED AT A DUCT 3
ELE9.1.110.9 RADIUS OF CURVATURE 3
ELE9.1.120.9 DRAW-IN PITS 3
ELE9.1.130.9 SPACE FACTOR 3
ELE9.1.140.9 SEGREGATION OF CABLES OF DIFFERENT CIRCUIT CATEGORIES 3
ELE9.1.150.9 SEALING OF DUCT ENTRIES TO BUILDING 3
ELE9.1.160.9 SEALING OF DUCT ENTRIES TO MANHOLES/DRAWPITS 3

ELE9.2 METAL CABLE TRAYS 4

ELE9.2.010.9 MATERIALS FOR TRAYS 4
ELE9.2.020.9 DIMENSION OF TRAYS 4
ELE9.2.030.9 BEND PIECES 4
ELE9.2.040.9 PERFORATIONS IN BEND PIECES 4
ELE9.2.050.9 TEE PIECES 4
ELE9.2.060.9 CONNECTIONS BETWEEN ADJACENT LENGTHS OF TRAY 5
ELE9.2.070.9 CUTTING OF TRAYS 5
ELE9.2.080.9 CABLE TRAY ACCESSORIES 5
ELE9.2.090.9 HOLES IN TRAYS 5
ELE9.2.100.9 SPACE BEHIND TRAYS 5
ELE9.2.110.9 FIXING OF TRAYS 5
ELE9.2.120.9 FIXING OF CABLES ON TRAYS 5

ELE9.1 CABLE DUCTS

ELE9.1.010.9 MATERIALS FOR DUCTS

Cable ducts shall be formed from concrete, PVC, metal or such other materials as may be specified by the Contract Manager in ELE2 or on the Drawings.

ELE9.1.020.9 METALLIC DUCTING

Metallic ducting shall comply with the same requirements as metal trunking.

ELE9.1.030.9 CONCRETE DUCTS CAST IN-SITU

Ducts cast in in-situ concrete shall be formed so that the radial thickness of the concrete or screed surrounding the cross-section of the complete ducting shall not be less than 15 mm at every point.

ELE9.1.040.9 CABLES IN CONCRETE DUCTS

Cables in ducts formed from concrete shall be PVC insulated and PVC sheathed with wire armour, or paper insulated with lead sheath and armoured or mineral insulated with PVC outer covering.

ELE9.1.050.9 CABLES IN WOOD DUCTS

Cables in ducts formed from wood shall be PVC insulated, or PVC insulated and PVC sheathed, and shall be held in position by clips, saddles, or equal and Approved fixings.

ELE9.1.060.9 CABLES IN UNDERGROUND DUCTS

Cables in underground ducts shall be of armoured type as specified in ELE7.

ELE9.1.070.9 INTERNAL BARRIERS

1. In every vertical duct, which is designed as totally enclosed without ventilation, internal barriers shall be provided to prevent the air at the top of the duct from attaining an excessively high temperature;
2. The distance between adjacent barriers shall be the distance between floors;
3. Where the floor to floor distance exceeds 5 m, additional barriers shall be provided at intervals not exceeding 5 m.

ELE9.1.080.9 FIRE BARRIERS

Where a cable duct passes through fire resistant structural elements, such as floors or walls designated as fire barriers, the opening thus formed shall be sealed with fire resistant materials having the same degree of fire resistance as the structural element. In addition, suitable internal fire barriers shall also be provided. An internal barrier may also serve as an internal barrier described previously in ELE9.1.070 above.

ELE9.1.090.9 ACCESSORIES FASTENED TO DUCT COVER

Where a duct cover is used as a support for fixing socket outlet or other accessories, provision shall be made to enable the cover to be removed, so that the enclosed cables can be accessed without taking down the socket outlet or other accessories from the cover.

ELE9.1.100.9 STEEL CONDUITS TERMINATED AT A DUCT

Steel conduits terminating at a duct shall each be securely fixed by means of conduit coupler and brass male brush.

ELE9.1.110.9 RADIUS OF CURVATURE

Where a change in direction in a duct occurs, provision shall be made to enable the cables in the duct to have adequate radii of curvature in accordance with ELE7 and ELE8.

ELE9.1.120.9 DRAW-IN PITS

1. Where cables in a duct are inaccessible for the greater part of their lengths, adequate number of draw-in pits shall be provided at regular intervals of not greater than 45 m;
2. Sufficient room shall be available in the draw-in pits to enable cables to be manoeuvred without damage;
3. In the case of armoured cables, the draw-in pits shall be concrete or brick lined and shall be fitted with a waterproof heavy cast iron lid;
4. Draw-in pits shall not be filled with sand or other materials.

ELE9.1.130.9 SPACE FACTOR

The space factor in a cable duct shall not exceed 35%.

ELE9.1.140.9 SEGREGATION OF CABLES OF DIFFERENT CIRCUIT CATEGORIES

Separate ducts shall be provided for cables of different circuit categories. However, cables of different categories may be allowed to pass through the same draw-in pit provided that they are properly and appropriately segregated.

ELE9.1.150.9 SEALING OF DUCT ENTRIES TO BUILDING

1. After the cables have been installed, both the cables and the exposed duct end shall be sealed to form a gas, water and fire barrier;
2. Open ends of spare ducts shall be closed with duct plugs as shown on drawings to prevent gas and water ingress. If the open ends of spare ducts are located in two separate fire compartments, either one end shall be further sealed with fire resistant material of fire rating not less than the fire resistant requirement of the compartments.

ELE9.1.160.9 SEALING OF DUCT ENTRIES TO MANHOLES/DRAWPITS

After the cables have been installed, all cables duct ends at the manholes/drawpits, including the spare ducts shall be sealed up to form a gas and water barrier according to the installation details as shown on the Drawings.

ELE9.2 METAL CABLE TRAYS

ELE9.2.010.9 MATERIALS FOR TRAYS

Metal cable trays shall be perforated, formed from plain steel sheet complying with BS 1449:Part 1 and shall be hot-dipped galvanised to ISO 1460, ISO 1461 after perforation. Cable trays shall have corrosion protection not lower than medium protection to BS EN 50085-1 and BS EN 50085-2-1 or Class 5 to IEC 61537.

ELE9.2.020.9 DIMENSION OF TRAYS

Cable trays have the following dimensions:

Nominal width	Minimum height of upstand	Nominal thickness of steel sheet
100 mm	12 mm	1.2 mm
150 mm	12 mm	1.2 mm
225 mm	12 mm	1.5 mm
300 mm	20 mm	1.5 mm
450 mm	20 mm	2.0 mm
600 mm	20 mm	2.0 mm

ELE9.2.030.9 BEND PIECES

Bend pieces shall be of the same material, thickness and finish as the main body of the cable tray and shall have an inner radius of 50 mm and a straight length of 100 mm at each end.

ELE9.2.040.9 PERFORATIONS IN BEND PIECES

1. No perforation shall be made in the circular portion of all bend pieces having a nominal width of 150 mm or 100 mm;
2. Perforation may be allowed in bend pieces having a nominal width of 225 mm or above provided that the perforation is made along a line passing through the centre of curvature of the bend pieces and set at an angle θ to the normal of the axis of the cable tray;
3. The values of θ are tabulated below:

Nominal width of cable tray	Value of θ
225 mm and 300 mm	45°
450 mm and 600 mm	30° and 60°

ELE9.2.050.9 TEE PIECES

Tee pieces shall be of the same material, thickness and finish as the main body of the cable tray. The distance measured between the point of the intersection and the end of the tee piece shall not be less than 100 mm.

ELE9.2.060.9 CONNECTIONS BETWEEN ADJACENT LENGTHS OF TRAY

1. Connections between adjacent lengths of tray, tee or bend pieces, shall be made by butt joints and fixed by mushroom-head steel roofing bolts and nuts complying with BS 1494:Part1;
2. The connection shall be mechanically strong so that no relative movement between the two lengths can occur.

ELE9.2.070.9 CUTTING OF TRAYS

Cable trays shall be cut along a line of plain metal only, i.e. they shall not be cut through the perforation. All cut edges of the galvanised cable tray shall be prepared and treated with a cold galvanised paint.

ELE9.2.080.9 CABLE TRAY ACCESSORIES

1. Manufacturer's standard items of accessories shall be used;
2. Site fabrication of accessories shall only be allowed after Approval and shall be kept to a minimum;
3. Where special sections are required, the material, thickness and finish shall be as specified for the standard items.

ELE9.2.090.9 HOLES IN TRAYS

Holes cut in a cable tray for the passage of cables shall be provided with grommets. Alternatively they shall be bushed or lined.

ELE9.2.100.9 SPACE BEHIND TRAYS

A minimum clear space of 20 mm shall be left behind all cable trays.

ELE9.2.110.9 FIXING OF TRAYS

1. Cable trays shall be fixed securely to the walls, ceiling or other structure by means of mild steel hangers or brackets of adequate mechanical strength;
2. The hangers or brackets shall be painted in accordance with ELE28.7;
3. Fixings for cable trays shall be disposed at regular intervals not exceeding 1200 mm and on both sides of, and at a distance not exceeding 225 mm from, a bend or intersection.

ELE9.2.120.9 FIXING OF CABLES ON TRAYS

1. For horizontal run of multi-core cables to BS 5467, cable ties for securing these cables to cable trays shall be made from nylon or polypropylene material. In the cases of low smoke zero halogen or fire-resistant multi-core cables, stainless steel cable ties shall be used;
2. For vertical run of multi-core armoured cables, cable cleats of cast iron with hot dipped galvanised finish or die cast aluminium shall be used for the fixture of multi-core armoured cables. In the case of multi-core non-armoured cables mounted vertically, metallic cable clamps or clips shall be used;
3. Single-core cables shall be secured to the cable tray by non-magnetic metallic cable cleats, clamps or clips specially designed to suit the dimensions of the cables. In the case of low smoke zero halogen or fire-resistant single-core cables, the cable cleats, clamps or clips shall be resistant to a flame at 950°C;

4. The cleats, clamps or clips of these single-core cables shall be secured to the cable tray by means of bolts, washers and nuts.

ELE11 WIRING SYSTEM IN STEEL CONDUITS

ELE11.1 CONDUIT SYSTEM 2

ELE11.1.010.9 CONCEALED CONDUIT SYSTEM 2
ELE11.1.020.9 SURFACE CONDUIT SYSTEM 2
ELE11.1.030.9 MINIMUM SIZE OF CONDUIT 2
ELE11.1.040.9 STANDARD 2

ELE11.2 CONDUITS AND FITTINGS 3

ELE11.2.010.9 TYPE-TESTING 3
ELE11.2.020.9 FLEXIBLE STEEL CONDUITS 3
ELE11.2.030.9 CONDUIT FITTINGS 3
ELE11.2.040.9 METAL BOXES FOR ACCESSORIES 3
ELE11.2.050.9 CLASS OF PROTECTION AGAINST CORROSION 3
ELE11.2.060.9 CORROSION RESISTANCE TEST 4

ELE11.3 CONDUIT AND WIRING INSTALLATION 5

ELE11.3.010.9 CONDUIT CONTINUITY 5
ELE11.3.020.9 JOINTS IN STEEL CONDUITS 5
ELE11.3.030.9 PROVISION OF ADAPTABLE BOXES 5
ELE11.3.040.9 SPACING BETWEEN CONDUITS 5
ELE11.3.050.9 TERMINATION OF STEEL CONDUITS AT METAL CASING 5
ELE11.3.060.9 CONDUIT BENDS 6
ELE11.3.070.9 CHASES FOR CONDUITS 6
ELE11.3.080.9 CONDUITS CROSSING EXPANSION JOINTS 6
ELE11.3.090.9 USE OF EXTENSION PIECE 6
ELE11.3.100.9 PREVENTION OF INGRESS OF FOREIGN MATTER 6
ELE11.3.110.9 PREVENTION OF ACCUMULATION OF WATER OR MOISTURE 7
ELE11.3.120.9 CONDUITS LAID DIRECT IN THE GROUND 7
ELE11.3.130.9 FIXING OF SURFACE MOUNTED BOXES 7
ELE11.3.140.9 FIXING OF SADDLES 7
ELE11.3.150.9 CONDUITS INSTALLED OUTDOORS OR IN DAMP SITUATIONS 7
ELE11.3.160.9 SWABBING OUT OF CONDUITS 7
ELE11.3.170.9 CONDUITS PASSING THROUGH FIRE RESISTANT BARRIERS 7
ELE11.3.180.9 IDENTIFICATION 8
ELE11.3.190.9 CABLE CAPACITY OF CONDUITS 8
ELE11.3.200.9 METHOD OF DRAWING CABLES INTO CONDUITS 8
ELE11.3.210.9 SEGREGATION OF CABLES OF DIFFERENT CIRCUIT CATEGORIES 8
ELE11.3.220.9 "LOOPING-IN" WIRING SYSTEM 8
ELE11.3.230.9 NUMBER OF FINAL CIRCUITS IN CONDUIT 8
ELE11.3.240.9 GROUPING OF CABLES IN CONDUIT 8
ELE11.3.250.9 NEUTRAL CABLE OF LIGHTING POINT 8

ELE11.4 TOOLS AND WORKMANSHIP 9

ELE11.4.010.9 TOOLS 9
ELE11.4.020.9 CUTTING OF HOLES 9
ELE11.4.030.9 REMOVAL OF BURRS AND SHARP EDGES 9
ELE11.4.040.9 MAKING GOOD OF DAMAGED COATING 9

ELE11.1 CONDUIT SYSTEM

ELE11.1.010.9 CONCEALED CONDUIT SYSTEM

Unless otherwise specified in ELE2 or shown on the Drawings, conduits shall be concealed within walls, floor slabs, false ceilings, or other suitable space.

ELE11.1.020.9 SURFACE CONDUIT SYSTEM

Where surface conduits are specified, they shall be fixed by distance saddles, and shall run only in a vertical or horizontal direction.

ELE11.1.030.9 MINIMUM SIZE OF CONDUIT

The minimum outside diameter of any conduit to be used shall be 20 mm. Where special situations demands, 16 mm conduit may be used subject to prior Approval being obtained from the Contract Manager.

ELE11.1.040.9 STANDARD

Steel conduits, except flexible conduits, shall be of heavy gauge, screwed, longitudinally welded. All conduits shall comply with BS 4568: Part 1 or IEC 61386-21 or BS EN 61386-21.

ELE11.2 CONDUITS AND FITTINGS

ELE11.2.010.9 TYPE-TESTING

Steel conduits and conduit fittings shall be type-tested for complete compliance with the following Standards by an Accredited Laboratory:

1. Steel conduits: BS 4568:Part 1 or IEC 61386-21 or BS EN 61386-21;
2. Conduit fittings: BS EN 61386-1 or IEC 61386-1;
3. Steel boxes for Electrical Accessories: IEC 60670-1 with dimensions to BS 4662.

ELE11.2.020.9 FLEXIBLE STEEL CONDUITS

1. Flexible steel conduits and solid type brass adaptors shall comply with BS EN 61386-1, or IEC 61386-1 and IEC 61386-23. In addition, the conduits shall be of the metallic watertight pattern, PVC oversheathed and with a separate circuit protective conductor drawn into the conduit for each continuity. PVC oversheath will not be required for installations within ventilated ceiling voids;
2. Length of each flexible conduit shall not be more than 1 m for general applications or 2 m inside false ceiling and raised floor.

ELE11.2.030.9 CONDUIT FITTINGS

1. All conduit fittings shall comply with BS EN 61386-1 or IEC 61386-1;
2. Adaptable boxes complete with covers shall be of cast iron, galvanised, or sheet steel having a protection against corrosion in accordance with IEC 60670-1. Unless otherwise specified, boxes of the preferred sizes only, as given in IEC 60670-1, shall be used. Screws for securing the cover shall be of stainless steel;
3. Circular boxes, dome covers and hook covers shall be of galvanised malleable cast iron. Ceiling mounted boxes shall be of deep pattern type having an internal depth of not less than 60 mm;
4. Bushes and plugs shall be of brass;
5. Distance saddles shall be of galvanised cast iron. The screws for fixing the saddles shall be of brass;
6. Solid or inspection tee-pieces, couplers or elbows shall not be used on any conduit installation.

ELE11.2.040.9 METAL BOXES FOR ACCESSORIES

1. Metal boxes for the enclosure of electrical accessories in conduit installation shall comply with IEC 60670-1 with dimensions to BS 4662;
2. 35 mm and 47 mm deep boxes shall be used to house accessories such as domestic switches, socket outlets, etc.;
3. 16 mm and 25 mm deep boxes may be used to house specially designed electrical accessories of shallow pattern subject to prior Approval.

ELE11.2.050.9 CLASS OF PROTECTION AGAINST CORROSION

1. Steel conduits shall have Class 4 protection against corrosion in accordance with BS 4568: Part 1 or IEC 61386-1 or BS EN 61386-1 i.e. heavy protection both inside and outside (e.g. hot-dip zinc coating or sherardizing);

2. Steel conduit fittings shall have Class 4 protection in accordance with BS EN 61386-1 or IEC 61386-1 i.e. heavy protection both inside and outside (e.g. hot-dip zinc coating or sherardizing);
3. Metal boxes for the enclosure of electrical accessories shall have protection both inside and outside in accordance with IEC 60670-1.

ELE11.2.060.9 CORROSION RESISTANCE TEST

Upon request from the Contract Manager, documentary evidence that the batch/consignment of steel conduits and conduit fittings delivered to site having satisfied the corrosion protection requirement as stipulated in the relevant Standards mentioned in ELE11.2.010 shall be provided.

ELE11.3 CONDUIT AND WIRING INSTALLATION

ELE11.3.010.9 CONDUIT CONTINUITY

1. The steel conduit installation shall be mechanically and electrically continuous throughout, and efficiently earthed;
2. Earth continuity of the conduit installation shall be tested before concreting of floors and walls and also on completion of the entire installation;
3. Where the circuit protective conductor is formed by the conduits, the terminal of the socket outlet shall be connected by a separate protective conductor, having the same cross sectional area and type as the live conductors, to an earth terminal incorporated in the associated metal box or enclosure;
4. Flexible conduit shall not be used as a protective conductor.

ELE11.3.020.9 JOINTS IN STEEL CONDUITS

1. Joints in steel conduits shall be made by means of a solid coupler into which the adjacent ends of the two conduits shall be inserted and screwed up tightly in order to make the conduit run mechanically and electrically continuous;
2. Running couplings shall be avoided. Where such a coupling cannot be avoided, the coupler shall be screwed up tightly onto the short threaded portion of one conduit, the threaded portion of which shall project approximately half way into the length of the coupler. The threaded portion of the mating conduit should also project approximately half way into the coupler;
3. Electrical continuity should be ensured by tightening up a hexagon locknut against the coupler;
4. Any exposed threads on either conduit shall be painted with at least two coats of anti-rust paint.

ELE11.3.030.9 PROVISION OF ADAPTABLE BOXES

1. An adequate number of suitably sized adaptable boxes shall be provided in all conduit runs to enable cables to be drawn in easily and without damage;
2. Adaptable boxes shall be provided immediately after every two bends, after a bend plus a total maximum straight run of 10 m or after a maximum straight run of 15 m;
3. Where an adaptable box is required for conduits installed in the floor screed, it shall be fitted in such a manner that the lid is covered by the same material as the remainder of the floor, and shall remain accessible at all times.

ELE11.3.040.9 SPACING BETWEEN CONDUITS

Adjacent or parallel conduits cast in concrete (except the first 200 mm straight runs from the same box) shall be separated by a spacing of not less than 25 mm so as to allow concrete aggregate to pass and set between them.

ELE11.3.050.9 TERMINATION OF STEEL CONDUITS AT METAL CASING

1.

   a. Where a steel conduit terminates at a metal casing, a coupler or a brass adaptor for flexible conduit together with a brass male bush shall be used;

b. The brass male bush shall be screwed into the coupler or adaptor from the inside of the metal casing through a clearance hole drilled in the metal casing to suit the bush;

c. Both the conduit and the bush shall be screwed tightly into the coupler or adaptor so as to grip the metal casing securely for mechanical and electrical continuity;

d. Threads on the steel conduit shall be at least half the coupler length, and no threads on the metal casing shall be allowed;

e. The connection between the flexible conduit and the adaptor shall be securely fixed and effectively watertight.

2. Where the metal casing is painted or enamelled, the electrical continuity between the conduit and the casing shall be achieved by means of a separate protective conductor of adequate size connecting the conduit and an earth terminal inside the metal casing through a copper earthing placed between the bush and the metal casing. Neither the paint nor the enamel shall be damaged or removed to achieve electrical continuity.

ELE11.3.060.9 CONDUIT BENDS

Conduits shall not be bent with an acute angle. The internal radius of the bend shall not be less than 2.5 times the outside diameter of the conduit.

ELE11.3.070.9 CHASES FOR CONDUITS

Chases for conduits to be concealed in walls, columns or beams shall be vertical or horizontal.

ELE11.3.080.9 CONDUITS CROSSING EXPANSION JOINTS

1. Where a conduit crosses an expansion joint, special arrangements shall be made to allow relative movement to occur on either side of the expansion joint;
2. A separate circuit protective conductor shall be installed to maintain an effective electrical continuity across the expansion joint;
3. The circuit protective conductor shall have a cross-sectional area rated to suit the largest live conductors drawn into the conduits in accordance with for the Electrical CoP.

ELE11.3.090.9 USE OF EXTENSION PIECE

1. An extension piece shall be fitted to a conduit box where the plaster wall finish (including plaster) is more than 25 mm from the conduit box;
2. Only extension pieces of the correct depth shall be used;
3. Under no circumstances shall multiple extension pieces be permitted.

ELE11.3.100.9 PREVENTION OF INGRESS OF FOREIGN MATTER

1. During the building construction, all open ends of the conduit termination, which are liable to be filled with water, moisture or other foreign matter, shall be plugged with Approved conduit stopping plugs; paper or rag materials will NOT be allowed for this purpose;
2. Conduit boxes in similar circumstances shall also be similarly plugged to prevent concrete or plaster from entering the boxes during the building construction.

ELE11.3.110.9 PREVENTION OF ACCUMULATION OF WATER OR MOISTURE

1. The conduits shall be so laid to prevent accumulation of condensed moisture in any part of the installation. Due care shall also be taken to prevent the ingress of water into the conduits from leakage in walls and ceilings of the building structure;
2. Approved type of sealant for the prevention of condensed moisture shall be applied to ceiling conduit outlets installed in a cool space subject to the influx of warm air.

ELE11.3.120.9 CONDUITS LAID DIRECT IN THE GROUND

Steel conduits laid direct in ground or buried in soil shall be painted with two coats of bituminous paint before installation.

ELE11.3.130.9 FIXING OF SURFACE MOUNTED BOXES

In surface conduit installations, conduit boxes, adaptable boxes and metal boxes for accessories shall be securely fixed to walls, ceilings or other substantial parts of a structure by means of suitable brass screws correctly spaced. The fixing of these boxes shall be independent of the fixing of the associated conduits.

ELE11.3.140.9 FIXING OF SADDLES

1. Galvanised distance saddles, for the support of surface conduits, shall be provided throughout the entire route at regular intervals;
2. The spacing between the adjacent saddles shall not be more than those given in the Electrical CoP;
3. Each bend of a surface conduit shall be supported by a saddle on either side of the bend, and the saddles shall be fixed as near to the bend as practicable;
4. Distance saddles shall be fixed with brass screws in Rawplugs or other Approved method.

ELE11.3.150.9 CONDUITS INSTALLED OUTDOORS OR IN DAMP SITUATIONS

Where conduits are installed outdoors or in damp situations all conduit fittings and conduit accessories, shall not be placed in contact with other metals with which they are liable to set up electrolytic action. In addition, where the conduit installation is subjected to weather, the conduit fittings and conduit accessories shall be provided with weatherproof sealant or other materials to ensure that the installation is completely weatherproof.

ELE11.3.160.9 SWABBING OUT OF CONDUITS

Conduits shall be swabbed out and free from moisture before wiring work is commenced. The swabbing operation shall be carried out under the supervision of the authorised representative of the Contract Manager. Only Approved draw-in tape or wire of appropriate size and absorbent cloth shall be used.

ELE11.3.170.9 CONDUITS PASSING THROUGH FIRE RESISTANT BARRIERS

Where conduits pass through fire resistant structural elements, such as walls and floors designated as fire barriers, the opening made shall be sealed according to the appropriate degree of fire resistance of the wall and floor. In addition, where conduits are installed in channels, ducts, ducting, trunking or shafts which pass through such elements, suitable internal fire resistant barriers shall also be provided to prevent the spread of fire.

ELE11.3.180.9 IDENTIFICATION

Conduits, where required to be distinguished from pipelines of other services, shall use orange as the basic identification colour in compliance with BS 1710.

ELE11.3.190.9 CABLE CAPACITY OF CONDUITS

1. The number of cables drawn into a conduit shall be such that no damage will be caused to the cables or to the conduits during their installation;
2. In determining the size of the conduit, the "unit system" method as recommended by the Electrical CoP shall be adopted;
3. For cables and conduits NOT included in the Electrical CoP, the number of cables drawn into a conduit shall be such that the resulting space factor shall not exceed 40%.

ELE11.3.200.9 METHOD OF DRAWING CABLES INTO CONDUITS

Cables shall be drawn into conduits by using Approved draw-in tape or wire of the appropriate size. Only lubricating materials which are confirmed in writing from a cable manufacturer or recognised certification body that there will be no adverse effect on the cable insulation for the lifetime of the cable may be allowed to be used for drawing cables into conduits.

ELE11.3.210.9 SEGREGATION OF CABLES OF DIFFERENT CIRCUIT CATEGORIES

Separate conduits shall be provided for cables of different circuit categories.

ELE11.3.220.9 "LOOPING-IN" WIRING SYSTEM

Each conductor in a run shall be of one continuous length and wired on the "loop-in" system. No joint in cable run will be allowed.

ELE11.3.230.9 NUMBER OF FINAL CIRCUITS IN CONDUIT

A conduit serving final circuits direct from a distribution board or from an adaptable box used as a final distribution point shall contain one final circuit except in the case of lighting final circuit where two circuits with 1.5 mm^2 cables will be permitted in a 20 mm conduit. For 3 phase final circuits, a separate conduit shall be used for each circuit.

ELE11.3.240.9 GROUPING OF CABLES IN CONDUIT

1. Where an adaptable box is used as the final distributing point, a number of final circuits may be grouped together between the distribution board and the adaptable box by means of conduits of appropriate diameter. All live conductors of the same a.c. circuits shall be drawn into the same conduit;
2. Correction factors for grouping, as recommended by the Electrical CoP, shall be applied in determining the size of cables to be installed.

ELE11.3.250.9 NEUTRAL CABLE OF LIGHTING POINT

The neutral cable of a lighting final circuit shall be routed in the conduit direct to the lighting point and shall not pass through the switch box.

ELE11.4 TOOLS AND WORKMANSHIP

ELE11.4.010.9 TOOLS

Conduit bends shall be formed on a bending machine, and the conduits shall not be flattened at bends.

ELE11.4.020.9 CUTTING OF HOLES

Holes in metal work for the termination of conduits shall be drilled with a twist drill of the correct size or by means of other hole cutting device.

ELE11.4.030.9 REMOVAL OF BURRS AND SHARP EDGES

Burrs and sharp edges are to be removed from the ends of conduits before they are installed.

ELE11.4.040.9 MAKING GOOD OF DAMAGED COATING

Where the protective coating on a steel conduit has been damaged after installation, such surface shall be painted with at least two coats of an Approved anti-rust paint to prevent corrosion.

ELE12 WIRING SYSTEM IN STEEL TRUNKING

ELE12.1 TRUNKING SYSTEM 2

ELE12.1.010.9 ARRANGEMENT OF CABLES 2
ELE12.1.020.9 PROVISION OF CABLE RETAINING BARS AND CABLE SUPPORTS 2
ELE12.1.030.9 CABLE CAPACITY OF TRUNKING 2
ELE12.1.040.9 CORRECTION FACTORS FOR GROUPING 2
ELE12.1.050.9 SEGREGATION OF CABLES OF DIFFERENT CIRCUIT CATEGORIES 2

ELE12.2 MATERIALS FOR TRUNKING SYSTEM 3

ELE12.2.010.A GENERAL 3
ELE12.2.020.A CLASS OF PROTECTION AGAINST CORROSION 3
ELE12.2.030.9 CONSTRUCTION 4
ELE12.2.040.A MARKING ON TRUNKING 4
ELE12.2.050.9 DIMENSIONS 4
ELE12.2.060.9 CONNECTIONS BETWEEN LENGTHS OF TRUNKING 4
ELE12.2.070.9 TRUNKING COVERS 4
ELE12.2.080.9 SCREWS 5

ELE12.3 INSTALLATION OF TRUNKING SYSTEM 6

ELE12.3.010.9 LAYOUT 6
ELE12.3.020.9 TRUNKING CONTINUITY 6
ELE12.3.030.9 CONNECTION TO APPARATUS 6
ELE12.3.040.9 CONNECTION TO DISTRIBUTION BOARD 6
ELE12.3.050.9 FIXING OF TRUNKING 6
ELE12.3.060.9 CABLES THROUGH TRUNKING 6
ELE12.3.070.9 TRUNKING PASSING THROUGH FIRE RESISTANT BARRIERS 6
ELE12.3.080.9 PREVENTION OF ELECTROLYTIC ACTION 7
ELE12.3.090.9 PREVENTION OF INGRESS WATER 7

ELE12.4 TOOLS AND WORKMANSHIP 8

ELE12.4.020.9 CUTTING IN TRUNKING 8
ELE12.4.030.9 MAKING GOOD OF DAMAGED COATING 8

ELE12.1 TRUNKING SYSTEM

ELE12.1.010.9 ARRANGEMENT OF CABLES

Cables in each final circuit and/or in each sub-main shall be bunched and tied or clipped together.

ELE12.1.020.9 PROVISION OF CABLE RETAINING BARS AND CABLE SUPPORTS

1. Trunking, which is installed in such a position that the cables would fall out when the cover is removed, shall be fitted with cable retaining bars or other suitable devices to prevent cables from falling out;
2. Trunking installed in a vertical plane shall contain sufficient supporting devices within the trunking to prevent strain on the cables due to the weight of the cables, and to prevent vertical movement of the cables.

ELE12.1.030.9 CABLE CAPACITY OF TRUNKING

1. The number of cables put into a trunking shall be such that no damage is caused to the cable or the trunking;
2. In determining the size of the trunking required for a particular installation, the "unit system" method as recommended by the Electrical CoP shall be adopted;
3. For cables and trunking not included in the Electrical CoP, the number of cables to be enclosed in the trunking shall be such that the resulting space factor shall not exceed 45%.

ELE12.1.040.9 CORRECTION FACTORS FOR GROUPING

Where more than three loaded conductors or more than one multi-core cable are enclosed in a common trunking, suitable correction factors for grouping, as recommended by BS 7671 or IEC 60364, shall be applied in determining the size of the cables to be installed.

ELE12.1.050.9 SEGREGATION OF CABLES OF DIFFERENT CIRCUIT CATEGORIES

1. Where a common trunking is used to accommodate cables for different circuit categories, they shall be effectually segregated by means of partitions or dividers;
2. The partitions or dividers shall be adequately secured to the body of the trunking.

ELE12.2 MATERIALS FOR TRUNKING SYSTEM

ELE12.2.010.A GENERAL

1. The steel trunking shall be manufactured in a process conforming to the relevant quality assurance standard ISO 9001:2015. Valid manufacturer's certificate of accreditation to the recognised Quality Assurance System issued within three years before the material delivery to site shall be submitted;
2. Trunkings and fittings shall comply with BS EN 50085-2-1, IEC 61084-2-1 or equivalent unless otherwise specified;
3. Manufacturer's standard fittings such as tee or angle pieces, connectors etc. shall be used throughout unless prior approval has been obtained from the CM;
4. Factory prefabricated trunking assemblies of repetitive pattern can be used for congested areas like meter rooms on various floors. Mock-up installation shall be set up for the CM's approval prior to mass production of the prefabricated trunking assemblies.

ELE12.2.020.A CLASS OF PROTECTION AGAINST CORROSION

1. Trunking and fittings shall have continuous hot-dip zinc coating on both sides to BS EN 10346:2015 with a minimum coating designation of Z275. Test report of trunking materials showing the compliance with the above standard issued by an organisation accredited under HOKLAS of the HKAS, or an organisation accredited by an accreditation body mutually recognised by HKAS, shall be submitted. "Common batch / reference number", as indicated in the test certificate / report, shall be shown in the corresponding Delivery Notes from the suppliers / manufacturer and shall be marked on each trunking body by laser engraved print or other permanent means indicating that the material tested is of the same batch as material used for the project;
2. On-site non-destructive sample tests by coating thickness gauge as specified in BS EN ISO 2178:2016 shall be conducted by the Sub-contractor in the presence of the CM or his representative as part of the inspection and acceptance procedures for coating of steel trunking. Three (3) numbers of steel trunking shall be randomly selected from each batch (for every 1,000 numbers of steel trunking per batch) for non-destructive sample test. In case the trunkings are divided into sub-batches during delivery, three (3) numbers of steel trunking shall be randomly selected on the first day of delivery of each batch. Five (5) test points evenly distributed along the steel trunking shall be tested. All test points shall comply with the range of coating thickness as required in the coating designation of Z275 according to BS EN 10346:2015;
3. Additional two (2) samples shall be tested if the material failed in the first round of non-destructive tests. Five (5) test points on each selected trunking shall be tested by calibrated coating thickness gauge and five (5) measurements shall be taken within a circle of 1cm diameter at each test point. The arithmetic mean of these five (5) measurements for each test point shall satisfy the range of coating thickness as required in coating designation of Z275 according to BS EN 10346:2015. The Contractor may arrange destructive test at their own cost for verification if the results in both rounds of non-destructive tests do not comply with the coating requirements, otherwise the whole batch of material would not be accepted.

ELE12.2.030.9 CONSTRUCTION

1. Trunking shall be of square or rectangular cross-section of which one side of the trunking shall be removable or hinged;
2. If screws are used to secure the cover or the connector, they shall not project internally over 2mm to avoid causing damage to the cables inside;
3. Where partitions or dividers are provided for the segregation of circuits, they shall be rigidly fixed to the main body of the trunking.

ELE12.2.040.A MARKING ON TRUNKING

1. Every standard length of trunking shall bear an easily legible and durable marking by means of moulding, pressing or engraving showing the name or the trademark of the manufacturer, British Standard and / or International Electrotechnical Commission Standard, as appropriate. For short pieces without durable marking, the marking shall be provided at the internal wall of every piece of trunking in the form of painting or printed adhesive label;
2. Marking of common batch / reference number as stipulated in clause ELE12.2.020 (1) should be provided.

ELE12.2.050.9 DIMENSIONS

1. The sizes, body and cover thicknesses and preferred lengths of surface trunking shall comply with Code 14C of the Electrical CoP;
2. Trunking to special order, having dimensions differing from those given in Code 14C of the Electrical CoP, may be used provided they meet all the other requirements as stated in this specification and with tolerance in external dimensions not exceeding +5%.

ELE12.2.060.9 CONNECTIONS BETWEEN LENGTHS OF TRUNKING

1. Connections between adjacent lengths of trunking, tee or angle pieces, accessories, etc. shall be made by means of U-shaped butt joints. The two adjacent ends of the trunking shall be fixed so that there shall be no relative movement between them. At least two screws shall be used to attach each connector to each section of the trunking;
2. Electrical continuity shall be achieved by means of a copper tape of minimum size 2mm x 12mm connecting the two adjacent ends of the trunking;
3. Prefabricated trunking assemblies shall have sections connected by welding or screws. Welding points shall be touched up with anti-rust paint.

ELE12.2.070.9 TRUNKING COVERS

1. Trunkings and fittings shall have removable or hinged covers extending over the entire length. The covers shall be of the same material and finish as those of the trunking body;
2. Removable covers shall be held in position on the trunking by the natural elasticity of the material of the cover (e.g. spring capped trunking); a means formed as an integral part of the cover (e.g. captive screws); or stainless steel spring clips fixed rigidly on trunking body by welding or by adhesive suitable for fixing metallic parts;
3. Bends, tee junctions, etc. shall be fitted with removable or hinged covers;
4. When trunking is mounted up-side-down or installed inside lift shaft, the trunking covers shall be fixed by screws.

ELE12.2.080.9 SCREWS

1. Screws used for securing the cover or connector and for the fixing of the trunking shall have isometric threads;
2. They shall be of brass or steel and if of steel they shall be protected against corrosion by a finish at least equal to the zinc coating specified in BS 7371-12;
3. Electro-brass plated screws or self-tapping screws will not be acceptable.

ELE12.3 INSTALLATION OF TRUNKING SYSTEM

ELE12.3.010.9 LAYOUT

Trunking shall be installed neatly on the surface of the walls, columns or beams and shall be truly vertical and horizontal.

ELE12.3.020.9 TRUNKING CONTINUITY

The trunking body and cover shall be mechanically and electrically continuous throughout, and efficiently earthed.

ELE12.3.030.9 CONNECTION TO APPARATUS

Connection between trunking and apparatus shall be by a screwed coupler and brass male bush, or a standard flange coupling or an adaptor neck, fabricated or casted. Direct attachment of trunking to apparatus will only be permitted if cable entries are provided with smooth bore bushes or grommets and the return edge of the lid of the trunking is left intact.

ELE12.3.040.9 CONNECTION TO DISTRIBUTION BOARD

Where connection is made between trunking and a distribution board, the cable entry or entries shall be sized to accept all cables from all used and "spare" ways.

ELE12.3.050.9 FIXING OF TRUNKING

1. Individual pieces of trunking shall be independently supported by means of at least two fixed points per piece;
2. On straight runs supports for trunking shall be fixed at regular intervals with maximum spacings as given in Code 25B of the Electrical CoP;
3. For runs with bends, supports shall be fixed as near to the bend as practicable;
4. Overhead trunking shall be suitably supported by means of mild steel hangers, brackets or other Approved devices, so that no visible sag is observed when loaded with cables. These supports shall be painted with at least two coats of an Approved anti-rust paint to prevent corrosion.

ELE12.3.060.9 CABLES THROUGH TRUNKING

Cables penetrating through trunking shall be protected by conduits except for PVC insulated and sheathed cables if such cables form part of a surface wiring system. In such cases, the holes in the trunking, through which such cables penetrate shall be fitted with suitable rubber grommets or insulated bushes.

ELE12.3.070.9 TRUNKING PASSING THROUGH FIRE RESISTANT BARRIERS

1. Whenever trunking passes through a fire resistant structural element, such as a floor or wall, designated as fire barrier, the opening thus formed shall be sealed with Approved type of fire resisting material according to the appropriate degree of fire protection required. In addition, suitable internal fire barriers shall also be provided to prevent the spread of fire or smoke through the trunking;
2. In vertical trunking installations, internal fire barriers shall be provided between floors or at intervals of 5 m apart whichever is less.

ELE12.3.080.9 PREVENTION OF ELECTROLYTIC ACTION

Whenever the trunking is installed in damp situations, or where the trunking is likely to be exposed to weather, the trunking shall be kept away from other metalwork with which electrolytic action is liable to be established.

ELE12.3.090.9 PREVENTION OF INGRESS WATER

Every entry to the trunking shall be so placed as to prevent and/or to be protected against the ingress of water.

ELE12.4 TOOLS AND WORKMANSHIP

ELE12.4.020.9 CUTTING IN TRUNKING

Holes in trunking shall be drilled, punched or cut by ring saw. After cutting, burrs and sharp edges on the trunking shall be removed to prevent abrasion of cables.

ELE12.4.030.9 MAKING GOOD OF DAMAGED COATING

Where the protective coating on the trunking has been damaged after installation or after welding, such surface shall be painted with at least two coats of an Approved anti-rust paint to prevent corrosion.

ELE13 WIRING SYSTEM IN PLASTIC CONDUIT OR PLASTIC TRUNKING

ELE13.1 CONDUIT SYSTEM 2
ELE13.1.020.9 STANDARDS 2
ELE13.1.030.9 COLOUR 2
ELE13.1.040.9 FLAME RESISTANCE 2
ELE13.1.050.9 TEMPERATURE CLASSIFICATION 2

ELE13.2 RIGID PLAIN PVC CONDUITS 3
ELE13.2.010.9 CONSTRUCTION AND SIZE 3
ELE13.2.020.9 MECHANICAL PROPERTIES 3
ELE13.2.030.9 TYPE-TEST CERTIFICATES 3
ELE13.2.040.9 MARKING 3

ELE13.4 PVC CONDUIT FITTINGS 4
ELE13.4.010.9 CONSTRUCTION 4
ELE13.4.020.9 TYPE-TEST CERTIFICATES 4

ELE13.5 PVC CIRCULAR CONDUIT BOXES, PVC BOXES FOR ELECTRICAL ACCESSORIES AND PVC ADAPTABLE BOXES 5
ELE13.5.010.9 CONSTRUCTION AND DIMENSIONS 5
ELE13.5.020.9 MECHANICAL PROPERTIES 5
ELE13.5.030.9 TYPE-TEST CERTIFICATES 5
ELE13.5.040.9 TOLERANCE IN SETTING-OUT OF CONCEALED JUNCTION/ADAPTABLE BOXES ON WALLS AND SLABS INSIDE DOMESTIC FLATS AND AT PUBLIC AREAS IN STANDARD BLOCKS 6
ELE13.5.050.9 CONCEALED CONDUITS INSTALLATION ON PANEL WALLS WITH PRE-INSTALLED CONDUITS 6

ELE13.6 CONDUIT AND WIRING INSTALLATION 7
ELE13.6.010.9 CONDUIT BENDS 7
ELE13.6.020.9 BENDING, JOINTING AND TERMINATING OF CONDUITS 7
ELE13.6.030.9 EARTHING 7
ELE13.6.040.9 EARTHING FOR PRE-INSTALLED STEEL CONDUIT 7

ELE13.7 TRUNKING AND FIXING 8
ELE13.7.010.9 GENERAL 8
ELE13.7.020.9 FIXING OF TRUNKING 8
ELE13.7.030.9 EARTHING 8
ELE13.7.040.9 ALLOWANCE FOR THERMAL EXPANSION 8

ELE13.1 CONDUIT SYSTEM

ELE13.1.020.9 STANDARDS

1. Rigid plain polyvinyl chloride (PVC) conduits, conduit fittings and PVC boxes shall comply with the respective Standards listed below:

PVC conduits	IEC 61386-21 or BS EN 61386-21
PVC conduits fittings	IEC 61386-1 or BS EN 61386-1 or BS 4607:Part 1 for male bush and female adaptor or BS 4607:Part 5 for plain moulded slip type couple and expansion type coupler
PVC circular conduit boxes and adaptable boxes	IEC 60670-1 or BS EN 61386-1 or BS 4607-5
PVC boxes for electrical accessories	IEC 60670-1 and dimensions to BS 4662

2. All PVC conduits, fittings and boxes shall be of the same make.

ELE13.1.030.9 COLOUR

All PVC conduits, fittings and boxes shall be white in colour.

ELE13.1.040.9 FLAME RESISTANCE

All PVC conduits, fittings and boxes shall be non-flame-propagating and self-extinguishing.

ELE13.1.050.9 TEMPERATURE CLASSIFICATION

All PVC conduits, fittings and boxes shall comply with the temperature classification for transport, installation and permanent application not less than -5°C. For PVC conduits, where the ambient temperature at the place of manufacture is likely to be below -5°C, the temperature classification of conduits shall be capable for transport, installation and permanent application not less than -25°C.

ELE13.2 RIGID PLAIN PVC CONDUITS

ELE13.2.010.9 CONSTRUCTION AND SIZE

1. PVC conduits shall be rigid, plain and of a non-threadable type;
2. The nominal diameter of rigid plain PVC conduits shall be within the range of 20 mm to 32 mm unless otherwise specified.

ELE13.2.020.9 MECHANICAL PROPERTIES

Rigid plain PVC conduits shall have heavy mechanical strength, capable of withstanding the heavy compression and impact tests specified in IEC 61386-21 or BS EN 61386-21.

ELE13.2.030.9 TYPE-TEST CERTIFICATES

1. Rigid plain PVC conduits shall be type-tested for complete compliance with IEC 61386-21 or BS EN 61386-21 by an Accredited Laboratory;
2. Test certificates or test reports are acceptable for the purpose of product testing and certification.

ELE13.2.040.9 MARKING

1. Rigid plain PVC conduits shall be marked on the surface with the first four digit classification code for declared properties in accordance with IEC 61386-21 or BS EN 61386-21;
2. The PVC conduits shall have a minimum classification code of 4421. If the ambient temperature at the place of manufacturer of the PVC conduits is likely to be below -5°C, the classification code of the PVC conducts shall be upgraded to 4441.

ELE13.4 PVC CONDUIT FITTINGS

ELE13.4.010.9 CONSTRUCTION

1. Plain, moulded slip-type couplers and expansion type couplers to IEC 61386-1 or BS EN 61386-1 shall be used in the jointing of conduits;
2. Saddles and spacers in compliance with IEC 61386-1 or BS EN 61386-1 shall be used for fixing of conduits unless otherwise specified.

ELE13.4.020.9 TYPE-TEST CERTIFICATES

1. PVC conduit fittings shall be type-tested for complete compliance with the following standards by an Accredited Laboratory:
   a. Plain moulded slip type coupler: IEC 61386-1 or BS EN 61386-1 or BS 4607-5;
   b. Male bush and female adaptor: IEC 61386-1 or BS EN 61386-1 or BS 4607-1.
2. Test certificates or test reports are acceptable for the purpose of product testing and certification.

ELE13.5 PVC CIRCULAR CONDUIT BOXES, PVC BOXES FOR ELECTRICAL ACCESSORIES AND PVC ADAPTABLE BOXES

ELE13.5.010.9 CONSTRUCTION AND DIMENSIONS

1. All PVC boxes and their covers shall comply with the relevant International Standard and British Standard Specifications listed above in ELE13.1.020;
2. All screw holes shall be fitted with metal inserts. Other than PVC adaptable boxes, each box shall be provided with a brass earthing terminal complete with screw for the connection of circuit protective conductor (CPC);
3. Ceiling-mounted circular conduit boxes shall be of deep pattern type having an internal depth of not less than 60 mm. Extension rings shall comply with IEC 60670-1;
4. Each PVC box shall be moulded in one piece;
5. The minimum wall thickness of IEC 60670-1 boxes and adaptable boxes shall be 2 mm;
6. For flush installation, the overall sizes of the covers of the PVC adaptable boxes shall be larger than the adaptable boxes on each edge by at least 5 mm. Screws for securing the cover shall be of stainless steel;
7. BS 4662/IEC 60670 boxes equipped with spouts for mounting wiring accessories can be used as an alternative for easy connection to conduits.

ELE13.5.020.9 MECHANICAL PROPERTIES

1. All PVC boxes shall comply with the requirements for mechanical properties stated in the relevant International Standard and British Standard Specifications listed in ELE13.1.020 above;
2. PVC adaptable boxes shall be moulded of sufficient mechanical strength to withstand forces encountered in concealed conduit wiring system application and complete with provision for prevention of deformation of the boxes where necessary;
3. Boxes for the suspension of luminaires or other equipment, where considerable heat will be produced, shall be fitted with steel insert clips;
4. Plastic boxes shall not be used in situations where the temperature of the box is likely to exceed 60°C or where the mass suspended from the box exceeds 3 kg.

ELE13.5.030.9 TYPE-TEST CERTIFICATES

1. PVC circular conduit boxes, PVC boxes for electrical accessories and PVC adaptable boxes shall be type-tested for complete compliance with IEC 60670-1 by an Accredited Laboratory;
2. Test certificates or test reports are acceptable for the purpose of product testing and certification.

ELE13.5.040.9 TOLERANCE IN SETTING-OUT OF CONCEALED JUNCTION/ADAPTABLE BOXES ON WALLS AND SLABS INSIDE DOMESTIC FLATS AND AT PUBLIC AREAS IN STANDARD BLOCKS

The deviation of the installed position of concealed junction/adaptable boxes from the specified position as shown in the Drawings shall be within a tolerance of ±150 mm with the following considerations:

1. Inside domestic flats:

   In general, the sockets outlets and lighting switches etc. shall be at the same level in the same room. Vertical levels of boxes designed at the same level on the same structural wall shall be within ±8 mm, and that on the same panel wall shall be within ±3 mm.

2. At public areas:

   In general, junction boxes shall be aligned and properly confined in a small area. The regular pattern of the boxes and their alignment along the corridors' ceiling slabs shall be maintained within ±10 mm.

3. The installed position of boxes after taking the above tolerance into consideration shall not contravene the requirements of the position of switches/sockets as stipulated in the Design Manual - Barrier Free Access 2008; nor have conflict with other installations such as skirting, door frame, etc.;

4. Deviations exceeding the tolerance under special site condition shall be subject to the approval of the Contract Manager.

ELE13.5.050.9 CONCEALED CONDUITS INSTALLATION ON PANEL WALLS WITH PRE-INSTALLED CONDUITS

1. Coordinate with Main Contractor for the alignment of the concealed conduit in the slab and the pre-installed in panel walls;

2. Interconnect conduits from ceiling slab to pre-installed conduits in panel wall partitions including the provision of conduits, couplers, sockets and all electrical accessories;

3. Wherever necessary, adjust alignment of conduits in ceiling slab and conduit ends at the open slots of panel walls for smooth interconnection;

4. Interconnect the draw wires in the conduits in ceiling slab and the draw wires in the pre-installed conduits for subsequent wiring work;

5. Attend and coordinate with the Main Contractor for the making good of the open slots on panel wall;

6. Installation of concealed conduits in panel walls shall follow the Electrical CoP. Unless otherwise specified, mechanical protection cover for pre-installed conduits shall comply with the Electrical CoP.

ELE13.6 CONDUIT AND WIRING INSTALLATION

ELE13.6.010.9 CONDUIT BENDS

Conduit bends shall have an internal radius of at least 4 times the outside diameter of the conduit.

ELE13.6.020.9 BENDING, JOINTING AND TERMINATING OF CONDUITS

The method of carrying out the conduit bends, conduit joints, fixing conduits to boxes without spouts, and the tools and materials to be used shall be as recommended by the manufacturer of the conduits.

ELE13.6.030.9 EARTHING

Unless otherwise specified, a PVC insulated cable shall be drawn into the conduit system to serve as the circuit protective conductor (CPC), the cross-sectional area of which shall comply with Electrical CoP for the size of the largest live conductors enclosed.

ELE13.6.040.9 EARTHING FOR PRE-INSTALLED STEEL CONDUIT

In case pre-installed steel conduit is adopted in panel wall, provide earthing of the metal boxes to the corresponding wiring accessories with cost agreed with and borne by the Main Contractor.

ELE13.7 TRUNKING AND FIXING

ELE13.7.010.9 GENERAL

Trunking of sizes up to 100 mm x 100 mm shall have covers of the clip-on type. Larger sizes shall have covers secured by special plastic rivets.

ELE13.7.020.9 FIXING OF TRUNKING

1. The trunking shall be fixed and supported in the normal way by screws, but the holes in the trunking shall be made oversize to allow for the movement of expansion;
2. Washers shall be used under the head of the screw which should not be tightened to its full extent;
3. The spacing between adjacent supports for trunking shall not be larger than those given in the Electrical CoP.

ELE13.7.030.9 EARTHING

Unless otherwise specified, a PVC insulated cable shall be drawn into the trunking system to serve as the circuit protective conductor (CPC), the cross-sectional area of which shall comply with the Electrical CoP for the size of the largest live conductors enclosed.

ELE13.7.040.9 ALLOWANCE FOR THERMAL EXPANSION

Due allowance shall be made for the expansion of the PVC tubing at high temperatures. Expansion coupling or other fittings shall be included in a straight run of 8 m or more. Saddles or clips shall be of sliding fit.

ELE14 LIGHTNING PROTECTION SYSTEM

ELE14.1 PROTECTION OF STRUCTURES AGAINST LIGHTNING..... 2

ELE14.1.010.9 INSTALLATION OF LIGHTNING PROTECTION SYSTEMS 2
ELE14.1.020.9 SCOPE 2
ELE14.1.050.9 AIR TERMINATION ON ROOF AND UPPER ROOF 2
ELE14.1.055.9 AIR TERMINATION ON SIDE WALLS 2
ELE14.1.060.9 DOWN CONDUCTORS 2
ELE14.1.080.9 EARTH TERMINATION 3
ELE14.1.110.9 BONDING TO OTHER SERVICES 3
ELE14.1.120.9 BONDING TO METALWORK 3
ELE14.1.130.9 JOINTS IN CONDUCTORS 3
ELE14.1.140.9 TESTING 4

ELE14.1 PROTECTION OF STRUCTURES AGAINST LIGHTNING

ELE14.1.010.9 INSTALLATION OF LIGHTNING PROTECTION SYSTEMS

1. The lightning protection system shall comprise an air termination network connected by down conductors to earthing electrodes;
2. The lightning protection systems shall be installed in accordance with Project Specific Specification and Drawings, and as directed by the Contract Manager.

ELE14.1.020.9 SCOPE

1. This section covers lightning protection systems applicable to buildings and similar structures;
2. It does not cover the protection of overhead lines and other specialised applications;
3. The installation shall conform to the requirement and recommendations set out in IEC 62305-1 and IEC 62305-2 and IEC 62305-3 and IEC 62305-4, or BS EN 62305-1 and BS EN 62305-2 and BS EN 62305-3 and BS EN 62305-4, or AS/NZS 1768.

ELE14.1.050.9 AIR TERMINATION ON ROOF AND UPPER ROOF

1. An air termination consisting of a network of aluminium roof conductors shall be provided on roof and upper roof as shown on the Drawings;
2. All salient points of the roof structure shall be incorporated in the air termination network;
3. All metallic projections, chimneys, ducts, vent pipes, railings, gutters, etc., on or above the main surface of the roof of the roof structure, shall be fixed to, and form part of, the air termination network by appropriate clamps;
4. Aluminium roof conductors shall be of 25 mm x 3 mm and fixed to the roof structure at regular intervals of not more than 0.5 m by means of spacer saddles;
5. The spacer saddles shall be of pressing or casting aluminium alloys.

ELE14.1.055.9 AIR TERMINATION ON SIDE WALLS

1. Air termination on external wall of the building, if required, shall be in form of tinned copper plate of thickness not less than 4 mm mounted on the cast in bonding point as shown on the Drawings;
2. The cast in bonding point shall be of copper and pre-welded to a 70 mm^2 PVC insulated cable. The cable shall be bonded to two reinforcement bars by means of rod-to-cable clamps;
3. The tinned copper plate shall have good contact with the cast in bonding point and shall be properly protected to avoid covering up by the external wall paint. The fixing screws shall be welded to the tinned copper plate after testing to be having negligible resistance to the down conductor. The Sub-contractor shall coordinate with the Main Contractor on the sequence of installation during construction.

ELE14.1.060.9 DOWN CONDUCTORS

1. Down conductors shall be of 25 mm x 3 mm aluminium strips, or steel reinforcement bars as shown on the Drawings;

2. The reinforcement bars extended from the foundation shall be tested to be having low earthing resistance before selected as down conductors. At each down conductor position, two reinforcement bars shall be used;
3. Continuity shall be maintained between different sections of the selected reinforcement bars by using clamps as shown on the Drawings. Each connection shall be tested to be at negligible resistance before concreting. The Sub-contractor shall ensure the reinforcement bars at the same position, from foundation up to the roof, to be used as the down conductors;
4. The reinforcement bars selected as down conductors shall be connected to the aluminium roof conductors and the cast in bonding point on external wall according to the details and locations as shown on the Drawings;
5. The total resistance measured from the earth inspection pit to each down conductor on roof and to each cast in bonding point on external wall shall be recorded.

ELE14.1.080.9 EARTH TERMINATION

The building foundation shall be used as the earth electrode of the lightning protection system. The steel reinforcement bars of the foundation shall be connected to earth inspection pits via cast in bonding point and copper tape as shown on the Drawings. The complete lightning protection system shall have a combined resistance to earth not exceeding 10 ohms. Where it is difficult, due to local conditions, to obtain a value of less than 10 ohms by the sole use of the foundation, additional rod electrodes complying with ELE17.3 shall be provided and connected to the copper link inside the earth inspection pits until the combined resistance to earth not exceeding 10 ohms. The proposed installation details shall be submitted for the Contract Manager's approval prior to commencement of works.

ELE14.1.110.9 BONDING TO OTHER SERVICES

1. Lightning protection systems shall normally be kept segregated from the metalwork of other services;
2. The earthing of electrical system shall be bonded to the lightning protection system through the main earthing terminal provided inside the main switch room and services rooms as shown on the Drawings;
3. Cables, earthing systems and pipes belonging to the Supply Company, the Telephone Companies, the Hong Kong & China Gas Co. Ltd. and other utility companies shall not be bonded except with the written permission of such companies.

ELE14.1.120.9 BONDING TO METALWORK

Unless otherwise stated, metalwork on roof shall be bonded to the roof conductor by means of 25 mm x 3 mm aluminium strip. The bonding of movable items to the lightning protection system shall use flexible copper braid with termination nut suitable for connection to aluminium conductor. The connections shall be of negligible resistance, metal to metal and mechanically sound with non-ferrous nuts, bolts and washers using clamps where necessary.

ELE14.1.130.9 JOINTS IN CONDUCTORS

Joints in aluminium roof conductors shall be made by suitable tape clamps. The tape clamps shall each be provided with at least 4 screws or bolts. All such joints shall have negligible resistance and good mechanical strength.

ELE14.1.140.9 TESTING

1. On completion of the installation, the lightning protection system shall be tested and recorded in accordance with the checklists given in Appendix 13 of the Electrical CoP;
2. The earthing resistance of the foundation metalwork shall also be tested in accordance with Code 21 of the Electrical CoP with test instruments approved by the Contract Manager;
3. The results of all tests shall be submitted to the Contract Manager for record.

ELE16 MISCELLANEOUS INSTALLATIONS

ELE16.1 TELECOMMUNICATION SYSTEMS 2

ELE16.1.010.A SCOPE 2
ELE16.1.020.9 CONDUITS FOR TELEPHONE AND PA SYSTEMS 2
ELE16.1.030.9 OUTLET BOXES FOR TELEPHONE POINTS 2
ELE16.1.040.9 OUTLET BOXES FOR PA SYSTEMS 2
ELE16.1.060.A CONDUITS FOR CABD SYSTEM 2
ELE16.1.070.A OUTLET BOXES FOR CABD SYSTEM 2

ELE16.2 BELL AND AUDIBLE WARNING SYSTEM 3

ELE16.2.040.9 CALL BELL AND DOOR BELL SYSTEMS 3
ELE16.2.050.9 BELLS FOR EXTRA LOW VOLTAGE 3
ELE16.2.060.9 BELL TRANSFORMERS 3
ELE16.2.070.9 CONNECTION OF BELL TRANSFORMERS 3
ELE16.2.080.9 CALL BELL PUSHES 3
ELE16.2.090.9 MOUNTING OF CALL BELL PUSHES 4
ELE16.2.140.9 SEGREGATION OF CIRCUITS 4

ELE16.1 TELECOMMUNICATION SYSTEMS

ELE16.1.010.A SCOPE

1. This sub-section covers the conduit installations for the following systems:
   a. Telephone;
   b. Inter-communication and Public Address (PA) Systems;
   c. Communal Aerial Broadcast Distribution (CABD) System.
2. Separate conduits shall be provided for each of these systems;
3. Nylon draw-wires of adequate strength shall be provided in all empty conduits.

ELE16.1.020.9 CONDUITS FOR TELEPHONE AND PA SYSTEMS

Conduits shall be of PVC not smaller than 20 mm in diameter, and shall be installed in accordance with ELE11.

ELE16.1.030.9 OUTLET BOXES FOR TELEPHONE POINTS

1. At each telephone outlet position, the conduit shall be terminated at a 47 mm deep BS 4662 box for electrical accessories with blank cover plate. If the outlet is installed with a telephone outlet plate by the FTNS operator, the provision of blank cover plate is not required;
2. Outlet boxes shall be located at skirting level or otherwise as stated on the Drawing;
3. The cover plate shall be of moulded material unless otherwise specified.

ELE16.1.040.9 OUTLET BOXES FOR PA SYSTEMS

1. At each PA outlet position, the conduit shall be terminated at a 47 mm deep BS 4662 box for electrical accessories with blank cover plate. If the outlet is installed with equipment on top, the provision of blank cover plate is not required;
2. Outlet boxes shall be fixed at skirting level or otherwise as stated on the Drawing.

ELE16.1.060.A CONDUITS FOR CABD SYSTEM

1. Conduits for CABD system shall be of PVC, not smaller than 25 mm in diameter, and shall be installed generally in accordance with ELE11;
2. They shall be kept clear of power and telephone conduits and shall be arranged to cross them at right angles whenever possible;
3. Draw-in boxes shall be provided at intervals of not exceeding 10 metres and at all 90° changes of direction, unless otherwise shown on the Drawings.

ELE16.1.070.A OUTLET BOXES FOR CABD SYSTEM

1. At each CABD outlet position, the conduit shall be terminated in a 47 mm deep BS 4662 box for electrical accessories with blank cover plate. If the outlet is installed with CABD socket, the provision of blank cover plate is not required;
2. Outlet boxes shall be fixed at skirting outlet plate level or otherwise as shown on the Drawing.

ELE16.2 BELL AND AUDIBLE WARNING SYSTEM

ELE16.2.040.9 CALL BELL AND DOOR BELL SYSTEMS

1. Bells shall operate at a voltage not exceeding 24V a.c. obtained from a double wound transformer which shall be connected to the mains supply through a 2A fused connection unit, unless otherwise specified;
2. Unless otherwise specified cables shall be 1.5 mm² PVC insulated cables enclosed in conduit for concealed conduit installation.

ELE16.2.050.9 BELLS FOR EXTRA LOW VOLTAGE

1. Call bells shall be of the underdome type having a gong of approximately 75 mm diameter and shall be fixed to a substantial frame;
2. Door bell shall be 2 tones sound and of a wall mounted design with white or ivory colour cover and is to be free of any projection on the rear surface;
3. Door bell shall be classified, as a minimum requirement, to Class II as described in IEC 60335-1;
4. The insulating enclosure of the door bell shall be opened only with the use of a tool and this insulating enclosure shall provide a degree of protection of at least IP20 as described in IEC 60529. Where the enclosure can be opened without the use of a tool, every conductive part which is accessible if the enclosure is open shall be behind an insulating barrier which prevents a person from coming into contact with those parts; this insulating barrier shall provide a degree of protection of at least IP20 as described in IEC 60529 and be removable only by use of a tool.

ELE16.2.060.9 BELL TRANSFORMERS

1. Bell transformers shall be a single phase, double wound, safety isolating transformer specifically intended to supply domestic sound signalling equipment and comply with IEC 61558-2-8. Factory test certificates shall be submitted as evidence of compliance with the required standard;
2. The transformer shall be inherently short circuit proof. The reactance of the transformer winding shall be of such value that a continuous short circuit across the terminals of the secondary winding shall not damage the transformer, or cause dangerous overheating;
3. The windings, core and terminals of the transformer shall be contained within an insulating plastic case.

ELE16.2.070.9 CONNECTION OF BELL TRANSFORMERS

Bell transformers shall be connected to the lighting final circuit as shown on the Drawing, unless otherwise specified.

ELE16.2.080.9 CALL BELL PUSHES

1. Call bell pushes for indoor use shall be of flush pattern with white or ivory colour front plate;
2. Call bell pushes for outdoor use, or for areas where they may be subjected to rain or water, shall be weatherproof.

ELE16.2.090.9 MOUNTING OF CALL BELL PUSHES

1. In conduit installations, bell pushes shall be fixed in 35 mm deep, BS 4662 boxes for electrical accessories;
2. In surface cable installations, bell pushes shall be fixed in a plastic pattress;
3. Bell pushes shall not be mounted on doors without Approval.

ELE16.2.140.9 SEGREGATION OF CIRCUITS

Cables for operation at extra low voltage shall not be routed in the same conduit with cables for operation at higher voltages.

ELE17 EARTHING AND PROTECTION AGAINST INDIRECT CONTACT

ELE17.1 GENERAL 3
ELE17.1.010.9 SCOPE 3
ELE17.1.020.9 COMPLIANCE WITH RULES AND REGULATIONS 3
ELE17.1.030.9 BONDING FOR EXTRANEOUS CONDUCTIVE PARTS 3

ELE17.2 MAIN EARTHING TERMINALS 4
ELE17.2.010.9 LOCATION 4
ELE17.2.020.9 SEPARATE BUILDINGS OR UNITS 4
ELE17.2.030.9 CONNECTION TO EARTH 4

ELE17.3 EARTH ELECTRODES 5
ELE17.3.010.9 TYPES OF EARTH ELECTRODES 5
ELE17.3.020.9 ROD ELECTRODES 5

ELE17.4 EARTHING CONDUCTORS 6
ELE17.4.010.9 CONDUCTOR MATERIALS 6
ELE17.4.020.9 CONNECTION TO ELECTRODES 6

ELE17.5 MAIN EQUIPOTENTIAL BONDING CONDUCTORS 7
ELE17.5.010.9 CONDUCTOR MATERIALS 7
ELE17.5.020.9 BONDING POSITIONS 7
ELE17.5.030.9 BONDING METHOD 7

ELE17.6 SUPPLEMENTARY BONDING CONDUCTORS 8
ELE17.6.010.9 CONDUCTOR MATERIALS 8
ELE17.6.030.9 APPLICATION 8
ELE17.6.040.9 BONDING METHODS 8

ELE17.7 CIRCUIT PROTECTIVE CONDUCTORS (CPC) 9
ELE17.7.010.9 GENERAL 9
ELE17.7.030.9 CPC FOR FLEXIBLE CONDUIT 9
ELE17.7.040.9 CPC FOR BUSBAR TRUNKING AND BUSWAY 9
ELE17.7.050.9 CPC FOR FINAL RING CIRCUIT 9

ELE17.8 JOINTS IN PROTECTIVE CONDUCTORS 10
ELE17.8.010.9 PROVISION FOR DISCONNECTION 10
ELE17.8.020.9 MEANS OF DISCONNECTION 10
ELE17.8.030.9 USE OF SWITCHING DEVICES 10

ELE17.9 IDENTIFICATION AND LABELLING 11
ELE17.9.010.9 COLOUR IDENTIFICATION 11
ELE17.9.020.9 LABELS FOR EARTHING AND BONDING CONNECTIONS 11

ELE17.10 SIZING OF PROTECTIVE CONDUCTORS 12
ELE17.10.010.9 PROTECTIVE CONDUCTORS 12
ELE17.10.020.9 PROTECTIVE CONDUCTORS BURIED IN SOIL 12
ELE17.10.030.9 EQUIPOTENTIAL BONDING CONDUCTORS 12

ELE17.11 EARTH FAULT LOOPS 13
ELE17.11.010.9 AUTOMATIC DISCONNECTION TIME 13

ELE17.11.030.9 MAXIMUM EARTH FAULT LOOP IMPEDANCE 13

ELE17.12 USE OF RESIDUAL CURRENT-OPERATED CIRCUIT BREAKER (RCCB) 14

ELE17.12.010.9 GENERAL 14
ELE17.12.020.9 APPLICATION IN HOUSEHOLD INSTALLATIONS 14
ELE17.12.030.9 EQUIPMENT OUTSIDE SAME EQUIPOTENTIAL ZONE 14

ELE17.1 GENERAL

ELE17.1.010.9 SCOPE

Unless otherwise specified the protective measures for fault protection is by earthed equipotential bonding and automatic disconnection of supply.

ELE17.1.020.9 COMPLIANCE WITH RULES AND REGULATIONS

The Sub-contractor shall provide the earthing system for the electrical installation, and also bond the electrical installation and extraneous conductive parts to fully comply with the Electrical CoP, BS 7671, Supply Rules and BS 7430 Code of practice for earthing.

ELE17.1.030.9 BONDING FOR EXTRANEOUS CONDUCTIVE PARTS

1. Building exposed metallic parts such as metallic doors, windows, louvres, burglar bars, railings, water supply pipeworks, drainage pipe, catladder etc. are extraneous conductive parts requiring equipotential bonding;
2. Main equipotential bonding

   Main equipotential bonding conductors should be provided in accordance with ELE17.5,
3. Supplementary Bonding

   Supplementary bonding conductors should be provided in accordance with ELE17.6,
4. The Sub-contractor shall ensure the bonding for extraneous conductive parts is sound and the result complies with the Electrical CoP and BS 7671 by proper measurement with records at good time. For those parts of equipotential bonding system found not electrical conductive, the Main Contractor and the Sub-contractor shall be responsible for rectification of their own works as early as possible.

ELE17.2 MAIN EARTHING TERMINALS

ELE17.2.010.9 LOCATION

A solid copper main earthing terminal of ample size shall be provided for every electrical installation at a position near the main incoming switch or switchboard for the connection of the circuit protective conductors, the main equipotential bonding conductors, the structural earthing terminal and the earthing conductors to create the equipotential zone.

ELE17.2.020.9 SEPARATE BUILDINGS OR UNITS

Where an installation distributes to a number of buildings or units, a separate main earthing terminal shall be provided for each individual building or unit at the point of intake thereby creating a separate equipotential zone in each building or unit.

ELE17.2.030.9 CONNECTION TO EARTH

The mains earthing terminal shall be connected to Earth via an earthing conductor to an earth electrode or a group of electrodes.

ELE17.3 EARTH ELECTRODES

ELE17.3.010.9 TYPES OF EARTH ELECTRODES

Unless otherwise specified in Project Specific Specification or on the Drawings, rod electrodes shall be installed.

ELE17.3.020.9 ROD ELECTRODES

1.

a. Rod electrodes shall be of mild steel inner core with a bonded hard drawn copper sleeve of an Approved type.

b. The overall diameter of the rod shall not be less than 14 mm and the thickness of the copper sleeve shall not be less than 0.25 mm;

c. The minimum length shall be 2.4 m. The length shall comprise a single piece of rod or two 1.2 m pieces coupled together;

d. Additional lengths, whenever required, shall each be of 1.2 m, connected together by a coupling;

e. The penetrating end of the rod electrode shall be a hardened steel point.

2. Rod electrodes shall be driven into the ground within an earth pit. Only Approved tools e.g. electric hammer or pneumatic hammer shall be used for their installation;

3. The number of rod electrodes and the location of the earth pits shall be determined on site such that the resultant earth loop impedance will effect the disconnection of supply within 5 sec. by the protective device in case of any earth faults occurred at any part of the installation other than the final circuits;

4.

a. In cases where the earthing resistance achieved by one rod is not sufficiently low for the purpose required, additional lengths or additional rods shall be installed;

b. For the latter application, the additional rods shall be driven into the ground outside the resistance area of the previously installed rods;

c. Under normal circumstances, a mutual separation of 3.5 m is considered adequate;

d. All rods thus installed shall be connected together by means of 25 mm x 3 mm copper tapes enclosed in PVC ducts and laid at a minimum depth of 600 mm below ground surface;

e. The connecting copper tapes shall be run in direct lines between the rods.

ELE17.4 EARTHING CONDUCTORS

ELE17.4.010.9 CONDUCTOR MATERIALS

Earthing conductors shall be copper tapes 25 mm x 3 mm in cross section and for outdoor application, the copper tapes shall be tinned.

ELE17.4.020.9 CONNECTION TO ELECTRODES

1. The earthing conductor shall be connected to the earth electrode(s) by means of Approved copper connector-clamps such that the connection can only be disconnected by means of a tool;
2. The connection shall be contained within a concrete lined earth pit with a substantial removable cover to ensure accessibility and maintainability.

ELE17.5 MAIN EQUIPOTENTIAL BONDING CONDUCTORS

ELE17.5.010.9 CONDUCTOR MATERIALS

Unless otherwise specified, main equipotential bonding conductors shall be of copper.

ELE17.5.020.9 BONDING POSITIONS

1. Main equipotential bonding conductors shall connect the extraneous conductive parts of other services within the premises to the main earthing terminal of the installation;
2. Such extraneous conductive parts shall include main water and gas pipes, other service pipes and risers and exposed metallic parts of the building structure liable to transmit a potential;
3. Connections shall be made as near as practicable to the point of entry of the non-electrical services into the premises concerned, and shall be on the installation side of the possible breaks in the system, such as gas meter or water meter.

ELE17.5.030.9 BONDING METHOD

Unless otherwise specified or shown on Drawings, the main equipotential bonding conductors shall be securely and reliably connected to extraneous conductive parts of the non-electrical services by means of a connector-clamp of an Approved type suitable for the particular applications or other effective bonding methods approved by the Contract Manager. All contact surfaces shall be clean and free from non-conducting materials, such as grease or paint, before making the connection.

ELE17.6 SUPPLEMENTARY BONDING CONDUCTORS

ELE17.6.010.9 CONDUCTOR MATERIALS

Unless otherwise specified, supplementary bonding conductors shall be of copper.

ELE17.6.030.9 APPLICATION

Supplementary bonding of extraneous conductive parts will be required whenever such conductive parts are likely to be accessible simultaneously with other extraneous conductive parts, or exposed conductive parts, and are not electrically connected to the main equipotential bonding by means of permanent and reliable metal-to-metal joints of negligible impedance.

ELE17.6.040.9 BONDING METHODS

1. Unless otherwise specified or shown on Drawings, the supplementary bonding conductors shall be solidly and effectively connected to the extraneous or exposed conductive parts by means of a connector-clamp of an Approved type suitable for the application or other effective bonding methods approved by the Contract Manager. All contact surfaces shall be clean and free from non-conducting materials, such as grease or paint, before making the connection;
2. For surface conduit installations, the supplementary bonding conductors shall be terminated at the nearest conduit or conduit box forming an integral part of the conduit installation;
3. Unless otherwise specified or shown on Drawings, for concealed conduit installations, the subject extraneous or exposed conductive part shall be terminated via a cord outlet plate with 1 no. supplementary bonding conductor. The BS 4662 conduit box of the cord outlet plate, forming an integral part of the conduit installation shall be located as near as possible to the bonding position and the exposed part of the supplementary bonding conductor shall be made as short as possible;
4. When necessary and required, insulated connector enclosed in base box of cord outlet plate (for bonding conductor) or base box of electrical equipment in vicinity of extraneous or exposed conductive part can be used for interconnection of all associated supplementary bonding conductors from related extraneous or exposed conductive part or from earthing terminal of the nearby electrical equipment in order to achieve the requirements of the Electrical CoP on electrical bonding.

ELE17.7 CIRCUIT PROTECTIVE CONDUCTORS (CPC)

ELE17.7.010.9 GENERAL

Circuit protective conductors (CPC) may be formed by a separate conductor/cable, the metallic sheath or armour of a cable, part of the same cable as the associated live conductor, rigid steel conduits, trunking or ducting, or the metal enclosure of the wiring system. Flexible conduits and the exposed conductive parts of equipment shall not form part of the circuit protective conductors.

ELE17.7.030.9 CPC FOR FLEXIBLE CONDUIT

For every length of flexible conduit, a separate circuit protective conductor shall be provided inside the conduit to ensure the earth continuity of the installation between the two ends of the flexible conduit.

ELE17.7.040.9 CPC FOR BUSBAR TRUNKING AND BUSWAY

1. A copper tape, 25 mm x 3 mm in cross section shall be provided for the entire length of a busbar trunking or busway. The copper tape shall be bonded to the busbar trunking or busway at intervals not exceeding 3 m and at the position of each tape-off point;
2. Subject to prior Approval the provision of copper tapes for a busbar trunking or busway may be exempted provided that the enclosure of the busbar trunking or busway can be proved to satisfy the full requirements of the circuit protective conductor.

ELE17.7.050.9 CPC FOR FINAL RING CIRCUIT

For wiring systems using PVC insulated, PVC sheathed cables, the circuit protective conductor of every ring final circuit shall also be run in the form of a ring having both ends connected to the earth terminal at the origin of the circuit.

ELE17.8 JOINTS IN PROTECTIVE CONDUCTORS

ELE17.8.010.9 PROVISION FOR DISCONNECTION

Provision shall be made in an accessible position for disconnecting a protective conductor from the main earthing terminal or the earth electrode to permit testing and measurements of earthing resistance.

ELE17.8.020.9 MEANS OF DISCONNECTION

Such joints shall only be disconnected by means of a tool, be mechanically strong and shall be tinned to maintain the electrical continuity reliably.

ELE17.8.030.9 USE OF SWITCHING DEVICES

No switching devices shall be inserted in a protective conductor.

ELE17.9 IDENTIFICATION AND LABELLING

ELE17.9.010.9 COLOUR IDENTIFICATION

1. All cables used as protective conductors, including earthing conductors, main equipotential bonding conductors, supplementary bonding conductors and circuit protective conductors shall be identified by the colour combination "green and yellow";
2. Bare copper tapes used as protective conductors shall also be made similarly identifiable, by the application of tapes with the above colour combination at maximum 2 m intervals and at each tee-off points.

ELE17.9.020.9 LABELS FOR EARTHING AND BONDING CONNECTIONS

Every point of connection for earthing conductor to an earth electrode and the main equipotential bonding shall be provided with a warning notice in accordance with ELE28.1.

ELE17.10 SIZING OF PROTECTIVE CONDUCTORS

ELE17.10.010.9 PROTECTIVE CONDUCTORS

1. The cross sectional area of a protective conductor, excluding equipotential bonding conductors, shall comply with Code 11 C of the Electrical CoP. Alternatively, it can be calculated using the formula given in Regulation 543.1.3 of BS 7671;
2. When a separate PVC insulated copper cable is used as the protective conductor and not contained in conduit, trunking, ducting or other enclosure of a wiring system, it shall have a minimum cross sectional area of 4 mm^2 and shall be insulated to BS EN 50525-2-31 or better unless its CSA is greater than 6 mm^2;
3. When metal enclosures for cables are used as protective conductors, they shall have CSA equivalent to that of copper, not less than that resulting from the above-mentioned adiabatic equation.

ELE17.10.020.9 PROTECTIVE CONDUCTORS BURIED IN SOIL

Where protective conductors are buried in the soil, they shall comply with Code 11H(a) of the Electrical CoP.

ELE17.10.030.9 EQUIPOTENTIAL BONDING CONDUCTORS

1. The cross sectional area of a main equipotential bonding conductor shall comply with Code 11E(d) of the Electrical CoP;
2. The cross-sectional area of a supplementary bonding conductor shall comply with Code 11F(d) of the Electrical CoP.

ELE17.11 EARTH FAULT LOOPS

ELE17.11.010.9 AUTOMATIC DISCONNECTION TIME

The characteristics of the protective devices for automatic disconnection shall be coordinated with the earthing impedances of the circuits and comply with Code 11B(b) of the Electrical CoP.

ELE17.11.030.9 MAXIMUM EARTH FAULT LOOP IMPEDANCE

1. The maximum permissible earth fault loop impedance shall comply with Code 11 I of the Electrical CoP;
2. Where the armouring of an armoured cable forms part of the circuit protective conductor, and if the maximum earth fault impedance exceeds the specified limits, a separate protective conductor of appropriate size shall be provided.

ELE17.12 USE OF RESIDUAL CURRENT-OPERATED CIRCUIT BREAKER (RCCB)

ELE17.12.010.9 GENERAL

1. RCCBs shall be installed for final circuits where the earth fault loop impedance is too high to allow sufficient earth fault current to operate the overcurrent protective device within the specified automatic disconnection time of 0.4 seconds or 5 seconds. In such cases, the product of the rated residual operating current in amperes of the residual current-operated circuit breaker and the earth fault loop impedance, in ohms, of the circuit shall not exceed 50;
2. Residual current-operated circuit breaker shall meet the requirements specified in ELE3.6.

ELE17.12.020.9 APPLICATION IN HOUSEHOLD INSTALLATIONS

RCCBs used to protect socket outlet circuits in a household or similar installation shall have a rated operating residual current not exceeding 30 mA.

ELE17.12.030.9 EQUIPMENT OUTSIDE SAME EQUIPOTENTIAL ZONE

For circuits supplying fixed equipment outside the equipotential zone shall refer to Code 11B(b)(iii) of the Electrical CoP.

ELE18 DOMESTIC APPLIANCES

ELE18.1 GENERAL 2

ELE18.1.010.9 COMPLIANCE WITH REGULATION 2

ELE18.2 400MM SWEEP ROTARY CEILING FAN 3

ELE18.2.010.9 CAPACITY 3
ELE18.2.020.9 DIMENSION 3
ELE18.2.030.9 DUTY 3
ELE18.2.040.9 CONSTRUCTION 3

ELE18.3 400MM SWEEP ELECTRIC WALL FAN 4

ELE18.3.010.9 CAPACITY 4
ELE18.3.020.9 DIMENSION 4
ELE18.3.030.9 DUTY 4
ELE18.3.040.9 CONSTRUCTION 4

ELE18.4 DOMESTIC EXHAUST FAN 5

ELE18.4.010.9 CAPACITY 5
ELE18.4.020.9 DUTY 5
ELE18.4.030.9 CONSTRUCTION 5

ELE18.5 ELECTRIC HAND AND FACE DRYER 6

ELE18.5.010.9 GENERAL 6
ELE18.5.020.9 STANDARD CONSTRUCTION 6
ELE18.5.030.9 ALTERNATIVE CONSTRUCTION 6
ELE18.5.040.9 MAINTAINABILITY 6

ELE18.6 QUARTZ MOVEMENT WALL CLOCK 7

ELE18.6.010.9 GENERAL 7
ELE18.6.020.9 CONSTRUCTION 7
ELE18.6.030.9 ACCURACY 7

ELE18.7 CEILING FANS 8

ELE18.7.010.9 SCOPE 8
ELE18.7.020.9 CAPACITY 8
ELE18.7.030.9 DUTY 8
ELE18.7.040.9 CONSTRUCTION 8

ELE18.1 GENERAL

ELE18.1.010.9 COMPLIANCE WITH REGULATION

Domestic appliances together with their electric components and cabling shall comply with the currently-in-force edition of Electrical Products (Safety) Regulation, CAP 406G, Laws of Hong Kong.

ELE18.2 400MM SWEEP ROTARY CEILING FAN

ELE18.2.010.9 CAPACITY

The unit shall be capable of an air delivery of not less than 1.1 m^3/s.

ELE18.2.020.9 DIMENSION

The sweep diameter of the unit shall be 400 mm.

ELE18.2.030.9 DUTY

1. The unit shall be suitable in all respects for operation in ambient air condition of 40°C and 95% R.H;
2. The unit shall be suitable for operation on 220V, 50Hz, single phase a.c. supply;
3. The fan shall not require periodic lubrication;
4. The fan shall operate quietly at all speeds.

ELE18.2.040.9 CONSTRUCTION

1. General:
    a. The unit shall be of deluxe pattern with smooth, safe edges and "easy-to-disassemble" design for cleaning;
    b. The fan shall have high quality aluminium or plastic blades;
    c. The fan shall be fully balanced after assembly;
    d. The blades shall be enclosed by chromed, closely meshed metal guard. The gap of the guard slots shall preferably be not greater than 13 mm at the widest;
    e. The fan shall be provided with rotary mechanism for a swing of 360° when mounted on the ceiling;
    f. The whole unit shall be finished to manufacturer's standard light colour Approved by the Contract Manager.
2. Electrics:
    a. All electrical components, cables etc. shall conform to the appropriate British Standards Specification, or shall be of fully equivalent quality and capacity;
    b. All exposed metal parts of the unit shall be suitably earthed via the 3 core flexible cable;
    c. The fan shall be provided with two (2) metres of 0.75 mm^2, 3 core, PVC insulated and sheathed flexible cable.

ELE18.3 400MM SWEEP ELECTRIC WALL FAN

ELE18.3.010.9 CAPACITY

The unit shall be capable of an air delivery of not less than 1.1 m^3/s.

ELE18.3.020.9 DIMENSION

The sweep diameter of the unit shall be 400 mm.

ELE18.3.030.9 DUTY

1. The unit shall be suitable in all respects for operation in ambient air condition of 40°C and 95% R.H;
2. The unit shall be suitable for operation on 220V, 50Hz, single phase a.c. supply;
3. The fan shall not require periodic lubrication;
4. The fan shall operate quietly at all speeds.

ELE18.3.040.9 CONSTRUCTION

1. General:
    a. The unit shall be of deluxe pattern with smooth, safe edges and "easy-to-disassemble" design for cleaning;
    b. The fan shall have high quality aluminium or plastic blades;
    c. The fan shall be fully balanced after assembly;
    d. The blades shall be enclosed by chromed, closely meshed metal guard. The gap of the guard slots shall preferably be not greater than 13 mm at the widest;
    e. The unit shall be suitable for direct fixing on to a wall. Conversion from Desk Fan will NOT be accepted;
    f. The unit shall be fitted with "3-speed and off" push bottom or pull switch.
    g. The fan shall be provided with oscillating and tilting mechanism for horizontal swing and vertical adjustment respectively;
    h. The oscillator shall have a clutch that slips or disengages if the fan meets an obstruction as it swings. The mechanism shall also be easily disengaged when not required;
    i. The whole unit shall be finished to manufacturer's standard light colour Approved by the Contract Manager.
2. Electrics:
    a. All electrical components, cables etc. shall conform to the appropriate British Standards Specification, or shall be of fully equivalent quality and capacity;
    b. All exposed metal parts of the unit shall be suitably earthed via the 3 core flexible cable;
    c. The fan shall be provided with two (2) metres of 0.75 mm^2, 3 core, PVC insulated and sheathed flexible cable.

ELE18.4 DOMESTIC EXHAUST FAN

ELE18.4.010.9 CAPACITY

The unit shall be capable of the following air extraction rate:

1. 0.06 m³/s for 150 mm diameter fan;
2. 0.23 m³/s for 230 mm diameter fan;
3. 0.47 m³/s for 300 mm diameter fan.

ELE18.4.020.9 DUTY

1. The unit shall be suitable in all respects for operation in ambient air condition of 40°C and 95% R.H;
2. The unit shall be suitable for operation on 220V, 50Hz, single phase a.c. supply;
3. The fan shall operate quietly at all speeds;
4. The unit casing, outlet grille, fan blade and shutters shall be moulded in rigid flame-retardant plastic. This shall also apply to the motor casing if not manufactured in metal.

ELE18.4.030.9 CONSTRUCTION

1. General:
   a. The unit shall be suitable for mounting on window glass and partitions;
   b. The unit shall have in-built draught excluding shutters suitable for remote control through an "on/off" switch;
   c. The unit shall have "easy-to-disassemble" design for cleaning and maintenance;
   d. The fan shall be fitted with silent running, self-aligning, self-oil bearings;
   e. The fan shall be fully balanced after assembly;
   f. The whole unit shall be finished in white or ivory colour or alternatively to manufacturer's standard light colour Approved by the Contract Manager.
2. Electrics:
   a. The fan shall be driven by a totally enclosed, single phase, induction motor;
   b. All exposed metal parts of the fan shall be suitably earthed via the 3-pin plug;
   c. The fan shall be of single speed and be capable of being switched on and off by a remote 5A switch;
   d. The fan shall be provided with two (2) metres of 0.75 mm², 3 core, PVC insulated and sheathed flexible cable.

ELE18.5 ELECTRIC HAND AND FACE DRYER

ELE18.5.010.9 GENERAL

1. The electrically operated hand and face dryer shall be of good design and pleasant appearance, suitable for heavy duty operation. It shall be of robust construction, intrinsically safe, tamperproof and the drying cycle shall not exceed 35 seconds;
2. The dryer shall be suitable for operation on 220V, 50Hz, single phase, a.c. supply with full bonding to earth through an amply sized 3 core supply cable;
3. The dryer shall be suitable for mounting on the surface of walls, including ceramic tiles.

ELE18.5.020.9 STANDARD CONSTRUCTION

1. The front shall be manufactured from a fully enveloping one piece metal, or Approved high strength plastic cover, fitted with a capacitive touch switch, or insulated metal push button marked "Touch or Push" (as applicable) to start, bi-directional air flow nozzle spring loaded to automatically return to the hand drying position and permanently engraved operating instructions recessed if applicable;
2. Metallic covers shall be finished with acid resistant porcelain enamel;
3. The cover shall be secured to the dryer base by recessed Allen head, or similar type bolts. The base shall be secured to the wall by at least three mounting bolts;
4. The air inlet shall be at the bottom and shall be protected by a suitably sized protective vaned grill. The air outlet shall similarly be protected by metal vanes inside the bi-directional nozzle;
5. All metal parts shall be of stainless, cadmium, or chromium plated steel;.
6. The dryer shall be suitable for back and side cable entry with an insulated bushing;
7. The dryer shall be complete with internal electrical overload protection for the fan motor and preferably also for the heater unit.

ELE18.5.030.9 ALTERNATIVE CONSTRUCTION

As an alternative, tenderers may offer units having an infra-red proximity detector, in lieu of the touch switch, or push button control. In this case the operation instructions shall, by internationally recognisable symbols, clearly indicate the method of operation. It would also be preferable for these instructions to state in both English and Chinese:

"Place hands below the air outlet to start."

ELE18.5.040.9 MAINTAINABILITY

The equipment offered shall be designed for easy maintenance.

ELE18.6 QUARTZ MOVEMENT WALL CLOCK

ELE18.6.010.9 GENERAL

1. The clock shall be of deluxe wall hanging pattern having a nominal clock-face diameter of not less than 300 mm;
2. It shall be of Quartz-crystal oscillator controlled movement type and battery operated.

ELE18.6.020.9 CONSTRUCTION

1. The clock shall be of a design which can be flush mounted on the wall and is to be free of any projections on the rear surface;
2. The clock dial shall be white with large Arabic Numerals in black and graduated in minutes;
3. The hour, minutes and second full sweep hands shall preferably be of distinct colour complete with a glass or clear plastic covered front;
4. The rim of the clock shall either be metal or plastic finished in white or ivory colour and the clock movement shall be enclosed to protect it from dust;
5. The type and voltage of the battery powering the clock shall be specified in the supplier's quotation. It shall have a minimum normal use life of at least one year and shall be easily replaceable by non-skilled labour.

ELE18.6.030.9 ACCURACY

The accuracy of timekeeping shall not exceed ±0.5 sec./day at room temperature (25°C) and the clock unit shall be tropicalised and dust-proof.

ELE18.7 CEILING FANS

ELE18.7.010.9 SCOPE

Each ceiling fan shall be complete with speed regulator. The sweep diameter of the unit shall be 900 mm, 1200 mm or 1400 mm as shown on the Drawings or specified in Project Specific Specification.

ELE18.7.020.9 CAPACITY

The unit shall be capable of an air delivery as below:

Sweep diameter of the unit (mm)	Air delivery (m^3/s)
900	2.2
1200	3.9
1400	4.5

ELE18.7.030.9 DUTY

1. The unit shall be suitable in all respects for operation in ambient air condition of 40°C and 95% R.H.;
2. The unit shall be suitable for operation on 220V, 50Hz, single phase A.C. supply;
3. The unit shall be designed for heavy duty commercial and domestic usage;
4. The fan shall operate quietly at all speeds.

ELE18.7.040.9 CONSTRUCTION

1. Motor:
    a. The motor shall be a totally enclosed, capacitor run induction motor, with internal stator and external squirrel-cage rotor;
    b. The rotor shall be mounted in grease lubricated ball bearings;
    c. The power factor shall not be less than 0.8 at any speed. The motor shall be rated for continuous operation under ambient air conditions of 40°C and 95% R.H. and the temperature of the windings shall not exceed 50°C after two (2) hours of continuous operation;
    d. All electrical components, cables etc. shall conform to the appropriate British Standards Specification or shall be of fully equivalent quality and capacity.
2. Blades:
    a. 900 mm Sweep diameter units:
        i. The fan shall be fitted with three (3) blades. "Twisted" blades are preferred;
        ii. The blade assemblies shall consist of one piece all aluminium blades of not less than 1.5 mm thickness;
        iii. Where the one piece blades are twisted to give the required angle of incidence to the blades there shall be large radius bends to prevent stress concentrations in the blade roots;
        iv. Anti-vibration bushes shall be installed between the one piece blades and the motor frame;

v. The blades, shall be securely fastened to the frame of the motor by machine screws and spring washers, the whole designed to ensure that there is no possibility of a blade becoming detached during operation.

b. 1200 mm & 1400 mm Sweep diameter units:

i. The fan shall be fitted with three (3) blades. "Twisted" blades are preferred;

ii. The blade assemblies shall consist of blades manufactured from heavy gauge aluminium riveted to steel blade carriers. The rivets shall conform to appropriate British Standards Specification;

iii. The blade carriers will be manufactured from mild steel plate of not less than 3 mm in thickness and of not less than 40 mm width at the narrowest point, pressed to shape. The blades shall be of not less than 1.5 mm thickness;

iv. Where the blade carriers are twisted to give the required angle of incidence to the blades there shall be large radius bends to prevent stress concentrations in the blade roots;

v. Anti-vibration bushes shall be installed between the blades and blade carriers;

vi. The blade carriers shall be securely fastened to the frame of the motor by machine screws and spring washers, the whole designed to ensure that there is no possibility of a blade becoming detached during operation.

3. Terminals and capacitor:

a.

i. The plastic terminal block and capacitor shall be mounted in a ferrous metal connecting piece, located between the fan and the down-rod;

ii. The leads from the stator windings shall be connected to the terminal block;

iii. An earthing terminal, consisting of a round head brass screw and washer shall be provided on the connecting piece;

iv. All exposed metal parts of the fan unit shall be connected to this earthing terminal.

b.

i. The bottom portion of the connecting piece shall be screwed on to the shaft of the motor;

ii. The connecting piece shall be tightened on to a shoulder formed on the motor shaft;

iii. A 4 mm minimum thickness steel hexagonal lock-nut shall then be fitted and tightened in position. The connecting piece shall additionally be secured in the fully tightened position by two hardened steel grub screws;

iv. These screws shall engage in shallow depressions drilled in the shaft after the connecting piece has been tightened in place to ensure positive locking.

4. Down-rod assembly:

a. The down-rod assembly shall consist of a down-rod and a steel shackle with a hard rubber roller for suspension of the fan;

b.

i. The down-rod shall be supplied, as required, in lengths of 200 mm, 300 mm, 450 mm, 600 mm, 750 mm, 900 mm and 1200 mm measured from the top of the connecting piece to the centre of the pin in the shackle at the top;

ii. Cables of a length to suit the down-rod shall be provided;

iii. The down-rod shall be manufactured from 12 mm bore standard mild steel/iron pipe of not less than 3 mm, wall thickness, having an external diameter of approximately 20 mm;

iv. It shall be accurately threaded at one end and shall be screwed into the top portion of the fan connecting piece (capacitor housing) from which it shall protrude by a minimum of 2 mm;

v. It shall be locked in position by two (2) hexagonal steel lock nuts, having a minimum thickness of 6 mm, tightened on to the upper machined surface of the fan connecting piece;

vi. The down-rod shall also be locked to the fan connecting piece by means of a steel split-pin, of not less than 5 mm diameter, passing through both the fan connecting piece and the down-rod.

c.

i. The split-pin holes in the fan connecting piece shall be of such a diameter that the split-pin is a light push fit therein;

ii. The matching split-pin holes in the down-rod shall be just sufficiently large so that the split-pin shall be a light push fit, when the hole is in its worst position relative to the threading;

iii. All burrs and sharp edges shall be removed from the split-pin holes in both the fan connecting piece and the down-rod.

d.

i. The steel suspension shackle shall be welded to the down-rod;

ii. Welding shall be of good quality and to the satisfaction of the Contract Manager;

iii. The rubber roller shall be mounted on an 8 mm diameter steel clevis pin secured by a split-pin.

e.

i. The ends of the down-rod shall be rounded off and free from burrs;

ii. There shall be no sharp edges which could cause damage to the insulation of the wiring.

5. Suspension joints and threaded parts:

a. Joints along the suspension rod must be of double-locking design. i.e. at least two independent positive locking devices must be employed to prevent a joint from loosening itself;

b. All factory-assembled threaded components which form part of a suspension joint must be bonded with glue as approved by the Contract Manager;

c. The maximum clearance between threaded mating parts must not exceed 1% of their mean diameter;

d. The down-rod threaded end shall be interchangeable with the existing government ceiling fans;

e. The direction of rotation of the fan shall be such that all screwed joints tend to be tightened when the fan is in operation.

6. Canopies:

   Two (2) canopies shall be provided manufactured from plastic or pressed steel sheet and fitted over the upper and lower ends of the down-rod. They shall be fixed to the down-rod by grub screws.

7. Balance:

   a. All fans shall be fully balanced after assembly, with any necessary adjustment being made to ensure that they shall not oscillate due to out-of-balance forces;

   b. All blades shall be given a single identification number, or letter, permanently stamped thereon, with a corresponding mark stamped on the motor body so that the fan blades may be reassembled in the correct position.

8. Finish:

   The whole fan shall be finished in high quality stove enamel, white or ivory colour.

9. Speed Regulator:

   a. The speed regulator shall be of robust construction with at least three (3) speed controls and an "OFF" position, built on a flame retardant moulded plastic, or insulated steel base and enclosed by a flame-retardant moulded plastic cover or metal cover. Plastic cover shall be in white or ivory colour to match the fan. Metal cover shall be of stainless steel or metalclad finish;

   b. For choke type regulator, an earth terminal shall be provided on the base with an earth wire permanently connected to the steel core of the choke unit;

   c. The rotary switch of the speed regulator shall be designed for smooth and easy movement by hand between different speed positions.

ELE19 INSTALLATION OF DOMESTIC APPLIANCES

ELE19.1 GENERAL 2
ELE19.1.010.9 CONNECTIONS TO APPLIANCES 2
ELE19.1.020.9 USE IN BATHROOMS 2
ELE19.1.030.9 ENGRAVING FOR IDENTIFICATION 2
ELE19.1.040.9 EARTHING OF APPLIANCES 2
ELE19.1.050.9 APPLIANCES REQUIRING AN EXCLUSIVE CIRCUIT 2

ELE19.2 CEILING FANS & CEILING-MOUNTED ROTARY FANS 3
ELE19.2.010.9 METHOD OF SUPPLY 3
ELE19.2.020.9 FIXING 3
ELE19.2.030.9 FAN REGULATORS 3

ELE19.3 WALL-MOUNTED FANS 4
ELE19.3.010.9 METHOD OF SUPPLY 4
ELE19.3.020.9 FIXING 4

ELE19.4 EXHAUST FANS 5
ELE19.4.010.9 METHOD OF SUPPLY 5
ELE19.4.020.9 FIXING 5
ELE19.4.030.9 BUILDERS WORK IN CONNECTION WITH FIXING VENTILATION FANS 5

ELE19.6 ELECTRIC FIRES AND HEATERS 6
ELE19.6.010.9 WALL-MOUNTED RADIATORS 6
ELE19.6.020.9 PANEL FIRES 6
ELE19.6.030.9 TUBULAR HEATERS 6

ELE19.7 WATER HEATERS & WATER BOILERS 7
ELE19.7.010.9 OVERSINK WATER HEATERS 7
ELE19.7.020.9 OTHER TYPES OF WATER HEATER 7
ELE19.7.030.9 WATER BOILERS 7
ELE19.7.040.9 WASH BOILERS & TEA URNS 7

ELE19.8 ELECTRIC COOKERS 8
ELE19.8.010.9 BABY BELLING COOKERS 8
ELE19.8.020.9 HOUSEHOLD COOKERS 8

ELE19.9 ELECTRIC HAND DRYERS 9
ELE19.9.010.9 ELECTRIC HAND DRYERS 9

ELE19.10 ROOM COOLERS 10
ELE19.10.010.9 METHOD OF SUPPLY 10
ELE19.10.020.9 POSITION OF CONNECTION UNIT AND TERMINAL BLOCK 10

ELE19.11 REFRIGERATORS 11
ELE19.11.010.9 METHOD OF SUPPLY 11

ELE19.1 GENERAL

ELE19.1.010.9 CONNECTIONS TO APPLIANCES

1. Domestic appliances shall each be connected to the electrical supply through a suitable wiring accessory and a suitable length (preferably 1.5 m to 2 m) of flexible cable or PVC insulated cables enclosed in a flexible conduit;
2. For portable appliances, plugs and sockets shall be used. For fixed appliances, the wiring accessories shall be opened or removed only by means of a tool;
3. Wiring accessories shall meet the requirements of ELE20. They shall be installed as near as practicably possible to the appliances they are supplying. Fuse-links shall comply with BS 1362 and shall have current ratings suitable for the appliances to be controlled;
4. Flexible cables for final connection to domestic appliances shall be white in colour unless otherwise specified, and shall be circular sheathed, twin with CPC to BS EN 50525-2-11 (PVC-insulated) or to BS EN 50525-2-21 (rubber-insulated), all with copper conductors. The cores of the flexible cables shall have identification colours in accordance with Code 13 D of the Electrical CoP.

ELE19.1.020.9 USE IN BATHROOMS

No portable appliance shall be installed in a room containing a fixed bath or shower. Fixed appliances installed in such a room shall be located out of reach by a person using the bath or shower, and the controlling switches shall be located outside the room.

ELE19.1.030.9 ENGRAVING FOR IDENTIFICATION

The front plate of every switched socket outlet, connector box, spur box or control switch feeding a fixed domestic appliance shall be engraved in accordance with ELE28 to indicate its correct function.

ELE19.1.040.9 EARTHING OF APPLIANCES

All domestic appliances except Class II equipment to BS 2754 shall be effectively earthed to the main earth via a circuit protective conductor. Where the cables for final connection to a fixed appliance are enclosed in a flexible conduit, effective earthing shall be achieved by means of a separate circuit protective conductor drawn into the flexible conduit.

ELE19.1.050.9 APPLIANCES REQUIRING AN EXCLUSIVE CIRCUIT

The following types of domestic appliances shall be supplied from an exclusive final circuit:

1. Household electric cookers;
2. Water heaters other than oversink water heaters;
3. Water boilers;
4. Room coolers;
5. Appliances having a nominal power rating of 3 kW or above.

ELE19.2 CEILING FANS & CEILING-MOUNTED ROTARY FANS

ELE19.2.010.9 METHOD OF SUPPLY

1. Supply to a ceiling fan or a ceiling mounted rotary fan shall be by means of a 2A fused connector box with earthing facilities;
2. The fused connector box shall be square, suitable for mounting on a moulded box or plastic pattress to BS 4662 or IEC 60670-1.

ELE19.2.020.9 FIXING

1. Every ceiling fan shall be suspended from a substantial hook fixed securely to the ceiling structure;
2. Rotary fans shall be fixed direct to the ceiling structure.

ELE19.2.030.9 FAN REGULATORS

1. Fan regulators shall be fixed on the surface of walls;
2. In a concealed conduit installation, the fan regulator shall be mounted on a back-plate over a recessed 35 mm deep BS 4662 or IEC 60670-1 box where the conduit shall be terminated. The back-plate shall be made of 3 mm thick galvanised steel with suitable grommeted hole for cable entry;
3. In a surface conduit installation, the fan regulator shall be mounted on a special fabricated box made of 1.5 mm thick galvanised sheet steel and having the same size as the regulator. The conduit shall be terminated at this specially made surface mounted box through which the cables shall enter the fan regulator;
4. In a surface wiring installation, the fan regulator shall be mounted on a wooden block. Grooves shall be formed at the back surface of the wooden block to suit the cables, and holes shall be drilled to enable the cables to enter the fan regulator from the rear.

ELE19.3 WALL-MOUNTED FANS

ELE19.3.010.9 METHOD OF SUPPLY

Supply to a wall mounted fan shall be by means of a 2A fused connector box in a similar manner as for a ceiling fan, except that the fused connector box shall be fixed on the wall adjacent the fan.

ELE19.3.020.9 FIXING

Wall mounted fans shall be fixed by means of a wall mounting bracket supplied with the fans or sit on a mounting bracket or batten made of teak wood or other material approved by the Contract Manager.

ELE19.4 EXHAUST FANS

ELE19.4.010.9 METHOD OF SUPPLY

1. Unless otherwise specified, supply to a domestic type exhaust fan shall be by means of a connection unit, and shall be controlled by a fused connection unit with double-pole switch as shown on the Drawing;
2. Supply to an industrial type exhaust fan shall be by means of a fused spur box and shall be controlled by a 20A switch D.P. with pilot light.

ELE19.4.020.9 FIXING

1. Exhaust fans shall be installed on the structural opening by means of a steel mounting plate;
2. Where an exhaust fan is intended to draw exhausted air through a fume cupboard, the fan shall be ducted to the fume cupboard by means of PVC pipes of suitable size and length.

ELE19.4.030.9 BUILDERS WORK IN CONNECTION WITH FIXING VENTILATION FANS

The openings in slabs or walls or window glass for mounting roof extractors and/orother ventilation fans shall be provided by the Main Contractor. However, the Sub-contractor shall submit detailed drawings to the Contract Manager to indicate the dimensions of the openings and the details of the diaphragm plates and the proposed method of mounting for Approval prior to installation.

ELE19.6 ELECTRIC FIRES AND HEATERS

ELE19.6.010.9 WALL-MOUNTED RADIATORS

Supply to wall-mounted radiators shall be fed through a fused spur box and shall be controlled by a 15/20A, D.P. switch with pilot light.

ELE19.6.020.9 PANEL FIRES

1. Method of supply:

   Panel fires rated at 3 kW or less shall be supplied and controlled by a connection unit and a double-pole switch with pilot light.

2. Fixing:

   The connection unit shall be installed on the same side of the panel fires as where the flexible cable enters the panel fires unless otherwise specified.

ELE19.6.030.9 TUBULAR HEATERS

Tubular heaters shall be supplied and controlled by a 13A 3-pin switched socket outlet.

ELE19.7 WATER HEATERS & WATER BOILERS

ELE19.7.010.9 OVERSINK WATER HEATERS

1. Method of supply:
    a. Supply to an oversink water heater shall be by means of a fused spur box and shall be controlled by a 15/20A, D.P. switch with pilot light at a distance of not less than 2 m from any water taps;
    b. The front plate of the fused spur box shall have an outlet hole and the necessary cordgrip for the flexible cable.
2. Fixing:

    In a surface wiring installation, the fused spur box and the 15/20A, D.P. switch shall each be mounted on a moulded box or plastic pattress to BS 4662 or IEC 60670-1.

ELE19.7.020.9 OTHER TYPES OF WATER HEATER

1. Method of supply:

    Supply to domestic water heaters, other than oversink type, shall be controlled by a 20A D.P. switch with pilot light.
2. In a concealed or surface conduit installation:
    a. The PVC insulated cables shall be enclosed in a conduit from the control switch to a standard circular conduit box fitted with a dome cover and then through a flexible conduit from the dome cover to the water heater;
    b. The dome cover and the conduit box shall be fixed as near to the water heater as practicable.
3. In a surface wiring installation:
    a. The control switch shall be mounted on a moulded box or plastic pattress;
    b. Final connection to the water heater shall be taken direct from the control switch via a flexible cable, twin with CPC;
    c. The control switch shall be fixed as near to the water heater as practicable.

ELE19.7.030.9 WATER BOILERS

The installation of a water boiler shall be similar to that for a water heater except that the control switch shall have a rating of 30A.

ELE19.7.040.9 WASH BOILERS & TEA URNS

1. Method of supply:

    Wash boilers and tea urns having a rating of 3 kW or less, shall be supplied and controlled by a connection unit and a double-pole switch with pilot light.
2. Fixing:

    The connection unit shall be installed on the same side of the wash boiler and tea urn as where the flexible cable enters the wash boiler and tea urn unless otherwise specified.

ELE19.8 ELECTRIC COOKERS

ELE19.8.010.9 BABY BELLING COOKERS

The installation of a Baby Belling type cooker shall be similar to that for a wash boiler.

ELE19.8.020.9 HOUSEHOLD COOKERS

1. Method of supply:

   Supply to a household cooker shall be controlled by a cooker control unit of rating not less than 45A unless otherwise specified. The control unit shall be installed at a height of 1350 mm above finished floor level;

2. In a concealed or surface conduit installation:

   a. The PVC insulated cables from the control unit shall be enclosed in a conduit and terminated at an insulated terminal block inside a 47 mm deep BS 4662 or IEC 60670-1 conduit box;

   b. The PVC insulated cables shall then be changed into PVC insulated and sheathed cable twin with CPC before connecting to the cooker;

   c. The insulated terminal block shall be mounted on the wall at 300 mm above finished floor level;

   d. The PVC insulated and sheathed cable twin with CPC shall be 1.5 m to 2 m long to allow the cooker to be moved for cleaning purposes.

3. In a surface wiring installation:

   PVC insulated and sheathed cable twin with CPC shall be used throughout.

ELE19.9 ELECTRIC HAND DRYERS

ELE19.9.010.9 ELECTRIC HAND DRYERS

The supply to an electric hand dryer shall be by means of a fused spur box complete with an integral D.P. switch and pilot light. The front plate of the fused spur box shall have an outlet hole and the necessary cordgrip for the flexible cable.

ELE19.10 ROOM COOLERS

ELE19.10.010.9 METHOD OF SUPPLY

Supply to a room cooler shall be by means of a connection unit or an insulated terminal block and a control switch, both of which shall have a current capacity of not less than the rated value of the room cooler. The control switch shall be D.P. with pilot light.

ELE19.10.020.9 POSITION OF CONNECTION UNIT AND TERMINAL BLOCK

The connection unit or insulated terminal block shall be installed adjacent to the room cooler and shall be on the same side of the room cooler as where the flexible cable enters the room cooler. Where it is not possible to ascertain where the flexible cable enters the room cooler, the connection unit or insulated terminal block shall be installed on the left side of the room cooler, as viewed from the front.

ELE19.11 REFRIGERATORS

ELE19.11.010.9 METHOD OF SUPPLY

Supply to a refrigerator shall be by means of a fused spur box fitted with a 20A D.P. switch or a 13A socket outlet as shown on the Drawing.

ELE20 WIRING ACCESSORIES

ELE20.1 WIRING ACCESSORIES - GENERAL 2

ELE20.1.010.9 STANDARD 2
ELE20.1.020.9 COLOUR AND CONSISTENCY 2
ELE20.1.030.9 MOUNTING 2
ELE20.1.040.9 ENCLOSURES 2
ELE20.1.050.9 ENGRAVING 2

ELE20.2 DOMESTIC SWITCHES 3

ELE20.2.010.9 GENERAL 3
ELE20.2.020.9 LIGHTING SWITCHES 3
ELE20.2.030.A D.P. SWITCHES FOR APPLIANCES 4
ELE20.2.040.9 SPARKLESS SWITCHES 4
ELE20.2.050.9 TIME SWITCHES 4
ELE20.2.060.9 SWITCHES EXPOSED TO WEATHER 4
ELE20.2.070.9 APPLICATION IN BATHROOMS ETC. 4
ELE20.2.080.9 DOOR BELL PUSH BUTTON 4

ELE20.3 SOCKET OUTLETS 5

ELE20.3.010.9 GENERAL 5
ELE20.3.020.9 13A SOCKET OUTLETS 5
ELE20.3.030.9 INTEGRAL SWITCH FOR SOCKET OUTLETS 6
ELE20.3.040.9 WEATHERPROOF SOCKET OUTLETS 6
ELE20.3.060.9 SHAVER SUPPLY UNITS 6
ELE20.3.070.9 SOCKET OUTLETS TO SURFACE CONDUIT INSTALLATIONS 6
ELE20.3.080.9 PLUGS 6
ELE20.3.090.9 SOCKET OUTLETS IN HAZARDOUS AREAS 6
ELE20.3.100.9 SOCKET MOUNTING HEIGHT 7
ELE20.3.110.9 SOCKET OUTLETS FOR DIFFERENT VOLTAGE SYSTEMS 7
ELE20.3.120.9 APPLICATION IN BATHROOMS ETC. 7

ELE20.4 CONNECTION UNITS 8

ELE20.4.010.9 CONNECTION UNITS - GENERAL 8
ELE20.4.020.9 FUSED CONNECTION UNITS 8

ELE20.5 INSULATED TERMINAL BLOCKS 10

ELE20.5.010.9 VOLTAGE RATING 10
ELE20.5.020.9 CONSTRUCTION 10
ELE20.5.030.9 DESIGN 10

ELE20.1 WIRING ACCESSORIES - GENERAL

ELE20.1.010.9 STANDARD

Wiring accessories shall meet the general requirements of BS EN 60670-22 and BS 5733, unless otherwise specified.

ELE20.1.020.9 COLOUR AND CONSISTENCY

Unless otherwise specified, wiring accessories of the same cover plate material shall be of the same colour scheme and for those used for domestic purpose, they shall be in white. All wiring accessories in domestic units, with the exception of batten lampholders, shall be from the same range of product of a single manufacturer.

ELE20.1.030.9 MOUNTING

1. In surface cable installations, they shall be fixed onto moulded boxes or pattresses;
2. In conduit installations, they shall be mounted on either plastic moulded boxes or cast iron galvanised boxes;
3. Where a waterproof or flameproof pattern is required, they shall be mounted as the particular circumstances demand.

ELE20.1.040.9 ENCLOSURES

Moulded boxes or pattersses and steel or cast iron boxes for the enclosure of wiring accessories shall comply with IEC 60670-1 and dimensions to BS 4662 and shall meet the requirements specified in ELE11, ELE12 and ELE13 where appropriate.

ELE20.1.050.9 ENGRAVING

The front plate of each socket or control switch feeding an essential circuit or a fixed electrical appliance, such as wash boiler, water heater, cooker, wall-mounted fan, wall mounted radiator, incinerator, exhaust fan, room cooler, etc., shall be engraved according to the appliance being controlled. Details of the inscription shall be submitted to the Contract Manager for approval. See Project Specific Specification for particular project requirements, if any.

ELE20.2 DOMESTIC SWITCHES

ELE20.2.010.9 GENERAL

1. Standard:

   Switches for domestic and similar purposes shall comply with BS EN 60669-1.

2. Mounting:

   a. They shall be mounted at a height of 1350 mm above finished floor level unless otherwise specified;

   b. Unless otherwise specified, lighting switches shall be designed for flush mounting on to pattresses or boxes to IEC 60670-1 and dimensions to BS4662.

3. Type-testing:

   Lighting switches shall be type-tested for complete compliance with BS EN 60669-1 by an Accredited Laboratory.

ELE20.2.020.9 LIGHTING SWITCHES

1. Type:

   Lighting switches shall be suitable for use on a.c. circuits, and shall be of the quick make-and-break type when used in d.c. circuits. Suspension pear type switches will not be permitted.

2. Front plate:

   a. The front plate shall be made of an insulating material such as urea-formaldehyde or polycarbonate and white in colour;

   b. The B.S. number shall be indelibly marked on the lighting switch assembly;

   c. The whole assembly shall have a pleasant appearance and shall be fixed onto the enclosure by means of bright electroplated oval head screws;

   d. The screws shall be flush with the surface of the front plate.

3. Cable terminals:

   a. Cable terminals shall be suitably positioned for easy cable termination and suitably shrouded to prevent accidental contact with other metal or current-carrying parts;

   b. The ends of the terminal screws shall be so shaped as to prevent damage to the conductor;

   c. Current carrying parts of cable terminals shall be made of copper, brass, phosphor-bronze or other metal at least equivalent with regard to its conductivity and resistance to corrosion.

4. Plastic pattresses:

   a. Lighting switches for surface cable installations shall be fixed onto proprietary-made plastic pattresses;

   b. The pattress shall be complete with copper earthing terminal and shall be at least 25 mm internal depth to accommodate the cables to be installed and to prevent acute bends of the cables;

   c. The colour, shape and material of the pattress shall match that of the front plate of the switch.

5. Rating:

   Lighting switches shall be single pole rated at 5AX or 10AX as specified in Project Specific Specification or on the Drawings;

6. Multi-gang mounting:

   When lighting switches are mounted adjacent to one another, they shall be grouped in a single enclosure (multigang box) and shall share a common switch plate, subject to a maximum of three lighting switches per single-gang plate;

7. Location:

   Lighting switches, installed adjacent to a door shall be located on the handle side of the door and shall be as near to the door as practicable.

ELE20.2.030.A D.P. SWITCHES FOR APPLIANCES

1. Switches controlling appliances with heating elements or appliances permanently connected to the supply shall be of double pole type, and shall have a rating not smaller than the current capacity of the appliances being controlled;
2. The front plate of each such switch shall be of large press button type and shall be properly engraved in accordance with ELE20.1.050;
3. The pilot light, shall be formed by a LED lamp or neon lamp with resistor and a red coloured lens.

ELE20.2.040.9 SPARKLESS SWITCHES

1. Sparkless switches shall be of the tilting mercury type;
2. The contacts of a sparkless switch shall be contained in a sealed glass capsule;
3. The rating shall be as specified in Project Specific Specification or on the Drawings.

ELE20.2.050.9 TIME SWITCHES

As ELE3.17.

ELE20.2.060.9 SWITCHES EXPOSED TO WEATHER

Switches mounted outdoors, or in positions where they may be exposed to rain or water, shall be weatherproof with ingress protection of at least IP55 to BS EN 60529 or IEC 60529. Switches with covers on top to achieve the IP requirement are not acceptable.

ELE20.2.070.9 APPLICATION IN BATHROOMS ETC.

No switch shall be installed inside a room containing a fixed bath or shower or inside a toilet.

ELE20.2.080.9 DOOR BELL PUSH BUTTON

Door bell pushes button shall be of large press button type and flush pattern with white or ivory colour front plate to BS EN 60669-1.

ELE20.3 SOCKET OUTLETS

ELE20.3.010.9 GENERAL

1. Socket outlets and plugs rated at 5A and 15A for general application shall comply with BS 546 and the Electrical CoP;
2. Socket outlets and plugs rated at 13A shall comply with BS 1363: Parts 1 & 2;
3. All socket outlets shall be of 3 pin, and shall be of the shuttered type;
4. 5A socket outlets may be unshuttered provided they are installed on the ceiling or at high level and are not normally accessible;
5. Socket outlets intended for supplying fixed or stationary appliances shall be located as near as possible to the appliances.

ELE20.3.020.9 13A SOCKET OUTLETS

1. Design:

   Unless otherwise specified, socket outlets shall be designed for flush mounting onto pattresses or boxes to IEC 60670-1 and dimensions to BS 4662;

2. Type-testing:

   Socket outlets shall be of 3-pin shuttered type and shall be type-tested for complete compliance with BS 1363: Part 2 by an Accredited Laboratory;

3. Front plate:

   a. The front plate shall be made of an insulating material such as urea-formaldehyde or polycarbonate and white in colour;

   b. The B.S. number shall be indelibly marked on the socket outlet assembly;

   c. The whole assembly shall have a pleasant appearance and shall be fixed onto the enclosure by means of bright electroplated oval head screws;

   d. The screws shall be flush with the surface of the front plate.

4. Cable terminals:

   a. Cable terminals shall be suitably positioned for easy cable termination and suitably shrouded to prevent accidental contact with other metal or current-carrying parts;

   b. The ends of the terminal screws shall be so shaped as to prevent damage to the conductor;

   c. Current carrying parts of cable terminals shall be made of copper, brass, phosphor-bronze or other metal at least equivalent with regard to its conductivity, and resistance to corrosion.

5. Plastic pattresses:

   a. Socket outlets for surface cable installations shall be fixed onto proprietary-made plastic pattresses;

   b. The pattress shall be at least 25 mm internal depth to accommodate the cables to be installed and to prevent acute bends of the cables;

   c. The colour, shape and material of the pattress shall match that of the front plate of the socket outlet.

ELE20.3.030.9 INTEGRAL SWITCH FOR SOCKET OUTLETS

For socket outlet with integral switch, the integral switch shall be of single pole, forming part of the same front plate as the socket outlet.

ELE20.3.040.9 WEATHERPROOF SOCKET OUTLETS

Weatherproof socket outlets of appropriate types and ratings shall be provided as shown on drawings. The socket outlets shall comply correspondingly with the following requirements:

1. Industrial type surface mounting socket outlet to BS EN 60309-2 or IEC 60309-2 with a push-on cap and cap retaining ring having ingress protection of at least IP44 to BS EN 60529 or IEC 60529. The socket outlet shall be suitable for wall mounting and the outlet shall face downward, to facilitate plug insertion and to minimize ingress of water;
2. General purpose type socket outlet to BS 1363 with the plug fully enclosed by protective cover and with the cord entry properly sealed when in use condition and having ingress protection of at least IP44 to BS EN 60529 or IEC 60529. The hinge mechanism for the protective cover shall be of sturdy construction with opening angle greater than 120 degrees.

ELE20.3.060.9 SHAVER SUPPLY UNITS

1. Electric shaver supply units shall comply with BS EN 61558-1 and BS EN 61558-2-23, or IEC 61558-1 and IEC 61558-2-23 and shall be insulated, suitable for flush mounting;
2. Each unit shall comprise two outlets one for 110V and the other for 220V obtained from a double wound transformer;
3. The complete unit shall be enclosed in a galvanised metal box for flush mounting, or a cast iron or plastic surface box for surface mounting.

ELE20.3.070.9 SOCKET OUTLETS TO SURFACE CONDUIT INSTALLATIONS

In pump rooms, plant rooms, boiler houses, switch rooms and other places where surface conduit and accessories are installed, socket outlets shall be metalclad, with bronze front plate, unless otherwise specified.

ELE20.3.080.9 PLUGS

1. Plugs for 13A socket outlets shall be fitted with a fuse, complying with BS 1362 or IEC 60269-1, suitably rated to suit the appliance connected to it;
2. Where the current rating of the appliance cannot be ascertained, a 13A fuse shall be fitted;
3. Every plug shall be fitted with a cord grip which is so designed that no stress will be taken by the terminals or the conductors of the flexible cable connected to it;
4. The extent of provision of plugs, if required, is given in Project Specific Specification or Drawings.

ELE20.3.090.9 SOCKET OUTLETS IN HAZARDOUS AREAS

1. The installation of socket outlets in hazardous areas should be avoided as far as possible;
2. Where it is absolutely essential to install a socket outlet in such an area, the socket outlet shall comply with BS EN 60309-2 or IEC 60309-2 and shall be controlled by a sparkless switch;

3. The socket outlet shall be interlocked with the plug so that removal or insertion shall not be possible unless the controlling switch is in the OFF position;
4. The plug shall have shrouded pins and the design of the pin contacts shall be such as to guard against development of hot spots or sparking.

ELE20.3.100.9 SOCKET MOUNTING HEIGHT

Unless otherwise specified socket outlets shall be mounted at a height of 1350 mm above finished floor level in kitchens, sculleries, ironing rooms and the like, and at a height of 300 mm above finished floor level in other locations.

ELE20.3.110.9 SOCKET OUTLETS FOR DIFFERENT VOLTAGE SYSTEMS

Socket outlets and plugs for one voltage system shall not be interchangeable with those for use at other voltage and/or frequency systems in the same installation.

ELE20.3.120.9 APPLICATION IN BATHROOMS ETC.

No socket outlets, other than shaver supply units complying with BS, shall be installed inside a room containing a fixed bath or shower or inside a toilet.

ELE20.4 CONNECTION UNITS

ELE20.4.010.9 CONNECTION UNITS - GENERAL

1. Design:

   Unless otherwise specified, connection units shall be suitable for flush mounting onto pattresses or boxes to IEC 60670-1 and dimensions to BS 4662;

2. Type-testing:

   Connection units shall be type-tested to BS 5733 by an Accredited Laboratory;

3. Current rating:

   The current rating of connection units shall be at least 20A unless otherwise specified on the Drawings;

4. Front plate:

   a. The front plate shall be made of an insulating material such as urea-formaldehyde or polycarbonate and white in colour;

   b. Where pilot light and integral switch are specified, the light shall comprise a neon lamp and a red coloured lens, and the switch shall be of double pole, unless otherwise specified, and forming part of the same front plate;

   c. The front plate shall also incorporate a flex outlet with a clamp for anchoring the flexible cord;

   d. The whole assembly shall have a pleasant appearance and shall be fixed onto the enclosure by means of bright electroplated oval head screws;

   e. The screws shall be flush with the surface of the front plate.

5. Cable terminals:

   a. Cable terminals shall be suitably positioned for easy cable termination and suitably shrouded to prevent accidental contact with other metal or current-carrying parts;

   b. The ends of the terminal screws shall be so shaped as to prevent damage to the conductor;

   c. Current carrying parts of cable terminals shall be made of copper, brass, phosphor-bronze or other metal at least equivalent with regard to its conductivity and resistance to corrosion.

6. Plastic pattresses:

   a. Connection units for surface cable installations shall be fixed onto proprietary-made plastic pattresses;

   b. The pattress shall be complete with copper earth terminal and shall be at least 25 mm internal depth to accommodate the cables to be installed and to prevent acute bends of the cables;

   c. The colour, shape and material of the pattress shall match that of the front plate of the unit.

ELE20.4.020.9 FUSED CONNECTION UNITS

1. Fused connection units shall comply with BS 1363: Part 4 and contain plugs incorporating cartridge fuse-links to BS 1362 or IEC 60269-1 of a.c. rating either 2A or 13A as shown on the drawings;

2. The plug shall only be removable by the use of a tool;
3. The unit shall be clearly marked with the word "FUSE" or "FUSED" in a conspicuous position on the front plate;
4. Fused connection unit shall be type-tested by an Accredited Laboratory.

ELE20.5 INSULATED TERMINAL BLOCKS

ELE20.5.010.9 VOLTAGE RATING

The rated voltage of terminal blocks shall not be less than 435V between terminals and 250V to earth.

ELE20.5.020.9 CONSTRUCTION

Terminal blocks shall comprise brass connectors with screw connections, all contained within a moulded block suitable for working temperature up to 100°C.

ELE20.5.030.9 DESIGN

Terminals shall be designed to clamp the conductor between metal surface with sufficient contact pressure but without causing damage to the conductors. With the largest recommended conductor in position, and tightly clamped, there shall be at least two full threads of the screw engaging in the connector.

ELE21 LAMPS, LUMINAIRES, ETC. AND LIGHTING INSTALLATION

ELE21.1 LAMPS 5
ELE21.1.010.A LED MODULE AND LED LAMP 5
ELE21.1.015.9 DOUBLE-CAPPED LED TUBULAR LAMP 6
ELE21.1.020.X DELETED 7
ELE21.1.025.X DELETED 7
ELE21.1.030.X DELETED 7
ELE21.1.040.X DELETED 7
ELE21.1.050.X DELETED 7
ELE21.1.060.9 PROVISION OF LIGHT SOURCES 7

ELE21.2 LAMPHOLDERS 8
ELE21.2.010.A BATTEN LAMPHOLDERS 8
ELE21.2.020.9 CORD GRIP LAMPHOLDERS 8
ELE21.2.030.9 LAMPHOLDERS FOR WEATHERPROOF LUMINAIRES 9
ELE21.2.040.9 LAMPHOLDER FOR LED TUBULAR LAMPS 9

ELE21.3 LUMINAIRES 10
ELE21.3.010.9 GENERAL 10
ELE21.3.020.A INDOOR LUMINAIRES (EXCEPT SF84 & SF85) 10
ELE21.3.030.A OUTDOOR LUMINAIRES 12
ELE21.3.040.A INDOOR BATTEN TYPE LED LUMINAIRES (SF11 TO SF24, SF33 & SF39) 15
ELE21.3.050.A CORROSION RESISTANT TYPE LED LUMINAIRES (SF25, SF26 & SF34 - SF36) 15
ELE21.3.060.X DELETED 16
ELE21.3.080.X DELETED 16
ELE21.3.090.9 FLAMEPROOF LUMINAIRES 16
ELE21.3.100.A SPOT LIGHTS (SF42) 16
ELE21.3.110.X DELETED 17
ELE21.3.120.A FULLY RECESSED LIGHTS (DOWN LIGHTS) (SF44) 17
ELE21.3.130.X DELETED 17
ELE21.3.140.A BULKHEAD FITTING (SF83) 17
ELE21.3.150.N LIGHT EMITTING DIODE (LED) STRIP (SF90) 17

ELE21.4 POLE TOP LANTERNS (SF 29) 19
ELE21.4.010.A GENERAL 19
ELE21.4.020.A LAMP TYPE 19
ELE21.4.030.A CONSTRUCTION 19

ELE21.5 GLOBE LANTERNS (SF 86, SF 87) 20
ELE21.5.010.A GENERAL 20
ELE21.5.020.A LAMP TYPE 20
ELE21.5.030.A CONSTRUCTION 20

ELE21.6 SIDE-ENTRY STREET LANTERNS (SF 30, SF 31) 21
ELE21.6.010.A GENERAL 21
ELE21.6.020.A LAMP TYPE 21
ELE21.6.030.A CONSTRUCTION 21

ELE21.7 OUTDOOR AREA FLOODLIGHTS (SF 46) 22
ELE21.7.010.9 GENERAL 22

ELE21.7.020.A LAMP TYPE 22
ELE21.7.030.9 LIGHT DISTRIBUTION 22
ELE21.7.040.9 MAIN BODY CONSTRUCTION 22
ELE21.7.050.9 FRONT FRAME AND GLASS 22
ELE21.7.060.9 REFLECTOR 22
ELE21.7.070.9 WIND SPEED PERFORMANCE 22
ELE21.7.080.9 STABILITY 22
ELE21.7.090.9 ANGULAR ADJUSTMENT 23
ELE21.7.100.9 FIXING ACCESSORIES 23
ELE21.7.110.9 WINDAGE AREA AND WEIGHT 23
ELE21.7.120.A INTEGRATED CONTROL-GEAR 23
ELE21.7.130.9 CABLE ENTRY 23

ELE21.8 BOLLARDS (SF 37) 24

ELE21.8.010.A GENERAL 24
ELE21.8.020.A LAMP TYPE 24
ELE21.8.030.A CONSTRUCTION 24

ELE21.9 STEEL LAMP COLUMNS (3, 4, 5, 10, 12 M NOMINAL HEIGHT) 25

ELE21.9.010.9 GENERAL 25
ELE21.9.020.A CONSTRUCTION 25
ELE21.9.030.A DIMENSIONS 25
ELE21.9.040.9 CORROSION PROTECTION 26
ELE21.9.050.9 STRENGTH 26

ELE21.10 LOW BAY FLOODLIGHTS (WIDE LIGHT DISTRIBUTION) (SF70) 27

ELE21.10.010.A GENERAL 27
ELE21.10.020.A LAMP TYPE 27
ELE21.10.030.A CONSTRUCTION 27
ELE21.10.040.9 LIGHT DISTRIBUTION 27

ELE21.11 SELF-CONTAINED EXIT SIGNS AND DIRECTIONAL SIGNS 29

ELE21.11.010.9 TYPE OF FITTING 29
ELE21.11.030.9 STANDARDS 29
ELE21.11.040.9 CONSTRUCTION AND COMPONENTS 29
ELE21.11.050.9 FITTINGS TO EXIT SIGN AND DIRECTIONAL SIGN 30
ELE21.11.060.9 OPERATION 30
ELE21.11.070.9 SAMPLE 30
ELE21.11.080.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 30

ELE21.12 EMERGENCY LIGHTING MODIFICATION UNITS (CONVERSION KITS) 31

ELE21.12.010.9 QUALITY SURVEILLANCE SCHEME 31
ELE21.12.020.A CONSTRUCTION 31
ELE21.12.030.9 OPERATION MODE 31
ELE21.12.040.9 CHARGING SYSTEM 31
ELE21.12.050.9 BATTERIES 31
ELE21.12.060.9 BATTERY PROTECTION 31
ELE21.12.070.9 LIGHT OUTPUT DURING EMERGENCY OPERATION MODE 32
ELE21.12.080.9 INDICATION AND TESTING FACILITIES 32

ELE21.12.090.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 32

ELE21.13 INSTALLATION OF LAMPS AND LUMINAIRES 33

ELE21.13.010.A "GRID" SYSTEMS 33
ELE21.13.020.9 TUBE PENDANTS 33
ELE21.13.030.9 PLAIN PENDANTS 33
ELE21.13.040.9 LUMINAIRES MOUNTED ON WOODEN BATTENS 33
ELE21.13.050.9 CABLES IN ENCLOSED LUMINAIRES 33
ELE21.13.060.X DELETED 33
ELE21.13.070.9 PAINTING OF PLASTIC ITEMS 33
ELE21.13.080.9 PAINTING OF EXPOSED METAL PARTS 34
ELE21.13.090.9 LUMINAIRE TRACK SYSTEMS 34
ELE21.13.100.9 PHOTOCELL DEVICES 34

ELE21.14 EXTERNAL LIGHTING SYSTEM 35

ELE21.14.010.A SCOPE 35
ELE21.14.020.9 SPECIFICATION AND DRAWINGS 35
ELE21.14.030.9 LUMINAIRES 35
ELE21.14.040.9 CONSTRUCTION OF LAMP POLES 35
ELE21.14.050.9 FOUNDATIONS FOR LAMP POLES 35
ELE21.14.060.9 SERVICE BOXES 35
ELE21.14.070.9 UNDERGROUND CABLES TO POLES 36
ELE21.14.080.A CABLES BETWEEN SERVICE BOX AND LUMINAIRES 36
ELE21.14.090.9 SWITCHES FITTED TO POLES 36
ELE21.14.100.X DELETED 37
ELE21.14.110.9 TESTING OF ILLUMINATION LEVEL 37

ELE21.16 NEW TUBULAR BULKHEAD FLUORESCENT LUMINAIRE WITH ELECTROMAGNETIC BALLAST (SF 71 & SF 73) 38

ELE21.16.010.X DELETED 38
ELE21.16.020.X DELETED 38
ELE21.16.030.X DELETED 38
ELE21.16.040.X DELETED 38

ELE21.17 NEW CIRCULAR BULKHEAD FLUORESCENT LUMINAIRE WITH ELECTROMAGNETIC BALLAST (SF 75 & SF 77) 39

ELE21.17.010.X DELETED 39
ELE21.17.020.X DELETED 39
ELE21.17.030.X DELETED 39
ELE21.17.040.X DELETED 39

ELE21.18 NEW TUBULAR BULKHEAD FLUORESCENT LUMINAIRE WITH ELECTRONIC BALLAST (SF 72 & SF 74) 40

ELE21.18.010.X DELETED 40
ELE21.18.020.X DELETED 40
ELE21.18.030.X DELETED 40
ELE21.18.040.X DELETED 40

ELE21.19 BULKHEAD LUMINAIRE (SF 76 & SF 78) 41

ELE21.19.010.A GENERAL 41
ELE21.19.020.A LAMP TYPE 41

ELE21.19.030.9 LIGHT DISTRIBUTION....41
ELE21.19.040.A CONSTRUCTION....42

ELE21.20 ELECTRONIC BALLAST 43
ELE21.20.010.X DELETED....43
ELE21.20.020.X DELETED....43
ELE21.20.030.X DELETED....43
ELE21.20.040.X DELETED....43
ELE21.20.050.X DELETED....43
ELE21.20.060.X DELETED....43

ELE21.21 FLUORESCENT LUMINAIRE AND LAMP (T5) 44
ELE21.21.030.X DELETED....44
ELE21.21.040.X DELETED....44

ELE21.22 MOTION DETECTOR UNIT 45
ELE21.22.010.A GENERAL....45
ELE21.22.020.A CONSTRUCTION....45
ELE21.22.030.9 MOTION SENSOR....45
ELE21.22.040.9 MOCK-UP INSTALLATION....45
ELE21.22.050.X DELETED....45

ELE21.23 BULKHEAD TYPE LIGHT EMITTING DIODE (LED) LUMINAIRES (SF84 & SF85) 46
ELE21.23.010.9 GENERAL....46
ELE21.23.020.9 CONSTRUCTION....47
ELE21.23.030.9 LED PANEL....48
ELE21.23.040.9 LED DRIVER....48
ELE21.23.050.9 PERFORMANCE REQUIREMENTS....49
ELE21.23.060.9 STANDARD....50
ELE21.23.070.9 LIGHT DISTRIBUTION....51
ELE21.23.080.9 VERIFICATION OF PERFORMANCE....51
ELE21.23.090.X DELETED....52
ELE21.23.100.9 QUALITY ASSURANCE....52
ELE21.23.110.9 UNIT RATES OF SPARE PARTS....53

ELE21.24 LIGHTING MANAGEMENT SYSTEM.... 54
ELE21.24.010.N GENERAL....54
ELE21.24.020.N SYSTEM REQUIREMENT....54

ELE21.1 LAMPS

ELE21.1.010.A LED MODULE AND LED LAMP

1. The LED module and self-ballasted LED module shall be manufactured and tested to comply with BSEN 62031 or IEC 62031:
2. The performance of the LED module and self-ballasted LED lamp shall comply with the following requirements:
   a. Luminous Efficacy (lumen/watt)

      The luminous efficacy of different types of luminaires under different colour temperatures to be used in the Sub-contract shall be provided to indicate its performance;

   b. Lumen Maintenance (L70)

      The lumen output shall deliver at least 70% of its initial value after operating 35,000 hours and 25,000 hours for LED module and self-ballasted LED lamp respectively. For compliance with the L70 threshold lumen maintenance requirements, the lumen maintenance data of each colour temperature LED light source using 6,000 hours is acceptable for projecting the L70. The required lumen maintenance at 6,000 hours shall not be less than 94.1% and 91.8% for L70 = 35,000 hours and L70 = 25,000 hours respectively;

   c. Colour Rendering Index (CRI)

      CRI shall be minimum 80 and 60 for indoor luminaires and outdoor luminaires respectively;

   d. Correlated Colour Temperature (CCT)

      The colour temperature of a group of LED light sources in the same room or space shall not be visually noticeable. The nominal CCT of the LED light source shall preferably be one of the following values:

2,700K	2,725 ± 145K
3,000K	3,045 ± 175K
3,500K	3,465 ± 245K
4,000K	3,985 ± 275K
5,700K	5,665 ± 355K
6,500K	6,530 ± 510K

3. Self-ballasted LED lamps for general lighting services shall comply with BS EN 62560 or IEC 62560 and BS EN 62612 or IEC 62612, and the following requirements:
   a. The operating frequency of the built-in driver shall be not less than 20kHz or at a sufficiently high frequency to ensure no flickering causing health risk to viewers;

   b. The lamp shall have been in continuous and satisfactory operation locally in similar application and supply scale for at least one year up to the time of material submission. The corresponding in-service records with supply scale and proven satisfactory operation shall be provided upon request by the Contract Manager;

c. The lamp manufacturing plant and facilities shall conform to ISO 9001 with proper quality control scheme in place to ensure delivering consistent and high-quality products. Relevant documentation shall be provided upon request by the Contract Manager to substantiate the quality assurance system covering the purchasing and quality control of lamp components, design and manufacturing process, qualification and experience of plant operating personnel as well as testing and delivery of end products.

4. Self-ballasted LED lamps with single lamp cap up to 60W shall have obtained a Grade 1 Energy Label under the Mandatory Energy Efficiency Labelling Scheme of Electrical and Mechanical Services Department.

ELE21.1.015.9 DOUBLE-CAPPED LED TUBULAR LAMP

1. Double-capped LED tubular lamp shall be suitable for direct connection to supply mains of 220V±6% and 50Hz±2%, and CCT 4000K, unless otherwise specified, with built-in driving and control circuits, and safety design to avoid voltage being present at the opposite pin when inserted at one end. The operating frequency of the built-in driver shall be not less than 20kHz or at a sufficiently high frequency to ensure no flickering causing health risk to viewers. The LED tubular lamp shall be compatible with market norms and capable to operate irrespective of the tube orientation when inserted in luminaires or lamp holders with simple wiring connection;

2. The lamp shall comply with BS EN 62776 or IEC 62776 in addition to the corresponding International Standards listed in ELE21.1.010 and meet the following minimum requirements:

   a. Luminous efficacy: 100 lm/W;

   b. Lamp life: 35 000 hours (L70);

   c. Colour Rendering Index: 80;

   d. Total power factor: 0.85;

   e. The initial luminous output of double-capped LED tubular lamp shall not be less than that shown on the table below:

Length of double-capped LED tubular lamp	Initial luminous output (lm)
600 mm	920
1200 mm	1700
1500 mm	2400

3. The lamp shall be suitable to operate and fully compatible with emergency lighting modification unit without flickering, if supplied under this Sub-contract, as stipulated in ELE21.12;

4. The lamp shall have been in continuous and satisfactory operation locally in similar application and supply scale for at least one year up to the time of material submission. The corresponding in-service records with supply scale and proven satisfactory operation shall be provided upon request by the Contract Manager;

5. The lamp manufacturing plant and facilities shall conform to ISO 9001 with proper quality control scheme in place to ensure delivering consistent and high-quality products. Relevant documentation shall be provided upon request by the Contract Manager to substantiate the quality assurance system covering the purchasing and quality control of lamp components, design and manufacturing process, qualification and experience of plant operating personnel as well as testing and delivery of end products.

ELE21.1.020.X DELETED

ELE21.1.025.X DELETED

ELE21.1.030.X DELETED

ELE21.1.040.X DELETED

ELE21.1.050.X DELETED

ELE21.1.060.9 PROVISION OF LIGHT SOURCES

The Sub-contractor shall supply and fix light source(s) in all luminaires except those in the luminaires at acoustic balcony and the lampholders in domestic units.

ELE21.2 LAMPHOLDERS

ELE21.2.010.A BATTEN LAMPHOLDERS

1. Unless otherwise specified, batten lampholders shall be suitable for flush mounting on plastic pattresses or BESA boxes;
2. Batten lampholders shall be type-tested for complete compliance with BS EN 60238 or IEC 60238 by an Accredited Laboratory;
3. The lampholder shall be of all-insulated Edison screw socket pattern manufactured from moulded hard white or ivory colour plastic material which shall be unaffected by the heat from the lamp, and shall be fitted with a shaded carrier ring and a ventilated shield unless otherwise specified;
4. The screw shell of the lamp holder shall not be designed as a current carrying part;
5. The metal screw shell shall be made of corrosion resistant material or electroplated to prevent corrosion and type-tested with neutral salt spray test for 48 hours in accordance with BS EN ISO 9227 or ISO 9227 by an Accredited Laboratory. For the electroplated metal screw shell, the protection rating showing the ability of the coating to prevent the base metal from corrosion with no visible defect shall be 10/- in accordance with BS EN ISO 10289 or ISO 10289. For metal screw shell made of corrosion resistant material, no rust shall appear on the surface of the shell;
6. The whole assembly shall have a pleasant appearance and shall be fixed onto the enclosure by means of bright electroplated oval head screws;
7. An earthing terminal shall be provided to each lampholder for connection to the circuit protective conductor of the final circuit;
8. Cables terminals shall be made of brass, suitably positioned for easy cable termination and suitably shrouded to prevent accidental contact with other metal or current-carrying parts. The ends of the terminal screws shall be so shaped as to prevent damage to the conductor;
9. Batten lampholders for surface cable installation shall be fixed onto proprietary-made plastic pattresses. The pattress shall have sufficient space for accommodating the cables to be installed and to prevent acute bends of the cables. The colour, shape and material of the pattress shall match that of the lampholder;
10. Batten lampholders shall be of type “E27” unless otherwise specified.

ELE21.2.020.9 CORD GRIP LAMPHOLDERS

1. Cord grip lampholders to BS EN 61184 or IEC 61184 shall be white or ivory in colour and fitted with cord grips so designed that no stress can be taken by the conductors of terminals;
2. Lampholders shall be of the all-insulated bayonet socket pattern fitted with shade carrier ring, a ventilated shield, or a moulded white plastic cone as required;
3. They shall be suitable for PVC insulated and sheathed, circular flexible cable of not less than 0.75 mm² size;
4. White moulded plastic break joint rings shall be used;
5. Where a flexible cord supports, or partly supports, a luminaire, the maximum mass supported by the cord shall not exceed the values as given in ELE8.3.4.030;
6. Lampholders shall be of type "22d" with temperature rating of "T2" unless otherwise specified.

ELE21.2.030.9 LAMPHOLDERS FOR WEATHERPROOF LUMINAIRES

Weatherproof luminaires shall be fitted with porcelain lampholders, complying with BS EN 61184 or IEC 61184.

ELE21.2.040.9 LAMPHOLDER FOR LED TUBULAR LAMPS

Lampholders for use with LED tubular lamps shall be bi-pin type, complying with IEC 60061-1 and BS EN 60061-2 or IEC 60061-2. They shall be made in moulded white plastic material and designed to hold the tube in position without the need for an additional clip.

ELE21.3 LUMINAIRES

ELE21.3.010.9 GENERAL

1. Luminaires shall be well constructed and shall comply with the requirements of BS 4533 or BS EN 60598 or IEC 60598 and be chosen to suit the conditions under which they will operate;
2. Luminaires to be supplied shall contain components of the same brands and models as those shown on type test certificates. However, luminaires equipped with alternative controlgear will be acceptable if the Sub-contractor can meet the following conditions to the satisfaction of the Contract Manager:
    a. The Sub-contractor shall seek the luminaire manufacturer's confirmation that the use of these alternatives will neither jeopardize safety nor have any adverse effect on performance;
    b. The Sub-contractor shall submit the luminaire manufacturer's test certificates that can prove the concerned luminaire, together with alternative controlgear, to have satisfactorily undergone endurance tests and thermal tests specified in BS EN 60598-1 or IEC 60598-1 or BS 4533 Section 102.1 or IEC 60598-2-1 respectively. Tests conducted on the luminaire manufacturer's premises are acceptable;
    c. Luminaires with alternative controlgear shall be of the same construction as the original one that comes with a full set of type test certificates;
    d. Alternative controlgear shall meet their respective product standards stipulated in the Specification.
3. For other special luminaires, particularly specified in the project the Sub-contractor shall confirm to provide adequate substantiations to justify these special luminaires on safety and performance aspects to the satisfaction of the Contract Manager. For special luminaires other than those specified in this specification and without comprehensive test reports, the Sub-contractor shall submit adequate substantiations to justify these special luminaires be suitable for the installation without jeopardising their safety and performance to the satisfactory of the Contract Manager, particularly on operation voltage / frequency / power factor (220V, 50Hz at 0.85 lagging or above), heat resistant of wiring (at least 90^{O}C), IP rating (minimum IP54 for outdoor luminaires), insulation resistance (not less than 1MΩ between phases and phase to earth), excessive temperature rise (not to cause the luminaires be operated in overheat condition) and safety device provision to prevent dropping (required for luminaires mounted on high position). In addition, under no circumstances shall the wiring be visible in the lamp compartment.

ELE21.3.020.A INDOOR LUMINAIRES (EXCEPT SF84 & SF85)

1. The luminaires shall comply with the following standards in conjunction with BS EN 60598-1 or IEC 60598-1, where the luminaires fall into the respective categories:

IEC 60598-2-1	Luminaires – Part 2: Particular requirements. Section 1: Fixed general purpose luminaires
BS 4533-102.1	Luminaires – Part 102: Particular requirement – Section 102.1: Specification for fixed general purpose luminaires
BS EN 60598-2-2 or IEC 60598-2-2	Luminaires – Part 2 Particular requirements. Section 2: Recessed luminaries

BS EN 60598-2-22 or IEC 60598-2-22	Luminaires – Part 2 Particular Requirements. Section 22: Luminaires for emergency lighting

2. LED luminaires shall comply with the following requirements:

   a. Optics such as diffuser, reflector etc. for luminaires adopting LED tubes or lamps shall be specifically designed for use with LED tubes or lamps to achieve desirable polar curve / luminous distribution and to avoid glare;

   b. The driver control unit for LED luminaire shall include the components of power factor correction and radio interference suppression. The operating frequency of the built-in driver shall be not less than 20kHz or at a sufficiently high frequency to ensure no flickering causing health risk to viewers. The driver shall conform to the following international standards if applicable:

BS EN 55015 or EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
BS EN 61000-3-2 or IEC 61000-3-2	Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current $\leqq$ 16A per phase)
BS EN 61347-1 or IEC 61347-1	Lamp controlgear – Part 1: General and safety requirements
BS EN 61347-2-13 or IEC 61347-2-13	Lamp controlgear – Part 2-13: Particular requirements for DC or AC supplied electronic controlgear for LED modules
BS EN 61547 or IEC 61547	Equipment for general lighting purposes – EMC immunity requirements
BS EN 62384 or IEC 62384	DC or AC supplied electronic control gear for LED modules – Performance requirements

Certificate of compliance shall be provided for each of the different ratings of drivers to be used;

c. Technical information of the LED drivers shall be provided to indicate the performance of the drivers. The data shall include, but not limited to, minimum and maximum input voltage, frequency, maximum operating temperature, rated output voltage, rated output current, rated output power and power factor;

d. The rated life of LED driver shall not be less than 35,000 hours operating at maximum allowable ambient temperature of not lower than 40°C;

e. The irradiance and radiance emission limits of the LED luminaires, that are exposed to view directly, shall be tested to comply with the hazard 'Risk Group 1' (low risk) or 'Exempt Group' as stated in the requirements of the BS EN/IEC 62471 – Photobiological safety of lamps and lamp systems;

f. The LED luminaires shall be certified to 'Restriction of Hazardous Substances (RoHS) Compliance';

g. Full set of photometric data for each type of LED luminaires prepared to CIBSE TM5 or IES format shall be submitted for general lighting design purpose;

h. The LED luminaires shall be rated for continuous service at the intended application conditions with maximum ambient temperature exceeding 40^{o}C without affecting the performance requirements as for luminaire efficacy, lumen maintenance (L70), colour rendering index, total power factor, and correlated colour temperature as stated in this specification;

i. Each model of LED luminaire or self-ballasted LED lamp shall be tested to comply with the performance requirements stated in this specification. The Sub-contractor shall submit the test report and certify each model of LED luminaire or self-ballasted LED lamp to be complying with the BS EN or IEC standards or other recognised international/national standards.

3. The luminaire shall have been in continuous and satisfactory operation locally in similar application and supply scale for at least one year up to the time of material submission. The corresponding in-service records with supply scale and proven satisfactory operation shall be provided upon request by the CM;

4. The luminaire manufacturing plant and facilities shall conform to ISO 9001 with proper quality control scheme in place to assure delivering consistent and high-quality products. Relevant documentation shall be provided upon request by the CM to substantiate the quality assurance system covering the purchasing and quality control of luminaire components, design and manufacturing process, qualification and experience of plant operating personnel as well as testing and delivery of end products;

5. The overall power factor of the luminaire shall not be less than 0.85 lagging;

6. Internal wiring shall be appropriately colour coded, neatly wired and properly terminated;

7. A sample of the luminaires shall be submitted to the CM for inspection and Approval as and when required.

ELE21.3.030.A OUTDOOR LUMINAIRES

1. The luminaires shall comply with the following standards in conjunction with BS EN 60598-1 or IEC 60598-1, where the luminaires fall into the respective categories:

IEC 60598-2-1	Luminaires – Part 2: Particular requirements.

	Section 1: Fixed general purpose luminaires
BS 4533-102.1	Luminaires – Part 102: Particular requirement – Section 102.1: Specification for fixed general purpose luminaires
BS EN 60598-2-3 or IEC 60598-2-3	Luminaires – Part 2 Particular Requirements. Section 3: Luminaries for road and street lighting
BS EN 60598-2-5 or IEC 60598-2-5	Luminaires – Part 2 Particular Requirements. Section 5: Floodlights

2. LED luminaire shall comply with the following requirements:

   a. Optics such as diffuser, reflector etc. for luminaires adopting LED tubes or lamps shall be specifically designed for use with LED tubes or lamps to achieve desirable polar curve / luminous distribution and to avoid glare;

   b. The driver control unit for LED luminaire shall include the components of power factor correction and radio interference suppression. The operating frequency of the built-in driver shall be not less than 20kHz or at a sufficiently high frequency to ensure no flickering causing health risk to viewers. The driver shall conform to the following international standards if applicable:

BS EN 61347-2-13 or IEC 61347-2-13	Lamp controlgear – Part 2-13: Particular requirements for DC or AC supplied electronic controlgear for LED modules
BS EN 61547 or IEC 61547	Equipment for general lighting purposes – EMC immunity requirements
BS EN 62384 or IEC 62384	DC or AC supplied electronic control gear for LED modules – Performance requirements
BS EN 55015 or EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
BS EN 61000-3-2 or IEC 61000-3-2	Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current $\leqq$ 16A per phase)
BS EN 61347-1 or IEC 61347-1	Lamp controlgear – Part 1: General and safety requirements

   Certificate of compliance shall be provided for each of the different ratings of drivers to be used;

   c. Technical information of the LED drivers shall be provided to indicate the performance of the drivers. The data shall include, but not limited to, minimum and maximum input voltage, frequency, maximum operating temperature, rated output voltage, rated output current, rated output power and power factor;

   d. The rated life of LED driver shall not be less than 35,000 hours operating at maximum allowable ambient temperature of not lower than 40°C;

   e. The irradiance and radiance emission limits of the LED luminaires, that are exposed to view directly, shall be tested to comply with the hazard 'Risk Group 1' (low risk) or 'Exempt Group' as stated in the requirements of the BS EN/IEC 62471 – Photobiological safety of lamps and lamp systems;

f. The LED luminaires shall be certified to 'Restriction of Hazardous Substances (RoHS) Compliance';

g. Full set of photometric data for each type of LED luminaires prepared to CIBSE TM5 or IES format shall be submitted for general lighting design purpose;

h. The LED luminaires shall be rated for continuous service at the intended application conditions with maximum ambient temperature exceeding 40^{o}C without affecting the performance requirements as for luminaire efficacy, lumen maintenance (L70), colour rendering index, total power factor, and correlated colour temperature as stated in this specification;

i. Each model of LED luminaire or self-ballasted LED lamp shall be tested to comply with the performance requirements stated in this specification. The Sub-contractor shall submit the test report and certify each model of LED luminaire or self-ballasted LED lamp to be complying with the BS EN or IEC standards or other recognised international/national standards.

3. The luminaire shall have been in continuous and satisfactory operation locally in similar application and supply scale for at least one year up to the time of material submission. The corresponding in-service records with supply scale and proven satisfactory operation shall be provided upon request by the CM;

4. The luminaire manufacturing plant and facilities shall conform to ISO 9001 with proper quality control scheme in place to assure delivering consistent and high-quality products. Relevant documentation shall be provided upon request by the CM to substantiate the quality assurance system covering the purchasing and quality control of luminaire components, design and manufacturing process, qualification and experience of plant operating personnel as well as testing and delivery of end products.

5. Internal wiring shall be appropriately colour coded, neatly wired and properly terminated;

6. The overall power factor of the luminaire shall not be less than 0.85 lagging;

7. The type of protection against electric shock shall be Class I or II; and the degree of protection against ingress of dust and moisture shall be at least IP54 unless otherwise specified;

8. Outdoor luminaires shall be able to withstand the weather. Metalwork shall be protected against corrosion, and luminaire parts which have to be removed for access to the interior shall be properly gasketed to restrict the entrance of moisture and dirt. Stirrup mounting and similar parts shall be heavily galvanised, and bolts shall either be made of stainless steel or be galvanised;

9. The adjustment nuts and bolts of the luminaires that will be mounted high on buildings or columns shall be captive to prevent loss or accident during servicing. Safety devices shall be provided to prevent luminaires mounted on high positions from dropping;

10. The luminaires installed in such locations that are within hand reach shall be strongly constructed, fitted with an impact-resistant transparent or diffusing cover, and shall have secret key fixings for the cover to the body of the luminaires. Where necessary, wire guards shall be fitted over the cover to give extra protection;

11. A sample of each of the luminaires shall be submitted to the CM for inspection and Approval as and when required.

ELE21.3.040.A INDOOR BATTEN TYPE LED LUMINAIRES (SF11 TO SF24, SF33 & SF39)

1. A type-test certificate together with the associated report(s) issued by an Accredited Laboratory shall be submitted as evidence of compliance with the required standard;
2. The luminaires shall be classified, as a minimum requirement, to Class I and IP20 as described in BS EN 60598-1 or IEC 60598-1;
3. Each luminaire shall be supplied as a complete set comprising, where applicable, the main part, end plates, cover plate / reflector / diffuser, double-capped LED tubular lamps, bi-pin lampholder, fused terminal block, integral earthing terminal and internal wiring, etc.;
4. A fused terminal block, fitted with a suitably-rated fuse to BS 1362 or IEC 60269-1, shall be properly fixed to the body in such a way as to be easily accessible for fuse replacement;
5. The main part of the luminaire shall be made of substantive sheet steel of minimum thickness 0.5 mm, pretreated to prohibit corrosion on both sides and finish coated in gloss white stoved enamel or epoxy powder on the outside surface. It shall be formed and suitably shaped into one continuous U-channel piece to give a fairly rigid structure on its own, but can be further strengthened by ribs where necessary;
6. The luminaire shall be provided with cover plate (for SF11 to SF14, SF33), reflector (for SF15 to SF19, SF39), or diffuser (for SF20 to SF24) as appropriate. The cover plate and reflector shall be of the same material and finish as the main part, but the reflector shall be finish coated on both inside and the outside surfaces. The cover plate and reflector shall be of one continuous piece formed and suitably shaped to give adequate mechanical strength. The fixing screw for the cover plate and reflector shall be captive with the main part. The diffuser shall be made of clear prismatic plastic material unless otherwise specified;
7. The end plate for the main part shall be of white finish and can be made of plastic or sheet steel. If made of sheet steel, the end plate shall be of the same material and finish as the main part. A knockout shall be formed on the end plate for conduit entry. The bi-pin lampholder can either be integral with the end plate or alternatively be mounted on the main part or end plate;
8. The main part shall be formed with knockouts on the mounting face for fixing to conduit and BESA box. The fused terminal block shall be conveniently positioned and securely fixed to the main part. The mounting face of the main part shall be purposely formed with small protrusions to adequately cover the heads of any fixing screws projecting beyond its outside surface;
9. A label shall be affixed near the lampholders to indicate only double-capped LED tubular lamp is suitable for the luminaire and fluorescent tube shall not be used.

ELE21.3.050.A CORROSION RESISTANT TYPE LED LUMINAIRES (SF25, SF26 & SF34 - SF36)

1. A type-test certificate together with the associated test report(s) issued an Accredited Laboratory shall be submitted as evidence of compliance with the required standard;
2. The luminaire shall be classified, as a minimum requirement to Class I and IP54 as described in BS EN 60598-1 or IEC 60598-1;
3. The luminaire shall be supplied as a complete set comprising, where applicable, the main part, reflector/diffuser, bi-pin lampholder, fused terminal block, integral earthing terminal and internal wiring, etc.;

4. A fused terminal block fitted with a suitably-rated fuse to BS 1362 or IEC 60269-1 shall be properly fixed to the body in such a way as to be easily accessible for fuse replacement;
5. The main part of the luminaire shall be a one piece moulded polycarbonate or glass fibre reinforced plastic finished in light grey colour. The mounting face of the main part shall be formed with a knockout for back entry and holes for mounting screws. The two ends of the main part shall each be provided with a hole for conduit entry which shall be sealed with a suitable plastic plug;
6. The reflector shall be made of substantive sheet steel pretreated and finish coated in gloss white stoved enamel or epoxy powder. It shall be of one continuous piece formed and suitably shaped to give adequate mechanical strength. The bi-pin lampholder shall be conveniently positioned and securely fixed onto the tray;
7. The reflector shall be securely mounted to the main part by screws, or other suitable means, which shall remain captive with the main part;
8. The diffuser shall be a one piece moulded clear prismatic polycarbonate with smooth outer surface. It shall be fixed to the main part by means of an adequate number of stainless steel clips. The clips shall remain captive with the main part when the diffuser is removed;
9. A neoprene or silicone gasket shall be provided between the main part and the diffuser and shall be retained firmly in the purposely formed groove in the main part;
10. A label shall be affixed near the lampholders to indicate only double-capped LED tubular lamp is suitable for the luminaire and fluorescent tube shall not be used.

ELE21.3.060.X DELETED

ELE21.3.080.X DELETED

ELE21.3.090.9 FLAMEPROOF LUMINAIRES

Not used.

ELE21.3.100.A SPOT LIGHTS (SF42)

1. The luminaire shall be licensed with the BSI Kitemark Scheme or with an equivalent Quality Surveillance Scheme. The licence and associated type-test report(s) issued by BSI or the licensing organisation shall be submitted as evidence of compliance with the required standard;
2. The luminaire shall be classified, as Class I or Class II, IP20 (minimum) and suitable for direct mounting on normally flammable surfaces as described in BS EN 60598-1 or IEC 60598-1;
3. The luminaire shall be fitted with a LED lamp of wattage and type of diffusion (flood or spot) as specified on the Drawings;
4. The main part of the luminaire shall be rotatable in all directions within 90 degree perpendicular to the exposed side of the mounting surface;
5. The luminaire shall be of surface mounting type unless otherwise specified;
6. The colour of the exposed part of the luminaire shall be as specified on the Drawings.

ELE21.3.110.X DELETED

ELE21.3.120.A FULLY RECESSED LIGHTS (DOWN LIGHTS) (SF44)

1. The luminaire shall be designed and constructed in accordance with BS EN 60598-2-2 or IEC 60598-2-2. The luminaire shall be licensed with the BSI Kitemark Scheme or with an equivalent Quality Surveillance Scheme. The licence and associated type-test report(s) issued by BSI or the licensing organisation shall be submitted as evidence of compliance with the required standard;
2. The luminaire shall be classified, as Class I or Class II protection, IP54 for outdoor condition (Other than outdoor condition, the corresponding IP rating to suit specific environmental conditions) and suitable for direct mounting on normally flammable surfaces as described in BS EN 60598-1 or IEC 60598-1;
3. The luminaire shall be fitted with a LED lamp of wattage and type of diffusion (flood or spot) as specified on the Drawings;
4. The main part of the luminaire shall be able to be dismantled from the exposed side of the mounting surface without having to dismantle any part of the mounting surface;
5. The colour of the exposed part of the luminaire shall be as specified on the Drawings.

ELE21.3.130.X DELETED

ELE21.3.140.A BULKHEAD FITTING (SF83)

1. The luminaire shall be classified, as a minimum requirement to Class I and IP55 as described in BS EN 60598-1 or IEC 60598-1 and suitable for wall mounted;
2. The luminaire shall be supplied as a complete set comprising the main part, reflector / gear tray, diffuser, lampholder, fused terminal block, integral earthing terminal, driver unit and internal wiring;
3. The luminaire shall be fitted with a LED lamp unless otherwise specified on the Drawings;
4. The luminaire shall have die-cast aluminium housing, UV-stabilized vandalproof polycarbonate diffuser. The diffuser shall be held in place by the retaining ring which is fixed onto the housing by stainless screws;
5. A neoprene or silicone rubber gasket shall be provided between the main part and the diffuser and shall be retained firmly in the main part.

ELE21.3.150.N LIGHT EMITTING DIODE (LED) STRIP (SF90)

1. The LED strip shall be classified, as a minimum requirement, to Class III and IP65 for outdoor condition (Other than outdoor condition, the corresponding IP rating to suit specific environmental conditions) as described in BS EN 60598-1 or IEC 60598-1;
2. The LED strip shall be rated with d.c. supply voltage of 12/24V for operating in extra low voltage;
3. The LED strip set shall be supplied comprising the flexible bending strip completed with cable wiring, LED driver of at least same IP rating of the LED strip unless otherwise specified and the LED driver completed with stainless steel weatherproof enclosure in outdoor condition, aluminium profile and all necessary accessories;

4. The material of the surface shall be made of silicone with a smooth surface with UV and flame resistant. The strip shall be affixed inside the aluminium profile where appropriate. The strip shall be easily replaced and reassembled for maintenance;
5. The lumen maintenance at 50,000 hours for the LED strip shall not be less than 70%. Lumen maintenance life time shall be in accordance with IES LM-80 and extrapolated methodologies of IES TM-21;
6. Unless otherwise specified, the luminous efficacy shall not be less than 60 lm/W and the colour rendering index shall not be less than 80;
7. The mounting detail with durable fixing method shall be submitted and approved by the CM;
8. The driver shall comply ELE21.3.020 in Clause 5(b)(c)(d) for indoor condition and ELE21.3.030 in Clause 5(b)(c)(d) for outdoor condition;
9. The controller shall be capable for dimming control by means of pulse width modulation and / or colour changing for specified dimmable and / or colour changing function;
10. The LED strip shall be RGB LED module for dimmable and colour changing function and the control system shall comply with ELE21.24 for overall control of the LED strip for specified dimmable and / or colour changing function.

ELE21.4 POLE TOP LANTERNS (SF 29)

ELE21.4.010.A GENERAL

1. Lanterns shall comply with BS EN 60598-2-3 or IEC 60598-2-3 and shall be suitable for vertical pole top mounting or on wall-mounted bracket;
2. The degree of protection against ingress of dust and moisture shall be at least IP54 as described in BS EN 60598-1 or IEC 60598-1.

ELE21.4.020.A LAMP TYPE

1. Lanterns shall be compatible with LED lamps;
2. The exact wattage of lamp used shall be as shown on the Drawings unless otherwise specified.

ELE21.4.030.A CONSTRUCTION

1. The lantern body shall consist of a truncated mould-cone held between a cast aluminium base incorporating a spigot cap and a die-cast light alloy upper rim. The vertical rods which join the base to the upper rim shall also support the lamp holder assembly;
2. The lantern shall be covered with an aluminium or UV stabilised glass reinforced polyester top canopy secured by a nylon or aluminium alloy screw cap. Alternatively, the canopy can be hinged to the upper rim and secured with a stainless steel toggle switch catch;
3. A clear anti-vandal UV stabilised polycarbonate prismatic cone designed to give a symmetrical all round light distribution in the lower hemisphere, shall be securely fixed to the lantern;
4. The fitting shall be supplied with an integral set of the required control gear including driver unit as appropriate to the LED lamp fitted.

ELE21.5 GLOBE LANTERNS (SF 86, SF 87)

ELE21.5.010.A GENERAL

1. Lanterns shall comply with BS EN 60598-2-3 or IEC 60598-2-3 and shall be suitable for vertical pole-top mounting or on wall-mounted bracket;
2. The degree of protection against ingress of dust and moisture shall be at least IP54 as described in BS EN 60598-1 or IEC 60598-1;
3. Type-test report(s) issued by BSI or an Accredited Laboratory shall be submitted as evidence of compliance with the above BS.

ELE21.5.020.A LAMP TYPE

1. Lanterns shall be compatible with LED lamps;
2. The exact wattage of lamp used shall be as shown on the Drawings unless otherwise specified.

ELE21.5.030.A CONSTRUCTION

1. The diffuser support of the lantern shall be made of corrosion-resistant die-cast aluminium alloy with black enamelled finish. Diffuser support made of matt black or grey high strength plastic may be accepted;
2. The globe shall be made of clear polycarbonate with obscure globe at upper hemisphere and UV stabilised. The globe shall be secured to the support by means of captive socket headed screws shrouded on the bottom of the diffuser support. The globe shall be easily removed and reassembled for maintenance;
3. A heat shield shall be provided and fixed positively on to its correct position without adjustment;
4. Suitable prismatic glass refractor or aluminium lamp shield enclosing the lamp shall be provided to control the glare;
5. The bracket to which the lantern is fixed shall be of the same manufacturer as the lantern and fixed as recommended by the manufacturer;
6. All control gear including driver unit shall be provided and housed inside the globe.

ELE21.6 SIDE-ENTRY STREET LANTERNS (SF 30, SF 31)

ELE21.6.010.A GENERAL

1. Lanterns shall comply with BS EN 60598-2-4 or BS EN 60598-2-3 or IEC 60598-2-3 and shall be suitable for side entry to suit 25 mm BSP mounting bracket;
2. The degree of protection against ingress of dust and moisture shall be at least IP54 as described in BS EN 60598-1 or IEC 60598-1.

ELE21.6.020.A LAMP TYPE

1. Lanterns shall be compatible with LED lamps;
2. The exact wattage of lamp used shall be shown on the Drawings unless otherwise specified.

ELE21.6.030.A CONSTRUCTION

1. The main body of the lantern shall be cast from pressure die-cast aluminium alloy or high impact, corrosive resistant material with a separate compartment for housing the control gear including driver unit;
2. Lanterns shall be so constructed that their live parts are not accessible when the lanterns have been installed and wired as in normal use, and when opened as necessary for replacing lamps even if the replacement cannot be achieved by hand;
3. The lantern shall incorporate an injection moulded UV stabilised polycarbonate diffuser which shall be securely fixed to the main body of the lanterns. Another device shall be provided to prevent the diffuser from falling should the fixing device fail under normal conditions;
4. Optical control shall be achieved by means of the diffuser and silver anodized aluminium reflector to give the required light distribution;
5. The bracket to which the lantern is fixed shall be obtained from the same manufacturer as the lantern and fixed as recommended by the manufacturer.

ELE21.7 OUTDOOR AREA FLOODLIGHTS (SF 46)

ELE21.7.010.9 GENERAL

1. Floodlights shall comply with BS EN 60598-2-5 or IEC 60598-2-5 and shall be suitable for outdoor use;
2. The degree of protection against ingress of dust and moisture shall be at least IP65.

ELE21.7.020.A LAMP TYPE

1. Floodlights shall be compatible with LED lamps;
2. The exact wattage of lamp used shall be as shown on the Drawings unless otherwise specified.

ELE21.7.030.9 LIGHT DISTRIBUTION

The light distribution shall be as specified in ELE2 or on the Drawings.

ELE21.7.040.9 MAIN BODY CONSTRUCTION

The main body shall be manufactured in aluminium alloy. Luminaire of one-piece glass reinforced plastic moulded body may be acceptable.

ELE21.7.050.9 FRONT FRAME AND GLASS

The front glass shall be toughened type and framed by a non-ferrous metal or glass reinforced plastic frame with silicon rubber gasket. The frame shall be hinged and secured to the main body by screw catches or swivel bolts which shall not possibly fall off even in loose position.

ELE21.7.060.9 REFLECTOR

The reflector shall be made of durable and highly reflective material.

ELE21.7.070.9 WIND SPEED PERFORMANCE

The floodlight, including its fixing/mounting accessories, will be able to withstand wind speeds of 150 km/h on the projected surface of the floodlight assembly without undue deformation, deflection or vibration.

ELE21.7.080.9 STABILITY

1. Fixings which carry the weight of the floodlight and internal accessories shall be provided with appropriate means to prevent dislodgement of any part of the floodlight either in service or during maintenance. Parts of the floodlight which are fixed other than with at least two devices, for example, screws or equivalent means of sufficient strength, shall have such extra protection necessary to prevent those parts from falling if a fixing device fails under normal conditions;
2. A safety chain shall also be provided between the floodlight and the lamp pole to ensure that the floodlight will not drop down should the floodlight support fail. the chain shall be of galvanised steel and of adequate strength to support at least three times the weight of the floodlight.

ELE21.7.090.9 ANGULAR ADJUSTMENT

Floodlights shall be provided with means for angular adjustment in the azimuth and zenith planes and there shall be provision for positive locking after any such adjustment has been effected.

ELE21.7.100.9 FIXING ACCESSORIES

All exposed external hinges, screws, bolts, washers of the luminaires shall be of stainless steel. All the associated means for attaching the floodlight to its support, such as mounting/fixing bracket, universal pole clamp etc., shall be made of galvanised steel or appropriate corrosion resistant materials.

ELE21.7.110.9 WINDAGE AREA AND WEIGHT

The maximum projected area in any horizontal direction of the pole-mounted floodlight, including the fixtures and gear box etc., shall be 0.2 m^2. The total weight of each floodlight assembly shall be not more than 18 kg in aggregate.

ELE21.7.120.A INTEGRATED CONTROL-GEAR

Unless otherwise specified, all control gear including driver unit shall be provided and integrated inside the lantern.

ELE21.7.130.9 CABLE ENTRY

Compression type cable gland suitable for 9-11 mm O/D cable for cable entry shall be provided.

ELE21.8 BOLLARDS (SF 37)

ELE21.8.010.A GENERAL

1. Bollards shall comply with BS EN 60598-2-4 or BS EN 60598-2-3 or IEC 60598-2-3 and shall be of outdoor type with a cylindrical external shape;
2. The degree of protection against ingress of dust and moisture shall be at least IP54 as described in BS EN 60598-1 or IEC 60598-1;
3. The dimensions of the bollard shall be as indicated on the Drawings or otherwise specified.

ELE21.8.020.A LAMP TYPE

1. Bollards shall be compatible with LED lamps;
2. The exact wattage of lamp used shall be as shown on the Drawings unless otherwise specified.

ELE21.8.030.A CONSTRUCTION

1. The external body of the bollard shall be of extruded aluminium with a durable and scratch-proof outer coating to a colour specified by the Contract Manager. The bollard shall be of base-plate mounted type;
2. The optical assembly of the bollard shall be made of a clear UV stabilised polycarbonate lens with or without an external corrosion resistant metal louvre as specified;
3. A wiring compartment shall be provided within the bollard. It shall be of adequate size to accommodate all the control gear including driver unit, wiring, etc., and space for one MCB with room for working with hands and tools easily. A gland plate, for armoured cable or conduit termination, shall be provided inside the wiring compartment;
4. Removal of any part of the luminaire should only be possible by using tools other than a slotted head or Philips head screw driver.

ELE21.9 STEEL LAMP COLUMNS (3, 4, 5, 10, 12 M NOMINAL HEIGHT)

ELE21.9.010.9 GENERAL

The columns shall comply with BS 5649 Part 5 and BS EN 40-1 and BS EN 40-2 and BS EN 40-3-1 and BS EN 40-3-2 and BS EN 40-3-3, or BS 5649 Part 5 and EN 40-1 and EN 40-2 and EN 40-3-1 and EN 40-3-2 and BS EN 40-3-3. In general 3, 4 and 5 m columns shall be suitable for post top lanterns and 10 and 12 m columns shall be suitable for mounting four floodlights and complete with mounting arm(s), step bars, and a working platform.

ELE21.9.020.A CONSTRUCTION

1. Construction shall be similar or equivalent to that shown in the Master Details of the Housing Department;
2. Unless otherwise approved, columns shall be provided with ground root but, if mounted on podium slab, shall be provided with flange plate;
3. The base compartment shall have adequate room to accommodate a corrosion resistant services box to house MCBs and cable connection unit;
4. The compartment door shall be fixed flush with the column by corrosion resistant bolts or tamper proof door lock;
5. The whole column, after installation, shall have ingress protection not less than IP33 and shall be effectively earthed;
6. For column fixed with post top lantern and IP CCTV camera, a lower compartment door with corrosion resistant services box for post top lantern and an upper compartment door with steel adaptable box for IP CCTV camera shall be provided respectively;
7. The segregation of power and signal cables inside column shall comply with EMSD's Code of Practice for the Electricity (Wiring) Regulations.

ELE21.9.030.A DIMENSIONS

The following dimensions shall be complied with:

Nominal Height	Minimum Root Length	Minimum Door Size	Min Clear Compartment Space (depth x width)
3, 4, 5 m (Fixed with post top lantern and IP CCTV camera)	800 mm	200 x 70 mm (Upper Door) 400 x 80 mm (Lower door)	80 x 60 mm
3, 4, 5 m	800 mm	400 x 80 mm	80 x 60 mm
10 m	1500 mm	500 x 140 mm	140 x 140 mm
12 m	1700 mm	500 x 140 mm	140 x 140 mm

ELE21.9.040.9 CORROSION PROTECTION

The whole column including all ferrous accessories shall be hot-dip galvanised to BS EN ISO 1461 after fabrication. The external surface above ground shall be painted with etched primer suitable for galvanised surfaces before any finish coating according to ELE21.14. The external surface of the ground section shall be protected with bitumen coating to a height 50 mm above the cement skirt.

ELE21.9.050.9 STRENGTH

The column shall be of adequate strength to withstand the imposed static and wind load. It shall be fabricated in accordance with the Master Details of the Housing Department, or otherwise, the structural design shall be verified by calculation in accordance with BS EN 40-3-1 or EN 40-3-1 and BS EN 40-3-3 or EN 40-3-3 with partial load factors Class B and maximum horizontal deflection Class 1. The calculation shall be counter-checked by an independent Registered Professional Engineer (RPE) recognised by Hong Kong Engineers Registration Board.

ELE21.10 LOW BAY FLOODLIGHTS (WIDE LIGHT DISTRIBUTION) (SF70)

ELE21.10.010.A GENERAL

1. Unless otherwise specified below, the luminaire shall be in compliance with sub-clauses ELE21.4.030 (1) to (4);
2. The luminaire shall comply with BS 4533 : Section 102.1 or EN 60598-2-1 or IEC 60598-2-1 and shall be suitable for ceiling mounting;.
3. The degree of protection against ingress of dust and moisture shall be at least IP54 as described in BS EN 60598-1 or IEC 60598-1.

ELE21.10.020.A LAMP TYPE

1. Floodlights shall be compatible with LED lamps;
2. The exact wattage of lamp used shall be as shown on the Drawings unless otherwise specified.

ELE21.10.030.A CONSTRUCTION

1. The luminaire shall be of robust construction with excellent resistance against vandalism. The main body shall be made of die-cast aluminium or steel coated in corrosion resistant textured finish;
2. The diffuser shall be a one piece moulded prismatic polycarbonate which shall be securely fixed to the main body by means of an adequate number of stainless steel screws. Gasket of appropriate type shall be provided between the main body and the diffuser and shall be retained firmly in the purposely formed groove in the main body;
3. The reflector shall be made of durable and highly reflective material, painted white or as approved;
4. All control gear including driver unit shall be provided and integrated inside the luminaire.

ELE21.10.040.9 LIGHT DISTRIBUTION

The luminaire shall be capable of giving a uniform light distribution for a mounting height as low as three metres with limited glare. As requested by the Contract Manager, photometric data shall be submitted for assessment to ascertain that the luminaire is suitable for the intended application. Unless otherwise specified, the luminaire, in each of transverse plane and axial plane, shall have the light distribution characteristic as follows:

Angle from Vertical Plane (Degrees) (5 degrees step)	Luminous Intensity (Cd / 1000 lumen)
0 - 25	Not less than 90 in both planes
30 - 55	Not less than 80 in either transverse or axial plane

60 - 70	Not less than 50 in either transverse or axial plane

ELE21.11 SELF-CONTAINED EXIT SIGNS AND DIRECTIONAL SIGNS

ELE21.11.010.9 TYPE OF FITTING

Unless otherwise specified, all EXIT or directional signs shall be internally illuminated by LED, acceptable to the Fire Services Department and suitable for operation at 220V±6%, 50Hz ± 2%, single phase a.c. supply.

ELE21.11.030.9 STANDARDS

The complete EXIT or directional signs shall, where applicable, meet the requirements of Fire Services COP, BS 5499: Part 10 and BS EN/IEC 60598-2-22. The driver control unit regulating the operation of LED shall comply with BS EN/IEC 62384.

ELE21.11.040.9 CONSTRUCTION AND COMPONENTS

1. The dimensions, lettering, construction and the general layout of EXIT or directional signs shall conform to the appropriate type of standard EXIT or directional signs as shown on the Master Details of the Housing Department unless otherwise specified. If the dimensions and construction of EXIT or directional signs based on the Manufacturer's proposal are deviated from the above, Contract Manager's prior approval shall be obtained;
2. The LED and associated control gear shall be securely fixed and contained inside the sign box. The live parts shall be properly shielded when the sign box is opened for maintenance. The assembly shall comply with the following:
    a. The LED shall be of white colour and with colour temperature within 5000 – 9000K;
    b. Adequate LED shall be provided to produce a luminance of at least 100 cd/m^2 in white area of the sign in both normal and emergency operation mode during the entire life of the LED;
    c. The total power consumption including the charger and control gear for the EXIT or directional sign shall not be greater than 5W during full charge of the battery unless otherwise approved;
    d. The minimum lumen output of the LED shall be maintained at or above 70% of the initial value after operating for 5.7 years (i.e. 50 000 hours) and this lifetime (L70) shall be supported with calculation using TM-21-11;
    e. The following document shall be submitted for Contract Manager's checking:
        i. Test report showing the offered sign complies with the standards specified in ELE21.11.030;
        ii. Job reference.
3. All components such as fused terminal block, driver control unit, etc. shall be securely fixed and contained inside the sign box. Internal wiring shall be heat-resistant PVC cable suitable for operation at or above 90°C and comply with BS 6231 Table 2 (Type CK) or IEC 60227-3 and be appropriately colour coded, neatly wired and properly terminated;

ELE21.14 EXTERNAL LIGHTING SYSTEM

ELE21.14.010.A SCOPE

This section covers pole mounted LED lighting installation for street lighting, security lighting, floodlighting and general area lighting.

ELE21.14.020.9 SPECIFICATION AND DRAWINGS

External lighting installations shall be installed in accordance with ELE2.

ELE21.14.030.9 LUMINAIRES

1. The type of lamps and luminaires including reflectors to be used shall be as specified in this Specification or as directed by the Contract Manager;
2. The luminaires shall be securely mounted on the poles;
3. A safety chain shall also be provided between the luminaires and the lamp pole to ensure that the luminaires will not be dropped down in case the luminaires support fails;
4. The chain shall be of galvanised steel and of adequate strength to support at least three times the weight of the luminaire.

ELE21.14.040.9 CONSTRUCTION OF LAMP POLES

1. Lamp poles shall be constructed of mild steel pipe of one, two or three sections of diameter and modulus all as specified on Drawings;
2. Pole caps, cat ladders and platforms shall be fitted where shown;
3. Material samples and working drawings shall be submitted when requested by the Contract Manager;
4. The poles shall be finished overall with at least two coats of primer and two coats of finishing paint after erection;
5. The colour of the finishing paint shall be as directed by the Contract Manager.

ELE21.14.050.9 FOUNDATIONS FOR LAMP POLES

Lamp poles shall be securely bolted down in an upright position to the foundations constructed in accordance with the Drawings.

ELE21.14.060.9 SERVICE BOXES

1. A mild steel service box shall be provided on each pole at an appropriate height above ground level to accommodate the MCB control box. The construction of the service box and the MCB control box shall be as shown on the Drawings;
2. Each lamp circuit shall be protected by an MCB. Where the CSA of the incoming/outgoing cable cores are larger than that which can be accommodated by the terminal of the MCB, a fixed insulator connector block of adequate rating shall be installed with a tail to the MCB. Alternatively, a copper busbar may be used;
3. Where the service box serves more than one circuit, the supply to the MCBs shall be by means of a copper busbar of adequate rating. The phase conductors of the incoming/outgoing cables shall then be terminated to the busbar by means of cable sockets;

4. If emergency lighting modification unit is specified inside the EXIT or directional sign box, the emergency lighting modification unit (conversion kit) shall comply with ELE21.12; the EXIT sign and directional signs shall comply with BS 5266-1 and BS EN/IEC 60598-2-22 and the operation shall comply with ELE21.11.050 and ELE21.11.060 respectively.

ELE21.11.050.9 FITTINGS TO EXIT SIGN AND DIRECTIONAL SIGN

The Sub-contractor shall supply and install the following fittings and features on the external surface of the EXIT or directional sign if emergency lighting modification unit (conversion kit) is specified.

1. LED indication lamp to show that the mains supply is "on";
2. LED indication lamp to show that the battery is being charged;
3. A self-returning switch to simulate failure of normal supply to test the emergency operation of the EXIT or directional sign.

ELE21.11.060.9 OPERATION

The EXIT sign and directional sign shall be of maintained type if emergency lighting modification unit (conversion kit) is specified:

1. Under normal conditions, the 220V a.c. mains shall power the LED and charge a sealed nickel cadmium battery or nickel-metal hydride battery through a battery charger. On failure of mains supply, the emergency lighting modification unit shall instantaneously switch to battery power operation. Upon restoration of mains supply, the unit shall switch back to normal power and the batteries shall be re-charged again. The changeover operations shall be automatic;
2. The duration of emergency operation shall be at least 3 hours after the mains supply fails with a light output up to the end of the duration of not less than the requirements specified in ELE21.12.070;
3. The charging system shall be capable of recharging the battery to full capacity in 24 hours after a total discharge of the battery.

ELE21.11.070.9 SAMPLE

A sample of the EXIT or directional signs box shall be submitted for Approval prior to installation.

ELE21.11.080.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of self-contained exit signs and directional signs delivered to Site or installed.

ELE21.12 EMERGENCY LIGHTING MODIFICATION UNITS (CONVERSION KITS)

ELE21.12.010.9 QUALITY SURVEILLANCE SCHEME

The emergency lighting modification units (conversion kits) shall be licensed with BSI Kitemark Scheme or with an Equivalent Quality Surveillance Scheme. The license issued by BSI or other licensing organisation shall be submitted as evidence of compliance with the required standard.

ELE21.12.020.A CONSTRUCTION

1. The modification unit comprising an emergency lighting module, a battery pack and related connecting devices (e.g. cables, screw, etc.) can be fully or partially contained inside the connected luminaire;
2. The emergency lighting module shall comply with BS EN/IEC 61347-1 and BS EN/IEC 61347-2-7 and shall comply with BS EN/IEC 61347-2-13 for luminaire with LED. The type-test report(s) issued by BSI or the licensing organisation shall be submitted as evidence of compliance with the required standard;
3. The cables used for the modification unit shall be heat-resistant PVC cable suitable for operation at or above 90^{o}C and comply with BS 6231 Table 2 (Type CK) or IEC 60227-3;
4. The batteries used for the modification unit shall be high temperature (70^{o}C) sealed rechargeable nickel cadmium batteries complying with BS EN/IEC 61951-1, or nickel-metal hydride batteries complying with BS EN/IEC 61951-2;
5. The complete modification unit or remaining components of the modification unit, if mounted separately from the connected luminaire, shall be housed inside a metallic box with inner or outer finishes protected against corrosion.

ELE21.12.030.9 OPERATION MODE

The unit shall be capable of being connected in maintained or non-maintained operation modes as specified on the Drawing.

ELE21.12.040.9 CHARGING SYSTEM

The charging system shall be capable of recharging the battery to full capacity in 24 hours after a total discharge of the battery.

ELE21.12.050.9 BATTERIES

Batteries with adequate initial capacity shall be chosen to compensate for the loss of effective capacity during service life cycle such that the interval between batteries replacement shall not be less than four years.

ELE21.12.060.9 BATTERY PROTECTION

The battery shall be protected against over-discharge by a low voltage "cut-out" device which shall disconnect the battery from the load once the discharging voltage of the battery drops below 1V per cell.

ELE21.12.070.9 LIGHT OUTPUT DURING EMERGENCY OPERATION MODE

The batteries shall be of adequate capacity such that, from 5 seconds to 3 hours after failure of normal supply, the light output of the emergency luminaire shall not be less than the following ballast lumen factor of the lamp/LED at normal supply voltage:

LED Tubular Lamp / Fluorescent Lamp Type and Wattage	Minimum Ballast Lumen Factor
LED Tubular Lamp (600mm)	0.24
LED Tubular Lamp (1200mm)	0.14
LED Tubular Lamp (1500mm)	0.10
18W Tubular (600 mm)	0.24
30W Tubular (900 mm)	0.14
36W Tubular (1200 mm)	0.14
58W Tubular (1500 mm)	0.10
18W Compact 4-pin	0.21
24W Compact 4-pin	0.16
36W Compact 4-pin	0.14
LED Exit Sign and Directional Sign	Minimum Ballast Lumen Factor
450mm long (approx.)	0.5
610mm long (approx.)	0.5

ELE21.12.080.9 INDICATION AND TESTING FACILITIES

The emergency modification unit shall have the following fixtures:

1. LED indication lamp to show that the mains supply is "on";
2. LED indication lamp to show that the battery is being charged;
3. A self-returning switch to simulate failure of normal supply for testing the emergency operation of the complete emergency lighting assembly.

ELE21.12.090.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall produce documentary evidences in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of emergency lighting modification units (conversion kits) delivered to Site or installed.

ELE21.13 INSTALLATION OF LAMPS AND LUMINAIRES

ELE21.13.010.A "GRID" SYSTEMS

1. Unless otherwise stipulated, luminaires installed on the "grid" system, shall be suspended from the ceiling by means of two chromium plated steel chains, with 20 mm oval links. The chains shall be fixed to chromium-plated carrier rings which shall be screwed into 2A 3-pin socket front plates by removing one of the fixing screws. Where no socket exists at a point at which it is necessary to suspend a chain, a carrier ring stud shall be embedded into the ceiling slab as circumstances dictate;
2. Electricity supply to the luminaires shall be obtained from the nearest 2A 3-pin socket enclosed in a circular conduit box in the ceiling via a 3-core circular flexible cable having CSA of not less than 0.75 mm²;
3. Sockets shall be positioned as shown on the Drawings, but if no drawing exists, they shall be positioned on a square grid at approximately 1.5 m centres, depending upon the size and geometry of the area concerned.

ELE21.13.020.9 TUBE PENDANTS

Tube pendants shall comprise a dome cover and a piece of screwed steel conduit of suitable length to give the required mounting height of the luminaire. A lock nut shall be provided to bear against the conduit entry of the luminaires.

ELE21.13.030.9 PLAIN PENDANTS

Plain pendants shall comprise a ceiling rose and a cord-grip lampholder connected by a flexible cord having a suitable length to give the required mounting height of the lamp shade.

ELE21.13.040.9 LUMINAIRES MOUNTED ON WOODEN BATTENS

When a luminaire is not provided with facility for a surface cable entry the luminaire shall be mounted on a suitably shaped wooden batten or pattress. The cable shall then enter the luminaire from the rear through a slot and a hole formed in the batten.

ELE21.13.050.9 CABLES IN ENCLOSED LUMINAIRES

1. Cables entering or within the gear compartment of an enclosed type luminaire shall be properly protected against damage due to the excessive heat generated by the lamp within the luminaire;
2. Protection shall be by means of sleeving the insulation of the cables with fibre glass or other equivalent heat resistant insulating materials. The sleeves shall be provided for all cables within the luminaire;
3. Alternatively protection shall be by means of using heat resisting cables selected in accordance with Requirement 522.2.2 of BS 7671.

ELE21.13.060.X DELETED

ELE21.13.070.9 PAINTING OF PLASTIC ITEMS

Painting of the factory fabricated lighting equipment and luminaire to meet the colour requirements stipulated in this Specification or to meet the directions of the Contract Manager is not acceptable.

ELE21.13.080.9 PAINTING OF EXPOSED METAL PARTS

Metal parts such as cover plates for adaptable boxes, blanking plate for any boxes and conduit pendants, etc. shall be painted white or a suitable colour to match the interior finish of a particular location as specified in ELE28.7.

ELE21.13.090.9 LUMINAIRE TRACK SYSTEMS

1. The electrical supply track system for luminaires (hereinafter referred as the track system) shall be designed and constructed in accordance with the requirements as described in BS EN 60570 or IEC 60570;
2. A type-test certificate together with the associated test report(s) issued by BSI or an Accredited Laboratory shall be submitted as evidence of compliance with the required standard;
3. The track system shall be classified as Class I, IP20 (minimum) and suitable for ordinary interior use for mounting on, or flush with, or suspended from walls and ceilings;
4. The track system shall have a rated current of not exceeding 16A per conductor for distribution of supply to luminaires. It shall consist of three conductors for a single circuit system or five conductors for a system of three separately switchable circuits;
5. Components of the track system shall be so designed that there is no risk of accidental contact between the earthing contacts of the components and the current-carrying parts of the track during insertion and removal by the user;
6. Suitable adaptors shall be used to provide sound electrical and mechanical connections of luminaires to the track so that the weight of the adaptors and/or luminaires are not supported by the electrical connections of the adaptors and the track. The live parts of the adaptor shall not be touchable when the adaptor is in partial or complete engagement and is wired as in normal use. Each adaptor when used in a 3-circuit track system shall be provided with a pre-switched circuit selection function so that the luminaire can be switched to the designed circuit before installation;
7. The track shall be protected from corrosion by using anodized aluminium or stove enamelled paint or equivalent material.

ELE21.13.100.9 PHOTOCELL DEVICES

1. Photocell devices shall be of adjustable type suitable for on/off control under illumination level ranging at least from 50 to 1500 lux, with ingress protection of at least IP55. The device shall comply with IEC 60669-2-1 with a built-in additional circuitry to achieve an on/off time delay of at least 30 seconds and switch-off threshold greater than the illumination level after switching on of the controlled luminaires so as to eliminate hunting due to short period changes in illumination or light from controlled luminaires. The photocell devices shall have indication to show activation/deactivation status upon reaching the preset on/off level or the time delay setting be adjustable to zero to facilitate commissioning on Site. The required functions shall be demonstrated on Site upon completion of installation;
2. A label in red numbers and characters of legible size shall be provided by the side of each photocell device to indicate the corresponding control zone.

4. Each control box shall be fitted with a neutral block of adequate rating and having sufficient number of ways for the incoming/outgoing cable cores. It shall be securely fixed to the base of the control box by means of a 6 mm thick paxolin block;
5. The service box shall be fitted with a 3 mm thick galvanised mild steel cover made waterproof with a 3 mm thick soft rubber or neoprene gasket. The cover shall be fixed by means of four M6 brass fixing bolts and washers and shall be hinged if specified;
6. Provision shall be made in the batten plate of the box for supporting and terminating up to three numbers of incoming/outgoing PVC/SWA & PVCS cables by means of suitable cable glands. The cable sizes shall be as specified in ELE2 or on the Drawings.

ELE21.14.070.9 UNDERGROUND CABLES TO POLES

1. Underground cables for external lighting systems shall be copper cored, PVC insulated, steel wire armoured and PVC sheathed cables (PVC/SWA & PVCS) unless otherwise specified;
2. Cables shall enter and leave the pole below ground level and each cable shall terminate in a gland fixed to the MCB control box;
3. The cable cores between the glands and the terminals shall not be in tension.

ELE21.14.080.A CABLES BETWEEN SERVICE BOX AND LUMINAIRES

1.
   a. Cables from the neutral terminal block and the MCBs to the luminaires shall be PVC insulated and PVC sheathed having CSA as specified;
   b. Arrangements shall be made to prevent the cores from being under tension where they are attached to terminals;
   c. All cables shall be contained within the poles;
   d. Rubber grommets shall be installed where cable pass through any metal works.

2. Where the design of the cable termination of the luminaires is only suitable for flexible cables, PVC insulated and PVC sheathed flexible cables shall be used. Such cables shall enter the luminaires by means of suitable waterproof compression glands;
3. Where four or more floodlights are mounted on a pole, the flexible cables shall be connected to the luminaires by means of a mild steel connector box with waterproof hinged cover. The connector box shall be fitted near to the top of the pole, all as shown on the Drawings.

ELE21.14.090.9 SWITCHES FITTED TO POLES

1. Where specified switches may be mounted on the pole for local control;
2. Switches mounted on the pole shall be fixed on to it by tapped holes and brass fixing screws;
3. The switches shall be waterproof or be contained within a waterproof type galvanised metal case, with an external galvanised metal operating knob or handle;
4. Switches shall be fitted at least 2 m above finished ground level.

ELE21.14.100.X DELETED

ELE21.14.110.9 TESTING OF ILLUMINATION LEVEL

1. Illumination and luminance measurements shall be carried out after dark using Lux meter and luminance meter with valid calibration certificates issued by accredited calibration laboratory;
2. The proposed measurement procedures, measurement locations and aiming adjustment of luminaires shall be submitted for Contract Manager's agreement before carrying out the test; particularly to avoid obtrusive light affecting occupants of nearby properties and to direct the light into the area required to avoid waste light. When situations necessitate the technical support from the local lighting specialist / supplier(s), the Sub-contractor shall arrange and bear the necessary cost for the local lighting specialist / supplier(s)'s presence and advice during commissioning of the external lighting installation at project completion stage;
3. The Sub-contractor shall carry out re-adjustment of the aiming angle of the luminaires or if necessary, to incorporate additional lourvres, baffles or shields to the respective luminaires to control the affect of spill light;
4. The date, time and climatic conditions when the measurement was conducted, measurement locations, type and geometric details of the lighting installation, location and aiming of luminaires, installation drawings, record photos, technical details of measuring instruments etc., shall all be prepared and detailed in a submission report with format to be agreed by the Contract Manager.

ELE21.16 NEW TUBULAR BULKHEAD FLUORESCENT LUMINAIRE WITH ELECTROMAGNETIC BALLAST (SF 71 & SF 73)

ELE21.16.010.X DELETED

ELE21.16.020.X DELETED

ELE21.16.030.X DELETED

ELE21.16.040.X DELETED

ELE21.17 NEW CIRCULAR BULKHEAD FLUORESCENT LUMINAIRE WITH ELECTROMAGNETIC BALLAST (SF 75 & SF 77)

ELE21.17.010.X DELETED

ELE21.17.020.X DELETED

ELE21.17.030.X DELETED

ELE21.17.040.X DELETED

ELE21.18 NEW TUBULAR BULKHEAD FLUORESCENT LUMINAIRE WITH ELECTRONIC BALLAST (SF 72 & SF 74)

ELE21.18.010.X DELETED

ELE21.18.020.X DELETED

ELE21.18.030.X DELETED

ELE21.18.040.X DELETED

ELE21.19 BULKHEAD LUMINAIRE (SF 76 & SF 78)

ELE21.19.010.A GENERAL

1. The luminaire shall comply with BS 4533: Section 102.1 or EN 60598-2-1 or IEC 60598-2-1;
2. The luminaire shall be licensed with the BSI Kitemark/ENEC Mark Scheme or with an equivalent Quality Surveillance Scheme. The license and associated type-test report(s) issued by BSI or the licensing organisation shall be submitted as evidence of compliance with the required standard;
3. The luminaire shall be classified, as a minimum requirement, to Class I and IP54 as described in BS EN 60598-1 or IEC 60598-1;
4. The luminaire shall meet the electromagnetic compatibility requirements specified in BS EN 55015 and BS EN 61000-3-2 and BS EN 61547, or EN 55015 and IEC 61000-3-2 and IEC 61547. Test certificates or reports shall be submitted as evidence of compliance with the required standard;
5. The overall power factor of the luminaire shall not be less than 0.95 unless otherwise specified.

ELE21.19.020.A LAMP TYPE

1. The luminaire shall be compatible with LED lamps;
2. The exact wattage of lamp used shall be as shown on the Drawings unless otherwise specified.

ELE21.19.030.9 LIGHT DISTRIBUTION

1. The luminaire, in each of transverse plane and axial plane, shall have the light distribution characteristic certified by independent accredited laboratory as follows:

Angle from Vertical Plane (Degrees)	Luminous Intensity (Cd / 1000 lumen)	
	Transverse plane	Axial plane
0 - 5	> 125	> 125
10 - 15	> 120	> 120
20 - 25	> 115	> 115
30 - 35	> 110	> 110
40 - 45	> 85	> 85
50 - 55	> 75	> 75
60 - 65	> 60	> 60
70 - 75	> 40	> 40
80 - 90	> 20	> 20

2. Photometric data shall be submitted for assessment to ascertain that the luminaire is suitable for the intended application as requested by the Contract Manager.

ELE21.19.040.A CONSTRUCTION

1. The luminaire shall be supplied as a complete set comprising the main body, gear tray/reflector, diffuser, LED lamp, lampholder, fused terminal block, integral earthing terminal, driver unit and internal wiring;
2. The main body of the luminaire shall be a one piece moulded polycarbonate or aluminium alloy diecasting, pretreated and finished stoved enamel in cream or white colour on the outside surface. The main body shall be formed with knockouts on the mounting face for fixing to conduit and BESA box;
3. The gear tray shall be made of substantive sheet steel or diecast aluminium alloy, pretreated and finish coated in gloss white stoved enamel. The reflector/gear tray shall be securely mounted to the main body by screws, or other suitable means, which shall remain captive with the main body, or the tray, when the tray is detached from the main body. In the detached position, the tray shall be securely strapped or hinged to the main body;
4. The driver unit and lampholder shall be conveniently positioned and securely fixed onto the tray;
5. A fused terminal block, fitted with a suitably-rated fuse to BS 1362 or IEC 60269-1, shall be properly fixed to the body in such a way as to be easily accessible for fuse replacement;
6. The luminaire shall be neatly wired up with heat resistant PVC cable to BS 6231 with a maximum conductor temperature of 90°C. Internal wiring shall be neatly wired and properly terminated. Under no circumstances shall the wiring be visible in the lamp compartment;
7. The diffuser shall be a one piece moulded clear prismatic or reeded polycarbonate. A circular trim can be mounted if required. The diffuser or the trim shall be fixed to the main body with secret head captive screws or equivalent, openable by a special tool, and shall be securely strapped or hinged to the main body when opened. The quality of diffuser, trim and main body if polycarbonate is used, shall be certified by an independent accredited laboratory on the following tests:
    a. Impact test complying with BS EN 60598-1 or IEC 60598-1 with impact energy of 6.5Nm at 25°C without visible damage; and
    b. Exposure test complying with BS EN ISO 4892-2 for a period of not less than 48 hours exposure without visible change.
8. A neoprene or silicone gasket shall be provided between the main body and the diffuser and shall be retained firmly in the purposely formed groove in the main body.

ELE21.20 ELECTRONIC BALLAST

ELE21.20.010.X DELETED

ELE21.20.020.X DELETED

ELE21.20.030.X DELETED

ELE21.20.040.X DELETED

ELE21.20.050.X DELETED

ELE21.20.060.X DELETED

ELE21.21 FLUORESCENT LUMINAIRE AND LAMP (T5)

ELE21.21.030.X DELETED

ELE21.21.040.X DELETED

ELE21.22 MOTION DETECTOR UNIT

ELE21.22.010.A GENERAL

Motion detector unit shall consist of a motion sensor mounted on a steel housing with terminal block inside for connection of cable. It shall be used to control the on / off of the light fitting by detection of motion and ambient light level. The unit shall be surface mounted via the concealed conduit entry on the body of the light fitting.

ELE21.22.020.A CONSTRUCTION

1. The housing of the motion detector unit shall be made of galvanized sheet steel of not less than 1.6 mm thick. The inside and outside surfaces shall be painted with one coat of primer, followed by a coat of stoved enamel finish of colour same as that of the light fitting to be controlled;
2. Cable termination blocks, properly fixed to the housing, shall be provided for connection of cables in / out the unit. A fused terminal block, fitted with a suitably rated fuse to BS 1362 or IEC 60269-1, shall be provided for the phase conductor;
3. The connection between the motion detector unit and the light fitting shall be neatly wired up with heat resistant PVC cable to BS 6231 or IEC 60227-3 with a maximum conductor temperature of 90ºC. Alternatively, protection shall be by means of sleeving the insulation of the cables with fibre glass or other equivalent heat resistant insulating materials. The sleeves shall be provided for all cables within the luminaire.

ELE21.22.030.9 MOTION SENSOR

1. The motion sensor shall be flush-mounted on the housing and comply with the following specification:
   a. Type of sensor: passive infrared, ceiling mounted;
   b. Operation voltage: 220V, 50Hz, single phase a.c. supply;
   c. Detection range: 360 degree;
   d. Detection distance: 3 m at floor level for 2.5 m mounting height;
   e. Connected load: capable to supply upto 100W circuit of fluorescent light fittings;
   f. Time delay: automatically turns off 10 minutes (adjustable) after no motion object is detected;
   g. Built-in light level sensor (to be provided when specified on Drawings): turns the connected light fitting off when natural light level raised above a pre-set level which shall be adjustable to suit the site conditions;
   h. Quality standard: U.L. listed or equivalent certification.
2. The setting of the motion detector unit shall not be affected by switching on/off of the power supply to the circuit.

ELE21.22.040.9 MOCK-UP INSTALLATION

The motion detector units and the associated light fittings shall be installed at the sample floor for testing. Approval on the motion detector units shall be given only when the function has been tested to be satisfactory.

ELE21.22.050.X DELETED

ELE21.23 BULKHEAD TYPE LIGHT EMITTING DIODE (LED) LUMINAIRES (SF84 & SF85)

ELE21.23.010.9 GENERAL

1. The luminaires shall be suitable for operation at:
   a. 220V + 10%, 50 Hz + 2%, single phase, mains supply;
   b. Ambient temperature: peak 40°C for 4 hours continuously with an average of 35°C over 24 hours period;
   c. Ambient relative humidity: up to 98%.
2. The luminaires shall be fully assembled and passed the burn-in test under the specified ambient conditions for 48 hours before shipment from factory;
3. The luminaires shall be integrated with thermal management system such that no force ventilation (e.g. electric fan) shall be employed for cooling;
4. Enclosure of the luminaires shall have a degree of protection meeting the minimum requirement of IP54 as described in IEC 60529;
5. The luminaires design shall duly consider elimination of discomfort glare with adoption of appropriate glare control diffuser and/or reflector, etc.. The rating of discomfort glare caused directly from the luminaires shall be calculated for each typical installation area in compliance with recommendations of authoritative guidance such as the CIE Unified Glare Rating Method. Full set calculation basing on eye level at 1.5m above finished floor together with photometric data shall be provided;
6. Technical information of the luminaires including identity and technical data of key components (e.g. LED, driver unit, light diffuser, etc.) together with relevant certificates of compliance and test report on measurements basing on the IES LM-79-08 Method shall be submitted. The IES LM-79-08 report shall be issued by testing laboratory accredited by the Hong Kong Accreditation Service (HKAS) or their equivalence under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or a scheme for which HOKLAS has concluded a mutual recognition agreement;
7. In case the luminaires manufacturer wishes to change any key component(s) (e.g. LED, driver unit, light diffuser, etc.) or to modify the circuit design, the new luminaires configuration shall produce at least the same quantity and quality of light (i.e. correlated colour temperature, colour rendering index, lumen output, etc.) and shall be submitted to the accredited laboratories specified in sub-clause (6) for testing. Full set of the relevant certified test reports in accordance with the IES LM-79-08 Method must be submitted for inspection;
8. The luminaires manufacturer shall have at least three years of proven experience and history in the design and manufacture of LED lighting systems; particularly lighting products for illumination purpose, relevant company information and job references shall be provided;
9. The luminaires including key components submitted for the IES LM-79-08 test shall have been in continuous and satisfactory operation either locally and / or overseas for at least one year up to the time of tender submission. The corresponding in-service records with supply scale and proven satisfactory operation shall be submitted for information.

ELE21.23.020.9 CONSTRUCTION

1. The luminaires shall be supplied as complete sets each comprising the housing enclosure, light diffuser, LED panel, segregation partition, fused terminal block, integral earth terminal, driver unit and internal wiring. Both the fused and earth terminal blocks shall be fitted at the inside surface of the housing instead of the segregation partition;
2. The housing of the luminaires shall be a one piece aluminium alloy diecasted, pretreated and finished in cream or white colour epoxy powder coating on the outside surface. The housing shall be formed with knockouts on the mounting face for fixing to conduit and BESA Box. The two ends of the housing shall each be provided with a threaded hole for 20mm diameter conduit entry and shall be fitted with a suitably threaded plastic plug;
3. The segregation partition shall be made of sheet steel or aluminium alloy. It shall be securely hinged to the housing and maintained in normal position by captive screw(s);
4. An isolating device with electrical contacting pins complying with IEC 60998-1 shall be provided inside the housing such that the mains supply will be isolated automatically on opening the hinged partition;
5. The LED panel shall be securely fixed onto the segregation partition interlaid with thermal grease, thermal pad or thermal epoxy. The driver unit shall be conveniently positioned either at the inside surface of the housing or on the other side of the segregation partition as appropriate to suit the housing enclosure and thermal management design. Both the LED panel and driver unit shall be easily replaceable without the use of special tools;
6. A fused terminal block fitted with a 2A fuse to BS 1362 or IEC 60269-3 shall be properly fixed onto the inside surface of the housing in such a way as to be easily accessible for fuse replacement;
7. Wiring inside the housing enclosure shall be of heat resistant copper cable to BS 6231 Table 2 or IEC 60227-3 or other international standards with rated conductor operating temperature of at least 90ºC. Internal wiring of different voltage categories shall be neatly segregated, wired and properly terminated. Under no circumstance shall the internal wiring be visible after removing the light diffuser from the housing enclosure;
8. The cable connection between components after the fused terminal block shall be in the form of plug and socket or other connection means to facilitate easy replacement of individual components;
9. The light diffuser shall be moulded prismatic / translucent polycarbonate or other types of durable material. It shall be fixed to the housing with secret head captive screws openable by a special tool, and shall be securely strapped or hinged to the housing when opened. The diffuser shall be certified by an independent accredited laboratory on compliance to the following tests:
    a. Impact test complying with Section 4.13 of IEC 60598-1 with impact energy of 6.5Nm at 25°C without visible damage;
    b. Exposure test complying with BS EN ISO 4892-2 for a period of not less than 48 hours exposure without visible change;
    c. Glow wire test at 850 ºC according to BS EN 60598-2-22.
10. A neoprene or silicone gasket shall be provided between the housing and the light diffuser and shall be retained firmly in the purposely formed groove in the housing;
11. Alternative luminaires construction may be accepted subject to meeting the performance specification and with the approval of the Contract Manager.

ELE21.23.030.9 LED PANEL

1. The LED panel comprising array of LEDs on a metal core printed circuit board or thermally enhanced substrate incorporated with thermal, mechanical, and electrical interfaces shall be fixed onto the segregation partition. The selected LEDs shall comply with the following minimum requirements:
    a. Colour rendering index (CRI) : not less than 75;
    b. Correlated colour temperature (CCT): 4,000K (nominal) [3,985K (target) + 275K tolerance];
    c. Chromaticity of LEDs: variation within 0.007 on the CIE 1976 (u',v') diagram over the Maintenance Period.
2. The Sub-contractor shall submit written confirmation from the luminaires manufacturer that the selected LED manufacturer has the patent right to produce the supplied LED chipsets including the relevant packaging technology together with the material submission;
3. Circuit design and configuration of the LEDs shall be such that in case a single LED fails open or short circuit, minimum 80% of the remaining LEDs shall maintain operation. Should a single LED fails open or short circuit, the other LEDs shall not be overstressed significantly thus increasing the likelihood that other LEDs will fail;
4. Detail specification of the LED array including the following information shall be submitted:
    a. Colour rendering index, correlated colour temperature including the binning and rated junction temperature of individual LED;
    b. Power rating, design driving current and forward voltage range of individual LED;
    c. IES LM-80-08 test report issued by the United States Environmental Protection Agency recognized accreditation bodies accredited laboratory basing on LED solder point temperature of 55^{o}C, 85^{o}C and a third temperature selected by the LED manufacturer;
    d. Basing on the luminaires design, internal components configuration, and the ambient conditions specified in ELE21.23.010, the associated calculations and thermal test report shall be submitted for substantiation of the anticipated maximum operating junction temperature of LED(s) within the array;
    e. Design operating voltage range of the LED array;
    f. Design total lumen output from the LED array;
    g. Design operating current and power consumption of the LED array at the respective driver unit dimming settings of 60%, 70%, 80%, 90% and full lumen output at 100%;
    h. Calculations on the projected service life at 90% and 70% of initial lumen output (i.e. L90 and L70).

ELE21.23.040.9 LED DRIVER

1. Constant current mode LED driver shall be offered for connection between the fused terminal block and the LED panel. The driver unit shall be compatible with the connected LED array and selected to fulfil the LED array power consumption requirement with safety margin;
2. The driver unit shall include components for power factor correction, radio interference suppression, harmonic suppression and also dimming facility;

3. Overload, short circuit, over voltage, over temperature and surge protection shall be incorporated with auto-recovery capability;

4. The dimming circuitry shall be designed for five steps lumen output control, namely, 60%, 70%, 80%, 90% and 100% with tolerance of ±5% at each step using either PWM or analogue DC voltage control signal. The dimming circuit design shall eliminate flickering effect and hence visual fatigue. A toggle / rotary switch with position indicator shall be provided on the segregation partition aside the LED panel to facilitate easy adjustment of the dimming setting;

5. Efficiency of the driver at dimming settings of 80% and above shall not be less than 80%;

6. The design service life of the driver units operating inside the luminaires at the ambient conditions specified in ELE21.23.010 shall be at least 50,000 hours basing on cumulative failure rate of 10%. In-house reliability validation report or test report issued by accredited laboratory for the driver unit shall be submitted;

7. Detail specification of the driver unit including the following information shall be provided:

   a. Make and technical data of electrolytic capacitors adopted inside the driver unit including the temperature rating, voltage rating and service life, etc.;

   b. Make and technical data of LED driver control IC including the MTBF rate / Failure-In-Time rate, life expectancy, circuit protections, etc., in case the component has been incorporated in the driver circuit;

   c. Electrical operating parameters and dimming methodology as adopted by the driver unit;

   d. Driver casing temperature at the manufacturer's declared temperature measurement point for the hottest spot on the driver casing. In any case, the design casing withstanding temperature shall not be less than 70 ºC;

   e. Test report for the driver unit casing temperature taken at the temperature measurement point under the operating ambient conditions specified in ELE21.23.010 and dimming setting at 100% full lumen output;

   f. Test report recorded the respective driver losses at the rated output current and at the operating current under different dimming settings;

   g. Drawing showing the physical dimensions and screw fixing positions of the driver unit.

ELE21.23.050.9 PERFORMANCE REQUIREMENTS

1. The luminaires shall comply with the following performance requirements:

a.	Maximum LED junction temperature within the array	:	not exceeding the temperature at which 70% of the initial lumen output be maintained at 50,000 operating hours referencing to the IES LM-80-08. The lumen output at 50,000 operating hours can be inferred from the test with test duration not less than 9,000 hours and from IES TM-21-11 for the offered LEDs basing on ambient temperature of luminaire projected to 40°C
b.	Luminaire efficacy	:	minimum 70 lm/W at 100% full lumen output
c.	Estimated lumen maintenance	:	lumen output of the installed luminaires shall be maintained at or above 90% and 70% of the initial value (i.e. minimum 700 lumen initially for SF84 and 1400 lumen for SF85) after operating for 2 years and 5.7 years respectively

basing on 24 hours operation a day

d.	Overall power consumption of the luminaires	:	Maximum 10W for SF84 and 20W for SF85 respectively
e.	Overall operating power factor of the luminaires	:	0.85 (minimum) at all dimming settings
f.	Total harmonic distortion (THDI)	:	15% (maximum) at 100% setting
g.	Surge immunity level according to IEC61000-4-5	:	4kV

ELE21.23.060.9 STANDARD

1. The bulkhead type LED luminaires, their components and constituent parts shall comply with the following standards:

Luminaires / Components / Materials	**Recognised Standard or Approved Equivalent**	
Luminaires	Luminaires – Part 1: General Requirement	IEC 60598-1 Class 1
	Luminaires – Part 2: Particular Requirements Section 1: Fixed General Purpose Luminaires	IEC 60598-2-1
	Luminaires – Part 2-22: Particular Requirements on non-flammability provisions and external parts subject to 850^{o}C glowing / hot wire test	BS EN 60598-2-22
	IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products	IES LM-79-08
	Electromagnetic Compatibility (EMC) Limits	IEC 61000-3-2 IEC 61000-3-3
	Limits and Methods of Measurement of Radio Disturbance Characteristics of Electrical Lighting and Similar Equipment	EN 55015 / CISPR 15
	Equipment for General Lighting Purposes – EMC Immunity Requirements	IEC 61547
	Telecommunications (Control of Interference) Regulations	Cap 106B
	Photo-biological Safety of Lamps and Lamp Systems	IEC 62471
LED chipset	IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources	IES LM-80-08
	LED Modules for General Lighting – Safety Specifications	IEC 62031
	IESNA Projecting Long Term Lumen Maintenance of LED Light Sources	TM-21-11

Driver unit	Lamp Controlgear - Part 1: General and Safety Requirements	IEC 61347-1
	Lamp Controlgear - Part 2-13: Particular Requirements for D.C. or A.C. Supplied Electronic Controlgear for LED Modules	IEC 61347-2-13
	DC or AC Supplied Electronic Control Gear for LED Modules – Performance Requirements	IEC 62384

ELE21.23.070.9 LIGHT DISTRIBUTION

1. Full set of photometric data for the luminaires prepared to IES format including the polar curve on the light distribution shall be submitted. The photometric data shall be certified by an independent accredited laboratory;
2. The luminous flux of SF85 shall be at least double that of SF84;
3. Software simulation of the lighting effect shall be submitted for Contract Manager's approval basing on photometric data of SF84 and the following design requirements:
    a. Typical corridor width of 1.5m;
    b. Fixing height of luminaires at 2.4m above finished floor;
    c. Spacing of 1.8m measured from centre to centre of adjacent luminaires;
    d. Reflectance of architectural finishes to be 0.8 for ceiling, 0.75 for the walls and 0.4 for the floor;
    e. Illumination level at the finished floor along the centre line of the corridor shall achieve a minimum of 85 lux (i.e. based on a maintenance factor of 70% with the driver units dimming setting at 100% full lumen output);
    f. Vertical illumination level measured on wall at 1.2m above finished floor shall achieve a minimum of 70 lux (i.e. based on a maintenance factor of 70% lumen maintenance with the driver units dimming setting at 100% full lumen output).

ELE21.23.080.9 VERIFICATION OF PERFORMANCE

1. The cumulative failure rate of each type of luminaires installed at each domestic block shall not exceed 5% and the lumen maintenance shall not be less than 90% of the initial illumination level at the end of Maintenance Period;
2. Typical installation areas installed with SF84 and SF85 with dimming setting designated by the Contract Manager at each domestic block shall be selected for verification of initial illumination level before completion of relevant Section of Works and illumination measurements shall be conducted in accordance with the illuminance grid spacing as recommended in BS EN 12464-1. The luminaires should have been initially run for a period recommended by the LED manufacturer before conducting the illumination measurement. Contract Manager or his representative, the Sub-contractor and the local supplier / agent together with the luminaires manufacturer shall be present to witness the illumination measurement while the associated report shall be submitted for record;
3. 5 nos. SF84 and 5 nos. SF85 shall be randomly selected from each domestic block, and packed at the presence of Contract Manager's representative and the Sub-contractor with proper marking and identification. These luminaires shall be further sent to an accredited laboratory for measurement of photometric parameters covering luminous flux, CRI, CCT and luminaire efficacy, etc.. The relevant photometric measurement report shall then be submitted for record and the luminaires shall be re-installed at different locations within the building as assigned by the Contract Manager or his representative;

4. Illumination measurements shall be, unless otherwise instructed by the Contract Manager, continuously conducted quarterly in the first year and half-yearly in the second year at each selected area as identified in sub-clause (2) after the initial illumination measurement. The Sub-contractor shall submit measurement report within 2 weeks after each measurement. In case the illumination level falls below 90% of that measured at the end of the Maintenance Period, the Sub-contractor shall take down the luminaires at the concerned area(s) identified in sub-clause (3) above for further sending to an accredited laboratory for verification of photometric performance. The associated costs for testing and installation of replacement luminaires for continuation of lighting services shall be borne by the Sub-contractor;

5. In case the cumulative failure rate stated in sub-clause (1) exceeds 5% or test report from the accredited laboratory indicates any taken down luminaires in sub-clause (4) with measured photometric parameter(s) below the Specification requirement, particularly if average lumen maintenance falls below 90% as compared with initial test result identified in sub-clause (3), the Sub-contractor shall accompany the local supplier / agent together with the luminaires manufacturer on investigating the cause(s) leading to the high failure rate and / or excessive degradation on the photometric performance. The Sub-contractor shall then submit a report explaining the root cause(s) and an improvement action plan for approval. Notwithstanding the explanation of root causes and the improvement action plan, the Contract Manager can instruct all the luminaires installed in the whole block(s) be replaced with brand-new ones, and the associated cost shall be borne by the Sub-contractor;

6. The Sub-contractor shall coordinate with the local supplier / agent together with the luminaires manufacturer to provide free on-site technical support during commissioning of the installation works at the project completion stage and illumination measurements and assessment of lighting performance during the Maintenance Period.

ELE21.23.090.X DELETED

ELE21.23.100.9 QUALITY ASSURANCE

1. The luminaires manufacturing plant and facilities shall conform to ISO 9001 with proper quality control scheme in place to assure delivering consistent and high-quality products. Relevant documentation shall be provided upon request by the Contract Manager to substantiate the quality assurance system covering the purchasing and quality control of luminaires components, luminaires design and manufacturing process, qualification and experience of plant operating personnel as well as testing (including the burn-in test) and delivery of end products;

2. The luminaires including their components shall be “Restricted of Hazardous Substances (RoHS)” and complying with EC Directive. The luminaires manufacturer shall keep up to date the appropriate documentation for the components used and quality control processes in place ensuring RoHS compliance. Relevant documentation shall be provided upon request by the Contract Manager;

3. The luminaires shall be of certified products under the “Product Certification Scheme for LED Lighting Products” published by the Hong Kong Electronic Industries Association. The product conformity certificate shall be issued by a certification body accredited by the Hong Kong Accreditation Service (HKAS) or an accreditation body which has entered into a mutual recognition agreement with the HKAS.

ELE21.23.110.9 UNIT RATES OF SPARE PARTS

1. The Sub-contractor shall obtain written confirmation from the local supplier / agent of the luminaires on the associated unit rates for major spare parts including the LED panel, driver unit and light diffuser, etc. at the end of the Maintenance Period for reference.

ELE21.24 LIGHTING MANAGEMENT SYSTEM

ELE21.24.010.N GENERAL

1. Where specified in the Project Specific Specification or shown on the Drawings, Lighting Management (LM) System shall be provided for overall control of lighting system;
2. All materials and equipment of the LM System shall be products of manufacturer certified under ISO 9001 quality assurance standard. The LM System shall be of proprietary product and have well-proven relevant local job references. For new LM system which has not been installed in Hong Kong before, demonstration on the performance of the LM system shall be provided to the satisfaction of the CM before approval of it.

ELE21.24.020.N SYSTEM REQUIREMENT

1. The LM System shall consist of, but not limited to, interfacing units, controllers, lighting control modules, field devices and distributed communication network that enables complete control and operation of the LM System. Where specified in the Project Specific Specification or shown on the Drawings, the user / operator workstation shall be provided and comprise of keyboard, mouse and minimum 23" LED monitor display;
2. Field devices shall include, but not limited to, local lighting control switches, dimming control switches, colour changing switches, and other devices as specified;
3. The LM System shall be fully addressable and configured in a total system integrated approach, allowing the connected field devices be independently supervised by the lighting control modules;
4. The LM System and equipment including the lightings shall be configured in high degree of flexibility in ease of extension, modification, adaptability and re-programming of the lighting installation to cater for future addition, alteration and rezoning / regrouping of lighting control;
5. The LM System shall be provided with maintenance by-pass or other similar feature so that the lighting fittings can be locally isolated for "ON" switching in case of ad-hoc need, emergency or equipment failure;
6. The communication network shall be of Cat 5 unshielded twisted pair (UTP) cable or similar to be approved by the CM. Where the LM system of digital addressable type is specified, the communication network shall be of the type as recommended by the system manufacturer.

ELE23 COMMUNAL AERIAL BROADCAST DISTRIBUTION SYSTEM

ELE23.3 GENERAL & SPECIAL REQUIREMENTS 3

ELE23.3.1 - SCOPE 3
ELE23.3.1.010.9 INSTALLATION TO COMPLY WITH THIS SPECIFICATION 3
ELE23.3.1.020.9 SCOPE OF THE WORKS 3
ELE23.3.1.030.9 TERMS AND DEFINITIONS 3
ELE23.3.1.040.9 EXECUTION OF THE WORKS 3

ELE23.3.2 - STATUTORY OBLIGATIONS AND OTHER REGULATIONS 4
ELE23.3.2.010.9 STATUTORY OBLIGATIONS AND OTHER REQUIREMENTS 4

ELE23.4 INSTALLATION METHODOLOGY 5

ELE23.4.1 - CABD SYSTEM DESIGN 5
ELE23.4.1.010.9 GENERAL 5
ELE23.4.1.020.9 VOLTAGE COVERED BY THIS SPECIFICATION 5
ELE23.4.1.030.9 ONE CABD SYSTEM PER BUILDING BLOCK 5
ELE23.4.1.040.9 CHOICE OF EQUIPMENT AND SITING OF AERIALS 5
ELE23.4.1.050.9 SELECTING THE GAIN OF TV AND FM AERIALS 5
ELE23.4.1.060.9 SEPARATE DOWN LEADS FOR THE TV AND FM SIGNALS 5
ELE23.4.1.070.9 SELECTION OF AMPLIFIERS 6
ELE23.4.1.080.9 LOSS ALLOWANCE 6
ELE23.4.1.090.9 ENCLOSURE OF HEADEND CIRCUIT COMPONENTS 6

ELE23.4.2 - PERFORMANCE REQUIREMENTS 6
ELE23.4.2.010.9 SIGNAL LEVELS AT FM/TV OUTLETS 6
ELE23.4.2.020.9 PERMISSIBLE DIFFERENT SIGNAL LEVELS IN AN OUTLET 6
ELE23.4.2.030.9 INTERMODULATION 7
ELE23.4.2.040.9 MUTUAL ISOLATION BETWEEN OUTLETS 7

ELE23.4.3 - TERRESTRIAL TELEVISION SYSTEM 7
ELE23.4.3.010.9 TERRESTRIAL AERIALS 7
ELE23.4.3.020.9 PREAMPLIFIERS AND FILTERS 7
ELE23.4.3.030.A AMPLIFIERS 7
ELE23.4.3.040.9 FREQUENCY CONVERTERS 8
ELE23.4.3.050.9 UHF MODULATORS 8
ELE23.4.3.060.9 SPLITTERS/TEE-UNITS 8
ELE23.4.3.070.A COAXIAL CABLES 8
ELE23.4.3.080.9 FM/TV OUTLETS 9
ELE23.4.3.090.9 FIBRE OPTICAL CABLE SYSTEM 9

ELE23.5 MATERIAL & EQUIPMENT 10

ELE23.5.1 - TERRESTRIAL TELEVISION SYSTEM 10
ELE23.5.1.010.9 TERRESTRIAL AERIALS 10
ELE23.5.1.020.9 PREAMPLIFIERS AND FILTERS 10
ELE23.5.1.030.9 AMPLIFIERS 12
ELE23.5.1.040.9 FREQUENCY CONVERTERS 16
ELE23.5.1.050.9 UHF MODULATORS 16
ELE23.5.1.060.9 SPLITTERS / TEE-UNITS 17
ELE23.5.1.070.9 COAXIAL CABLES 17
ELE23.5.1.080.9 FM / TV OUTLETS 17
ELE23.5.1.090.9 ALLOWANCES FOR DIGITAL TERRESTRIAL TV BROADCASTING (DTTB) SYSTEM 18

ELE23.6 INSPECTION, TESTING & COMMISSIONING DURING CONSTRUCTION PERIODS 19

ELE23.6.1 - GENERAL REQUIREMENTS 19
ELE23.6.1.010.9 GENERAL 19
ELE23.6.1.020.A COMPONENT ACCEPTANCE 20
ELE23.6.1.030.9 VERIFICATION OF MATERIALS AND EQUIPMENT DELIVERED 20
ELE23.6.1.040.9 INSPECTION AND TESTING OF INSTALLED WORKS 21
ELE23.6.1.050.9 COMMISSIONING AND FUNCTIONAL AND PERFORMANCE TESTS 21
ELE23.6.2 - EQUIPMENT CALIBRATION 22
ELE23.6.2.010.9 GENERAL 22
ELE23.6.3 - TESTING & COMMISSIONING 23
ELE23.6.3.010.9 VISUAL INSPECTION 23
ELE23.6.3.020.9 TESTING & COMMISSIONING 24

ELE23.7 MAINTENANCE REQUIREMENTS 26
ELE23.7.010.9 GENERAL MAINTENANCE REQUIREMENTS 26
ELE23.7.020.9 ON-CALL MAINTENANCE AND REPAIR SERVICE 26
ELE23.7.030.9 ROUTINE HALF-YEARLY INSPECTION, TESTING AND MAINTENANCE 28
ELE23.7.040.9 FINAL INSPECTION, TESTING AND MAINTENANCE 28
ELE23.7.050.9 TAKING RECORDS IN LOG-BOOK 28
ELE23.7.060.9 CONTRACT MANAGER TO BE INFORMED 28

ELE23.3 GENERAL & SPECIAL REQUIREMENTS

ELE23.3.1 - SCOPE

ELE23.3.1.010.9 INSTALLATION TO COMPLY WITH THIS SPECIFICATION

The communal aerial broadcasting distribution (CABD) installation shall comply in every respect with this Specification which details the intrinsic properties (including materials and workmanship) of the installation unless otherwise specified in the currently in force Hong Kong Laws, Project Specific Specification, Drawings and/or written instructions by the Contract Manager.

ELE23.3.1.020.9 SCOPE OF THE WORKS

This Specification, Project Specific Specification, Tender Equipment Schedule and Drawings detail the performance requirements of the Works. The Works to be carried out in accordance with this Specification shall include the whole of the design for a CABD installation only, installation and supply of all materials necessary to form a complete installation including any necessary tests, adjustments, commissioning and maintenance as prescribed and all other incidental sundry components together with the necessary labour for installing such components, for the proper operation of the installation.

ELE23.3.1.030.9 TERMS AND DEFINITIONS

In this Specification, the following words or expressions shall have the meanings assigned to them except when the context otherwise requires:

Guided Drawings	The drawings for reference purpose to show detailed arrangements of the common standard installations.
Headend	Equipment connected between the receiving aerials and the remainder of the broadcast reception system to process the signals to be distributed. The headend may, for example, comprise channel amplifiers, channel converters, combining and separating networks.
Splitter	A device in which the signal energy at the input port is divided equally or unequally between two or more output ports.
Tee-unit	A device that a 'through' output to connect a series of other Tee-units in cascade and one, or more user's tap for connecting to user's outlets.

ELE23.3.1.040.9 EXECUTION OF THE WORKS

1. The Sub-contractor shall employ a contractor on the “List of Approved Suppliers of Materials and Specialist Contractors for Public Works” for “Broadcast Reception Installation” to carry out the works for the CABD system. The name of the contractor shall be included on the Schedule of Information to be supplied by Tenderer at the time of tender submission. Subsequent to the acceptance of tender, the afore-mentioned contractor shall not be changed unless otherwise approved by the Contract Manager;

2. The “List of Approved Suppliers of Materials and Specialist Contractors for Public Works” for “Broadcast Reception Installation” may be found on the website of the Development Bureau, the Government of the HKSAR.

ELE23.3.2 - STATUTORY OBLIGATIONS AND OTHER REGULATIONS

ELE23.3.2.010.9 STATUTORY OBLIGATIONS AND OTHER REQUIREMENTS

The CABD installation shall comply with the statutory obligations stipulated in the following Laws of the HKSAR and other documents currently in force:

1. Statutory Obligations:
    a. The Specification No. HKTA-1103 "Performance Requirements of Television Signals Input to the Head End of Subscription Television System";
    b. The Specification No. HKTA-1104 "Performance Requirements for In-building Coaxial Cable Distribution System (IBCCDS)" issued by the Office of Communications Authority (OFCA) (hereinafter referred to as the Performance Specification;
    c. The Specification No. HKTA-1105 "Technical Information for Frequency Planning of In-Building Coaxial Cable Distribution System(IBCCDS)" issued by OFCA;
    d. Fire Service (Installations and Equipment) Regulations, Fire Services Ordinance, Chapter 95, and other subsidiary legislation made under the Ordinance;
    e. Other Statutory Regulations as detailed in ELE1.4.010.
2. Other Requirements:
    a. Testing & Commissioning Procedure No. 7 for Broadcast Reception Installation in Government Buildings, Hong Kong issued by Building Services Branch, Architectural Services Department, the Government of the HKSAR;
    b. Other Standards as detailed in ELE1.4.020.
3. Safety Requirements:
    a. The Specification No. HKTA-1101 "Performance and Safety Requirements for Subscription Television System";
    b. The Specification No. HKTA-1102 "Radiation Limits and Measurement Methods for In-Building Coaxial Cable Distribution System (IBCCDS)";
    c. The Specification No. HKTA-1104 "Performance Requirements for In-building Coaxial Cable Distribution System (IBCCDS)" issued by OFCA (hereinafter referred to as the Performance Specification.);
    d. The Specification No. HKTA-1105 "Technical Information for Frequency Planning of In-building Coaxial Cable Distribution System (IBCCDS)" issued by OFCA;
    e. Other safety requirements as detailed in ELE1.4.010.

ELE23.4 INSTALLATION METHODOLOGY

ELE23.4.1 - CABD SYSTEM DESIGN

ELE23.4.1.010.9 GENERAL

1. A CABD system is designed with an aim to convey the best receivable signal at a particular site to individual users sharing the same system. The CABD system performance shall comply with BS EN 60728-1 and BS EN 60728-10, or EN 60728-1 and EN 60728-10;
2. At any particular site, the CABD system shall be designed to convey the best receivable digital and analogue terrestrial TV and FM signals to individual users sharing the same system;
3. The CABD system shall allow for digital terrestrial TV broadcasting (DTTB) distribution whose details OFCA has announced. Furthermore, the CABD system shall meet the requirements laid down in HKTA 1104, HKTA 1105 & BS EN 60728-1 and BS EN 60728-10, or EN 60728-1 and EN 60728-10.

ELE23.4.1.020.9 VOLTAGE COVERED BY THIS SPECIFICATION

All apparatus, equipment, materials and wiring shall be suitable for use on 220V ±6%, 50 Hz ±2%, a single phase a.c. system.

ELE23.4.1.030.9 ONE CABD SYSTEM PER BUILDING BLOCK

One CABD system shall be installed for each building block in a particular project.

ELE23.4.1.040.9 CHOICE OF EQUIPMENT AND SITING OF AERIALS

1. For the avoidance of doubt, no signal field strength will be provided. The Sub-contractor shall be responsible for their own signal field strength measurements and deemed to have inspected, measured and investigated the actual conditions on site as necessary, and finding out any source of interference that may affect the installation for choice of equipment and sitting of aerials. The Sub-contractor shall be responsible for the performance of the CABD system in accordance with the specification.
2. The location of aerials shall be the best position for reception with minimum interference from reflection and tidal effect. Should the system be subject to such interference after the commissioning of the system, the Sub-contractor shall be responsible for all necessary rectification work including the relocation of aerials and modification / adjustment to the system to the satisfaction of the CM at no extra cost to the Employer during the Maintenance Period.

ELE23.4.1.050.9 SELECTING THE GAIN OF TV AND FM AERIALS

To maximize signal to noise ratio and to achieve good directivity, the gain of TV and FM aerials shall be chosen to be as high as possible and in compliance with other requirements when specified in the Project Specific Specification for the installation.

ELE23.4.1.060.9 SEPARATE DOWN LEADS FOR THE TV AND FM SIGNALS

1. The TV and FM signals shall be conveyed through separate down leads to the respective amplifiers in the headend circuit for amplification;

2. The Sub-contractor shall allow one spare down leads for future digital terrestrial television.

ELE23.4.1.070.9 SELECTION OF AMPLIFIERS

For systems design, which involves the use of amplifiers in the headend o drive the TV channel amplifiers and/or FM channel amplifier, the first amplifiers to be used for the TV and/or FM signal path shall be a TV bandpass preamplifier and/or a FM band preamplifier respectively. Alternatively, a TV bandpass filter shall be used for the TV signal path and shall be connected to the input of the first wideband amplifier, notwithstanding that it is a preamplifier or a distribution amplifier. Such design practice shall ensure that the amplifiers of the system shall not be overloaded by strong out-of-band signals.

ELE23.4.1.080.9 LOSS ALLOWANCE

A 3 dB attenuation factor shall be included in the calculation of system level to account for practical installation losses such as cable joints.

ELE23.4.1.090.9 ENCLOSURE OF HEADEND CIRCUIT COMPONENTS

The headend circuit components shall be enclosed in a well-ventilated enclosure fitted with lock. The equipment shall be adequately screened from radio interference caused by lift equipment, starters, etc.. The case shall be properly secured against the wall and have sufficient space for cable routing and bending.

ELE23.4.2 - PERFORMANCE REQUIREMENTS

ELE23.4.2.010.9 SIGNAL LEVELS AT FM/TV OUTLETS

The r.m.s. voltage of each vision carrier at the peak of the modulation envelope when measured at the user's outlet across a non-inductive 75 ohm resistor (or referred to 75 ohm) shall be:

1. Minimum level:
    a. 60 dBμV for analogue terrestrial TV signals;
    b. 50 dBμV for digital terrestrial TV signals;
    c. 50 dBμV for FM signals.
2. Maximum level:
    a. 77 dBμV for analogue terrestrial TV signals;
    b. 74 dBμV for digital terrestrial TV signals;
    c. 70 dBμV for FM signals.

ELE23.4.2.020.9 PERMISSIBLE DIFFERENT SIGNAL LEVELS IN AN OUTLET

1. The difference in level between the weakest and the strongest TV signals at the same outlet ("tilt") shall not exceed the following:
    a. 12 dB for frequency range between 47 and 862 MHz;
    b. 6 dB in the range of 60 MHz;
    c. 3 dB between adjacent channels.
2. The difference in level between the weakest and the strongest FM signals at the same outlet shall not exceed 15 dB for frequency range 88 and 108 MHz.

ELE23.4.2.030.9 INTERMODULATION

1. At each outlet, the level of any unwanted signal generated in the system in any channel shall make the minimum carrier-to-noise be the following:
   a. 44 dB for analogue terrestrial TV signals;
   b. 34 dB for digital terrestrial TV signals;
   c. 48 dB for FM signals.
2. Bit error rate (BER) of digital signals after error correction shall be better than 3 x 10^{-6};
3. Modulation error ratio (MER) shall be not less than 30 dB.

ELE23.4.2.040.9 MUTUAL ISOLATION BETWEEN OUTLETS

To minimize the local oscillator energy from one receiver causing interference to other receivers on the same cable system, the mutual isolation between outlets connected separately to a spur feeder shall not be less than 36 dB for Terrestrial TV, and 42 dB for FM signal.

ELE23.4.3 - TERRESTRIAL TELEVISION SYSTEM

ELE23.4.3.010.9 TERRESTRIAL AERIALS

1. The mast or poles and the aerials shall be of heavy duty construction and be designed to be able to operate normally under a loading pressure associated with a sustained wind speed of up to 170 km/hr. and gusts up to 240 km/hr. The Sub-contractor shall be responsible for liaison with the Main Contractor to ensure the support structure provided by the Main Contractor is adequate for their aerials installation and also be responsible for checking the positions of the builder's work on Site where reception is at its best before any concrete work is carried out;
2. If the FM aerial is required to be mounted on the same mast for the TV aerial, the TV aerial shall be mounted below the FM aerial and the two aerials shall be separated by at least 1.8 m apart so as to achieve the minimum interaction;
3. The aerial system shall be adequately earthed and protected against lightning in accordance with IEC 62305-1 by mean of bonding the aerial masts or supporting frames of antenna to the air termination for the lightning protection system under the sub-contract with at least 25x3 mm² aluminium tape or an acceptable equivalent;
4. Separate downleads shall be employed for the TV and FM aerials. The TV and FM signals shall not be combined in front of the channel amplifiers.

ELE23.4.3.020.9 PREAMPLIFIERS AND FILTERS

1. TV bandpass preamplifiers shall be used in weak TV field strength areas. Similarly, FM band preamplifiers shall be used in weak FM field areas;
2. Alternatively, TV/FM bandpass filters shall be incorporated if wideband preamplifier is used.

ELE23.4.3.030.A AMPLIFIERS

1. Signal amplification within the system shall be provided with channel amplifiers at the headend for signal processing and wideband distribution amplifiers;
2. At sites where the aerial is not in direct line-of-sight with the transmitter, the channel amplifier shall be equipped with automatic gain control circuitry;

3. When channel amplifiers are required, this shall include one channel amplifier for FM reception, at least two (2) channel amplifiers for closed circuit TV reception, two (2) additional spare interconnection points for future uses and Nine (9) channel amplifiers for reception of any one TV channel group as required by the location of reception in accordance with the frequency plans allocated for TV and FM. Only one TV channel group transmitted by any one transmitter shall be relayed;
4. The design levels used for the output of all amplifiers shall be 4 dB lower than their respective maximum allowable output with the exception of channel amplifiers equipped with AGC and all amplifiers following these AGC channel amplifiers. The maximum allowable output is the output level at which the specification limit for unwanted signal detailed in the wideband amplifiers, FM channel amplifiers and TV channel amplifiers and AGC channel amplifiers etc. can no longer be met with further increase in outputs;
5. The headend equipment of each system shall be installed at the topmost Telecom Room and / or as shown on the Drawings;
6. Cable routing shall be as short as possible and where possible screened from the sight of the TV Transmitter.

ELE23.4.3.040.9 FREQUENCY CONVERTERS

Television signals shall be conveyed at the received signal frequencies. If frequency conversion is required, the outlet frequencies shall be in the frequencies 470 to 862 MHz for television reception.

ELE23.4.3.050.9 UHF MODULATORS

The video signals from the closed circuit television system cameras shall be modulated to UHF range channels and combined at the headend of the system.

ELE23.4.3.060.9 SPLITTERS/TEE-UNITS

All splitters and tee units shall have a wide bandwidth to allow for cascaded mode of operation. The maximum number of tee units in cascade shall be limited to 6. Mock-up tests may be required to assess the design prior to installation, if in the opinion of the Contract Manager, the cascaded chain is too long as to create unacceptable signal tilting.

ELE23.4.3.070.A COAXIAL CABLES

1. The wiring installation from the aerial and any interconnecting point of free TV signals at the topmost Telecom Room to the head-end equipment, amplifiers and tee units / splitters on other floors shall be carried out in surface / concealed conduit system and surface trunking system, and as shown on the Drawings;
2. Coaxial cables terminating at aerial arrays shall be neatly and securely fixed to the supporting structures by means of PVC strapping with nylon stubs or flexible moulded nylon self-locking cable ties at intervals not greater than 250 mm;
3. Co-axial cable shall not be bent to a radius smaller than 15 times the outer diameter of the cable. Joints in the cable runs and looping of cables at outlet terminals shall NOT be allowed;
4. All wiring shall be properly installed and segregated in accordance with the Electrical CoP;
5. The wiring installation in each domestic unit shall be in concealed conduits. The TV / FM socket outlets shall be mounted on concealed BS 4662 boxes located as shown on the Drawings. The number of the Sub-contractor's coaxial cables to be installed in a conduit of any size shall be limited to two (2);

6. A set of spare conduits running from the Meter / Telecom Room on respective floors to individual flats, along with the conduits for CABD system, is designated for future telecommunication and broadcasting services. Under no circumstances, will the Sub-contractor be allowed to use these spare conduit facilities. In addition, the Sub-contractor shall propose the conduits to be used for the CABD system and the number of cables running in each of them whereas no works can commence without the CM's prior approval for such proposal;
7. All coaxial cables shall have distinctive labels along its length. All coaxial cables except the underground cables shall be white or ivory in colour.

ELE23.4.3.080.9 FM/TV OUTLETS

1. Looping of outlets to achieve the sufficient isolation shall not be acceptable. Only isolation using splitters and tee units with isolation shall be considered;
2. The FM/TV socket outlets shall be mounted at 100 mm above the skirting level unless otherwise specified and located as shown on the Drawings;
3. The outlets shall be fixed on electrical accessory boxes with made of insulating material in compliance with 47 mm deep. BS 4662 boxes whose colour and shape shall match those of the FM/TV outlets. Outlets shall be white or ivory in colour.

ELE23.4.3.090.9 FIBRE OPTICAL CABLE SYSTEM

1. Fibre optical cable system should be provided where the length of main trunk cable without splice exceeds 200 meters. The fibre optical cable in riser shall be enclosed in a galvanized iron cable trunking with space factor not exceeding 40%. In any case, the cable trunking should not be smaller than 50 mm X 50 mm. Where the main trunk is installed underground, the fibre optical cables shall be protected by minimum 100 diameter galvanized iron pipes and cable draws;
2. Fibre optical cable amplifier shall be provided where the total attenuation loss of the optical circuit exceeds the maximum output power of the transmitter;
3. Loose tube buffer fibre optical cables shall be specified for outdoor or locations subject to moisture or temperature variations;
4. The length of fibre optical cables without splice between the optical transmitter and the fibre optical splitter shall not exceed 5000 meters and between the fibre optical splitter and the fibre optical transceiver exceeds 2000 meters.

ELE23.5 MATERIAL & EQUIPMENT

ELE23.5.1 - TERRESTRIAL TELEVISION SYSTEM

ELE23.5.1.010.9 TERRESTRIAL AERIALS

The terrestrial aerials shall be suitable for both analogue and digital terrestrial television and shall comply with EN 60728-11 and EN 50083-2 and EN 60728-5 and the following:

1. TV aerial should have a gain of at least 13 dB and a front to back ratio not less than 20 dB. The aerial shall be of the type to minimize ghost image;
2. FM aerial should have a gain of 4 to 7 dB;
3. The impedance of the aerial should be 75 ohm unbalanced;
4. The aerial system should be provided with a durable protective coating;
5. The aerial mast should be made of stainless steel;
6. The aerial should be capable of receiving digital signal.

ELE23.5.1.020.9 PREAMPLIFIERS AND FILTERS

The performance of the preamplifiers, TV bandpass preamplifiers, FM bandpass preamplifiers, TV bandpass filters and FM bandpass filters shall be suitable for both analogue and digital terrestrial television and shall comply with EN 60728-11 and EN 50083-2 and EN 60728-5 and the following:

1. Preamplifiers

Television Standard	CCIR – PAL I System
Frequency	FM : 88 to 108 MHz TV : 470 to 862 MHz
Gain	According to manufacturer's specification
Gain Control Range	In accordance with manufacturer's specification
Input	Split input configuration preferred
Maximum Output Level	According to manufacturer's specification
Unwanted Signal (IM-Distortion)	Better than –60 dB* at maximum output level
Stray RF Radiation	Less than 4×10^{-9}W
Noise Figure	Less than 3.5 dB
Flatness of Response	± 1.5 dB
Screen Factor	Not less than 60 dB
Hum Modulation	Better than –50 dB
Voltage Standing Wave Ratio (VSWR)	Input VHF Better than 1.5 : 1 UHF Better than 2 : 1 Output Better than 2 : 1
Impedance (Input & Output)	75 ohm

Connectors for Coaxial Cables	Saddle & screw clamp or F type connector
Operating Temperature	-10°C to 60°C
Operating Humidity	Up to 98%
Power Supply	220V ± 6%, 50Hz ± 2Hz
Safety Isolation	Tested at 2 kV r.m.s. Designed to confirm to IEC 60065
Housing	Outdoor application

* Measured by two signal method with carrier frequencies set at reference zero

2. TV Bandpass Preamplifiers

Frequency Range	Within CH21 – CH62
Passband	According to manufacturer's specification & compatible with site conditions
Gain within Passband	According to manufacturer's specification
Unwanted Signal (IM Distortion)	Better than –60 dB* at maximum output level
Flatness of Response within passband	± 1.5 dB
Attenuation outside Passband (with reference to Passband Output Level)	At f_L -20 MHz ≥ 5 dB f_H +20 MHz f_L -60 MHz ≥ 18 dB f_H +60 MHz f_L -150 MHz ≥ 30 dB f_H +150 MHz where f_L: centre frequency of the lowest channel within the passband f_H: centre frequency of the highest channel within the passband
Noise Figure	Less than 3.5 dB
Impedance (Input & Output)	75 ohm
Screening Factor	Not less than 60 dB
Housing	Weatherproof housing suitable for outdoor mounting

* Measured by two signal method with carrier frequencies set at reference zero

3. FM Bandpass Preamplifiers

Frequency Range	88 to 108 MHz
Gain	According to manufacturer's specification & compatible with site conditions
Unwanted Signal Output (IM Distortion)	Better than –46 dB* maximum level

Flatness of Response within passband	± 1.5 dB
Selectivity (@ –20 dB point)	Not more than 60 MHz
Noise Figure	Less than 3.5 dB
Impedance (Input & Output)	75 ohm
Screening Factor	Not less than 60 dB
Housing	Weatherproof type housing for outdoor mounting

* Measured by two signal method with carrier frequencies set at reference zero

4. TV Bandpass Filters

Frequency Range	Within CH21 – CH62
Passband	According to manufacturer's specification & compatible with site conditions
Loss within Passband	Not more than 1.5 dB
Attenuation outside Passband	At f_L -20 MHz ≥ 3 dB f_H +20 MHz f_L -60 MHz ≥ 10 dB f_H +60 MHz f_L -150 MHz ≥ 20 dB f_H +150 MHz where f_L: centre frequency of the lowest channel within the passband f_H: centre frequency of the highest channel within the passband
Impedance (Input & Output)	75 ohm
Screening Factor	Not less than 60 dB

5. FM Bandpass Filters

Frequency Range	88 to 108 MHz
Loss within Passband	Not more than 1.5 dB
Selectivity (at –20 dB point)	Not more than 60 MHz
Impedance (Input & Output)	75 ohm
Screening Factor	Not less than 60 dB

ELE23.5.1.030.9 AMPLIFIERS

The performances of the wideband amplifiers, FM channel amplifiers and TV channel amplifiers & AGC modules shall be suitable for both analogue and digital terrestrial television and shall comply with EN 60728-11 and EN 50083-2 and EN 60728-3 and the following:

1. Wideband Amplifiers

Television Standard	CCIR – PAL I System
Frequency Range	88 to 862 MHz
Gain	According to manufacturer's specification & compatible with site conditions
Gain Control Range	According to manufacturer's specification & compatible with site conditions
Maximum Output Level	According to manufacturer's specification
Unwanted signal output (IM Distortion)	Better than –60 dB* at maximum level
Adjustable Slope	≥3 dB
Hum Modulation	Better than –50 dB
Stray RF Radiation	Less than 4 $x10^{-9}$W
Noise Figure	Less than 7 dB
Nominal Impedance (Input & Output)	75 ohm
Screen Factor	Not less than 60 dB
VSWR	Input VHF better than 1.5:1 Input UHF better than 2:1 Output better than 2:1
Impedance (Input & Output)	75 ohm
Coaxial Sockets	F type
Operating Temperature	-10°C to +60°C
Operating Humidity	Up to 98%
Deviation with Temperature	Gain less than 1.0 dB/20°C change Flatness less than 0.5 dB/20°C Output Level less than 0.5 dB/20°C Noise Figure less than 0.5 dB/20°C
Power	220 ± 6%, 50Hz ± 2Hz
Power Consumption	Less than 20W
Safety Isolation	Tested at 2 kV r.m.s. Designed to confirm to IEC 60065
Weather proofing	Indoor application
Housing	Either internally or externally fully screened metal box complete with suitable mounting legs for vertical mounting
Earthing	All metal parts to be properly earthed
Identification	Clearly mark 'IN' & 'OUT' signal sockets
Accessories	All necessary coaxial cable plug and accessories

* Intermodulation Ratio is measured by two signal method with carriers set at reference level of 0 dB.

2. FM Channel Amplifiers

Frequency Band	FM
Frequency Range	88 to 108 MHz
Gain	According to manufacturer's specification & compatible with site conditions
Gain Control Range	According to manufacturer's specification & compatible with site conditions
Noise Figure	Less than 7 dB
Output Level	According to manufacturer's specification
Unwanted Signal Output (IM Distortion)	Better than -60 dB* at maximum level
Selectivity (@-30 dB point)	Less than 60 MHz
Operating Temperature	-10°C to +60°C
Operating Humidity	Up to 98%
Impedance (Input & Output)	75 ohm
Deviation with Temperature	Gain less than 1.0 dB/20°C change Flatness less than 0.5 dB/20°C Output Level less than 0.5 dB/20°C Noise Figure less than 0.5 dB/20°C
Power Supply	220V ± 6%, 50 Hz ± 2 Hz D.C. output regulated with good transient suppression. Line powering facility is available by means of individual switches via the input coaxial sockets.
Safety Isolation	Tested at 2 kV r.m.s. Designed to conform to IEC 60065
Electromagnetic compatibility limit	According to EN 50083-2 Class A
Weather proofing	Indoor application
Housing	Modular type construction of robust and attractively designed plug-in units with connecting links between TV channel amplifier outputs. Fully internally metal-screened. Earthing on metal chassis.
Identification	Clearly marked 'IN' & 'OUT' signal sockets

* Measured by three signal method with carrier frequencies set at reference zero.

3. TV Channel Amplifiers & Automatic Gain Control (AGC) Modules.

   The TV channel amplifiers shall be suitable for working with a group of adjacent channels.

Television Standard	CCIR – PAL I System & Digital Terrestrial Television Broadcasting (DTTB) System suitable
Frequency Range	470 to 862 MHz, Channel Selectable with 0.25 MHz tuning steps

Gain	According to manufacturer's specification & compatible with site conditions
Gain Control Range	According to manufacturer's specification & compatible with site conditions
Minimum Output Level	>110 dBμV
Maximum Output Level	According to manufacturer's specification
Unwanted Signal Output (IM Distortion)	Better than –60 dB* at maximum level
Stray RF Radiation	Less than 4 $x10^{-9}$W
Noise Figure	Less than 7 dB
Flatness of Response	Better than ±1 dB within channel
AGC Facility	Better than ±1 dB output variation for a full range change of at least ±20 dB of the nominal input
Selectivity for non-adjacent channel application	At f_o ± 8 MHz not less than 70 dB
Hum Modulation	Better than –50 dB
Impedance (Input & Output)	75 ohm
Coaxial Sockets	F Type
Operating Temperature	-10°C to +60°C
Operating Humidity	Up to 98%
Deviation with Temperature	Gain better than –1.0 dB/20°C change Flatness better than 0.5 dB/20°C Output Level less than 0.5 dB/20°C Noise Figure less than 0.5 dB/20°C
Power Supply	220V ± 6%, 50 Hz ± 2 Hz D.C. output regulated and protected against accidental or fault condition short circuits with an automatic reset facility. Mains indicator light shall be of neon type.
Safety Isolation	Tested at 2 kV r.m.s. D.C. Designed to conform to IEC 60065
Electromagnetic Compatibility Limit	According to EN 50083-2 Class A
Weather Proofing	Indoor application
Housing	Modular type construction of robust and attractively designed plug-in with connecting links between amplifiers outputs. Fully internally metal-screened. Earthing on metal chasis.
Identification	Clearly mark 'IN' & 'OUT' signal sockets
Accessories	All necessary coaxial cable plugs and accessories

* Inter-modulation Ratio is measured by three signal method with both vision and sound carriers set at 7 dB and colour sub carrier at 17 dB.

ELE23.5.1.040.9 FREQUENCY CONVERTERS

The frequency converters shall comply the following:

Television Standard	CCIR – PAL I System & DTTB System suitable
Converted Frequency Band	470 to 862 MHz, channel selectable (specific frequency to be determined by OFCA, Hong Kong)
Frequency Stability	Drift ≤ ±75 kHz (0°C to 55°C) for supply voltage variation 220V ± 6%, 50 Hz ± 2%
Selectivity	Not less than 70 dB at f_o ±8 MHz (where f_o = centre frequency of channel)
Unwanted Signal (IM Distortion)	Better than –60 dB
Noise Figure	Less than 9 dB
Interference	As section 6 of HKTA 1104 specification issued by OFTA
Luminance Linearity	Less than 3%
Differential Gain	Less than 2%
Differential Phase	Less than 2°
Picture Sync Ratio Distortion	Less than 2%
Group Delay	Less than 25nS
Electromagnetic Compatibility Limit	According to EN 50083-2 Class A
Input & Output Socket	F Type
Input & Output Impedence	75 ohm
Minimum Output Level	110 dBμV/-60 dB IMD
Flatness of Response	±1 dB
AGC Facility	Better than ±1 dB output variation for a full range change of at least ±20 dB of the nominal input

ELE23.5.1.050.9 UHF MODULATORS

The UHF modulators shall comply the following:

Video Input Interface	RCA (CVBS)
RF Modulation Standard	DTMB
Video Encoding Standard	MPEG2 or H.264
Video Resolution Support	576i and 576p
LCN Assignment	1 to 999
Video Input Level	1 ± 0.3V (peak to peak)
Video Input Impedance	75 ohm
Video Bandwidth	0.020 – 5.0 MHz
Group Delay	≤ 50 ns
Differential Gain	3%
Differential Phase	3°
Video Signal to Noise Ratio	≥ 57 dB

Output Frequency Range	470 to 862 MHz (Fixed channel or channel selectable)	
Output Impedance (F type)	75 ohm	
Output Level	Without Integrated Channel Amplifier	>80 dBμV
	With Integrated Channel Amplifier	>110 dBμV
Frequency Response	±1 dB	
Unwanted Spurious Signals through out 470-860 MHz	≥60 dB	
Screening Factor	≥75 dB	

ELE23.5.1.060.9 SPLITTERS / TEE-UNITS

All splitters and tee units shall have a wide bandwidth to allow for cascaded mode of operation and shall comply with EN 60728-11 and EN 50083-2 and EN 60728-4 and the following:

Frequency Range	88 to 862 MHz
Number of Outputs or Taps Connection	According to manufacturer's specification
Through Loss	According to manufacturer's specification
Side Loss	According to manufacturer's specification
Electrical System	Transformer / directional / resistance
Mutual Attenuation between Outputs	Not less than 13 dB for splitters and not less than 30 dB for tee units at all in-band frequencies
Screening Factor	Not less than 75 dB for RF shield application
VSWR	470 to 600 MHz – 2:1 600 to 862 MHz – 1.5:1
Impedance	75 ohm

ELE23.5.1.070.9 COAXIAL CABLES

1. All coaxial cables used shall be of 75 ohm type copper cables designed for transmitting UHF (470 to 862 MHz) and VHF (88 to 108 MHz) signals. All coaxial cables used shall comply with the relevant sections of EN 50083-1, EN 50083-8 and EN 50117;
2. The feeder shall conform to IEC 60096-3 (cable designation 370 or above of BS 5425-1 and the trunk feeder shall be to cable designation 550 or above of BS 5425-1);
3. Underground cables shall be of low loss coaxial copper cable with polyethylene outer sheath, copper foil outer conductor. These shall conform to IEC 60096 (cable designation 550 MB or above of BS 5425-1).

ELE23.5.1.080.9 FM / TV OUTLETS

1. Outlets shall be dual socket type for FM / TV (88 to 862 MHz) signals complete with frequency dividing network and the respective socket shall be identified with labels embossed on the front plate;

2. The outlets shall comply with EN 60728-11 and EN 50083-2 and EN 60728-4 and shall be suitable for flush mounting on 47 mm deep BS 4662 boxes;

3. The FM / TV outlet shall comply the following:

Frequency Range	FM: 88-108 MHz TV: 470-862 MHz
Features	Double outlet configuration one for FM and one for TV, flush mounting type complete with cover, connected from tap output of tee unit. The TV socket outlet shall only accept a male plug.
Distribution Loss	FM (88 to 108 MHz) not more than 1.5 dB TV (470 to 862 MHz) not more than 1.5 dB
Mutual Attenuation	Between FM-TV not less than 15 dB from 88 to 862 MHz
Screening Factor	Not less than 60 dB for RF shield application Not less than 25 dB for non RF shield application
Connection to TV Outlet	F type
Connection for FM Outlet	F type
Impedance	75 ohm
Safety Isolation	Tested at 2 kV r.m.s. Designed to conform to IEC 60065

ELE23.5.1.090.9 ALLOWANCES FOR DIGITAL TERRESTRIAL TV BROADCASTING (DTTB) SYSTEM

1. The CABD system shall allow for the future additional channel installation of DTTB equipment whose details OFCA has already announced, such as digital headend amplifiers / converters to enable a satisfactory reception and distribution of DTTB broadcasting signals;

2. The DTTB equipment shall be compatible with the CABD system installed and in no circumstances cause interference to the original analogue terrestrial channels.

ELE23.6 INSPECTION, TESTING & COMMISSIONING DURING CONSTRUCTION PERIODS

ELE23.6.1 - GENERAL REQUIREMENTS

ELE23.6.1.010.9 GENERAL

1. The purpose of Inspection, Testing and Commissioning during construction is to ensure the quality of delivered material and equipment and the workmanship of the installation comply with the relevant Regulations, Standards, Code of Practice and requirements of the Sub-contract and the function and performance of the systems meet the requirements specified in the Sub-contract;
2. Inspection and testing shall be carried out on all new installations and alterations to an existing installation in accordance with the requirements of this Section;
3. At the start of the Sub-contract, the Sub-contractor shall propose and obtain agreements from the Contract Manager on the time frames for the process of verification of materials and equipment delivered on site, inspection and testing of installed works;
4. The Sub-contractor shall be responsible for the submission of relevant and sufficient documents to the Contract Manager to describe the materials, equipment and installations to be inspected, tested and commissioned before carrying out of the inspection, tests and commissioning;
5. The Sub-contractor shall provide all necessary specialists, labour, materials, tools, instruments and equipment for carrying out of inspections, testing including analyzing the data, and commissioning. The Sub-contractor's specialist approved by the Contract Manager shall undertake all testing and commissioning procedures;
6. The Sub-contractor shall dispatch competent and experienced commissioning engineers to carry out the test and commissioning of the installation. Such personnel shall collaborate closely with the Contract Manager on site, who will witness the tests carried out under the Sub-contract. The Sub-contractor shall provide the Contract Manager with access to inspect all equipment during any phase of the installation and shall provide all reasonable facilities for such access. The Sub-contractor shall notify the Contract Manager of impending tests in sufficient time to allow the Contract Manager to be present. Parts to be subjected to witnessed tests will not be accepted unless the relevant test result are provided and has been signed by the Contract Manager and Sub-contractor;
7. All tests at site shall be performed in the sequence required by the construction and commissioning programme. The Sub-contractor shall prepare itemised and detailed testing and commissioning schedule. These schedules shall be prepared and submitted to the Contract Manager at least three months before the commencement of the test and approved by the Contract Manager. The schedule shall be completed by the Sub-contractor and presented to the Contract Manager for approval;
8. All instrument used for testing should be calibrated as specified in the Specification for the inspection, measuring and testing of the installation. The Sub-contractor shall submit to the Contract Manager valid calibration certificates issued and signed by approved calibration organizations before the use of the instruments;

9. The entire installation shall be commissioned and tested in accordance with the latest edition of "Testing and Commissioning Procedure for Broadcast Reception Installation in Government Buildings, Hong Kong Special Administrative Region";
10. The Sub-contractor shall record all data and information gathered during all inspections, testing and commissioning and produce reports to the Contract Manager within 3 weeks after the inspection;
11. The Sub-contractor at their own expense shall rectify all defects in performance, material and workmanship before the installation is accepted.

ELE23.6.1.020.A COMPONENT ACCEPTANCE

1. The following components offered for the CABD installation shall have at least three(3) years of proven local performance history. Relevant job reference(s) shall be submitted to the CM for approval:
   a. TV and FM bandpass filters or preamplifier;
   b. Channel amplifers;
   c. Broadband amplifiers (with or without AGC) / Frequency converters;
   d. Splitters / tap-off units;
   e. FM / TV outlets;
   f. Coaxial cables.
2. The Sub-contractor shall arrange acceptance tests for preamplifiers, amplifiers, broadband filters and frequency converters, at least one month before and no earlier than six months before actual installation, and submit the test report to the CM.. In the event of the components failing the acceptance tests, the Sub-contractor shall resubmit fresh components for further tests until the components are accepted. The acceptance tests for the components are exempted, if the Sub-contractor is able to submit the relevant test records to the CM to verify that the components have been tested and accepted for using in HA projects in the last 24 months prior to the approval date of the material submission;
3. The Sub-contractor shall bear the cost of all testing required by the CM on any CABD equipment;
4. In addition, the CM shall have the right to order any components to be tested, if, in his opinion, the components are suspected of not complying with this Specification. All components failing such tests shall be replaced by the Sub-contractor at their own cost to the satisfaction of the CM.

ELE23.6.1.030.9 VERIFICATION OF MATERIALS AND EQUIPMENT DELIVERED

1. All materials and equipment delivered to site shall be verified by the Contract Manager that they comply with the requirements and conform to the materials and equipment approved by the Contract Manager;
2. The Sub-contractor shall request in writing the Contract Manager to inspect materials and equipment delivered on site in accordance with the agreed time frame;
3. The request for inspection shall be made together with detail descriptions of the materials/equipment including, but not limited to, brand name, model number, country of origin, their tested standards and record of Contract Manager's approval for the using the materials and equipment.

ELE23.6.1.040.9 INSPECTION AND TESTING OF INSTALLED WORKS

1. The Sub-contractor shall request in writing in accordance with the agreed time frame to the Contract Manager for the inspection and witness testing of installed works in order to ensure that the installed works conform to the approved drawings and also meet the requirements of the Sub-contract;
2. Inspection and testing of installed works may be carried out for the whole or portion by portion of an installation, as appropriate. The Sub-contractor shall make proposal to the Contract Manager and obtain the Contract Manager's agreement on the arrangement before commencement of the works;
3. The request shall be made together with descriptions or drawings showing details of the works including, but not limited to, area/location of the works and types of installations;
4. Request for inspection for works to be covered up subsequently shall be made according to the work progress and well before the installations are covered up by subsequent activity. The Sub-contractor is responsible for any delay and its associated financial or time loss arising from late or unsatisfactory planning and arrangement of inspection and testing of works incurred to himself and others, consequential or otherwise.

ELE23.6.1.050.9 COMMISSIONING AND FUNCTIONAL AND PERFORMANCE TESTS

1. All installations and equipment shall be properly commissioned and tested to ensure that they are operating to deliver the design capacities and at the most optimum favourable operation conditions of the installations and the equipment and they are functioning properly in accordance in accordance with the design requirements;
2. The Sub-contractor shall submit proposed testing and commissioning programmes, testing and commissioning methods, procedures and formats of test records to the Contract Manager for approval at least three (3) months before commencement of commissioning and testing or within four (4) months after commencement of the Sub-contract whichever is earlier. The submission shall be submitted together with a list of major equipment with their crucial information such as brand names, model numbers, types, capacities and locations;
3. The Sub-contractor shall check and ensure that all related building items such as false ceiling, partitions, windows, louvers, etc. that will affect proper operation of the system have been provided and ready for carrying out of the commissioning before starting commissioning works;
4. The Sub-contractor shall check and ensure that all related building services items including those provided by others are available and ready for carrying out of the commissioning before starting commissioning works;
5. The Sub-contractor shall carry out commissioning work portion by portion rather than waiting until completion of the whole system if the commissioning work is more effective and appropriate to be proceeded in such arrangement. Nevertheless, after completion of the whole installation, the Sub-contractor shall commission the whole system in one go in order to ensure that the whole system is operating smoothly to deliver the design capacities and at its optimum favourable operation condition;
6. The Sub-contractor shall test the system on their own and is satisfied that the performance of the system comply with the design requirements before making requests to the Contract Manager for witness of commissioning and tests;

7. Commissioning and testing shall be conducted strictly under the specified design condition as far as possible. For commissioning works or tests that would be affected by environment condition or other factors outside the Sub-contractor's control and it is unlikely that the commissioning works or tests can be arranged to be proceeded under the design condition, the Sub-contractor shall submit alternative proposal for the Contract Manager's approval for carrying out the commissioning works or tests under condition with slight deviation from the specified design condition. Nevertheless, the Sub-contractor shall demonstrate from the result of commissioning and testing, either by means of calculation or other methods that the system can operate to deliver the design capacities;
8. The Sub-contractor shall, at its own cost, provide temporary TV channels at the headend in addition to the receivable off air and CCTV channels at the time of testing and commissioning. This is to demonstrate that the system shall be able to operate and deliver the design output for a total of not less than 30 TV channels;
9. In addition to the commissioning and test reports submitted by the Sub-contractor within 3 weeks after the commissioning and tests, the Sub-contractor shall compile all inspection, test and commissioning records in one report and submit it to the Contract Manager within 4 weeks after contract completion.

ELE23.6.2 - EQUIPMENT CALIBRATION

ELE23.6.2.010.9 GENERAL

The Sub-contractor shall make available the calibrated equipment and the associated calibration records etc. whenever the relevant test is performed. The equipment together with the relevant documentation shall conform to the requirements as set out in the following:

1. Accreditation:

   The equipment shall be calibrated an accredited laboratories. The calibration shall be made against certified equipment having a known valid relationship to internationally or nationally recognized standards. Where no-such standards exist, the basis used for calibration shall be documented. In such cases, the laboratories shall provide satisfactory evidence of correlation of results, for example by participation in a suitable programme of inter-laboratory comparisons or proficiency testing.

2. Acceptance of the calibration of the equipment:

   The calibration and acceptance of the calibration of the equipment shall comply with the requirements as set out in the schedule.

3. Document the calibration process:

   The Sub-contractor shall define and document the process employed for the calibration of the equipment including details of equipment type, unique identification, location, frequency of checks, check method, acceptance criteria and the action to be taken when results are unsatisfactory.

4. Calibration records of the equipment:

   The Sub-contractor shall maintain and submit calibration records of the equipment to the Contract Manager and the records shall include:

   a. The description and unique identification of equipment;
   b. The date of equipment calibration;
   c. The calibration results obtained after and, where relevant, before any adjustment and repair;

d. The assigned calibration interval;

e. The calibration procedure;

f. The designated limits of permissible error or accuracy of equipment;

g. The source of the calibration used to obtain traceability;

h. The relevant environmental conditions and a statement about any corrections thus necessary;

i. A statement of the uncertainties involved in calibrating the equipment and of their cumulative effect;

j. Details of any maintenance such as servicing, adjustment, repairs or modifications carried out;

k. Any limitations in use;

l. Identification of the person(s) performing the calibration;

m. Identification of person(s) responsible for ensuring the correctness of the recorded information;

n. Unique identification (such as serial numbers) of any calibration certificates and other relevant documents concerned.

5. Calibration under suitable environmental conditions:

   Calibration shall be carried out under suitable environmental conditions considering the conditions under which the equipment is used for inspections, measurements and tests.

6. Label marked "calibrated":

   The Sub-contractor shall identify the equipment with a label marked "calibrated" and approved identification record to show the calibration status and the next due date.

7. Doubt on the accuracy of the equipment:

   The Sub-contractor shall re-calibrate the equipment at intervals as shown in the schedule, or at shorter periods when the Contract Manager has doubt on the accuracy of the equipment.

8. Return of equipment:

   The equipment shall be returned to the Sub-contractor at the completion of the Sub-contract when there is no outstanding or remedial works to be completed.

ELE23.6.3 - TESTING & COMMISSIONING

ELE23.6.3.010.9 VISUAL INSPECTION

A visual inspection shall be carried out before testing of the installation in order to verify the following:

1. Compliance with Regulations and / or CoP:

   The installation has been carried out in compliance with regulations and / or CoP.

2. Correctness:

   The correctness of the designation of the installation; and

3. Visual Damage:

   There is no visual damage to the installation.

ELE23.6.3.020.9 TESTING & COMMISSIONING

The Sub-contractor shall carry out complete performance tests for all equipment and systems installed by him, make all necessary adjustments, commission the installations and submit the test reports, all to the satisfaction of the Contract Manager who may require the Sub-contractor to repeat all or some of the tests in the presence of his or her representatives before the installation will be accepted. Where relevant, the following tests shall be carried out in the sequence indicated. In the event of any test indicating failure to comply, that test and those preceding tests, the results of which may have been influenced by the fault indicated, shall be repeated after the fault has been rectified.

1. Signal Level Measurement of TV Headend and Trunk Distribution Equipment:

    a. Measure the input and output signal levels of each headend and trunk distribution equipment item with the signal level meter, starting from the antenna side. All the TV channels to be distributed shall be measured. For FM signals, three of the principal programmes to be distributed, namely those with the lowest, middle and highest frequencies, shall be measured;

    b. The input and output signal levels shall agree with the calculation done by the Sub-contractor on the approved System Schematic Diagram(s).

2. The Automatic Gain Control (AGC) Performance of TV Channel Amplifiers:

    a. If the TV channel amplifiers are fitted with AGC facilities, the AGC functions shall be tested. The input signal of each AGC channel amplifier shall be varied by +10 dB and –10 dB from its nominal value. External amplifier and attenuator shall be temporarily inserted at the channel amplifier input for this test;

    b. For proper AGC function, the channel amplifier output shall not vary by more than ±1 dB.

3. Measurement of Signal Levels at FM/TV Outlets:

    a. The signal level at FM/TV outlets shall be measured by the signal level meter for each TV channel and three of the principal FM programmes to be distributed, namely those with the lowest, middle and highest frequencies;

    b. The signal levels shall fall within the following items:

Channel	Minimum Signal Level (dBμV)	Maximum Signal Level (dBμV)	"Tilt"
Analogue Terrestrial TV	60	77	i. 12 dB for 47 to 862 MHz ii. 6 dB in the range of 60 MHz iii. 3 dB between adjacent channels
Digital Terrestrial TV	50	74	
FM	50	70	15 dB

Note: "Tilt" is the difference in signal level between the strongest and the weakest TV signals.

4. Mutual Isolation between FM/TV Outlets:

    a. The mutual isolation between FM/TV outlets from the same tee unit shall be measured. About 3 pairs of outlets shall be tested for each type of tee unit;

    b. The mutual isolation shall not be less than 36 dB for terrestrial TV and 42 dB for FM signal.

5. Functional Testing:

The picture quality at TV outlets shall be measured by a Portable TV monitor c/w sound monitoring loudspeaker for each TV channel. The test results shall be recorded in the report.

ELE23.7 MAINTENANCE REQUIREMENTS

ELE23.7.010.9 GENERAL MAINTENANCE REQUIREMENTS

1. The Sub-contractor shall furnish maintenance, free of further charge, for the complete installation for a period of twenty-four (24) months from the date of acceptance. This maintenance shall include the following services:
   a. Routine inspection, testing and maintenance services;
   b. Emergency inspection, testing and repairs.
2. All inspection, testing, maintenance services and repairs shall be carried out generally in accordance with the manufacturers' recommendation/ instructions and to the satisfaction of the Contract Manager;
3. The Sub-contractor shall despatch competent and experienced engineers and technicians equipped with the testing instruments, tools, equipment etc. to inspect, service, test, adjust and maintain the installation in a satisfactory operating condition. The Sub-contractor shall allow for carrying out such inspection, service, testing, adjustment and maintenance at a time outside normal office hours including general holidays;
4. All labour and materials including cleaning materials, lubricants, battery electrolyte, tools, instruments etc., and transportation required for carrying out routine and emergency inspection, testing, repair, replacement and maintenance services shall be included in this Sub-contract. Any renewals or repairs necessitated by reason of negligence of the end user or misuse of the equipment by the end user or by reason of any other causes not due to the fault of the Sub-contractor shall be carried out by the Sub-contractor and paid for in accordance with the Sub-contract with prior notice to the Contract Manager;
5. The Sub-contractor shall be responsible for all repairs necessary to maintain the installation in a safe, reliable and operative condition at all times. The Sub-contractor must ensure that their servicing staff carrying out necessary repairs immediately utilising manufacturer's original replacement parts. Any component taken down for services shall be reinstated within 2 hours or otherwise replaced by a spare unit at the Sub-contractor's expenses;
6. After each routine inspection, testing and maintenance service, the Sub-contractor shall furnish to the Contract Manager within 14 days a report complete with the following details:
   a. Date and time of inspection, testing and maintenance service;
   b. Persons carrying out the task;
   c. Details of inspection and maintenance service;
   d. Results of all tests performed;
   e. Any external factors significantly affecting the service and test results;
   f. Any follow-up actions as required.

ELE23.7.020.9 ON-CALL MAINTENANCE AND REPAIR SERVICE

1. The Sub-contractor shall dispatch technically competent and specially trained personnel for on-call maintenance and repair service and restore the malfunction CABD System to proper working order within the time period as specified below:

a. The Sub-contractor shall respond immediately to system fault or breakdown affecting the service to a whole building or effecting 'no picture' for large-scale residents and inspect the failure within one hour during office hours or two hours if outside office hours after receiving a call for service from the Contract Manager or his or her representatives or from the estate office. The system shall be restored to normal within 4 hours. In the event that it being impossible to perform the requirement within the time stipulated, the Sub-contractor shall explain immediately to the Contract Manager or his or her representatives the reason for such non-conformance;

b. For any other system minor fault, or complaints not involving loss of picture, the Sub-contractor shall restore the system to proper working order within 24 hours from receiving a fault report from the Contract Manager or his or her representatives.

2. The on-call maintenance and repair services shall include all works, whether they are of mechanical, electrical or electronic nature which are found necessary to maintain the CABD System in good and safe working order at all times and in conformity with:

   a. The Specification No. HKTA-1103 "Performance Requirements of Television Signals Input to the Head End of Subscription Television System" issued by OFCA;

   b. The Specification No. HKTA-1104 "Performance Requirements for In-building Coaxial Cable Distribution System (IBCCDS)" issued by OFCA (hereinafter referred to as the Performance Specification);

   c. The Specification No. HKTA-1105 "Technical Information for Frequency Planning of In-Building Coaxial Cable Distribution System" issued by OFCA.

   Should the Sub-contractor find it necessary to remove any system equipment to his Workshop for repair, he shall install, at the time of removal, a suitable replacement equipment for temporary use at no cost to the Housing Authority in order to maintain the system in proper working condition during the entire period of repair;

3. In case a system breakdown call occurs in Outlying Islands (e.g. Cheung Chau), the Sub-contractor shall, as far as practicable, restore the system to normal operating condition in 24 hours from receiving the call;

4. The Sub-contractor shall provide all transport, labours and materials including cleaning materials, tools and testing instruments required for the on-call maintenance and repair service. The Sub-contractor shall employ sufficient number of competent technicians and have adequate number of testing instruments for the service;

5. The Sub-contractor should note that the cost for the provision of the on-call repair service for the CABD system as well as the overtime work during on-call services is deemed to have been included in this Sub-contract;

6. The on-call repair service for CABD System shall be provided once the system is included in the Sub-contract and shall last until the end of the Sub-contract. Therefore, the Sub-contractor should make sufficient allowance in her tender;

7. The Sub-contractor shall within one week after the commencement of the Sub-contract, submit a name list with at least two names and telephone numbers of his English and Cantonese speaking representatives to whom repair calls should be directed;

8. For indicative purposes, the average number of on-call maintenance and repair service is around 23 per month. However, this figure is likely to vary due to:

   a. Addition or deduction of CABD system in this Sub-contract;

b. Connection of the CABD drop-in cables to other Subscription TV networks or re-connection of CABD drop-in cables back to CABD system;

c. Addition of video signals from CCTV cameras on the CABD system;

d. Reception and distribution of DTTB signals in addition to analogue ones from 2007 onwards.

ELE23.7.030.9 ROUTINE HALF-YEARLY INSPECTION, TESTING AND MAINTENANCE

The Sub-contractor shall visit the installation at least once every six months to carry out tests, repairs and adjustment. All environmentally sensitive devices shall be inspected, cleaned, adjusted and calibrated. A test sequence shall be carried out in accordance with the manufacturer's instructions.

ELE23.7.040.9 FINAL INSPECTION, TESTING AND MAINTENANCE

1. At the final inspection, the Sub-contractor shall, in addition to the routine half-yearly inspection and testing, adjust all the electronic equipment to the optimum state of operational efficiency. All mechanical equipment and control panels shall be inspected for rusting or corrosion such that touching-up or re-painting shall be carried out as necessary;
2. A complete performance test of the whole installation shall be carried out and any defects in operation, materials and workmanship so developed shall be rectified.

ELE23.7.050.9 TAKING RECORDS IN LOG-BOOK

The Sub-contractor shall have their maintenance staff completing the site/installation record 'Log-Book' after each visit. The log books shall be provided by the Contract Manager and can be completed in either English or Chinese.

ELE23.7.060.9 CONTRACT MANAGER TO BE INFORMED

No replacements of installation or parts of installation shall be carried out at any time unless the Contract Manager has previously been notified and has signified their approval.

ELE24 SECURITY SYSTEM

ELE24.1 GENERAL REQUIREMENTS 4

ELE24.1.010.9 INFORMATION FURNISHED WITH TENDER 4
ELE24.1.020.9 AS-FITTED DRAWINGS 4
ELE24.1.030.9 ROBUST DESIGN 4
ELE24.1.040.9 SCREENING 4
ELE24.1.050.9 DOORPHONE SYSTEM VOLTAGE 4
ELE24.1.060.9 SUPPRESSION OF ELECTROMAGNETIC EMISSION 4
ELE24.1.070.9 WORKS BY OTHERS 4
ELE24.1.080.9 DOCUMENTATION 5
ELE24.1.090.9 EXECUTION OF THE WORK 6

ELE24.2 EQUIPMENT OF SECURITY SYSTEM 7

ELE24.2.1 CCTV VIDEO CAMERA 7
ELE24.2.1.010.A GENERAL 7
ELE24.2.1.020.X DELETED 8
ELE24.2.1.030.X DELETED 8
ELE24.2.1.040.X DELETED 8
ELE24.2.1.050.X DELETED 8
ELE24.2.1.060.X DELETED 8
ELE24.2.1.070.X DELETED 8
ELE24.2.1.080.A CAMERA MOUNTING 8
ELE24.2.1.090.N LENS 8
ELE24.2.1.100.N CAMERA CONSTRUCTION 9
ELE24.2.1.110.N CAMERA WITH PAN AND TILT FUNCTION 9

ELE24.2.2 LED VIDEO MONITOR 9
ELE24.2.2.010.A GENERAL 9

ELE24.2.3 VIDEO DISTRIBUTION AMPLIFIER 10
ELE24.2.3.010.X DELETED 10
ELE24.2.3.020.X DELETED 10
ELE24.2.3.030.X DELETED 10

ELE24.2.4 NETWORK VIDEO RECORDER (NVR) 10
ELE24.2.4.010.A TECHNICAL REQUIREMENTS 10

ELE24.2.6 QUAD MULTIPLEXER 13
ELE24.2.6.010.X DELETED 13

ELE24.2.7 TELEPHONE SET 13
ELE24.2.7.010.9 GENERAL 13

ELE24.2.8 CABLES 13
ELE24.2.8.010.9 GENERAL 13
ELE24.2.8.020.9 VIDEO CABLES 14
ELE24.2.8.030.9 CONTROL CABLES 14
ELE24.2.8.040.9 RADIO FREQUENCY CABLES 14
ELE24.2.8.050.9 OPTICAL FIBRE CABLES 14
ELE24.2.8.060.N LOCAL AREA NETWORK (LAN) CABLES 15
ELE24.2.8.070.N HIGH-DEFINITION MULTIMEDIA INTERFACE (HDMI) CABLES 15

ELE24.2.9 SEMICONDUCTOR DEVICES 15
ELE24.2.9.010.9 GENERAL 15

ELE24.2.10 CAPACITORS 15
ELE24.2.10.010.9 GENERAL 15

ELE24.2.11 RESISTORS 15
ELE24.2.11.010.9 GENERAL 15

ELE24.2.12 PRINTED CIRCUIT BOARDS 15
ELE24.2.12.010.9 GENERAL 15
ELE24.2.13 MAGNETIC DOOR CONTACT 16
ELE24.2.13.010.9 GENERAL 16
ELE24.2.14 EQUIPMENT RACK 16
ELE24.2.14.010.B GENERAL 16
ELE24.2.15 UNINTERRUPTED POWER SUPPLY 16
ELE24.2.15.010.A GENERAL 16
ELE24.2.15.020.9 TECHNICAL REQUIREMENT OF UPS EQUIPMENT 17
ELE24.2.15.030.9 TECHNICAL REQUIREMENT OF UPS BATTERY 18
ELE24.2.15.040.9 TECHNICAL REQUIREMENT OF EXTERNAL MAINTENANCE BYPASS SWITCH 18
ELE24.2.16 NETWORK SWITCH 18
ELE24.2.16.010.N GENERAL 18
ELE24.2.17 VIDEO ENCODER / DECODER 19
ELE24.2.17.010.N GENERAL 19

ELE24.3 INSTALLATION REQUIREMENTS 20

ELE24.3.2 DOORPHONE SYSTEM 20
ELE24.3.2.010.9 GENERAL 20
ELE24.3.2.020.9 ELECTRO-MAGNETIC LOCK 20
ELE24.3.2.030.A DOORPHONE PANEL 22
ELE24.3.2.035.N OCTOPUS CARD DOOR ACCESS SYSTEM (OCDAS) 24
ELE24.3.2.040.9 DOORPHONE CONTROL UNIT 25
ELE24.3.2.050.9 HANDSET 25
ELE24.3.2.055.9 LIGHTING CONTROL INTERFACE PANEL 25
ELE24.3.2.060.A OPERATION SEQUENCE 26
ELE24.3.2.070.A COMBINATION LOCK SYSTEM 28
ELE24.3.2.080.9 WIRING INSTALLATION 29
ELE24.3.2.090.9 STANDBY POWER SUPPLY 29
ELE24.3.2.100.A DOORPHONE SYSTEM FOR SSF COURT ENTRANCE GATES 30
ELE24.3.3 LOCAL CLOSED CIRCUIT TELEVISION MONITORING SYSTEM 33
ELE24.3.3.010.A GENERAL 33
ELE24.3.3.020.A DOORPHONE PANEL 33
ELE24.3.3.030.A LIFT 33
ELE24.3.3.040.A MAIN ENTRANCE / GUARD COUNTER 34
ELE24.3.3.050.A SIDE ENTRANCE 35
ELE24.3.3.055.A ROOF EXIT 35
ELE24.3.3.056.A G/F STAIRCASE EXIT AND OTHER STAIRCASE EXITS 35
ELE24.3.3.057.N EXTERNAL AREA 35
ELE24.3.3.060.A RECORDING 35
ELE24.3.4 LOCAL ALARM AND DOOR MONITORING SYSTEM 36
ELE24.3.4.010.9 LOCAL SYSTEM 36
ELE24.3.4.020.9 INTERFACING WITH THE CENTRAL SECURITY SYSTEM 37
ELE24.3.4.030.9 TELEPHONE SET 37
ELE24.3.5 CENTRAL SECURITY SYSTEM 37
ELE24.3.5.010.A GENERAL 37
ELE24.3.5.020.A CENTRAL ALARM AND DOOR MONITORING SYSTEM 39
ELE24.3.5.030.A CENTRAL CCTV SYSTEM 42

ELE24.3.6 CENTRAL SECURITY SYSTEM SIGNALS TERMINATION BOX 43
ELE24.3.6.010.9 TERMINATION 43
ELE24.3.7 CABLING AND CONNECTIONS 43
ELE24.3.7.010.9 CABLE 43
ELE24.3.7.020.9 CONNECTION 43
ELE24.3.8 EARTHING 44
ELE24.3.8.010.9 GENERAL 44
ELE24.3.9 CCTV AND INTERCOM SYSTEM FOR TEMPORARY REFUGE SPACE 44
ELE24.3.9.010.9 GENERAL 44
ELE24.3.9.020.9 INTERCOM SYSTEM 44
ELE24.3.9.030.A CCTV SYSTEM 46
ELE24.3.9.040.9 WIRING INSTALLATION 47

ELE24.4 TESTING, COMMISSIONING, ACCEPTANCE AND MAINTENANCE 48

ELE24.4.1 PERFORMANCE TESTS, ADJUSTMENTS, COMMISSIONING AND ACCEPTANCE 48
ELE24.4.1.010.9 GENERAL 48
ELE24.4.2 TEST 48
ELE24.4.2.010.B TEST FOR DOORPHONE PANEL 48
ELE24.4.2.020.9 ELECTRICAL TESTS 48
ELE24.4.2.030.A TEST FOR CCTV AND INTERCOM SYSTEM FOR TEMPORARY REFUGE SPACE 49
ELE24.4.3 SCOPE OF WORK DURING MAINTENANCE PERIOD 49
ELE24.4.3.010.A GENERAL 49
ELE24.4.3.020.A QUARTERLY SERVICING 50

ELE24.1 GENERAL REQUIREMENTS

ELE24.1.010.9 INFORMATION FURNISHED WITH TENDER

1. The Tenderer shall furnish the following information, as applicable, with his Tender, which will be considered incomplete without such information:
    a. Name of manufacturer, country of manufacture, type and catalogue number, and full technical performance details, of all major items of equipment offered;
    b. Voltage of operation, and current consumption;
    c. Type and size of wiring;
    d. Illustrated brochures showing all major items of equipment and their installation requirements;
    e. A list of spares and tools included in the offer;
    f. Details of any special works required to be carried out by others.

ELE24.1.020.9 AS-FITTED DRAWINGS

The provisions shall follow the details in ELE1.10.030.

ELE24.1.030.9 ROBUST DESIGN

All equipment shall be of robust design, having a durable nature and of pleasant appearance all to the satisfaction of the Contract Manager.

ELE24.1.040.9 SCREENING

All equipment shall be properly screened and/or shielded against any possible external frequency interference where necessary.

ELE24.1.050.9 DOORPHONE SYSTEM VOLTAGE

1. The Doorphone System shall be operated at not more than 50 V d.c. Where battery is used, an automatic charger shall be provided to maintain the charge, and tapping off from the battery to obtain different voltage levels shall not be allowed;
2. All system components, other than electronic circuits, shall preferably be operated at a single voltage level.

ELE24.1.060.9 SUPPRESSION OF ELECTROMAGNETIC EMISSION

The whole system should be suitably suppressed to fall within the limits allowed by BS EN 55014-1 for electromagnetic emission.

ELE24.1.070.9 WORKS BY OTHERS

The following works interfacing with the security system will be provided by other contractors:

1. Lift Installation
    a. CCTV cameras in lift cars and the associated video cables in lift shaft will be installed by the Lift Sub-contractor. The video cables connected to lift car cameras will be terminated at a connection unit at high level of the entrance lift lobby or otherwise as shown on the Drawings;

b. Volt free contacts will be provided by the Lift Sub-contractor in an interface box in ground floor meter room or otherwise as shown on the Drawings for each lift. The contacts shall consist of the following:

i. Two N.O. contacts for lift alarm, to be closed when the lift emergency alarm push button is pressed;

ii. One N.O. contact to be assigned to each lift landing floor, to be closed only when the lift is at the floor which the contact is assigned to. At any one time, only one of these contacts will be closed;

iii. Two N.O. contacts for lift travel directions, one to be closed when the lift is going up and the other to be closed when the lift is going down. Simultaneous closing of the two contacts will not occur.

All terminals for the dry contacts shall be properly labelled to indicate their functions. Subject to the CM's approval, it is acceptable that digital signals are used in lieu of the above dry contact signals, should an agreement be reached between the Sub-contractor and the Lift Sub-contractor. In this case, the details of communication protocol, data format and the hardware interface shall be clearly defined by the two parties and submitted to the CM for approval.

2. Building Works

The door and guard counter will be provided by the Main Contractor. The Sub-contractor shall coordinate with the Main Contractor on their construction details and make necessary allowance for the installation work.

ELE24.1.080.9 DOCUMENTATION

1. For each equipment offered, tenderers shall supply with the tender full and complete technical information in English sufficiently detailed to enable a technical appraisal of the equipment to be made. Submissions without sufficient information may be discounted;
2. Apart from the documents stipulated in Section ELE1.10, the Sub-contractor shall, within one month prior to equipment delivery, supply the number of equipment handbook in English language as stated in sub-clause (4) giving full details on:
   a. Principle of operations;
   b. Details of installation and setting-up procedures;
   c. Maintenance and operation instructions;
   d. Schematic and block diagrams;
   e. Circuit diagrams with details down to component levels with their respective descriptions;
   f. Printed circuit board layout;
   g. Calibration procedures;
   h. Full parts list; and
   i. If microprocessors are used, all program storage devices (ROM's, EPROM's etc.) shall be supplied with comprehensive part and version numbers for ordering of replacement; additionally, the method of generation/ duplication of the data in the storage device shall be given.
3. Should any Original Equipment Manufacturer (OEM) products be included, the documents as specified in sub-clause (2) above shall also be provided;

4. Three sets of the manufacturer's operations and maintenance manuals in English shall be provided with each equipment ordered, up to a maximum of six sets per model of equipment. The following table indicates the number of documents required:

No. of equipment per model	Sets of manufacturer's operation and maintenance manuals required
1 - 2	3 (at least 1 original)
3 - 5	4 (at least 2 originals)
6 or more	6 (at least 3 originals)

5. The Sub-contractor shall supply "As-fitted" drawings showing the positions of all items of equipment installed and the routing of interconnecting cables;

6. The Sub-contractor shall not use confidentiality as a reason for withholding the supply of relevant documentation required by Contract Manager. The Contract Manager's representative will if required certify that all sensitive material in handbooks will not be released to any organisation outside Contract Manager. Any charges for such material supplied shall be included within the Contract. The Sub-contractor should make sure that all his overseas/local principals understand such obligation when submitting tender;

7. The Contract Manager shall be granted the right of duplicating the documents stated above for internal use;

8. The Contract Manager shall be kept informed of any recommended modifications during the operational life of the equipment.

ELE24.1.090.9 EXECUTION OF THE WORK

The Sub-contractor shall verify to the satisfaction of the Contract Manager that they are licensed for carrying out type III security work under the Security and Guarding Services Ordinance Cap. 460 and are competent to complete the works, otherwise they shall employ a competent contractor, who has the required licence, to carry out the works. For the latter case, the Sub-contractor shall submit the proposed contractor's relevant information related to the licence, technical capability, working experience on security system to the Contract Manager for approval. Whenever necessary, the Sub-contractor shall also submit document and drawings for the completed projects to the Contract Manager for consideration. Inspection of the completed projects and visit of the proposed contractor's office and workshop may be conducted, if deemed necessary.

ELE24.2 EQUIPMENT OF SECURITY SYSTEM

ELE24.2.1 CCTV VIDEO CAMERA

ELE24.2.1.010.A GENERAL

1. The video camera shall be of internet protocol (IP) type. The IP camera shall be equipped with RJ-45 10/100Mbps self-adaptive Ethernet port for network communication. The IP camera shall be Open Network Video Interface Forum (ONVIF) / Internet Server Application Programming Interface (ISAPI) compliant to enhance interoperability;
2. The colour digital video signal shall conform to the ITU-T H.264 / MPEG-4 Advanced Video Coding (AVC) and / or ITU-T H.265 / MPEG-H Part 2 High Efficiency Video Coding (HEVC) and / or Motion JPEG video compression standard;
3. Each video camera shall house the lens, image pickup devices, electronic circuitry and sync pulse generation circuit. The camera imaging devices shall be of the solid state charge-coupled device (CCD) sensor or complementary metal-oxide semiconductor (CMOS) sensor;
4. The construction of the camera body shall be rugged and compact. The camera shall be capable to operate directly from 220V a.c. mains or operate at a lower d.c. or a.c. supply voltage, e.g. 12V d.c. or 24V a.c. mains or Power over Ethernet (PoE) complying with the IEEE 802.3af or 802.3at;
5. The image transfer mechanism of the CCD sensor shall be either interline transfer (IT) or frame interline transfer (FIT); or CMOS sensor shall be using progressive scan technique. The dimension of the sensor shall not be less than 1/2.8". In general, the resolution shall be 4 mega pixels (4MP) to 0.3 mega pixels (0.3MP) adjustable and the frame rate shall be not less than 25fps@4MP;
6. The signal to noise ratio shall not be less than 50dB and the dynamic range shall not be less than 60dB;
7. The video camera shall be provided with gamma correction circuitry;
8. The video camera shall be well-shielded against radio frequency pickup;
9. The colour video camera shall be provided with automatic white balance control;
10. The camera shall be with wide dynamic range (WDR), backlight compensation (BLC) and highlight compensation (HLC) technology to provide clear image in the environment of strong brightness contrast;
11. The minimum illumination such that the camera is capable to capture a visible and clear image shall be 0.01 lux at F1.6;
12. The video camera shall be equipped with electronic shutter speed control mode (either manual or fully automatic) covering the range from 1/8 to 1/10,000 second;
13. For pan-tilt-zoom camera, its built-in motor shall be computer controlled and shall move quietly when seeking a preset location or at variable speeds when tracking a target during manual operation. The pan travel and tilt shall be 360° continuous and 90° respectively. Auto-pan function shall be included. Not less than 4 times optical zoom and 16 times digital zoom shall be provided;

14. For dome-type camera, the quality of the image capture through that cover shall not be sacrificed under normal lighting condition;

15. For outdoor camera, the camera shall be capable to operate at an ambient temperature of -10°C to 55°C. The camera shall be equipped with infrared light source illumination such that it is capable to capture a visible and clear image or video recording at 0 lux in dark environment. The working distance of the infrared light source shall not be less than 30 metres. Provision shall also be allowed for adjusting the direction and angle of outdoor camera to prevent direct facing the sunlight.

ELE24.2.1.020.X DELETED

ELE24.2.1.030.X DELETED

ELE24.2.1.040.X DELETED

ELE24.2.1.050.X DELETED

ELE24.2.1.060.X DELETED

ELE24.2.1.070.X DELETED

ELE24.2.1.080.A CAMERA MOUNTING

1. Each camera shall be provided with a camera mounting which mechanically couples the camera to a wall or ceiling or parapet or pole so that the camera assembly can be suitably and stably located;

2. The mounting design shall allow free motion of the pan and tilt movements of the camera. The design of the mounting shall also take into account of the structural or architectural support where the camera mounting is fixed;

3. The mounting shall provide a field-adjustable mechanism and a suitable mechanical joint so that the camera assembly can be swung or tilted to the appropriate surveillance direction and locked into this particular position;

4. The colour of the camera mounting shall preferably be the same as that of the camera casing.

ELE24.2.1.090.N LENS

1. All video camera shall be equipped with auto-iris lenses;

2. If the lens is motorised for remote control, the response time of the following adjustment shall not be more than:

   a. full range iris control : 1.5 seconds;

   b. full range focus control (1 m to infinity) : 11 seconds;

   c. zoom control : speed of zoom shall be such as to double the field of view in 2.5 seconds.

   Operation of motorised drives for these controls shall not cause any radio frequency radiation or interference to the video signal, e.g. patterning, noise streaks, etc;

3. All video camera shall be equipped with fixed focal length lens unless otherwise specified. If motorized varifocal lens is required, the focal length shall be at least in the range of 2.8mm to 12mm.

ELE24.2.1.100.N CAMERA CONSTRUCTION

1. All indoor and outdoor cameras shall be fitted with integral protective casing. The casing shall accommodate the camera provided, complete with lens and other accessories. The outdoor camera casing shall be sturdy and tamper-proof and comply with IEC 62262 – IK10 impact-resistant casing. Notwithstanding, with the aid of tools, operation and maintenance staff shall gain ready access to the camera and other accessory of the cameras or casing for maintenance and cleaning purposes;
2. All power, control and video cables entering or leaving the camera externally shall be protected by a conduit;
3. The environmental protection rating of indoor camera shall be at least IP42; whereas, outdoor camera shall be at least IP66.

ELE24.2.1.110.N CAMERA WITH PAN AND TILT FUNCTION

1. Where specified on Drawings, camera with pan and tilt function shall be provided. The mechanism shall be capable of panning and tilting a camera and lens combination, as a minimum the following ranges:
   a. Pan : up to 360°
   b. Tilt : up to + 45° to -45° from the horizontal plane
2. Upon maximum load condition, the pan and tilt speed shall not be less than 7 degrees and 5 degrees per second respectively.

ELE24.2.2 LED VIDEO MONITOR

ELE24.2.2.010.A GENERAL

1. The LED video monitor shall be capable to handle both digital and analogue television / video signals. It shall be of either LCD panel lit with LED backlight or self-illuminated OLED panel;
2. The LED colour video monitor shall meet, but not be limited to, the following performance requirements:

(a)	Screen Size	24 inch (minimum viewable not less than 23.8”) or otherwise specified on the Drawings
(b)	Horizontal and Vertical Viewing Angle	150° or larger
(c)	Native Resolution	1920 (H) x 1080 (V) or better
(d)	Brightness	Not less than 250 cd/m2
(e)	Contrast Ratio	1000 : 1 or better
(f)	Input Terminal	HDMI, VGA
(g)	Power Source	220V AC + 10%, 50/60 Hz
(h)	Support Languages for On-screen instruction	English and Traditional Chinese

3. The video monitor shall be supplied with mounting hardware for desk mount, ceiling mount, wall mount and floor standing to suit the installation requirements.

ELE24.2.3 VIDEO DISTRIBUTION AMPLIFIER

ELE24.2.3.010.X DELETED

ELE24.2.3.020.X DELETED

ELE24.2.3.030.X DELETED

ELE24.2.4 NETWORK VIDEO RECORDER (NVR)

ELE24.2.4.010.A TECHNICAL REQUIREMENTS

1. The network video recorder (NVR) shall be designed for professional video, audio surveillance and alarm monitoring applications including recording, playback and signal transmission simultaneously. The NVR shall be Open Network Video Interface Forum (ONVIF) / Internet Server Application Programming Interface (ISAPI) compliant to enhance interoperability;
2. The NVR shall support recording of not less than 16 video inputs from IP camera;
3. The NVR shall compress and store the images received in its internal removable hard disks with a total data storage capacity not less than 28 days and minimum 4TB for 16 camera inputs simultaneously and which can be expandable for longer time continuous recording. The incoming bandwidth (bitrate) of NVR shall be not less than 96Mbps. The NVR shall be able to record at a minimum resolution of at least 1080 horizontal lines with at least 25 frames per second for each channel under the condition of at least 16 input channels simultaneously;
4. The NVR shall support displaying of live video images from connected cameras either in full screen, 2x2, 3x3 or 4x4 multiplexed screen modes and displaying recorded images . The NVR shall support 1080p and other High Definition video format including 1920x1080p, 1920x1080i, 1280x720p, 720x576p and 720x576i. Compression technique of H.264 and / or H.265 shall be provided. The decoding capacity of the NVR shall be capable of displaying at least one full sized 8MP stream at a time or four 1080p cameras across the board;
5. The NVR shall operate in multiplex manners including simultaneous local live viewing, recording, playback and network transmission without causing any adverse effect to the performance of each other in any circumstances. The NVR shall allow independent configuration of resolution, frame rate, bit rate and image quality for each channel, and support pause, play reverse, speed up, speed down, skip forward & skip backward when playback;
6. The network transmission of video signal from NVR to the networked PC at remote site shall comply with Transmission Control Protocol / Internet Protocol (TCP/IP) and the NVR shall support 10/100/1000Mbps Ethernet interface;
7. The NVR shall be equipped with alarm inputs to perform pre-selected function (i.e. image captured from the camera with the alarm being triggered, shall be popped up and displayed in full at the main monitor). The system operation shall automatically resume to normal after the pre-set time period;
8. The number of alarm inputs shall match with the number of video inputs;
9. The NVR shall allow the user to define the duration for event recording with a pre-event recording period not less than 3 seconds and for post-event within a range from minimum 1 to 99 seconds adjustable;

10. The NVR shall allow continuous recording and shall overwrite the oldest recorded images under a first in first out approach when all the hard disks are full. The DVR shall also allow an adjustable pre-set recording days of storage from 7 to 30 days;

11. The NVR shall be able to preserve the last setting used in system preferences and automatically resumed operation on resumption of power after interruption;

12. The NVR shall function as a standalone unit without the use of a personal computer for operation of live view or playback of video images. The status of the NVR shall be monitored on front panel or display monitor and control of NVR shall be operable through the front panel controls for the following:

    a. Indicate time and system operation condition;

    b. Start and stop recording;

    c. Control pause, stop, playback, fast forward / reverse and playback speed;

    d. Access on-screen search functions by event, date and time;

    e. Access / select the menu function on-screen;

f. Pan / tilt / zoom control of CCTV camera.13. The NVR shall be equipped with at least 2 nos. of spot monitor outlet(s) independent of the main monitor (tower guard). The main monitor shall be able to display up to 16 cameras on a single screen simultaneously either under playback or real time display condition. The spot monitor(s) shall only be able to display one selected camera or to display up to 16 cameras sequentially with one at each time. Alternatively, if spot monitor outlets are not built-in in the NVR, the Sub-contractor shall provide decoder for connection of 2 nos. of spot monitors;

14. The NVR shall provide alarm signal for the events including triggering from external alarm, detectors, video motion detection, video signal loss from camera, power interruption, hardware failure and hard disk overheat warning signal;

15. The NVR shall provide indication on screen whether the input video signal from each camera is under recording or not;

16. The network video recording system shall be able to search alarm for playback according to events. The alarms shall be logged and reported;

17. The NVR shall provide not less than 20 x 16 masking grids on each camera input for selection of area for video motion detection. The sensitivity level of the video motion detection shall also be configurable;

18. All images exported from the NVR can also be viewed on a networked PC at the remote sites through LAN or Internet via a proprietary software player provided by the NVR Manufacturer at no extra cost;

19. The proprietary software player shall be compatible for operation on a PC with Windows 10 or the latest version of Windows or other operating system to the satisfaction of the CM and also have a multi-site video reception software allowing for connection up to 16 nos. of networked NVRs at different sites under any pre-selected grouping of cameras for viewing on one screen of a designated networked PC simultaneously;

20. The NVR shall have multi-level login hierarchy for access by administrator, supervisor and operator at local or remote site to the system for setting of the operation configuration and normal operation of the NVR;

21. A standard USB style connector of latest version shall be provided at the NVR for interfacing with the USB flash drive, DVD writer or external hard disk for video backup functionality;

22. The backup video data file copied from the NVR can be viewed on any other PC via the proprietary player as mentioned in item 18 and 19 above which shall be free licence to the Authority;

23. The NVR shall incorporate digital watermark recording function. Letter issued by the NVR Manufacturer certifying the reliability / authentication of watermarking feature shall be provided under the Sub-contract;

24. The NVR shall be integrated with a built-in real-time clock capable of configuring the system's time and date for display. On-screen display shall include the date, time, camera location, hard disk currently under recording mode and site description name up to 12 alpha-numeric characters;

25. Date shall be displayed by 8 digits composite with year (4 digits), followed by month (2 digits) and day (2 digits) under the format of YYYYMMDD;

26. System time shall be synchronized among IP camera, NVR and PC. Time shall be displayed in international time by 6 digits composite with hour, minute and second under 2 digits each under the format of hhmmss;

27. All alpha-numeric characters displayed on screen shall be white in colour and edging with thick black colour lines;

28. NVR shall provide with HDMI and VGA output ports for cable connections to other video equipment;

29. 3-core 2 m long PVC insulated and PVC sheathed power cable shall be provided with the NVR. One end of the power cable shall be properly connected to the supply terminals inside the NVR while the other end of the cable shall be connected with a 13A 3-pin plug;

30. Operation manual both in English and Chinese shall be provided for each NVR. Each NVR shall be under individual packing with all accessories, hard copy of the operation manual and CD-ROM corresponding to the proprietary video software player as mentioned in items 18 and 19 for the system operation and backup;

31. The NVR shall have the mask function for every channel. When the area of a channel is masked, the image of the area then cannot be viewed by the monitor but can be recorded by the NVR;

32. Once the video images exported from NVR are being edited, these video images shall not be read at the proprietary remote client software to ensure the video integrity. The message “This is NOT the original images” or equal and equivalent with the agreement from the CM or his representatives shall also be shown on the screen;

33. Time-clock shall be avoided to display on individual channel screen but they must be stamped on the recorded films;

34. Fixed font size characters display on the screen shall be provided whenever in full screen, 2x2, 3x3 or 4x4 multiplexed screen modes.

ELE24.2.6 QUAD MULTIPLEXER

ELE24.2.6.010.X DELETED

ELE24.2.7 TELEPHONE SET

ELE24.2.7.010.9 GENERAL

1. The telephone set shall be a model certified by OFCA as in conformance with the relevant OFCA's standard. The telephone set shall have the following feature:
   a. Hands-free speaker phone;
   b. 28 Telephone memory;
   c. One touch redial;
   d. Wall mounting;
   e. Tone / pulse dialling.
2. The telephone set shall be submitted to the Contract Manager for approval.

ELE24.2.8 CABLES

ELE24.2.8.010.9 GENERAL

1. Singlecore cables shall conform to BS EN 50525-2-31 and the conductor size shall be not less than 1.0 mm^2. Multicore cables to be installed inside buildings shall be of copper conductor/PVC insulated/PVC sheathed non-armoured type with tinned copper drain wire and colour identification for cores. The conductor size shall be not less than 0.5 mm diameter Contract Manager's approval is required prior to the installation of cables;
2. Multicore cables to be installed underground shall be of copper conductors/PVC insulated/PVC inner sheathed/steel wire armoured/PVC sheathed type with colour identification for cores. The conductor size shall be not less than 0.5 mm diameter Contract Manager's approval is required prior to the installation of cables;
3. Non-armoured cables shall be installed in trunking/conduit systems and armoured cables shall be installed in underground galvanised steel/PVC ducts outside the building boundaries. A system of trunking/conduits and underground galvanised steel/PVC ducts shall be provided by the Sub-contractor for the Doorphone System installation as shown on the drawings, the Sub-contractor shall also be responsible for any additional provision to complete the installation;
4. Multicore cables shall be terminated at fixed terminals. Where cable termination blocks are used, they shall be of suitable size for the conductors;
5. Movable parts shall be connected to the system by means of flexible cables;
6. Labels shall be provided at visitor's panels, indicating panels, control panels, cable termination/junction boxes etc. to identify the function (e.g. door lock release) of the respective core of the outgoing cables;
7. The colour code of the wiring for the doorphone system shall comply with BT CW 1293 or IEC 60708-1.

ELE24.2.8.020.9 VIDEO CABLES

1. Video cables shall be of the coaxial type with a single central core of annealed copper. The dielectric shall be polythene with a shield of copper braid or tape. The cable shall be insulated with an overall sheath of PVC;
2. The attenuation characteristic of the cable shall be better than:
    a. 1.1 dB/100 m at 1 MHz;
    b. 3.8 dB/100 m at 10 MHz;
    c. 13.5 dB/100 m at 100 MHz.
3. Unless total conformance to a relevant recognised international standard, which is subject to Contract Manager's approval, is achieved, the cable shall have the following characteristics:
    a. Strand diameter not to be less than 0.58 mm;
    b. Dielectric diameter not to be less than 3.71 mm;
    c. Outer conductor diameter not to be less than 4.39 mm;
    d. Nominal overall diameter not to be greater than 6.2 mm;
    e. Capacitance not to be more than 67 pF/m;
    f. Bending radius not to be less than 60 mm;
    g. Weight not to be less than 55 kg/km;
    h. Characteristic impedance to be 75 ohm ± 3 ohm;
    i. Return loss ratio to be better than 20 dB at 10 MHz;
    j. Insulation resistance to be not less than 30 M ohm per km.

ELE24.2.8.030.9 CONTROL CABLES

1. Control cables shall be of the multicore type. Each core shall be made up of stranded annealed copper conductors with PVC insulation. The whole cable shall be screened with copper tape or copper braid and shall have an overall sheath of PVC;
2. The cable shall satisfy the following minimum characteristics:
    a. At least 7 strands per conductor.
    b. Strand diameter not to be less than 0.2 mm;
    c. Conductor resistance to be less than 90 ohm/km;
    d. Insulation resistance to be better than 20 Mohm/km measured between cores or between core and screen.

ELE24.2.8.040.9 RADIO FREQUENCY CABLES

The radio frequency cable shall comply with BS EN 50117-1 and BS EN 50117-2-1 and BS EN 50117-2-2 and BS EN 50117-2-3 and BS EN 50117-3 and BS EN 50117-4.

ELE24.2.8.050.9 OPTICAL FIBRE CABLES

The optical fibre cable shall be of multimode type with minimum 4 cores of 62.5μm diameter.

ELE24.2.8.060.N LOCAL AREA NETWORK (LAN) CABLES

The Category 6 UTP copper cables compliant with IEC 11801-1 Class E, ANSI/TIA 568.C2 shall be provided for the IP camera system.

ELE24.2.8.070.N HIGH-DEFINITION MULTIMEDIA INTERFACE (HDMI) CABLES

The HDMI cable shall be of premium high-speed HDMI cable. The cable shall be suitable for reliable transfer of 4K@60Hz resolution video. The cable bandwidth support is 18Gbps and is optimized for HDMI version 2.0.

ELE24.2.9 SEMICONDUCTOR DEVICES

ELE24.2.9.010.9 GENERAL

Unless otherwise specified or a particular application requires the use of other types, semiconductor devices shall be of silicon type, and shall have instantaneous electrical characteristics capable of handling the transient power, voltage and current which the devices may encounter in the circuit. The continuous power, voltage and current ratings of the semiconductor devices shall be not less than 1.5 times the respective maximum value at which the devices are intended to operate. Power devices shall be mounted on adequately sized heat sinks.

ELE24.2.10 CAPACITORS

ELE24.2.10.010.9 GENERAL

Capacitors shall have a nominal working voltage of not less than 1.5 times the maximum voltage at which they are intended to operate. The values of the nominal working voltage and capacitance shall be marked on the body of the capacitor.

ELE24.2.11 RESISTORS

ELE24.2.11.010.9 GENERAL

Resistors shall have resistance values better than ± 5% tolerance and, continuous power rating of not less than 1.5 times the maximum power which the resistors shall dissipate. The values of resistance and tolerance shall be marked on the body of the resistors.

ELE24.2.12 PRINTED CIRCUIT BOARDS

ELE24.2.12.010.9 GENERAL

All electronic circuits shall be fabricated on printed circuit boards. Printed circuit boards shall be of fibre glass material and all conducting parts shall be tin plated. Connections between circuit boards and from circuit boards to outgoing circuits shall be of plug-in type to facilitate easy replacement. Direct soldering of outgoing cable onto printed circuit boards shall not be allowed.

ELE24.2.13 MAGNETIC DOOR CONTACT

ELE24.2.13.010.9 GENERAL

1. Magnetic door contact shall be equipped with completed concealed magnetic switch and shall be recessed mounted into the door;
2. The design shall offer years of positive fail-safe separating power when door is opened even after years of being held closed. When the door is closed, high contact force shall be developed to ensure proper contact;
3. The magnetic door contact shall be U.L. listed for the application.

ELE24.2.14 EQUIPMENT RACK

ELE24.2.14.010.B GENERAL

1. Equipment rack made of 1.2 mm sheet steel shall be provided in meter room or ELV equipment room or other areas as shown on the Drawings to house the security equipment. There shall be lockable panels at the front and back of the rack. The front panel shall be glass. The rack shall be modular in design such that the trays and sliding shelves can be added or deleted if required;
2. The rack shall consist at least the following types of basic modules:
    a. Ventilation fan module;
    b. Power distribution panel;
    c. Cable trays;
    d. Illuminating lamp.
3. The size of rack shall be suitable for standard 483 mm rack mounted equipment with standard rack aperture;
4. The rack shall be painted with stove enamel paint of Approved colour;
5. Security equipment such as network video recorder (NVR), patch panel, router, ethernet switch, amplifiers, cable accessories etc., situated in a common location shall be housed in a single equipment rack. A spare space for the installation of one additional NVR in the future shall be provided in the equipment rack housing NVR.

ELE24.2.15 UNINTERRUPTED POWER SUPPLY

ELE24.2.15.010.A GENERAL

1. The Sub-contractor shall provide the following Uninterrupted Power Supply (UPS) systems for continual and uninterrupted power supply of security systems and other equipment as shown on the Drawings:
    a. Central UPS system for backup power supply duration of not less than two (2) hours in case of mains failure for the following systems and equipment of domestic block:
        i. CCTV and intercom system for temporary refuge space;
        ii. Local CCTV system;
        iii. Doorphone system;
        iv. Local alarm and door monitoring system;

v. Lift car CCTV system including CCTV camera and LED video monitor, etc.;

vi. Exit route & roof lighting indication panel;

vii. Lift alarm indication panel.

b. Central UPS system for backup power supply duration of not less than two (2) hours in case of mains failure for the following systems and equipment of Estate Management Office (EMO):

i. Central CCTV System;

ii. Central Alarm and Door Monitoring System;

iii. Local CCTV system;

iv. Local security alarm system.

2. The UPS system shall consist of UPS equipment, external maintenance bypass switch, MCB distribution board and all necessary cable wirings and accessories to form a complete working system as shown on the Drawings;

3. The Sub-contractor shall submit the sizing calculation for the kVA rating of the UPS and the battery capacity required to the CM for approval. In any case, the UPS equipment shall have a capacity of providing back-up power of duration not less than two (2) hours with 30% spare capacity.

ELE24.2.15.020.9 TECHNICAL REQUIREMENT OF UPS EQUIPMENT

1. The UPS shall be of static online double-conversion type conforming to IEC 62040. It shall consist of rectifier/charger, batteries, inverter and internal static transfer switch;

2. The UPS shall operate in three different operating modes:-

a. Normal mode

Under normal operation, the rectifier/charger unit shall convert the incoming a.c. mains power supply to d.c. power. The rectifier/charger unit output shall feed the inverter and charge up the batteries simultaneously. The inverter shall convert the d.c. power into a.c. mains power which feeds the load;

b. Discharging mode

Upon failure of the incoming a.c. mains supply, the inverter and the batteries shall continue to supply power to the load without interruption or disturbance. The UPS shall continuously run in this discharging mode until the batteries fully discharge or the incoming a.c. mains supply returns to normal at which the UPS returns to normal mode;

c. Bypass mode

The UPS shall automatically transfer the load via the internal static transfer switch to the incoming a.c. mains supply by-passing the rectifier/charger unit, batteries and inverter without any interruption when the UPS is overloaded or faulty.

3. The UPS shall include the following control and monitoring facilities on display panel of UPS:-

a. Mains on/off switch;

b. ‘Bypass Mode’ manual on/off switch;

c. Alarm reset/buzzer mute switch;

d. Indicating lights for load %, battery charge %, "UPS On" and "Mains Available";

e. Audio and visual alarms for "Mains Failed", "On Battery", "On Internal Static Transfer Switch", "Low Battery" and "UPS Fault".

4. The overall efficiency of the UPS, output to input, shall not be less than 88% when the UPS is operating at 50 - 100% rated load;

5. The UPS shall comply with the energy efficiency requirements for power quality as stipulated in the BEC;

6. The UPS shall be constructed in heavy duty metal enclosures and designed for floor or rack mounted to suit the site condition;

7. The UPS shall be natural air cooled or forced air ventilated to ensure that all components operate within their environmental ratings;

8. The UPS equipment shall be equipped with a device to protect batteries from over-discharging;

9. The UPS equipment shall allow minimum 30% spare capacity for future expansion.

ELE24.2.15.030.9 TECHNICAL REQUIREMENT OF UPS BATTERY

1. The batteries shall be valve regulated sealed lead acid batteries complying with IEC 60896-22, maintenance free with a design life of minimum 10 years rated at 20℃;

2. The batteries, after fully discharged, shall be fully charged in less than 10 hours.

ELE24.2.15.040.9 TECHNICAL REQUIREMENT OF EXTERNAL MAINTENANCE BYPASS SWITCH

1. External maintenance bypass switch shall be provided as shown on Drawings to allow maintenance personnel to manually isolate the UPS equipment from the load for maintenance purpose and connect the load directly to the incoming a.c. mains supply via external bypass connection using manual changeover switch;

2. The external maintenance bypass switch shall be of changeover switch manually controlled at mains voltage, either double-pole or four-pole type and tested to IEC 60947-3. The changeover switch shall be capable of making, breaking and carrying continuously the rated current and making on fault without overheating, damage or deterioration;

3. The external maintenance bypass switch shall be housed inside a lockable metal box which shall be operated by maintenance staff only.

ELE24.2.16 NETWORK SWITCH

ELE24.2.16.010.N GENERAL

1. Network switch shall be used for the switching of digital video transmission based on Internet Protocol;

2. Power over Ethernet (PoE) power supply shall be provided so that the network switch can provide power to the PoE type equipment;

3. The network switch shall provide Ethernet ports. Each port shall support 10/100/1000 Mbps connection speed. For cameras running on PoE, switch port shall be built-in with 802.3af and / or 802.3at PoE support by optional PoE inline adapter;

4. 10% spare Ethernet ports shall be allowed in each network switch for future expansion use.

ELE24.2.17 VIDEO ENCODER / DECODER

ELE24.2.17.010.N GENERAL

1. The digital video encoder / decoder shall use of compression technology conforming to the ITU-T H.264 / MPEG-4 Advanced Video Coding (AVC) and / or ITU-T H.265 / MPEG-H Part 2 High Efficiency Video Coding (HEVC) and / or Motion JPEG video compression standard;
2. It shall be capable of streaming video images from camera input at minimum 25 fps under all conditions of motion with the image, at the resolution of 4MP;
3. The digital video encoder shall be a video transmitter capable of digitally encoding a full motion video with the selected compression technology;
4. The digital video decoder shall be a video decoder capable of accepting digitally encoded digital stream and converting it into video format;
5. The digital video encoder / decoder shall be provided with HDMI input / output.

ELE24.3 INSTALLATION REQUIREMENTS

ELE24.3.2 DOORPHONE SYSTEM

ELE24.3.2.010.9 GENERAL

1. The doorphone system shall be of digital selection and display type complete with secret code door lock release feature. The system shall provide high fidelity communication between the visitors at the main entrance and the occupants in a particular flat of whom the visitors intend to visit. The system shall enable the occupant to remotely release the entrance door lock to allow the visitors to enter the building by operating a switch on the handset located within the flat;
2. The doorphone system shall only permit communication and control between the selected flat and the doorphone panel/door lock at the main entrance of the building. All flats which are not selected shall be cut off from the system, voice transmission to and from these flats and operation of the door lock release through the handsets in these flats shall be inhibited intrinsically by the system;
3. For linked blocks, the visitor panel shall be provided in the main entrance of the joint entrance lobby as shown on the drawings. In addition to the requirements as detailed in ELE24.3.2.030, a set of block selection feature shall be provided in the visitor panel. Once the block is selected in the panel, the operation sequence of the system shall follow the details in ELE24.3.2.060;
4. The operation of the doorphone system shall not be affected by any fault or incorrect wiring in any handset or prolonged removal of the handpiece of a handset from its base unit. If a handpiece is removed from its base unit without being called by a visitor from the doorphone panel, this handset shall be disconnected from the system and the services to other handsets shall be maintained. Once the disconnected handset is put back to the base unit properly, the service to this handset shall resume. If there is any faulty or incorrect wiring connection for a handset due to installation mistake or unauthorised alteration, the system shall be able to detect this condition and disconnect this handset automatically and maintain services to other handsets.

ELE24.3.2.020.9 ELECTRO-MAGNETIC LOCK

1. This clause shall be read in conjunction with the Drawings for electro-magnetic lock installation details;
2. The main entrance and side entrance shall be provided with electro-magnetic locks which shall have no mechanical moving parts. The lock shall be UL listed as a releasing device for exit door;
3. The lock shall provide instantaneous unlocking with no residual magnetism upon interruption of power supply;
4. The magnet core shall be permanently sealed by epoxy resin in a metal casing to form an integral magnet assembly. For recess-mounted application, the magnet assembly shall be secured to the door frame in such a way that loosening or undoing of any or all fixing screws on the magnet assembly shall not result in the assembly itself being pulled out from the recess aperture when the door is being opened by force;
5. The lock shall be fail-safe type. When power is cut off, the lock shall be automatically released to allow door opening. The lock shall also be automatically unlocked in case of mains power failure despite standby power supply is available;

6. The lock shall be equipped with a built-in lock status sensing device with dry contact output to positively indicate that the door is secured;
7. Installation of the electro-magnetic lock shall be in accordance with the standard details shown on the Drawings and all required mounting hardware / accessories shall be either supplied or approved by the manufacturer of electro-magnetic lock. The installation method shall be endorsed by the manufacturer of electro-magnetic lock as appropriate for their product in case the actual details differ from manufacturer's own standard methods;
8. The lock shall operate at low voltage of d.c. 12V and consume low current of not more than 400 mA. When locked, the traction force shall not be less than 226.8 kg. Even if the lock is forced open by excessive force, it shall not be damaged and shall be re-locked immediately afterwards;
9. Other provisions for the electro-magnetic lock shall include:
    a. Bypass key
        i. There shall be a keyswitch at the bottom of the doorphone panel and combination lock panel outside the entrances. Upon turning the keyswitch, power for the electro-magnetic lock shall be cut off and free access shall be allowed;
        ii. 5 sets of keys for the entrance door lock shall be provided by the Sub-contractor at the completion of the works to the Contract Manager.
    b. Door release
        i. A door release button shall be provided at the inside of the building and adjacent to each main and side entrance such that by pressing this button, the corresponding electro-magnetic lock shall be released for an adjustable period of 1 to 30 seconds. The lock shall be relocked after the expiry of the timer period. The button shall be fitted on a stainless steel plate and flushed mounted with the surface of stainless steel plate. The button borderlines shall be self-illuminated in green colour when the door is locked and change to red when the door is unlocked. The signals to change the illumination colour of button borderlines shall be derived from the output of the built-in lock status sensing device in the electro-magnetic lock;
        ii. Another door release button shall be provided at the guard counter for releasing the door lock of the main entrance by the tower guard. The lock shall be relocked after an adjustable period of 1 to 30 seconds;
        iii. The door release button shall be vandal resistant and suitable for operation under extreme humid condition. The button shall be submitted to the Contract Manager for approval.
    c. Emergency door release
        i. An emergency door release shall be provided adjacent to each main and side entrance on the inside of the building. Upon actuation of an emergency door release, power to the corresponding electro-magnetic lock shall be cut directly, not through a control circuit. The entrance shall then serve as an emergency exit. At the same time an alarm signal shall be indicated at the tower guard counter and sent to the security control room through the central alarm and door monitoring system, if available, for reporting of emergency;

ii. Emergency door release shall be of direct operation type equipped with resettable frangible element. The release shall comprise an electrical contact which will operate automatically upon displacing the resettable frangible element at the operating face of the release. Cover of the release shall be locked in position with a special tool and the frangible element shall be clipped firmly into place. The release shall be equipped with transparent hinged protective cover which shall be proprietary product for the emergency door release. The release and its mounting box shall be of pleasing appearance and styling, constructed by non-corrodible materials and finished in green colour. The release shall be engraved with the following labels in Chinese and English, "Emergency Door Release" and "緊急開門掣". All characters and letters on release shall be in white colour;

iii. A permanent operation instruction plate shall be provided above the emergency door release.

d. Safety measure

The circuit for controlling the supply to the electro-magnetic lock shall be designed such that the failure of any electronic components shall cause all the electro-magnetic door locks to be released.

e. Spare parts

A spare and complete set of mounting accessories such as washers, roll pins, centre bolts and lock nuts in labelled packing shall be handed over to the Contract Manager for each electro-magnetic lock at the completion of the works.

ELE24.3.2.030.A DOORPHONE PANEL

1. At each main entrance of the domestic block positioned as shown on the Drawings, the Sub-contractor shall supply and install a vandal proof panel with stainless steel faceplate comprising, but not limited to:

a. A set of numerical floor number selection push buttons (from 0 - 9), and an alphabetical "G" button for ground floor where necessary;

b. A set of numerical, or alphabetical as specified, flat number selection push buttons;

c. An Octopus Card reader, reader controller and network controller;

d. A reserved space for future provision of other door access device(s), such as QR code system;

e. A "Combination Lock" push button for the selection of secret code combination door lock;

f. A 5 x 7 dot matrix yellow LED display unit of sufficient digits to display the particular floor and flat number being selected. All LED in the display unit shall have equal and steady brightness. The display shall be right hand justified;

g. Self-illuminated operating instruction displayed in English and Chinese for the following:

PLEASE WAIT	請等候
PLEASE TALK	請通話
PLEASE ENTER	請進入
NO ANSWER	無答覆

INCORRECT INPUT, PRESS "CLEAR", INPUT AGAIN	輸入錯誤，按「取消」，重新輸入
SWIPE CARD AGAIN	重新拍卡

h. Voice message generator for giving audible instructions in either Cantonese or both Cantonese and English as directed by the CM for the following status:

PLEASE WAIT	請等候
PLEASE ENTER	請進入
NO ANSWER	無答覆
WRONG NUMBER, PLEASE PRESS THE CLEAR BUTTON AND TRY AGAIN	輸入錯誤 , 請按取消掣 重新輸入
SWIPE CARD AGAIN	重新拍卡

The voice message generator shall provide high quality audible instruction using digital data compression technique. The voice message generator shall provide 5 individual pre-recorded messages for a total time period (for 5 messages) of not less than 90 seconds. The generator shall accept 5 digital control inputs to output the 5 individual pre-recorded messages. The length of individual message shall be variable from 0 to 90 seconds. All messages shall be approved by the CM prior to being programmed into the memory of the generator. The voice output level shall be adjustable and the maximum level shall not be less than 60 dB at a distance of 1 metre from the panel.

i. A set of high fidelity and sensitivity two way communication unit. The output shall be clearly audible of at least 60 dB at a distance of 0.5 metre from the panel;

j. A "Clear" push button switch for resetting of incorrect entry of floor / flat number;

k. A push button for communication with the guard counter if specified on the Drawings;

l. A CCTV camera;

m. All push buttons shall be vandal resistant and weatherproof. Keypads shall be vandal resistant and weatherproof. All push buttons with numerical or alphabetical figures shall be back-lit by LED through plastic insert forming the figures. The figures shall be flushed with the surface of push button without protruding edge. The colour of the insert shall be red unless otherwise specified on the Drawings. The LED, with a life span of 35,000 hours minimum, shall be on throughout the operation of the panel. Keypad and push buttons shall be submitted to the CM for approval;

n. A Block selection feature shall be provided for linked block design;

o. Braille instructions as specified on the Drawings.

2. The Sub-contractor shall submit drawings for the arrangement of the "Doorphone Panel" to the CM for approval prior to manufacture;

3. Provision shall be allowed for future addition of different forms of QR code system.

ELE24.3.2.035.N OCTOPUS CARD DOOR ACCESS SYSTEM (OCDAS)

1. In addition to the basic function of access control by keypad combination lock system of the main and rear entrances of the domestic block, the doorphone system shall also be provided with smartcard (Octopus Card). The doorphone system shall be of automatic smart system accessible by scanning the registered Octopus Card. The function of the combination lock shall be disabled when the Octopus Card System is in operation. The combination lock is put into operation only during the suspension of the Octopus Card System;

2. The Sub-contractor shall be an Octopus authorized contractor for Access Control System category, or otherwise to employ an Octopus authorized system integrator as its sub-sub-contractor to provide the OCDAS;

3. The Sub-contractor shall demonstrate to the satisfaction of the CM that they are licensed for carrying out type III security work under the Security and Guarding Services Ordinance Cap. 460 and are competent to complete the works, otherwise they shall employ competent sub-sub-contractor(s), who have the required licence, to carry out the works relating to security. For the latter case, the Sub-contractor shall submit the proposed sub-sub-contractors' relevant information related to the licence, technical capability, working experience on security system to the CM for approval. Whenever necessary, the Sub-contractor shall also submit documents and drawings for the completed projects to the CM for consideration. Inspection of the completed projects and visit of the proposed contractor's office and workshop may be conducted, if deemed necessary;

4. The Sub-contractor or its sub-sub-contractor for the OCDAS shall have at least five OCDAS satisfactorily completed in the past three years;

5. The Sub-contractor shall coordinate with and support to other contractor(s) for the IT Security Risk Assessment and Audit (SRAA), Privacy Impact Assessment (PIA) and Privacy Compliance Audit (PCA) for the OCDAS, ensuring compliance with the Personal Data (Privacy) Ordinance (Cap. 486) and Housing Authority's IT Security Rules and Regulations. The Sub-contractor shall be required to review and submit the required documentations, provide necessary system and software program details, support on-site inspection of system installation, and support the systematic scanning of equipment, software program and source codes. The Sub-contractor shall follow up the result and report of the SRAA, PIA and PCA, and adopt the required changes / updates to the System for compliance. The Sub-contractor shall also comply with the latest edition of all relevant Ordinances and Regulations;

6. The Sub-contractor shall supply and install OCDAS comprising, but not limited to:

    a. An Octopus Card reader with access control unit integrated with the doorphone panel;

    b. An Octopus Card reader / validator at EMO for registration;

    c. Octopus Management Software;

    d. Permanent Central data station / computer completed with a fully developed Octopus Card access control system at EMO with Intel Core i7 Gen 13 with 3.4 GHz, CPU or above, 1 TB hard disk, 4 G DDR5 8.8 MHz Ram, DVD combo, Network switch, USB 3.2 ports, keyboard and Window 10 professional, or above;

    e. Temporary Central data station / computer completed with a fully developed Octopus Card access control system at EMO during mass intake. The exact quantity shall be requested by local estate management;

    f. Network Time Protocol Server with Global Positioning System (GPS) antenna at EMO;

g. Minimum 1 no. of LED video monitor (24" or above) for permanent operation;

h. Minimum 1 no. of LED video monitor (24" or above) for temporary operation. The exact quantity shall be requested by local estate management;

i. Door access control unit complete with power source of 220V AC 50Hz and an access control windows library which is written in visual C++ and interfacing with the Octopus reader (registration unit) to read and send Octopus Card unique ID back to the connected PC host application via serial port;

j. Master door access control unit;

k. LAN network (Provide connectivity between the Octopus access control system and the central data station installed at EMO);

l. Two-hour battery backup system to the Octopus Card reader / validator.

7. The OCDAS shall be able to allow reading and checking against the card registered database in order to process access / exit requests at the entrance door and store the entry information in the central database. The minimum storage for active users of Octopus Card registration shall be 100,000 quantities. The minimum record of entry data logging shall be 100,000 times before writing off the history for new input.

ELE24.3.2.040.9 DOORPHONE CONTROL UNIT

The doorphone control unit shall be totally enclosed containing all necessary components and accessories for satisfactory doorphone operation. The control unit shall be located in ground floor meter room where an a.c. supply in the form of a 13A connection unit.

ELE24.3.2.050.9 HANDSET

1. Each flat shall be provided with one handset positioned as shown on the Drawings. The handset shall be submitted to Contract Manager for approval prior to ordering;

2. Two separate and independent push buttons shall be provided integral with the handset, one for remotely releasing the main entrance door lock and the other for interfacing to the lighting control system for corridor lighting. The buttons shall be marked permanently with respective graphic symbols for easy identification of their functions. The graphic symbol for door lock release shall be in green colour and for corridor lighting in red colour. The buttons shall separate from each other by a minimum distance of 100 mm. The button for lighting control shall be at the lower portion of the handset and be operable without the need to lift the hand-piece for lighting control only;

3. All contacts and other equipment inside the handset shall be of durable type;

4. The handset shall be equipped with independent buzzer / speaker for the call tone and the buzzer / speaker shall be distinct from the loudspeaker at the handset. The call tone shall be of pleasant type and shall be clearly audible anywhere in the flat.

ELE24.3.2.055.9 LIGHTING CONTROL INTERFACE PANEL

1. The push button for lighting control on each handset shall be connected to a lighting control interface panel in the telecom/meter room on the respective floor;

2. Relays with single pole normally open (NO) contact and operated by DC control voltage derived from the doorphone system shall be provided in the lighting control interface panel. Pressing and releasing of a push button shall result in closing and opening of a corresponding NO contact in the interface panel. The output terminals of the NO contacts (one for each flat) shall be located in a segregated compartment in the interface panel for interfacing to the lighting control system. LED indicating lights shall be provided on the hinged cover of the interface panel to show the status of each push button. All relays, terminals and LED lights shall be properly labelled for easy identification;
3. The relays provided in the interface panel shall satisfy the following technical requirements:
    a. Contact: min. rated load 1A, max. switching voltage 250VAC;
    b. Coil operating voltage: 12 or 24 DC (to be drawn from the doorphone system);
    c. Insulation resistance: 100 MΩ (at 500V DC);
    d. Dielectric strength: 1000Vrms 1 minute between open contacts;
    e. 2000Vrms 1 minute between contact and coil;
    f. Mounting: by plug and socket;
    g. Conformance: UL or equivalent standard.
4. The interface panel shall be a metal enclosure properly earthed and finished in epoxy powder coating. A sample shall be submitted to Contract Manager for Approval and the approved sample can be utilized in the actual installation.

ELE24.3.2.060.A OPERATION SEQUENCE

1. The operation sequence of the doorphone system shall be as follows:
    a. The door lock shall be of automatic smart system accessible by scanning the registered Octopus Card. The function of the password entry lock shall be disabled when the Octopus Card scanning function is in operation. Upon completion of Octopus Card scanning function, the door lock shall be released. When unregistered Octopus Card is detected, the visual and audio instructions for "Swipe Card Again" shall be activated and the system shall reset to its normal condition after a predetermined period adjustable from 1 to 30 seconds;
    b. If the automatic smart system is malfunctioned, the four-digit secret code for releasing the lock shall be re-activated. In such case, the door shall be released only when the entry of a pre-assigned 4-digit code in proper sequence within a 10-second period otherwise a timer will activate causing the code already entered to reset. When the door is unlocked, the corresponding visual and audio instructions shall be activated. The unlocked period shall be adjustable from 1 to 30 seconds. The LED matrix display at the main entrance doorphone panel shall only display "*" during the code entry and before the door is released. When incorrect codes are entered, the visual and audio instructions for "Incorrect Entry" shall be activated and the system shall reset to its normal condition by pressing the "Clear" button or after a predetermined period adjustable from 1 to 30 seconds.
2. The operation sequence of the doorphone system for visitors shall be as follows:

a. When a visitor presses the appropriate floor number key on the floor selection key board followed by the flat number key on the other flat selection key board, the selected floor and flat number shall display on the screen immediately after the depression of each key, when any floor from ground floor to ninth floor is to be selected, the sequence shall not necessitate the entry of a "O" preceding the floor number. Depression of any button on the doorphone panel shall be accompanied by a beep tone;

b. An intermittent call tone shall be initiated at the handset of the selected flat. Simultaneously, a "Please Wait" voice message shall be generated at the doorphone panel and the illuminated signal on the instruction display shall change to "Please Wait" until the handset in that selected flat is picked up by the occupant. At the moment, the illuminated signal shall change to "Please Talk", then intercommunication between the occupant and the visitor can take place;

c. If the hand-piece is not picked up within a predetermined period, which is adjustable from 1 to 30 seconds, the call tone shall stop. A "No Answer" voice message shall be generated at the doorphone panel and the illuminated signal shall change from "Please Wait" to "No Answer" and after 3 seconds the system shall automatically revert back to normal;

d. The two way intercommunication between the occupant and the visitor shall be limited to a predetermined period ranging from 20 to 120 seconds. When the pre-determined period expires, the inter communication between the two parties shall be automatically cut off and the system shall revert back to its normal conditions;

e. Before the hand-piece is being put back to its normal position, pushing the door release push button on the hand-piece shall remotely release the electrical door lock at the main entrance door. A "Please Enter" voice message shall be generated at the doorphone panel and the illuminated signal shall change from "Please Talk" to "Please Enter". The communication shall be terminated after an adjustable period of 1 to 30 seconds after the release of the door lock. The lock shall then be reverted to locked state after the door is closed again. If the door is not opened by the visitor after a predetermined period adjustable from 1 to 30 seconds, the lock shall then revert to the locked state;

f. When the selection of floor or flat number is not completed within a preset time period which is adjustable from 1 to 15 seconds, the system shall revert to normal condition;

g. The display shall be blanked when the number of a non-existent floor / flat is entered, a "Wrong Number" voice message shall be generated at the doorphone panel and the illuminated signal on the instruction panel shall change to "Incorrect Entry". The system shall reset to its normal condition by pressing the "Clear" button or after a predetermined period adjustable from 1 to 30 seconds;

h. When the handset is not connected to the entrance panel, i.e. when the flat number is not pressed at the entrance panel by any visitor, operation of the door release button at any hand-piece shall not release the lock of the main entrance door;

i. The door lock shall be such that in case the electric push button inside the entrance door or the secret digital code door lock release is not operative the door can still be opened by operating a keyswitch at the bottom of the doorphone panel and combination lock panel outside the entrances. The door lock shall revert to its normal closing state when the door is closed;

j. When the "Clear" button is pressed at any stage during the operation of the doorphone panel, the system shall switch off the display, terminate any established communication link and revert to the "normal" condition.

ELE24.3.2.070.A COMBINATION LOCK SYSTEM

1.

a. Combination lock system for the main entrance and side entrance doors shall be built in the control unit of the doorphone system;

b. Correct entry of the code at any combination lock control panel or scanning the registered Octopus Cards shall only cause the electro-magnetic lock of the corresponding entrance to be released;

c. The combination lock system shall allow connection of up to 5 combination lock control panels for 5 side entrances in additional to the combination lock control panel at the main entrance. All the combination lock control panels can be operated at the same time without affecting each other.

2. For the main entrance, the combination lock system shall be accessed and controlled through the doorphone panel. If the "Combination Lock" button is pressed, the floor selection buttons shall serve as a combination lock control panel;

3. For each side entrance, a combination lock control panel shall be provided;

4. The combination lock control panel shall perform the following functions:

a. The four-digit secret code for releasing lock shall be kept in the non-volatile memory. The secret code shall be easily changeable by adjusting a set of selector switches or push buttons housed in the control unit in the meter room. Code changing by re-connecting jumpers is not acceptable;

b. The code shall be adjustable to any combination of the four digits from 0 to 9. An instruction procedure for code changing shall be fixed inside the door of the enclosure. Security measures shall be provided against illegal changes of the secret code;

c. An Octopus Card reader shall be capable of scanning the registered Octopus Card.

5. The combination lock control panel for the side entrance shall be constructed with 1.5 mm thick stainless steel faceplate and 1.2 mm thick stainless steel housing enclosure comprising:

a. A keypad fitted with a set of numerical push buttons (from 0 to 9). The keypad and push buttons shall be vandal resistant and weatherproof. All push buttons shall be back-lit by LED through plastic insert forming the numerical figures. The figures shall be flushed with the surface of push button without protruding edge. The colour of the insert shall be red unless otherwise specified on the Drawings. The LED, with a life span of 35,000 hours minimum, shall be on throughout the operation of the panel. Keypad and push buttons shall be submitted to the CM for approval;

b. A "clear" push button for resetting of incorrect entry;

c. An Octopus Card reader, reader controller and network controller;

d. A reserved space for future provision of other door access device(s), such as QR code system;

e. Operating status / instruction LED indicators with instructions in English and Chinese for the following:

i. SYSTEM ON 系統正常

ii. PLEASE ENTER 請進入

iii. INCORRECT ENTRY 錯輸入

f. Voice message generator to give audible instructions in either Cantonese or both Cantonese and English as directed by the Contractor Manager for the following status:

i.	Please enter	請進入
ii.	Wrong number, please press the clear button and try again	輸入錯誤 , 請按取消掣 重新輸入
iii.	Swipe card again	重新拍卡

The voice message generator shall be of the same specification as that used in the doorphone panel.

g. Braille instructions as specified on the Drawings.

Each pressing of the button shall have a 'beep' sound.

6. The enclosure for the secret code setting devices shall be fabricated from sheet steel with a thickness not less than 1.2 mm. All inside and outside surfaces of the enclosure shall be treated with anti-rust protective coating followed by an Approved painting;

7. The door lock shall be of automatic smart system accessible by scanning the registered Octopus Card. The function of the combination lock shall be disabled when the Octopus Card scanning function is in operation. Upon completion of Octopus Card scanning function, the door lock shall be released. (If combination lock is in operation, the door shall be released only when the entry of a pre-assigned 4-digit code in proper sequence within a 10 seconds period otherwise a timer will activate causing the code already entered to reset.) When the door is unlocked, the corresponding visual and audio instructions shall be activated. The unlocked period shall be adjustable from 1 to 30 seconds. The LED matrix display at the main entrance doorphone panel shall only display "*" during the code entry and before the door is released. When incorrect codes are entered, the visual and audio instructions for "Incorrect Entry" shall be activated and the system shall reset to its normal condition by pressing the "Clear" button or after a predetermined period adjustable from 1 to 30 seconds. When unregistered Octopus Card is detected, the visual and audio instructions for "Incorrect Entry" shall be activated and the system shall reset to its normal condition after a predetermined period adjustable from 1 to 30 seconds.

ELE24.3.2.080.9 WIRING INSTALLATION

The wiring from the equipment enclosure on each floor to the doorphone handset in each domestic flat shall be carried out by the Sub-contractor in concealed conduit wiring system as shown on the Drawings. The wiring from the meter room to each domestic flat through the concealed conduits shall be multicore cables with number of cores not less than four.

ELE24.3.2.090.9 STANDBY POWER SUPPLY

The Doorphone System shall be provided with standby power supply to enable the system to operate for a period of not less than four hours at average power consumption of 20 calls per hour subsequent to a mains failure. The stand-by power shall be of nickel cadmium or nickel-metal hydride type battery complete with trickle charger and with minimum nominal capacity of not less than 10AH. The battery shall be automatically recharged when the permanent supply restores.

ELE24.3.2.100.A DOORPHONE SYSTEM FOR SSF COURT ENTRANCE GATES

1. When it is specified on the Drawings, the main and side entrance gates of SSF development shall be provided with doorphone system. The system shall consist of electro-magnetic lock, doorphone panel and two way communication unit at main entrance gate, two way communication units and door release buttons at guard counters of domestic blocks, and electro-magnetic lock and combination lock panel at side entrance gate as shown on the Drawings. The equipment shall be suitable for operation under outdoor condition;

2. The electro-magnetic lock shall be suitable for outdoor application and the technical specification of electro-magnetic lock shall comply with ELE24.3.2.020 except the following:

   a. For ELE24.3.2.020 sub-clause (7), the installation of the electro-magnetic lock shall be coordinated with the design of entrance gate and the installation details shall be submitted to the CM for approval. All required mounting hardware / accessories shall be supplied or approved by the manufacturer of electro-magnetic lock. The installation method shall be endorsed by the manufacturer of electro-magnetic lock as appropriate for their product in case the actual details differ from manufacturer's own standard methods. The electro-magnetic lock shall be of weatherproof construction;

   b. For ELE24.3.2.020 sub-clause (9)(b)(i), the door release button shall be vandal resistant and weatherproof with ingress protection of at least IP55 to BS EN 60529 or IEC 60529. The button shall be submitted to the CM for approval;

   c. For ELE24.3.2.020 sub-clause (9)(c), the provision of emergency door release is not required.

3. For each main entrance gate, a doorphone panel with built-in two way communication unit shall be provided. The doorphone panel shall be suitable for operation under outdoor condition and provided with stainless steel weather shield. The panel shall be constructed with 1.5 mm thick stainless steel faceplate and 1.2 mm thick stainless steel housing enclosure comprising:

   a. A keypad fitted with a set of numerical push buttons (from 0 to 9);

   b. A "clear" push button for resetting of incorrect entry;

   c. An Octopus Card reader, reader controller and network controller;

   d. A reserved space for future provision of other door access device(s), such as QR code system;

   e. Operating status / instruction LED indicators with instructions in English and Chinese for the following:

      i. SYSTEM ON 系統正常

      ii. PLEASE ENTER 請進入

      iii. INCORRECT ENTRY 錯輸入

      iv. PLEASE WAIT 請等候

      v. PLEASE TALK 請通話

      vi. NO ANSWER 無答覆

   f. Voice message generator to give audible instructions in either Cantonese or both Cantonese and English as directed by the CM for the following status:

i.	Please enter	請進入

ii.	Wrong number, please press the clear button and try again	輸入錯誤 , 請按取消掣重新輸入
iii.	Swipe card again	重新拍卡
iv.	Please wait	請等候
v.	No answer	無答覆

The voice message generator shall provide high quality audible instruction using digital data compression technique. The voice message generator shall provide 5 individual pre-recorded messages for a total time period (for 5 messages) of not less than 90 seconds. The generator shall accept 5 digital control inputs to output the 5 individual pre-recorded messages. The length of individual message shall be variable from 0 to 90 seconds. All messages shall be approved by the CM prior to being programmed into the memory of the generator. The voice output level shall be adjustable and the maximum level shall not be less than 60 dB at a distance of 1 metre from the panel;

g. A set of high fidelity and sensitivity two way communication unit between main entrance doorphone panel and guard counter of individual domestic block. The output shall be clearly audible of at least 60 dB at a distance of 0.5 metre from the panel;

h. Push buttons for selection of communication with the guard counters of individual domestic blocks;

i. All push buttons shall be vandal resistant and weatherproof. Keypads shall be vandal resistant and weatherproof. All push buttons shall be back-lit by LED through plastic insert forming the figures. The figures shall be flushed with the surface of push button without protruding edge. The colour of the insert shall be red unless otherwise specified on the Drawings. The LED, with a life span of 35,000 hours minimum, shall be on throughout the operation of the panel. Keypad and push buttons shall be submitted to the CM for approval;

j. Braille instructions as specified on the Drawings;

k. Each pressing of the button shall have a 'beep' sound.

4. Provision shall be allowed for future addition of different forms of QR code system.

5. The operation sequence of the doorphone panel shall be as follows:

a. The "System On" indicator shall always be illuminated when the system is at normal condition;

b. When a visitor presses a guard counter selection push button, an intermittent call tone shall be initiated and an “INCOMING CALL” indication light shall light up at the handset of the selected guard counter. Simultaneously, a "Please Wait" voice message shall be generated at the doorphone panel and the illuminated signal "Please Wait" shall be illuminated on the instruction display until the handset in that selected guard counter is picked up by the security guard. At the moment, the illuminated signal shall change from "Please Wait" to "Please Talk" and the “INCOMING CALL” indication light at the handset of the guard counter shall turn off, then intercommunication between the security guard and the visitor can take place;

c. If the handset is not picked up within a predetermined period, which is adjustable from 1 to 120 seconds, the call tone shall stop and the “INCOMING CALL” indication light shall turn off. A "No Answer" voice message shall be generated at the doorphone panel and the illuminated signal shall change from "Please Wait" to "No Answer" and after 3 seconds the system shall automatically revert back to normal and illuminated signal "No Answer" shall turn off. An alarm signal for the unattended call of respective block shall also be generated to the central alarm and door monitoring system via the local alarm and door monitoring system of the respective domestic block;

d. The two way intercommunication between the security guard and the visitor shall be limited to a predetermined period ranging from 20 to 120 seconds. When the pre-determined period expires, the inter communication between the two parties shall be automatically cut off and the system shall revert back to its normal conditions;

e. After the handset is picked up and before the handset is put back to its normal position within the pre-determined intercommunication period, pushing the door release push button on the handset shall remotely release the electrical door lock at the main entrance gate. A "Please Enter" voice message shall be generated at the doorphone panel and the illuminated signal shall change from "Please Talk" to "Please Enter". The communication shall be terminated after an adjustable period of 1 to 30 seconds after the release of the door lock. The lock shall then be reverted to locked state after the door is closed again. If the door is not opened by the visitor after a predetermined period adjustable from 1 to 30 seconds, the lock shall then revert to the locked state;

f. After the termination of the communication link and the reverting of the door lock to its locked state, the illuminated indication "Please Enter" on the instruction display shall turn off;

g. When the handset is not connected to the entrance panel, i.e. when the guard counter selection push button of domestic blocks is not pressed at the entrance panel by any visitor, operation of the door release button at any handset shall not release the lock of the main entrance gate;

h. The door lock shall be such that in case the door release button inside the entrance gate or the secret digital code door lock release is not operative the gate can still be opened by operating a keyswitch at the bottom of the doorphone panel and combination lock panel outside the entrances. The door lock shall revert to its normal closing state when the door is closed;

i. When the "Clear" button is pressed at any stage during the operation of the doorphone panel, the system shall switch off the display, terminate any established communication link and revert to the "normal" condition.

6. For each side entrance gate, a combination lock control panel shall be provided. The combination lock control panel shall be suitable for operation under outdoor condition and provided with stainless steel weather shield. The panel shall be constructed with 1.5 mm thick stainless steel faceplate and 1.2mm thick stainless steel housing enclosure comprising:

   a. All the facilities for side entrance combination lock control panel as specified in ELE24.3.2.035 and ELE24.3.2.070 sub-clause (5).

7. The specification of combination lock system at doorphone panel of main entrance gate and combination lock panel of side entrance gate of SSF development shall be the same as the main entrance and side entrance doors of domestic block specified in ELE24.3.2.035 and ELE24.3.2.070. Setting of the four-digit secret codes for releasing lock of entrance gates shall be same as that for domestic blocks, in which the individual secret code of any domestic blocks shall be able to release lock of entrance gates;

8. The doorphone system for side entrances shall be of automatic smart system accessible by scanning the registered Octopus Card. The function of the combination lock shall be disabled when the Octopus Card scanning function is in operation. The combination lock is put into operation only upon completion of the Octopus Card scanning function.

ELE24.3.3 LOCAL CLOSED CIRCUIT TELEVISION MONITORING SYSTEM

ELE24.3.3.010.A GENERAL

1. Closed circuit television systems shall be installed at the various locations of each block as indicated on the Drawings; public signage related to CCTV surveillance shall be provided and installed in accordance with the details shown on the Drawings;

2. If the distance between the NVR and the LED video monitor is too large (exceeds 7 meters) for a direct connection by HDMI cable, a pair of HDMI extenders shall be used as shown on the Drawing or as indicated in Project Specific Specification.

ELE24.3.3.020.A DOORPHONE PANEL

1. IP CCTV camera shall be installed within the doorphone panel to capture the view of the visitors. The view shall be displayed at:

   a. Monitors at the guard counter;

   b. Tenants' television sets through the CABD installation.

2. The camera shall be built in the doorphone panel. Lighting other than those originally included in this sub-contract shall not be required for the camera to transmit clear and satisfactory pictures at night time. The capture angle of the IP CCTV camera shall be adjustable on Site;

3. Super wide angle lens integral with the camera shall be used. The camera and the integral lens shall have the angular field of view not less than 110° horizontal.

ELE24.3.3.030.A LIFT

1. IP CCTV camera installed by others within each lift of the building shall be connected to the local CCTV monitoring system. The view shall be displayed at:

   a. Monitors at the guard counter;

   b. Tenants' television sets through the CABD installation.

2. Lift floor number generator:

   a. Lift floor number generator shall be provided for each lift. The lift floor number generator shall superimpose the following characters on the CCTV picture captured from the lift car:

      i. Lift floor numbers;

ii. An up or down arrow showing lift travelling direction;

iii. Lift alarm button activated.

b. The image with superimposed characters shall be restricted for display at the monitor connected to the NVR at Security Counter only. The characters shall be positioned at one corner of the screen not interfering with other alphanumeric display, and clearly legible under all background conditions;

c. The characters to be generated shall be based on the status of the lift provided by Lift Sub-contractor in the form of either normally open volt free contacts or digital signals. Interface shall be through an interface box located at the ground floor meter room or otherwise at locations as shown on the Drawings. The following types and quantities of data will be provided:

i. Lift landing floor number, one for each landing floor;

ii. Lift travelling directions, one for up and one for down;

iii. Lift alarm activated status, one.

d. Closing of a particular contact or change of state of a digital signal shall cause the generation of the corresponding set of characters it represents on the CCTV picture and the characters shall be removed as soon as the signal resets. When multiple closures of the same type of contacts are detected simultaneously, a fault signal (such as a blinking asterisk) shall be generated in lieu of the floor number or the directional arrow to indicate the fault condition. In case of digital signals, detection of contradictory signals shall also activate the same fault condition;

e. The lift floor number generator shall conform to the following technical requirements:

Item	Technical Requirements
i. Video input	Composite 1Vp-p/ 75 Ohms
ii. Video output	Composite 1Vp-p/ 75 Ohms
iii. Control input	Minimum 64 N.O. contacts
iv. Character	Height 23 scanning line min.; Width 0.7 ms min.; Position selectable at each of the four corners on the screen; Brightness and greyscale adjustable.

f. The Sub-contractor shall be responsible to decode the data signal of lift IP camera into video signal for superimposition with lift floor number generator signal, and also transmission to CABD installation. The Sub-contractor shall be responsible to encode the lift images with superimposed characters into data signal for connection to network switch and NVR.

ELE24.3.3.040.A MAIN ENTRANCE / GUARD COUNTER

1. IP CCTV camera shall be installed at the main entrance of each domestic block to capture the view of the guard counter / visitor;
2. The view shall be displayed at central CCTV system;
3. The camera lens shall be super wide angle type. The camera and the integral lens shall have the angular field of view not less than 110° horizontal.

ELE24.3.3.050.A SIDE ENTRANCE

IP CCTV camera shall be installed at each side entrance of the block. The view shall be displayed at:

1. Monitors at the guard counter;
2. Central CCTV system.

The camera shall be the same as that installed for main entrance / guard counter CCTV system as specified in ELE24.3.3.040.

ELE24.3.3.055.A ROOF EXIT

IP CCTV camera shall be installed at the roof exit staircase to monitor the staircase area leading from the top domestic floor to the roof exit gate. The view shall be displayed at:

1. monitors at the tower guard counter;
2. Centralized CCTV system.

The camera shall be surface mounted under the ceiling. Super wide angle lens integral with the camera shall be used. The camera and the integral lens shall have the angular field of view not less than 110° horizontal.

ELE24.3.3.056.A G/F STAIRCASE EXIT AND OTHER STAIRCASE EXITS

IP CCTV camera shall be installed for each staircase exit to capture the view of G/F staircase exit and other staircase exits at specific floors as shown on the Drawings. The view shall be displayed at:

1. Monitors at the guard counter;
2. Central CCTV system.

The camera shall be the same as that installed for roof exit CCTV system as specified in ELE24.3.3.055. For outdoor cameras, including those which are mounted under outdoor canopy, camera protective casing as specified in ELE24.2.1.100 shall be provided.

ELE24.3.3.057.N EXTERNAL AREA

1. Outdoor IP CCTV camera shall be installed as shown on Drawings to capture the view of the external area;
2. The view shall be displayed at central CCTV system;
3. The camera lens shall be super wide angle type. The camera and the integral lens shall have the angular field of view not less than 110° horizontal.

ELE24.3.3.060.A RECORDING

1. The scenes captured by the above closed circuit television system except the camera inside the doorphone panel shall be recorded by a NVR installed at each building;
2. Video signal from cameras viewing guard counter and side entrances, should be presented for interface with the future central CCTV monitoring system in case the project does not include an Estate Management Office.

ELE24.3.4 LOCAL ALARM AND DOOR MONITORING SYSTEM

ELE24.3.4.010.9 LOCAL SYSTEM

1. A mimic panel made of 1.5 mm thick stainless steel plate with alarm buzzer and indicating light emitting diode (L.E.D.) showing the locations of the entrance doors and staircase exit doors at ground floor and other specific floors as shown on the Drawings shall be installed at the guard counter. The layout of the building ground floor and other specific floors as shown on the Drawings shall be engraved on the panel. An additional mimic panel shall be provided with indicating L.E.D. showing the locations of the staircase exit doors at roof level. The operation of the alarm and door monitoring system shall be as follows:

    a. Opening of any door shall cause the corresponding L.E.D. on the mimic panel to light up. Opening of the staircase exit door shall also cause the buzzer to sound intermittently. The L.E.D. and the buzzer if sounded shall go out if the door is closed afterward;

    b. In case any main / side entrance door and staircase exit door has been opened for an adjustable period of 0 (immediate alarm) to 10 minutes without being re-closed and reset or any roof exit gate has been opened for an independently adjustable period of 0 (immediate alarm) to 10 minutes without being re-closed and reset, the corresponding L.E.D. shall flash and the buzzer shall sound continuously. A local indicating light shall be illuminated and a local buzzer shall also be sounded. An alarm signal shall be sent to the centralized alarm and door monitoring system for alarm reporting to the security control room;

    c. The buzzer in the mimic panel shall be able to be muted by pressing the "Acknowledged" push button on the panel;

    d. Pressing the "Reset" push button on the mimic panel after re-closing the door shall reset the local alarm;

    e. In the event that any alarm has not been reset for an adjustable period of 1 to 10 minutes, an alarm signal shall be sent to the central alarm and door monitoring system for reporting the alarm to the security control room in the Estate Office;

    f. Activation of the emergency door release for door opening shall cause a signal to be sent to the central alarm and door monitoring system;

    g. Upon the activation of the guard counter panic alarm push button, L.E.D. on the mimic panel shall light up and an alarm signal shall be sent to the central alarm and door monitoring system;

    h. Pressing of the "Test" push button on the mimic panel shall cause all the L.E.D. to light up and the buzzer shall sound;

    i. When the doorphone system for SSF court entrance gate is specified, in the event that any call from doorphone panel at main entrance gate of SSF development is not picked up by the security guard of the respective block for an adjustable period of 1 to 120 seconds, an alarm signal for the respective block shall be sent to the central alarm and door monitoring system via the local system for reporting the alarm to the security control room in the Estate Office;

    j. In the event that any call from intercom slave station at temporary refuge space is not picked up by the security guard for an adjustable period of 1 to 120 seconds, an alarm signal shall be sent to the central alarm and door monitoring system for reporting the alarm to the security control room in the Estate Office.

2. In case interconnection is required to an existing central security system, the Sub-contractor shall ensure that the equipment provided for this system is compatible with the existing Central Security System for the interface requirements as stipulated in this Specification. The Sub-contractor shall be responsible for the verification of compatibility.

ELE24.3.4.020.9 INTERFACING WITH THE CENTRAL SECURITY SYSTEM

The details of interfacing requirement with central security system are specified in the Project Specific Specification.

ELE24.3.4.030.9 TELEPHONE SET

The requirements of provision of telephone sets are specified in the Project Specific Specification.

ELE24.3.5 CENTRAL SECURITY SYSTEM

ELE24.3.5.010.A GENERAL

1. Central Security System or Second Tier Security System shall be installed in the security control room located in the Estate Management Office (EMO). These systems shall oversee the security system in individual building within the whole estate;
2. The Central Security System shall consist of the following:
    a. Central alarm and door monitoring system in security control room;
    b. Central CCTV system in security control room;
    c. A Local Area Network (LAN) providing connectivity between:
        i. The local CCTV and alarm systems of all domestic blocks;
        ii. Central alarm and door monitoring system;
        iii. Central CCTV system;
        iv. Similar systems in other blocks as specified in Project Specific Specification and Drawings.
    d. As shown in Project Specific Specification and on the Drawings, for those blocks that cannot be connected to the above LAN due to the obstruction by a barrier, such as a public road inaccessible for cabling work, or other site constraint that disallow cabling work, the connection to those blocks shall be provided by broadband lines subscribed from a Broadband Internet Service Provider (BISP). Each Broadband line shall conform to the following, unless otherwise specified:
        i. Minimum 8 Mbps bandwidth for both uploading and downloading;
        ii. With or without Internet access;
        iii. Single fixed IP;
        iv. IP access right within estate between PC and NVR;
        v. All Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) ports of broadband line shall be opened.
    e. Telephone set at EMO and guard counters of domestic block and other location as specified in Project Specific Specification and Drawings.

3. The LAN mentioned in sub-clause 2 above shall conform to the following network standards on a backbone of Cat. 6 UTP or optical fiber in case the cable run between buildings exceeds 90m:

   100 Mbps: Ethernet IEEE 802.3u, 100BASE-TX, 100BASE-FX.

4. The schematic of LAN, if shown on the Drawings, is for indicative purpose only. The Sub-contractor shall be responsible for the final design of the LAN and submit a detailed proposal, with a fully developed schematic, performance analysis and the technical specifications of all the hardware / software required, for the CM's Approval. The system shall comprise all necessary components, such as switches, hubs, repeaters, bridges and routers, to form a fully functional network;

5. If broadband connection services are required, the Sub-contractor shall be responsible for the subscription and maintaining of the services at the EMO and the blocks, where the services are needed, for the entire period starting from testing and commissioning phase of the Works till the expiry of Maintenance Period. The details of the broadband connection services and the BISP shall be approved by the CM;

6. For all communication via Broadband Line, adequate data security shall be provided. All routers accessible from the Internet shall be configurable to run in Virtual Private Network (VPN) mode. The VPN routers shall be so selected that the data throughput shall be adequate for satisfactory transmission of CCTV images with no loss frame from the local systems to the central system with both firewall and VPN activated. The Sub-contractor shall verify the selection of the VPN routers in the performance analysis as stipulated in sub-clause 3 above;

7. The IP addresses and sub-netting arrangement of all the network devices on the LAN shall be submitted to the CM for approval. The Sub-contractor shall adopt the LAN IP format 192.168.xxx.xxx and subnetting Class C with subnet mast set at 240 unless otherwise specified. The third octet number shall be assigned by the CM;

8. At the end of testing and commissioning of the central security system, the Sub-contractor shall prepare the following network data records for future maintenance and management of the system:

   a. Network address list for all networked devices (with TCP/IP address of each network device, subnet setting, WAN IP address if any, etc.);

   b. Network map (includes hardware location, device IP addresses and cable number / reference, etc.);

   c. Network Equipment List (Equipment name, manufacturer name, Model no., Serial no., includes NVR, Ethernet Switch, Router, Personal Computer, LED video monitor, HDMI extender, Cat. 6 cable, fibre optic cable, patch panel etc.);

   d. Network hardware configuration (configuration information includes configuration files and protocol information, user name, password, etc. for each network device);

   e. User manual for all networking and networked devices.

9. The Sub-contractor shall provide hard copy and soft copy of the data record as specified in sub-clause (8) above. Hard copy for data described in sub-clauses (8)(a), (8)(b), (8)(c) & (8)(d) shall be attached to the T & C report and these hard copies together with data described in sub-clause (8)(e) shall be included the O & M manual. Soft copy of the all the data records shall be burned onto CD-ROM or DVD-ROM and also stored in a protected sector of the hard drive in the PC of the central security system. A network map shall also be provided in each equipment rack housing the network devices, this map shall be fixed on the front glass panel in a secure manner and facing inward;

10. The Sub-contractor shall provide customized hands-on training on the operation and management of the central security system. The training shall include the system overview, the operation of hardware and the use of application software. The Sub-contractor shall allow two training courses each for up to 20 personnel nominated by the CM. One training course shall be arranged after the completion of the installation and the second upon the expiry of the Maintenance Period. The Sub-contractor shall provide all necessary training tools, materials and handouts. The Sub-contractor shall submit details of the training, such as the programme, the duration and the contents, for the CM's approval.

ELE24.3.5.020.A CENTRAL ALARM AND DOOR MONITORING SYSTEM

1. General
    a. The central alarm and door monitoring system shall be provided for monitoring alarm signals from individual buildings for the whole estate. The central alarm and door monitoring system shall consist of the following:
        i. Alarm transmitter and necessary network device at each domestic block;
        ii. A central station consisting personal computer, printer, network devices and accessories at the security control room in estate office;
        iii. Software for processing the alarms / events.
    b. The communication between the transmitters at each local blocks and personal computer in EMO shall be through the LAN or Broadband Line connection;
    c. The total numbers of alarm signals required for the whole estate are specified in Project Specific Specification.
2. Alarm Transmitter
    a. The alarm transmitter shall have a minimum of 30 alarm inputs;
    b. Upon receipt of an alarm, the transmitter shall send the alarm status to the central station at the security control room to report the emergency event;
    c. The alarm transmitter shall test the alarm reporting function by reporting to the central station regularly at an adjustable time interval of ½ to 24 hours;
    d. The alarm transmitter shall accept the following signals through the dry contacts:
        i. Unattended prolonged opening or emergency opening of main / side entrance door;
        ii. Unattended prolonged opening of staircase exit door;
        iii. Emergency opening of roof staircase exit door;
        iv. Panic alarm at guard counter;
        v. Power failure to the control units;
        vi. Signals from spare dry contacts;
        vii. Lift alarm signals;
        viii. For SSF development, prolonged unattended call from doorphone panel at main entrance gate(s) of respective block;
        ix. Prolonged unattended call from intercom slave station at temporary refuge space.
3. Central station

The personal computer shall be of Approved registered trade name. The personal computer shall operate on Windows 10 or the latest version of Windows or other operating system approved by the CM and with standard USB style connector of latest version, minimum 8GB RAM memory, 1TB hard drive, DVD writer and the following peripheral hardware and software:

a. Peripheral Hardware

i. LED video monitor, 24 inch screen size;

ii. Keyboard and optical mouse;

iii. Laser jet colour printer;

iv. All necessary network devices.

b. Software

i. Alarm processing and display system for all alarm signals from the whole estate plus 100% other future alarm signals;

ii. All the texts / words shown on the screen for the information of and use by the guard supervisor shall be in Chinese. All the inputs required to be made by the guard supervisor shall be simple and user friendly to the approval of the CM;

iii. Only licensed original software shall be used in each system.

4. Software function

The software for processing and displaying the alarm in the central station shall have the following functions:

a. Alarm and event monitoring overview

The system shall be able to show a summary of all alarms and events and list the alarms and events in chronological sequence. The listed details shall include at least the following:

i. Time of alarm / event;

ii. Date of alarm / event;

iii. Name of building;

iv. Nature of alarm / event.

b. Password control

The system shall be able to protect from use by unauthorized person by means of password control. The system shall provide different password for individual user. There shall be one master password for a user who has the authority to assign authority to individual user.

c. Mimic map display

In order for the security guard to easily identify the exact location of an alarm, the system shall store sets of mimic map including:

i. The floor plans of each building with security doors and staircase exit doors within an estate with details of location of individual alarm detection points. All alarm detection points shall be properly labelled;

ii. Site layout plan in which a street map showing the location of all the buildings of an estate. The plan shall be properly labelled and easily updated in future.

These mimic map / plans shall be shown in at least 5 different colours.

d. History and reports

The system shall store the history of alarms and events received by the system for at least 31 days. The history shall be able to be retrieved by defining one or more of the parameters below:

i. Building name;

ii. Operator;

iii. Nature of event;

iv. Duration;

v. Type of action taken by the guard supervisor.

e. Remote terminal

The system shall have the ability to download information to another personal computer through LAN or Broadband Internet.

f. Database back-up

The system shall have facilities to back-up the data stored in the system on rewritable DVD.

g. Capacity for future expansion

i. The system shall have capacity and facilities for expanding the alarm / event monitoring systems such that the no. of alarm / event signals can be doubled in future;

ii. Under normal condition, the alarm / event monitoring overview screen shall be presented. This screen shall show all the current and past alarm and event data. The outstanding alarms shall be in red colour. The reset of the alarm circuit shall cause the colour of the corresponding alarm text changed to white and at the same time, a text indicating the reset of the alarm circuit shall be shown. Events other than alarm shall be shown in white colour;

iii. Upon receipt of an alarm signal from the transmitter, the alarm shall be shown up on the monitor in the form of mimics. Initially, the site layout plan shall be shown with the block having alarm changed to red colour and flashed intermittently. The buzzer shall sound continuously. After the signal is accepted by the guard supervisor, the floor plan of the block shall be displayed with the location of alarm point changed to red colour and flashed intermittently. Simple instructions with nature of alarm and action required to be shown at the bottom of the screen;

iv. After the instructions are acknowledged by the guard supervisor, an action screen listing all the possible actions to be carried out by the guard supervisor shall be shown. The confirmation of the actions carried out by the guard supervisor shall be time tagged and stored in the system;

v. Should there be another alarm occur while the previous alarm is being processed, there shall be a window on the screen indicating the nature of the latest incoming alarm / event and the number of outstanding alarms on queue. This allows the guard supervisor to judge the urgency of the situation;

vi. By returning to the alarm / event monitoring overview screen the guard supervisor may select the most important alarm or event and process it accordingly;

vii. The history of the alarms and events can be produced by the printer at the command of the guard supervisor.

ELE24.3.5.030.A CENTRAL CCTV SYSTEM

1. General

   a. The CCTV images captured by each local CCTV system shall be transmitted to the EMO via LAN or Broadband Internet as specified in Project Specific Specification and Drawings;

   b. The Sub-contractor shall programme and set up the NVR in each domestic block to transmit the video images to the personal computer in EMO;

   c. The Central CCTV system shall consist of the following components, to be provided by the Sub-contractor unless otherwise specified:

      i. Cameras at the local CCTV systems;

      ii. NVR's at the local CCTV systems;

      iii. LAN and Broadband Internet connection;

      iv. Central station (a personal computer with accessories) at security control room in EMO.

2. Central Station

   The personal computer shall be of Approved registered trade name. The personal computer (PC) shall operate on Windows 10 or any latest version of Windows or other operating system subject to the Contact Manager's approval. The PC shall be equipped with standard USB style connector of latest version, minimum 8GB RAM memory, 1TB hard driver, DVD writer and the following peripheral hardware and software:

   a. Peripheral Hardware

      i. LED video monitor, 24 inch screen size;

      ii. Keyboard and optical mouse;

      iii. Laser jet colour printer (shared with the central alarm and door monitoring system);

      iv. All necessary network devices.

   b. Software

      i. Remote end CCTV monitoring software to be provided by the NVR suppliers and installed and set up by the Sub-contractor;

      ii. The central CCTV video management and control function shall include but not limited to live view of CCTV channels, playback, record and store file, remotely configure the device parameters, control pan / tilt / zoom, get alarm information, respond and control motions of cameras.

ELE24.3.6 CENTRAL SECURITY SYSTEM SIGNALS TERMINATION BOX

ELE24.3.6.010.9 TERMINATION

All the video and panic alarm signals which all required to be interfaced with the central CCTV system shall be terminated properly to sockets in a separate metal housing at G/F of the meter room. The Sub-contractor shall collect the video transmitters and modems from the Estate Office and complete the Central Security System.

ELE24.3.7 CABLING AND CONNECTIONS

ELE24.3.7.010.9 CABLE

1. Video and radio frequency cables shall be run in concealed conduit separated from power and control cables unless otherwise shown on the Drawings. If surface wiring of video and radio frequency cables has to be performed, they shall maintain a distance of at least 100 mm from power conductors;
2. Internal wiring within console or equipment racks shall be neatly run and held fixed in cable ducts by non-rusting cleats or cable ties;
3. The installation and handling of the cables shall be undertaken at all times by adequate staff suitably trained and supplied with all the necessary equipment and tools. The arrangement of the cables and all method of laying shall be Approved by the Contract Manager and shall be an orderly manner, free from unnecessary bends and crossing and will permit the removal of any one cable without undue disturbance to adjacent cables.

ELE24.3.7.020.9 CONNECTION

1. Connection of cables between an equipment and a wall-mounted adaptor box; or between the equipment rack or console and the cable conduit or trunking shall be protected by flexi-conduit to BS EN 61386-1 or IEC 61386-1;
2. Cable connections to an equipment or control panel shall, as far as possible, be provided with plug-socket configuration. Where direct entry of a cable through a metallic cover or panel of an equipment rack is unavoidable, the hole through the metallic cover or panel shall be protected by rubber grommets to avoid cuts;
3. Jointing of cables shall be avoided. Where a joint is considered acceptable by the Contract Manager all cables shall be jointed by properly designed connectors or inside joint boxes;
4. The Sub-contractor shall provide 75 ohms BNC type video connectors for all cable connections to video equipment or connection panel of control consoles;
5. Handsets of the doorphone system in individual flats shall be connected to the main trunk cable through a termination box located in the meter room on each floor. A printed circuit board shall be provided in the termination box for the purpose of cable connection and termination. All terminal blocks and other system components such as diodes and resistors shall be mounted on this printed circuit board. Interconnections between incoming terminals, outgoing terminals and other system components shall be achieved by copper tracks etched on the printed circuit board and jumper wires shall not be used. Labels shall be printed on the printed circuit board to show the identity of each component, the function and associated flat number of each terminal. A sample of a fully completed printed circuit board together with a labelled circuit diagram shall be submitted for approval prior to manufacturing.

ELE24.3.8 EARTHING

ELE24.3.8.010.9 GENERAL

1. All consoles, operator panels, equipment chassis, camera housing, monitor housing that are constructed from metal shall be suitably earthed against electric shock;
2. If the system design or equipment configuration requires the signal circuit common (applicable to video, radio frequency or control circuitries) to be earthed to minimise interference and/or electromagnetic pick-up, these shall be earthed at a single point to avoid hum loops;
3. Earthing arrangements shall be in accordance with the Electrical CoP.

ELE24.3.9 CCTV AND INTERCOM SYSTEM FOR TEMPORARY REFUGE SPACE

ELE24.3.9.010.9 GENERAL

1. The following CCTV and intercom system shall be provided for temporary refuge space (TRS) in accordance with the Code of Practice for Fire Safety in Buildings 2011 (the Code) issued by Buildings Department:
    a. A closed-circuit television and direct intercom system, both backed up by uninterrupted power supply (UPS) system, shall be provided to every temporary refuge space for communication with the local guard counter and / or management office of the building or other location as specified;
    b. The height of the intercom slave station shall not be less than 900mm and not more than 1200mm above the floor level;
    c. The closed-circuit television and direct intercom system shall be linked to a monitor and a panel respectively at the local guard counter and / or management office or other location as specified showing or indicating the temporary refuge spaces at which persons with a disability are waiting for rescue.
2. An operation instruction plate of CCTV and intercom system shall be provided at the local guard counter and / or management office or other location as specified. The Sub-contractor shall submit details of operation instruction plate to the Contract Manager for approval prior to manufacture.

ELE24.3.9.020.9 INTERCOM SYSTEM

1. The intercom system shall comprise a master station located at the local guard counter and / or management office or other location as specified and a slave station at each temporary refuge space respectively;
2. The master station shall conform to the following technical requirements:
    a. The master station shall be a vandal proof panel with minimum 1.5mm thick stainless steel faceplate and designed for desk-top mounting. The housing shall be made of minimum 1.2mm thick stainless steel;
    b. Each master station shall comprise:
        i. A floor selection panel;
        ii. A handset unit.
    c. A floor selection panel shall be provided to incorporate the following controls / indicators:

i. Heavy duty Press-ON / Press-OFF floor selection buttons;

ii. Floor selection indication light;

iii. A heavy duty spring-loaded slave station "CALL" button;

iv. A buzzer volume control button;

v. A power supply status indicator;

vi. A lamp test button;

vii. A buzzer alarm.

d. The master station shall be capable of communicating with any one of the connected slave stations. Direct communication between the slave stations is not required.

3. The slave station shall conform to the following technical requirements:

a. Each slave station shall be a vandal proof panel with minimum 1.5mm thick stainless steel faceplate and designed for recessed-mounting. The base box shall be made of minimum 1.5mm thick galvanised steel;

b. Each slave station shall comprise:

i. A microphone and loudspeaker two way communication unit for hands free operation in a noisy environment such as fire alarm bell being activated;

ii. A heavy duty spring-loaded "CALL" button for communication with local guard counter and / or management office or other location as specified;

iii. A LED indication lamp “PLEASE WAIT” displayed in English and Chinese;

vi. A LED indication lamp “PLEASE TALK” displayed in English and Chinese;

v. All push buttons shall be vandal-proof type. The push buttons shall be flush mounted with its edge at least 1mm protruded from the surface of stainless steel plate. Push buttons shall be submitted to the Contract Manager for approval;

vi. Braille instructions as specified on the Drawings.

4. The Sub-contractor shall submit drawings for the arrangement of the master station and slave station to the Contract Manager for approval prior to manufacture;

5. The operation of intercom system shall be as follows:

a. To initiate a call at the master station, the operator shall press the floor selection button on the master station once. The respective floor indication light shall light up in RED colour automatically. When the "CALL" button at the master station is pressed, a high note call alarm shall be heard at the selected slave station and the “PLEASE TALK” indication lamp shall light up at the selected slave station. Communication between the operator at the master station and the persons with disability at the slave station can be made via the corresponding microphone and loudspeaker unit. On completion of the call, the system shall be reset by pressing the selected floor selection button again and the respective floor indication light at master station shall change to YELLOW colour in order to retain the indication of completed call. The YELLOW floor indication light can be turned off by pressing the selected floor selection button again;

b. To initiate a call at the slave station, the person with disability shall press the "CALL" button on the slave station once. The "PLEASE WAIT" indication lamp shall light up at the slave station. When the master station is being called by a slave station, the buzzer alarm at the master station shall sound and the corresponding floor indication light shall flash in RED colour and the operator can answer the call by pressing the floor selection button; the "PLEASE WAIT" indication lamp shall stop light up and the "PLEASE TALK" indication lamp shall light up at the selected slave station. The respective floor indication light at master station shall light up in RED colour automatically. Communication between the operator at the master station and the persons with disability at the slave station can be made via the corresponding microphone and loudspeaker unit. On completion of the call, the system shall be reset by pressing the selected floor selection button again and the respective floor indication light at master station shall change to YELLOW colour in order to retain the indication of completed call. If the master station is being called by the same slave station again at this stage, the buzzer alarm at the master station shall sound and the corresponding floor indication light shall flash in RED colour and the operator can answer the call by the same operation sequences as mentioned above. The YELLOW floor indication light can be turned off by pressing the selected floor selection button again;

c. If the call from slave station is not picked up within a predetermined period, which is adjustable from 1 to 120 seconds, an alarm signal for the unattended call shall also be generated to the central alarm and door monitoring system via the local alarm and door monitoring system;

d. The master station shall be so designed that it can communicate with only one slave station at a time. When the master station is engaged with one slave station, call from other slave station shall cause the corresponding floor indication light to flash only without activating the buzzer alarm. The operator shall follow the same procedure as described above in answering the waiting calls.

ELE24.3.9.030.A CCTV SYSTEM

1. The CCTV system shall be a local CCTV monitoring system. It shall comprise of the following:
   a. IP CCTV camera at each temporary refuge space;
   b. A monitor located at the local guard counter and / or management office or other location as specified;
   c. NVRs;
   d. Video multiplexing device for display of CCTV images of all TRS from all NVRs on single monitor via time interlace mode;
   e. Interfacing unit with intercom system for pop-up of CCTV images at TRS during communication.
2. The CCTV images captured by the IP CCTV camera at TRS shall be transmitted to the central CCTV system via LAN or Broadband Internet as specified in Project Specific Specification and Drawings;
3. The operation of CCTV system shall be as follows:
   a. Under normal condition, there shall be a view mode selector at the local guard counter and / or management office or other location as specified for the operator to select viewing of CCTV images in two different modes:
      i. display of CCTV images from selected single NVR in 4x4 screen mode;

ii. sequential display of 4x4 screen CCTV images of all TRS from all NVRs in view mode.

Under normal condition, all CCTV images are not recorded by the NVR.

b. When the operator initiates the communication with a particular slave intercom station or answers the call from a slave intercom station by pressing the floor selection button at master intercom station of intercom system, the CCTV image of the selected slave intercom station shall be automatically pop-up and displayed on the monitor. At the same time, when the operator initiates the communication at the master intercom station by pressing the floor selection button or when the persons with disability initiates the communication at the slave intercom station by pressing the "CALL button", the NVR will be triggered to start recording of the CCTV image of the TRS at selected floor;

c. On completion of the call, the operator will reset the intercom system by pressing the selected floor selection button once again and the floor indication light at master intercom station shall change to YELLOW. The CCTV system shall then resume to the view mode under normal condition automatically but the recording of the CCTV images of the TRS at selected floor shall still continue. The operator shall press the selected floor selection button again to turn off the YELLOW indication light and stop recording of the CCTV images of the TRS at selected floor.

4. The Sub-contractor shall provide all necessary video multiplexing devices for display of all CCTV camera images on a single monitor and interfacing devices for the interface with intercom system as described in the above operation sequence. The Sub-contractor shall submit drawings for the arrangement of the CCTV system to the CM for approval prior to manufacture;

5. The equipment of the CCTV system shall comply with the specification in ELE24.2;

6. The IP CCTV camera shall be similar to that used for lift CCTV system except that the camera shall be surface mounted under the ceiling. Super wide angle lens integral with the camera shall be used. The camera and the integral lens shall have angular field of view not less than 110° horizontal.

ELE24.3.9.040.9 WIRING INSTALLATION

Except for the installation in fireman's lift lobby area with guard counter, the wiring installation of CCTV and intercom system shall meet the minimum fire resisting cable requirements for audio / visual advisory systems as listed in Appendix 8 of Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment issued by Fire Services Department.

ELE24.4 TESTING, COMMISSIONING, ACCEPTANCE AND MAINTENANCE

ELE24.4.1 PERFORMANCE TESTS, ADJUSTMENTS, COMMISSIONING AND ACCEPTANCE

ELE24.4.1.010.9 GENERAL

The Sub-contractor shall carry out complete performance tests for all equipment and system installed by him, make all necessary adjustments, commission the installations, and submit the test reports, all to the satisfaction of the Contract Manager who may request the Sub-contractor to repeat all or some of the tests in the presence of his representatives before the installation will be accepted.

ELE24.4.2 TEST

ELE24.4.2.010.B TEST FOR DOORPHONE PANEL

During works completion of the doorphone panel on Site, the Sub-contractor shall perform the functional tests of the doorphone system to the satisfaction of the CM or his representatives:

1. Functional test of all push buttons in the visitor panel shall be conducted;
2. Functional test of the selection of flats and the two-way communication between the panel and the selected flats shall be conducted. After pressing the selected floor and flat, the correct pilot light shall be illuminated and the communication between the visitor panel and addressed flat's handset shall be functioned;
3. Functional Test of the Octopus Card Door Access System (OCDAS) in the visitor and doorphone panels;
4. During the system communication, the sound quality, sound output level, sensitivity of microphone, and door releasing button of the handset shall be checked;
5. The picture displayed in the video monitor receiving from the CCD video camera in the visitor panel shall have good quality.

ELE24.4.2.020.9 ELECTRICAL TESTS

1. The electrical installation associated with the installation shall be tested to comply with the Electrical CoP and I.E.E. Wiring Regulations, latest edition;
2. Essential performance parameters of all active components of the system as detailed in this Particular Specification including CCTV, amplifier, quad unit, UPS etc. shall be tested to the satisfaction of the Contract Manager. The Sub-contractor shall, at his own cost, deliver the equipment together with test report as required by the Contract Manager or his representative for bench testing and subsequently to the site;
3. The testing procedures recommended by the manufacturer for CCD cameras shall be submitted for Approval;

4. After completion of the installation and before acceptance, the system shall be tested by the Sub-contractor in the presence of the Contract Manager or his representative. All operational functions and performance parameters as specified shall be clearly demonstrated and verified.

ELE24.4.2.030.A TEST FOR CCTV AND INTERCOM SYSTEM FOR TEMPORARY REFUGE SPACE

1. Before delivery of the equipment for CCTV and intercom system to Site, the Sub-contractor shall perform the functional tests of the CCTV and intercom system at the Sub-contractor's workshop in Hong Kong. All tests shall be witnessed by the CM and carried out to the satisfaction of the CM and all test results shall be submitted to the CM for record purpose. During works completion, the Sub-contractor shall again perform the functional tests of the CCTV and intercom system to the satisfaction of the CM. The scope of functional tests shall include:
    a. Functional test of all push buttons in the master and slave stations;
    b. Functional test of the selection of slave stations and the two-way communication between the master station and the selected slave stations;
    c. During the system communication, the sound quality, sound output level and sensitivity of microphone shall be checked under fire alarm bell being activated;
    d. The CCTV camera images displayed in the video monitor shall have good quality. Functional test of interfacing of CCTV and intercom system and the selection of different viewing modes ((1) display of CCTV images from selected single NVR in 4x4 screen mode and (2) sequential display of 4x4 screen CCTV images of all TRS from all NVRs in view mode) shall be conducted.
2. The Sub-contractor shall provide training on the operation and maintenance of the CCTV and intercom systems in accordance with a proposed training programme approved by the CM. The training shall be conducted during normal working hours for the estate management staff. The Sub-contractor shall record one training session in 720p or better resolution video and hand over 2 copies of the video record to the CM.

ELE24.4.3 SCOPE OF WORK DURING MAINTENANCE PERIOD

ELE24.4.3.010.A GENERAL

The scope of work shall include:

1. To carry out all repairs necessary to maintain the Security System installation in good working order at all times;
2. To provide all transport, labour and materials, including cleaning materials, tools and all testing instruments required for the maintenance service;
3. To despatch competent and specially trained workmen to attend any requirement for an emergency inspection within 1 hour during office hours or 2 hours if outside office hours after receiving the report of a fault. The system shall be repaired and restored to normal within 24 hours. In the event that it being impossible to perform the requirement within the time stipulated, the Sub-contractor shall explain immediately to the CM or his representatives the reason for such non-conformance;

4. To despatch competent and specially trained workmen once monthly during normal working hours i.e. 0800 hours to 1700 hours, or as otherwise stated in the Schedule of Installations to inspect, clean and when necessary, align, adjust and maintain the whole installation, and to sign a "Maintenance Record Book" in the way described as follows:

    a. On arrival at the estate, the workmen shall report to the Estate Office and sign a "Maintenance Record Book" which will be kept by the Officer-in-Charge of the estate. At the time of signing, they shall note any message written in the book concerning the performance of any parts of the Security System on the estate, and shall take such action as may be required. They shall inspect the installation on the estate at the time of this regular inspection and make any repairs, replacements or adjustments which may be required, irrespective of whether or not such repair or adjustment is noted in the book;

    b. When leaving the estate, the workmen shall report to the Office-in-Charge and enter in the "Maintenance Record Book" a brief report on any repairs, replacements or adjustments, which have been carried out or on the fact that they have found the system operating satisfactorily.

5. Throughout the Maintenance Period, the Sub-contractor shall be responsible for the updating of the firmware of the NVR and the software of the NVR remote client as and when requested by the CM. After each firmware and software update, the Sub-contractor shall test the system and do all adjustment of system settings as necessary to make sure the system is back to full operational conditions and functionalities and record all the details in "Maintenance Record Book";

6. To provide quarterly reports on the condition of the system:

    a. To provide repairs and replacement parts at no additional cost to the Authority such as mechanical, electrical and electronic parts of the installation which the CM or the Sub-contractor in his judgement may consider necessary for the correct operation of the installation. Provided always that any renewals or repairs necessitated by reason of negligence or misuse of the equipment or by reason of any other cause beyond the Sub-contractor's control, with the exception of ordinary wear and tear, shall be carried out by the Sub-contractor if so required by the CM at an additional cost to be negotiated by both parties. Replacements shall be obtained from the manufacturer's spare parts list. Alternative components shall not be used without prior Approval by the CM;

    b. Should the Sub-contractor find it necessary to remove any system parts to his workshop for repair, the Sub-contractor shall install at the time of removal replacement parts of the equipment during the period of repair, free of cost to the Authority.

ELE24.4.3.020.A QUARTERLY SERVICING

The Sub-contractor shall carry out, at three months intervals, routine servicing and preventive maintenance to maintain the security systems in proper working condition within the Maintenance Period. The Sub-contractor shall conduct the inspection, servicing and maintenance works and submit a report to the CM after each inspection, as stated below:

1. Security door lock:

    a. Check and clean the door contact;

    b. Clean and check the proper operation of the electro-magnetic door lock and the conditions of all physical mounting and alignment;

    c. Check that the entrance door with electro-magnetic door lock can be released when the emergency door release for door release is activated;

d. Check that the entrance door with electro-magnetic door lock is unlocked in case of mains power failure.

2. Doorphone system:
   a. Check for and repair / replace the push buttons;
   b. Check the condition of electronic components and printed circuit board;
   c. Check the operation of L.E.D. matrix display and other indicators for proper operation;
   d. Check that the functional operation of the systems meets with the specification requirements.
3. Local closed circuit television system:
   a. Clean the lens and camera;
   b. Check the focus of camera;
   c. Adjust the angle of view of the camera;
   d. Check views of the camera on the monitor and in particular take note of the resolution of the picture;
   e. Check and adjust the contrast and brightness of the monitor;
   f. Clean the screen of the monitor;
   g. Check the operation of NVR;
   h. Check hard disk storage of NVR;
   i. Check accuracy and correctness of date / time / location setting;
   j. Check the quality of video image recorded in night time.
4. Local alarm and door monitoring system:
   a. Check that the functional operation of the system in particular the time delay setting meets with the specification requirements;
   b. Test the indicators and buzzer;
   c. Check the condition of the battery and charger.
5. Central alarm and door monitoring system:
   a. Check that the functional operation of the system meets with the specification requirements by means of simulating alarms at the building;
   b. Clean the floppy disk drive, if provided;
   c. Check the data storage and back up if necessary;
   d. Clean and check the proper operation of the printer.
6. Central CCTV system:
   a. Check that the functional operation of the system and the alarm reporting operation meets with the specification requirements;
   b. Check the views of the cameras on the monitor and in particular take note of the resolution of the picture;
   c. Check and adjust the contrast and brightness of the monitor;
   d. Clean the screen of the monitor;
   e. Check the operation of all network devices (routers, network hubs / switches etc.) at the local systems and the central system (i.e. at domestic blocks and EMO);

f. Check the operation of the Broadband Line connections.

7. CCTV and Intercom system for Temporary Refuge Space:
   a. Check and repair / replace the push buttons as necessary;
   b. Check the condition of electronic components and printed circuit boards;
   c. Check the operation of L.E.D. indicators for proper operation;
   d. Check the functional and operation of the systems for compliance with the specification requirements;
   e. Clean the lens and camera;
   f. Check the focus of camera;
   g. Adjust the angle of view of the camera;
   h. Check views of the camera on the monitor and in particular take note of the resolution of the picture;
   i. Check and adjust the contrast and brightness of the monitor;
   j. Clean the screen of the monitor;
   k. Check the operation of CCTV image distribution and control device;
   l. Check the sound quality, sound output level and sensitivity of microphone of the Intercom System.
8. Uninterrupted Power Supply (UPS):
   a. Operation checks of all alarms, indications, controls and protection facilities of UPS equipment;
   b. Check the condition of batteries;
   c. Functional check of external maintenance bypass switch..

ELE25 PUBLIC ADDRESS SYSTEM

ELE25.1 GENERAL REQUIREMENTS 2

ELE25.1.010.9 GENERAL 2
ELE25.1.020.9 SCHEMATIC DIAGRAM 2
ELE25.1.030.9 INFORMATION TO BE SUPPLIED WITH TENDER 2
ELE25.1.040.9 SAMPLES OF EQUIPMENT 2
ELE25.1.060.9 EXECUTION OF WORKS 2

ELE25.2 THE PUBLIC ADDRESS SYSTEM 3

ELE25.2.020.9 FUNCTIONALITY OF THE PUBLIC ADDRESS SYSTEM 3
ELE25.2.030.9 COMPONENTS OF THE PUBLIC ADDRESS SYSTEM 3
ELE25.2.040.9 REMOTE SIGNAL INPUT POINT (RSIP) 4
ELE25.2.050.9 PORTABLE PUBLIC ADDRESS SYSTEM 4

ELE25.3 EQUIPMENT FUNCTIONAL REQUIREMENTS AND PERFORMANCE CHARACTERISTICS 5

ELE25.3.010.9 GENERAL 5
ELE25.3.020.9 AM-FM RADIO TUNER 5
ELE25.3.030.9 CD PLAYER 5
ELE25.3.040.9 MICROPHONES 6
ELE25.3.050.9 INPUT SELECTION PANEL 6
ELE25.3.060.9 MONITOR PANEL 6
ELE25.3.070.9 VOLUME CONTROL PANEL 6
ELE25.3.080.9 EQUIPMENT CABINET 7
ELE25.3.090.9 CEILING SPEAKER 7
ELE25.3.100.9 HORN SPEAKER 7
ELE25.3.110.9 COLUMN SPEAKER 7

ELE25.4 INSTALLATION REQUIREMENTS 8

ELE25.4.010.9 GENERAL 8
ELE25.4.020.9 MOUNTING OF CEILING SPEAKER 8
ELE25.4.030.9 MOUNTING OF REMOTE SIGNAL INPUT POINT (RSIP) CONNECTORS 8
ELE25.4.040.9 AM-FM RADIO TUNER 8

ELE25.5 TESTING, COMMISSIONING, ACCEPTANCE AND MAINTENANCE 9

ELE25.5.010.9 PERFORMANCE TEST, ADJUSTMENTS, COMMISSIONING AND ACCEPTANCE 9
ELE25.5.020.9 ELECTRICAL TEST 9
ELE25.5.030.9 SCOPE OF WORK DURING MAINTENANCE PERIOD 9

ELE25.1 GENERAL REQUIREMENTS

ELE25.1.010.9 GENERAL

This Particular Specification is in addition to, and is to be read in conjunction with, the relevant sections of the latest issue/amendment of the General PA Specification. The installation shall comply with the above specifications where relevant.

ELE25.1.020.9 SCHEMATIC DIAGRAM

The proposed schematic diagrams for the systems given in the Drawings are intended to serve as guidelines only and may not be taken as the final design. If any deviations are proposed or expected, tenderer shall enclose details of the proposed alternatives with their tenders for consideration.

ELE25.1.030.9 INFORMATION TO BE SUPPLIED WITH TENDER

Tender shall be accompanied by specifications, catalogues, literatures etc. in English language for each item of equipment offered.

ELE25.1.040.9 SAMPLES OF EQUIPMENT

Tenderer may be required to submit sample of any equipment proposed to the Contract Manager for bench acceptance testing before installation.

ELE25.1.060.9 EXECUTION OF WORKS

1. The Sub-contractor shall employ a contractor on the “List of Approved Suppliers of Materials and Specialist Contractors for Public Works” for “Audio Electronics Installation” to carry out the works for the public address system. The name of the specialist contractor shall be included on the Schedule of Information to be supplied by Tenderer at the time of tender submission. Subsequent to the acceptance of tender, the afore-mentioned contractor shall not be changed unless otherwise approved by the Contract Manager;
2. The “List of Approved Suppliers of Materials and Specialist Contractors for Public Works” for “Audio Electronics Installation” may be found on the website of the Development Bureau, the Government of the HKSAR.

ELE25.2 THE PUBLIC ADDRESS SYSTEM

ELE25.2.020.9 FUNCTIONALITY OF THE PUBLIC ADDRESS SYSTEM

The System will be used for making announcement and playing background music to the selected areas of the commercial centre. The system shall allow:

1. Announcement to be made from the console by means of a hand-held microphone with on-off switch;
2. Background music to be played by means of a CD player with MP3 playback function and/or a radio tuner at the console; and
3. Speeches and music programmes fed from remote signal input points (RSIPs), as specified in Project Specific Specification and/or Drawings, to be broadcasted.

ELE25.2.030.9 COMPONENTS OF THE PUBLIC ADDRESS SYSTEM

The system shall comprise the following items, each to be complete with necessary accessories:

1. A hand-held type microphone with built-in "ON/OFF" talk switch completes with mike hanger and coiled cable of 1 m to 1.5 m long;
2. An AM/FM radio tuner;
3. A CD player with MP3 playback function;
4. An input selection panel - the input selection panel shall perform the input switching function as detailed in ELE25.3.050 below;
5. One mixer preamplifier - the mixer preamplifier shall accept all system inputs. Individual volume control shall be provided for each system input;
6. The quantities and power ratings of power amplifiers to be used for the system shall be clearly stated by the tenderer in his tender. The total load connected to each individual power amplifier shall not be more than 90% of its rated power;
7. A speaker selector shall allow speaker zones to be selected individually or collectively in any combinational manner, plus the all-call function. Details of speaker zones are given in Project Specific Specification and/or Drawings;
8. A volume control panel shall allow individual step volume control of each speaker zone. Details of speaker zones are given in Project Specific Specification and/or Drawings;
9. A monitor panel with two monitoring circuits;
10. A steel equipment cabinet rack for holding items (1) to (9) above;
11. 3W ceiling mount speakers, number to be given in Project Specific Specification and/or Drawings;
12. Wide range horn speakers, number and wattage to be given in Project Specific Specification and/or Drawings;
13. Column speakers, number and wattage to be given in Project Specific Specification and/or Drawings; and
14. Remote signal input circuits where each circuit consists of a number of remote signal input points connected in parallel. Details to be given in Project Specific Specification and/or Drawings.

ELE25.2.040.9 REMOTE SIGNAL INPUT POINT (RSIP)

All remote signal input point (RSIP)'s shall be connected to the equipment rack by microphone cables. A cannon socket shall be provided for each RSIP and installed in the manner as described in ELE25.4.030.

ELE25.2.050.9 PORTABLE PUBLIC ADDRESS SYSTEM

The portable system shall comprise the following equipment items, each to be complete with necessary accessories:

1. 2 hand-held type microphones each complete with a tiltable mount adaptor and a suitable floor stand of adjustable height. The length of cable required for each microphone shall be 10 m;
2. A portable mixer power amplifier (or a portable mixer-preamplifier plus a portable power amplifier) with at least 2 microphone inputs, 1 magnetic phono input, and 1 auxiliary input. A line level output is also required. Minimum output power of the amplifier is given in the Project Specific Specification and/or Drawings;
3. 2 Nos. speaker columns each complete with a suitable height floor stand support. Output power of the speakers is given in the Project Specific Specification and/or Drawings;
4. A 10 m long extension microphone cable shall be provided for connecting the line output of the amplifier to any one of the RSIPs of the Public Address System. The cable end for connecting to the RSIP shall be terminated with a cannon plug;
5. A 10 m long extension speaker cable shall be provided for each speaker column for connecting the speaker to the power amplifier;
6. The Sub-contractor shall supply a trolley with heavy duty casters. All the above equipment except the speakers and their accessories shall be mounted on it. The sub-contractor shall submit a shop drawing to the Contract Manager for Approval prior to fabrication.

ELE25.3 EQUIPMENT FUNCTIONAL REQUIREMENTS AND PERFORMANCE CHARACTERISTICS

ELE25.3.010.9 GENERAL

1. Unless otherwise specified herein, all equipment items to be supplied shall comply with the functional requirements and performance characteristics specified in Section 4 of the General PA Specification;
2. In case of any discrepancy between this specification and the General PA Specification the former shall take precedence;
3. The Monitor Panel, the Input Selection Panel and the Volume Control Panel for the Public Address System shall be made of 1.5 mm thick stainless steel plate or 3.2 mm thick anodized aluminium plate. All labels shall be engraved. Drawings of the panel layout shall be submitted for Approval prior to fabrication;
4. The requirements of sub-clause (3) shall apply also to the front panel of the Speaker Selector for the Public Address System if this item is custom made.

ELE25.3.020.9 AM-FM RADIO TUNER

1. A quartz synthesizer AM/FM tuner with auto-scan tuning shall be provided. It shall be equipped with at least 12 preset tunings with 6 for FM channels and 6 for AM channels. The tuning circuit of the tuner shall be stable enough to maintain unattended operation over long period;
2. The tuner shall be capable of receiving radio programmes in AM band of 530 to 1,605 kHz and FM band of 88 to 108 MHz;
3. The tuner shall be complete with band selector and volume control, and shall also satisfy the following minimum performance characteristics:
    a. Sensitivity shall be better than l00uV for AM (l,000 kHz) and l0uV for FM (26 dB quieting, 40 kHz deviation);
    b. Signal-to-noise ratio shall be greater than 40dB for AM and 65 dB for FM;
    c. Selectivity shall be not lower than 6 kHz for AM and 250 kHz for FM at – 3 dB point;
    d. Total harmonic distortion shall not exceed 2% for AM (5 mV, 400 Hz) and 1% for FM (1 kHz);
    e. FM intermodulation distortion shall not exceed 0.3%;
    f. FM frequency response shall not vary by more than 3dB over the frequency range 30 - 15,000 Hz;
    g. Output level shall be not less than 450 mV.

ELE25.3.030.9 CD PLAYER

1. This shall be a multi-CD player with MP3 playback function. It shall be of rugged design suitable for long hours playback of background music;
2. It shall comprise of a front access USB socket for audio file play back;

3. The multi-CD player shall have the series playback function so that after one disc finishes, the other shall start playing automatically;
4. It shall satisfy the following minimum performance characteristics:
   a. Frequency response : 20 to 20,000Hz ± 2 dB;
   b. Harmonic distortion : Less than 0.02% at 1 kHz;
   c. Signal to noise ratio : Better than 98 dB.

ELE25.3.040.9 MICROPHONES

All microphones shall be of unidirectional (cardioid) dynamic type.

ELE25.3.050.9 INPUT SELECTION PANEL

1. The panel shall comprise of push-button switches, illuminated indicators and the associated control circuitry to facilitate the selection of the following inputs.
   a. Tuner;
   b. CD player with MP3 playback function;
   c. Console microphone (selected by the microphone "ON/OFF" switch);
   d. Remote signal input point;
   e. Spare.
2. The microphone input shall have priority over all other inputs and is selected by its "ON/OFF" switch. The control circuitry shall be able to select the microphone input automatically when the microphone is switched to "ON" position and back to the previous selected input source when it is switched off;
3. Only one input shall be selected at any one time;
4. The input selection panel and the volume control panel mentioned in ELE25.3.070 should preferably be installed in a single panel mounted on the console.

ELE25.3.060.9 MONITOR PANEL

1. The panel, required for the Public Address System, shall consist of two monitoring circuits - Circuit A for monitoring the outputs of all power amplifiers and Circuit B for monitoring the zone outputs of the volume control panel. The number of zones is given in Project Specific Specification and/or Drawings;
2. All the facilities specified in Clause 4.2.9(b) of the General PA Specification, except item (ii), shall be provided for the Monitor Circuits A & B;
3. A master power ON/OFF switch with lamp indication shall be provided on the panel for the whole Public Address System.

ELE25.3.070.9 VOLUME CONTROL PANEL

1. The panel, required for the Public Address System, shall have a number of sets of rotary switches and auto-transformer circuits for varying the output voltage of the speaker lines individually. The number of sets is given in Project Specific Specification and/or Drawings;
2. For each control circuit, a minimum of six control steps giving attenuation right from full speaker line output (0 dB) to a value of not less than 15 dB shall be provided.

ELE25.3.080.9 EQUIPMENT CABINET

1. Equipment cabinet for the Public Address System shall be a steel cabinet rack of standard 19 inch (483 mm) EIA type;
2. The cabinet rack shall be made of mild sheet steel of at least 1.2 mm thick, complete with two layers of stoved enamel or one layer of epoxy powder paint, and coloured grey;
3. Provision of a front locking door for the rack is optional. However, it shall have a detachable back panel (or cover) to facilitate easy servicing. The back panel (or cover) shall be either fixed by screws or fitted with hinge and lock. Blank panels shall be provided to fill up gaps and spaces on the rack front;
4. It shall be complete with a blower fan unit to assure good ventilation;
5. Drawing of the cabinet rack and proposed equipment mounting layout shall be submitted for Approval prior to fabrication.

ELE25.3.090.9 CEILING SPEAKER

1. Ceiling mount speakers for the Public Address System shall be suitable for flush-mounting on false ceiling;
2. Input power rating of the ceiling mount speaker shall be at least 3W and equipped with matching transformer. The transformer shall be complete with at least l W, 2 W and 3 W tappings with insertion loss of not exceeding l dB;
3. The ceiling mount speaker shall have aluminium or metallic alumited punching grille and complete with a metal enclosure. The area of punching shall be not less than 10% of the total area of the metal grille;
4. If there is no false ceiling, surface type ceiling speaker shall be provided.

ELE25.3.100.9 HORN SPEAKER

Wide range horn speakers of outdoor type shall be provided for the Public Address System. Input power rating of the horn speaker is given in the Project Specific Specification and/or Drawings.

ELE25.3.110.9 COLUMN SPEAKER

1. Column speaker shall be of weatherproof type suitable for outdoor application for the both fix mounting and portable PA Systems. Enclosure shall be made of non-rusting metallic material;
2. Input power rating of the column speaker is given in the Project Specific Specification and/or Drawings...

ELE25.4 INSTALLATION REQUIREMENTS

ELE25.4.010.9 GENERAL

Unless otherwise specified in this specification or on the Drawings, all signal cables shall be provided in concealed conduit wiring system. Speaker and microphone cables shall be installed in separate conduits. Voltage of control cables sharing the same conduit with microphone cables shall be d.c. 24V or lower. Microphone cables shall mean all microphone cables carrying line or lower level audio signals.

ELE25.4.020.9 MOUNTING OF CEILING SPEAKER

1. The ceiling speakers shall be linked to the BESA boxes at conduit outlets by flexible conduits (with PVC oversheath and dome covers);
2. The Sub-contractor shall provide mounting brackets and necessary mounting materials for the ceiling speakers;
3. Mounting of the ceiling speakers, including mounting brackets, shall be carried out by the Sub-contractor;
4. Cutting of openings on the false ceiling for the speakers will be carried out by the Main Contractor, however information of which shall be provided by the Sub-contractor;
5. The tenderer shall enclose details of the installation method, together with complete information on exact dimensions of the ceiling speaker and mounting bracket, size of ceiling opening required, total mechanical loading of speaker including mounting bracket, etc. in his tender for consideration;
6. Proper connector, such as terminal block, shall be provided inside the speaker enclosure for the speaker cable to facilitate easy removal of the loudspeaker unit.

ELE25.4.030.9 MOUNTING OF REMOTE SIGNAL INPUT POINT (RSIP) CONNECTORS

If RSIP is required, the Cannon Socket for the RSIP of the Public Address System shall be flush mounted or a stainless steel plate. The plate shall be fixed inside a drip-proof stainless steel box complete with hinged cover and lock. The size of the box shall not be more than 180 x 180 x 100 (D) mm and it shall be fixed onto a BS 4662 box provided by others.

ELE25.4.040.9 AM-FM RADIO TUNER

The FM signal for the AM-FM Radio Tuner shall be obtained from the Communal Aerial Broadcast Distribution System socket outlet at the position as shown on the Drawings.

ELE25.5 TESTING, COMMISSIONING, ACCEPTANCE AND MAINTENANCE

ELE25.5.010.9 PERFORMANCE TEST, ADJUSTMENTS, COMMISSIONING AND ACCEPTANCE

The Sub-contractor shall carry out complete performance tests for all equipment and systems installed by him, make all necessary adjustments, commission the installations, and submit test reports, all to the satisfaction of the Contract Manager who may request the Sub-contractor to repeat all or some of the tests in the presence of his representatives before the installation is accepted. At the end of the maintenance period, the Sub-contractor shall repeat the tests to the satisfaction of the Contract Manager.

ELE25.5.020.9 ELECTRICAL TEST

The electrical installation associated with the installation shall be tested to comply with latest edition of the Electrical CoP and I.E.E. Wiring Regulations.

ELE25.5.030.9 SCOPE OF WORK DURING MAINTENANCE PERIOD

The scope of work shall include:

1. To carry out all repairs necessary to maintain the Public Address System installation in good working order at all times;
2. To provide all transport, labour and materials, including cleaning materials, tools and all testing instruments required for the maintenance service;
3. To despatch competent and specially trained workmen to attend any requirement for an emergency inspection and repair within 24 hours of receiving the report of a fault;
4. To despatch competent and specially trained workmen once monthly during normal working hours i.e. 0800 hours to 1700 hours, to inspect, clean and when necessary, align, adjust and maintain the whole installation, and to sign a "Maintenance Record Book" in the way described as follows:
    a. On arrival at the estate, the workmen shall report to the Estate Office and sign a "Maintenance Record Book" which will be kept by the Officer-in-Charge of the estate. At the time of signing, they shall note any message written in the book concerning the performance of any parts of the Public Address System on the estate, and shall take such action as may be required. They shall inspect the installation on the estate at the time of this regular inspection and make any repairs, replacements or adjustments which may be required, irrespective of whether or not such repair or adjustment is noted in the book;
    b. When leaving the estate, the workmen shall report to the Officer-in-Charge and enter in the "Maintenance Record Book" a brief report on any repairs, replacements or adjustments which have been carried out or on the fact that they have found the system operating satisfactorily.
5. To provide half-yearly reports on the condition of the system. The report should include, but not be limited to, the number of calls attended, the number and types of system parts replaced;
6.

a. To provide repairs and replacement parts at no additional cost to the Authority such as mechanical, electrical and electronic parts of the installation which the Contract Manager or the Sub-contractor in his judgement may consider necessary for the correct operation of the installation. Provided always that any renewals or repairs necessitated by reason of negligence or misuse of the equipment or by reason of any other cause beyond the Sub-contractor's control, with the exception of ordinary wear and tear, shall be carried out by the Sub-contractor if so required by the Contract Manager at an additional cost to be negotiated by both parties;

b. Replacements shall be obtained from the manufacturer's spare parts list. Alternative components shall not be used without prior Approval by the Contract Manager;

c. Should the Sub-contractor find it necessary to remove any system parts to his workshop for repair, the Sub-contractor shall install at the time of removal replacement parts of the equipment during the period of repair, free of cost to the Contract Manager.

ELE26 CARPARK CONTROL AND MANAGEMENT FACILITIES

ELE26.1 SCOPE OF WORK 3

ELE26.1.010.B PROVISION OF CARPARK CONTROL AND MANAGEMENT FACILITIES 3
ELE26.1.020.B ENTRANCE CONTROL POINTS 5
ELE26.1.030.B EXIT CONTROL POINTS 5
ELE26.1.040.B CARPARK CONTROL CENTRE 5
ELE26.1.045.A HA OPEN CARPARK 6
ELE26.1.050.A WIRING CONNECTION 6
ELE26.1.060.9 EXECUTION OF THE WORK 6

ELE26.2 SYSTEM DESCRIPTION 7

ELE26.2.010.B AUTOMATIC CARPARK CONTROL SYSTEM 7
ELE26.2.020.B VEHICLE IMAGE AND LICENCE PLATE RECOGNITION SYSTEM 9
ELE26.2.030.B OPERATION AT ENTRANCE CONTROL POINT 9
ELE26.2.040.B OPERATION AT EXIT CONTROL POINT 14
ELE26.2.050.C ACCS WORKSTATION AND REVENUE COLLECTION PROVISION 19
ELE26.2.060.A CAR COUNTING SYSTEM 27
ELE26.2.070.A INTERCOM SYSTEM 27
ELE26.2.080.A CARPARK CCTV SYSTEM 28
ELE26.2.090.9 INTERFACING REQUIREMENTS WITH OCTOPUS CLEARING SYSTEM 28
ELE26.2.100.A INTERFACING REQUIREMENTS WITH HA DATA HUB SERVER 29
ELE26.2.110.A DATA REQUIREMENTS FOR ACCS 33
ELE26.2.120.B REAL-TIME PARKING INFORMATION SYSTEM 35
ELE26.2.130.A DATA REQUIREMENTS FOR TRANSMISSION TO PARKING VACANCY INFORMATION SYSTEM OF THE TRANSPORT DEPARTMENT 35
ELE26.2.140.A DATA REQUIREMENTS FOR TRANSMISSION TO PARKING VACANCY INFORMATION SYSTEM OF THE ENVIRONMENTAL PROTECTION DEPARTMENT 35
ELE26.2.150.N CAR TYPE RECOGNITION SYSTEM BY VIDEO CONTENT ANALYTIC (VCA) SYSTEM 36
ELE26.2.160.N AUDIBLE AND VISUAL ALARM SYSTEM 36

ELE26.3 MATERIALS AND EQUIPMENT 37

ELE26.3.010.A GENERAL 37
ELE26.3.020.D CENTRAL DATA STATION / CASHIER COMPUTER WITH LICENSE PLATE AND CAR TYPE RECOGNITION SYSTEMS 37
ELE26.3.030.B REAL-TIME PARKING INFORMATION COMPUTER 38
ELE26.3.040.B ENTRANCE CONTROL UNIT 38
ELE26.3.050.B EXIT CONTROL UNIT 38
ELE26.3.055.X DELETED 39
ELE26.3.060.A AUTOMATIC DROP GATE BARRIER 39
ELE26.3.070.9 LOOP DETECTOR 39
ELE26.3.080.X DELETED 40
ELE26.3.090.X DELETED 40
ELE26.3.100.X DELETED 40
ELE26.3.110.9 "FULL" SIGN 40
ELE26.3.120.9 INTERCOM SYSTEM MASTER AND SLAVE STATIONS 40
ELE26.3.130.A CARPARK VACANCY DISPLAY BOARD 41
ELE26.3.140.B ULTRASONIC SENSORS OF REAL-TIME PARKING INFORMATION SYSTEM 41

ELE26.3.150.9 AUTOMATIC CUTTING-OFF THERMAL PRINTER 42
ELE26.3.160.A HOURLY PARKING PAY STATION 42
ELE26.3.170.N VIDEO CONTENT ANALYTIC SYSTEM 42
ELE26.3.180.N 32” LCD DISPLAY 43
ELE26.3.190.N AUDIBLE AND VISUAL ALARMS 43

ELE26.4 TESTING AND COMMISSIONING 44
ELE26.4.010.A TESTS 44
ELE26.4.020.9 TEST RECORD 44
ELE26.4.030.A TRAINING 44

ELE26.5 MAINTENANCE 45
ELE26.5.010.9 GENERAL 45
ELE26.5.020.9 24-HOUR ON-CALL SERVICE DURING MAINTENANCE PERIOD 45
ELE26.5.030.A PREVENTIVE MAINTENANCE 45

ELE26.1 SCOPE OF WORK

ELE26.1.010.B PROVISION OF CARPARK CONTROL AND MANAGEMENT FACILITIES

The Sub-contractor shall provide the following carpark control and management facilities as shown on the Drawings:

A. For Public Rental Housing (PRH) Development

1. Carpark control and management facilities for entrance and exit of carpark:
    a. Automatic Carpark Control System (ACCS) and revenue collection provision;
    b. Vehicle Image and Licence Plate Recognition System (VLRS);
    c. Intercom System;
    d. Car counting system and "FULL" sign;
    e. Carpark CCTV System at Entrance and Exit Control Points and at strategic locations in the car parking control area as shown on the Drawings;
    f. Video Content Analytic (VCA) System for car type recognition;
    g. Interfaces with the Octopus clearing system;
    h. System Interfaces to exchange electronic data with a HA data hub server via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP);
    i. Real-time parking information system with carpark vacancy display board and data interface with the parking vacancy information system of the Transport Department (TD) to indicate the number of vacant hourly parking spaces with and without electric vehicle (EV) charging facilities respectively via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP).

B. For Subsidized Sale Flats (SSF) Development with Housing Authority (HA) Standalone Carpark

1. Carpark control and management facilities for entrance and exit of SSF development:
    a. Automatic Carpark Control System (ACCS) and revenue collection provision;
    b. Vehicle Image and Licence Plate Recognition System (VLRS);
    c. Intercom System;
    d. Carpark CCTV System at Entrance and Exit Control Points and at strategic locations in the car parking control area as shown on the Drawings;
    e. VCA System for car type recognition;
    f. Interfaces with the Octopus clearing system.
2. Carpark control and management facilities for ingress and egress of HA Carpark:
    a. Automatic Carpark Control System (ACCS) and revenue collection provision;
    b. Vehicle Image and Licence Plate Recognition System (VLRS);
    c. Intercom System;
    d. Car counting system and "FULL" sign erected at estate entrance of main vehicular access;

e. Carpark CCTV System at Entrance and Exit Control Points and at strategic locations in the car parking control area as shown on the Drawings;

f. VCA System for car type recognition;

g. Interfaces with the Octopus clearing system;

h. System Interfaces to exchange electronic data with a HA data hub server via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP);

i. Real-time parking information system with carpark vacancy display board and data interface with the parking vacancy information system of the Transport Department (TD) to indicate the number of vacant hourly parking spaces with and without electric vehicle (EV) charging facilities respectively via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP).

C. For SSF Development with HA Open Carpark

1. Carpark control and management facilities for entrance and exit of SSF development:

   a. Automatic Carpark Control System (ACCS) and revenue collection provision;

   b. Vehicle Image and Licence Plate Recognition System (VLRS);

   c. Intercom System;

   d. Carpark CCTV System at Entrance and Exit Control Points and at strategic locations in the car parking control area as shown on the Drawings;

   e. VCA System for car type recognition;

   f. Interfaces with the Octopus clearing system.

2. Carpark control and management facilities for entrance and exit of HA Carpark:

   a. Automatic Carpark Control System (ACCS) and revenue collection provision;

   b. Intercom System;

   c. Car counting system and "FULL" sign erected at estate entrance of main vehicular access;

   d. Carpark CCTV System at hourly parking pay stations and at strategic locations in the car parking control area as shown on the Drawings;

   e. Interfaces with the Octopus clearing system;

   f. System Interfaces to exchange electronic data with a HA data hub server via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP);

   g. Real-time parking information system with carpark vacancy display board and data interface with the parking vacancy information system of the Transport Department (TD) to indicate the number of vacant hourly parking spaces with and without electric vehicle (EV) charging facilities respectively via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP).

ELE26.1.020.B ENTRANCE CONTROL POINTS

Unless otherwise specified, the Sub-contractor shall provide the following components at the entrance control point(s) at the entrance of carpark and / or SSF development as located on the Drawings:

1. Entrance Control Unit;
2. Floor-mounted drop gate barrier equipped with automatic raising arm and audible and visual alarms;
3. Underground presence and passage loop detectors;
4. Cameras for CCTV System and accessories completed with weatherproof housings including mounting poles and brackets;
5. VCA camera with mounting pole and bracket;
6. Cameras, floodlight and 32" LCD display for VLRS and accessories completed with weatherproof housings including mounting poles and brackets;
7. HA's "FULL" sign erected at estate entrance of the main vehicular access of PRH / SSF;
8. HA's Carpark vacancy display board erected near the main vehicular access of PRH / SSF.

ELE26.1.030.B EXIT CONTROL POINTS

Unless otherwise specified, the Sub-contractor shall provide the following components at the exit control point(s) at the exit of carpark and / or SSF development as located on the Drawings:

1. Exit Control Unit;
2. Floor-mounted drop gate barrier equipped with automatic raising arm and audible and visual alarms;
3. Underground presence and passage loop detectors;
4. Cameras for CCTV and accessories completed with weatherproof housing including mounting pole and bracket;
5. Cameras, floodlight and 32" display for VLRS and accessories completed with weatherproof housing including mounting pole and bracket.

ELE26.1.040.B CARPARK CONTROL CENTRE

Unless otherwise specified, the Sub-contractor shall provide the following components at the carpark control centre(s) as located on the Drawings:

1. Workstation for ACCS, VLRS and VCA system for calculating the parking fee;
2. Revenue collection provision;
3. Workstation for real time parking information system;
4. Manual button for barrier control (not required for HA Open Carpark without HA control drop gate inside SSF development);
5. Master station of intercommunication system;
6. Equipment rack to keep CCTV system equipment and network video recorders.

ELE26.1.045.A HA OPEN CARPARK

Unless otherwise specified, the Sub-contractor shall provide the following components at the entrance control point(s) at the entrance of carpark and / or SSF development as located on the Drawings:

1. Cameras for CCTV System and accessories completed with weatherproof housings including mounting poles and brackets;
2. HA's "FULL" sign erected at estate entrance of the main vehicular access of PRH / SSF;
3. Hourly parking pay station with the following components:
    a. Octopus Card reader / validator;
    b. Slave station of the intercom system;
    c. Thermal printer;
    d. Backlit LCD colour visual instruction display panel.

ELE26.1.050.A WIRING CONNECTION

The Sub-contractor shall provide all necessary cable wiring for data, communication and power connection between the entrance control point, the exit control point, the hourly parking pay station and the carpark control centre, at both above-ground and under-ground.

ELE26.1.060.9 EXECUTION OF THE WORK

1. The Sub-contractor shall verify to the satisfaction of the Contract Manager that they are licensed for carrying out type III security work under the Security and Guarding Services Ordinance Cap. 460 and are competent to complete the works, otherwise they shall employ competent sub-sub-contractor(s), who have the required licence, to carry out the works relating to security. For the latter case, the Sub-contractor shall submit the proposed sub-sub-contractors' relevant information related to the licence, technical capability, working experience on security system to the Contract Manager for approval. Whenever necessary, the Sub-contractor shall also submit documents and drawings for the completed projects to the Contract Manager for consideration. Inspection of the completed projects and visit of the proposed contractor's office and workshop may be conducted, if deemed necessary;
2. The Sub-contractor shall be an Octopus authorized contractor, or otherwise employ an Octopus authorized contractor as its sub-sub-contractor to provide the ACCS. All system hardware and software related to the Octopus clearing system shall be approved by the Octopus Cards Limited. The Sub-contractor shall provide copies of approval certificates to the Contract Manager for vetting;
3. The Sub-contractor or its sub-sub-contractor for the ACCS shall have at least five carpark systems satisfactorily completed for more than 6 months, in the past three years;
4. For Sub-contract of the latter phase of a housing estate, the Sub-contractor shall ensure the ACCS and VLRS to match with the ACCS and VLRS of the earlier completion phases in the same estate.

ELE26.2 SYSTEM DESCRIPTION

ELE26.2.010.B AUTOMATIC CARPARK CONTROL SYSTEM

1. The Automatic Carpark Control System (ACCS) shall include the following components as indicated on the Drawings:

A. For Public Rental Housing (PRH) Development

a. Carpark control and management facilities for entrance and exit of carpark:

i. Entrance Control Unit(s);

ii. Exit Control Unit(s);

iii. VLRS camera;

iv. Workstation for ACCS, VLRS and VCA system with 24" LED monitor;

v. Revenue collection facilities;

vi. Automatic drop gate barriers;

vii. Loop detectors;

viii. VCA camera for car type recognition;

ix. All necessary wiring and accessories.

B. For SSF Development with HA Standalone Carpark

a. Carpark control and management facilities for entrance and exit of SSF development:

i. Entrance Control Unit(s);

ii. Exit Control Unit(s);

iii. VLRS camera;

iv. Workstation for ACCS, VLRS and VCA system with 24" LED monitor;

v. Revenue collection facilities;

vi. Automatic drop gate barriers;

vii. Loop detectors;

viii. VCA camera for car type recognition;

ix. All necessary wiring and accessories.

b. Carpark control and management facilities for entrance and exit of HA carpark:

i. Entrance Control Unit(s);

ii. Exit Control Unit(s);

iii. VLRS camera;

iv. Workstation for ACCS, VLRS and VCA system;

v. Revenue collection facilities;

vi. Automatic drop gate barriers;

vii. Loop detectors;

viii. VCA camera for car type recognition;

ix. All necessary wiring and accessories.

C. For SSF Development with HA Open Carpark

a. Carpark control and management facilities for entrance and exit of SSF development:

i. Entrance Control Unit(s);

ii. Exit Control Unit(s);

iii. VLRS camera;

iv. Workstation for ACCS, VLRS and VCA camera with 24" LED monitor;

v. Revenue collection facilities;

vi. Automatic drop gate barriers;

vii. Loop detectors;

viii. VCA camera for car type recognition;

ix. All necessary wiring and accessories.

b. Carpark control and management facilities for entrance and exit of HA carpark:

i. ACCS Workstation;

ii. Revenue collection facilities;

iii. Hourly parking pay station(s);

iv. All necessary wiring and accessories.

2. The ACCS shall be able to handle the following types of parking modes:

a. Hourly or Concessionary Parking - operated by VLRS or by Octopus Card system;

b. Season / Monthly Parking - operated by VLRS or by Octopus Card system;

c. Complimentary Parking - operated by either Octopus Card system or manual control.

3. The ACCS shall be of fully automatic type. Under normal operation, no operator is required. Only in the suspension of the Octopus Card System, an operator at the ACCS Workstation is required to handle the cashier work;

4. The ACCS shall possess an anti-passback function for Octopus Cards. When any Octopus card has been accepted by an Entrance Control Unit, the card cannot be re-used again at any Entrance Control Unit of the ACCS until the card has been accepted by an Exit Control Unit of the ACCS. Same principle shall be applied to the Exit Control Unit;

5. The ACCS shall be designed, developed and implemented in accordance with the guidelines and policies set out by the Digital Policy Office (DPO) of the HKSAR Government, and in compliance with their security standards and requirements;

6. The Sub-contractor shall coordinate with and support to other contractor(s) for the Security Risk Assessment and Audit (SRAA), Privacy Impact Assessment (PIA) and Privacy Compliance Audit (PCA) for the ACCS, ensuing compliance with Personal Data (Privacy) Ordinance (Cap. 486) and Housing Authority's IT Security Rules and Regulation. The Sub-contractor shall be required to review and submit the required documentations, provide necessary system and software program details, support on-site inspection of system installation, and support the systematic scanning of equipment, software program and source codes. The Sub-contractor shall follow up the result and report of the SRAA, PIA and PCA, and adopt the required changes / updates to the ACCS for compliance. The Sub-contractor shall also comply with the latest edition of all relevant Ordinances and Regulations.

ELE26.2.020.B VEHICLE IMAGE AND LICENCE PLATE RECOGNITION SYSTEM

1. The Vehicle Image and Licence Plate Recognition System (VLRS) shall capture and store the image of incoming and outgoing vehicles and automatically detect, recognize and verify alphabetical and numerical characters on images of vehicle licence plates taken by VLRS cameras at low level at entrance / exit control points. The system shall be able to recognise all kinds of vehicle licence plate formats of Mainland China, Hong Kong and Macao;
2. The overall accuracy of the licence plate recognition shall be up to 95% at any time for clear images. Cameras shall be provided at all entrance and exit control points;
3. When vehicles enter the carpark, the VLRS cameras at entrance control point shall take images of the incoming vehicles and their licence plates. The computer shall store and record the entry time. The VLRS cameras at the exit control point shall also take images of the leaving vehicles and their license plates. The VLRS shall compare and verify whether a licence plate taken at exit has been recorded at entrance for parking payment prior to automatically raising up the exit barrier arm. If the verification process fails, an alarm shall be initiated at the carpark control centre to alert the operator;
4. The VLRS can be by-passed, disabled or isolated completely from the ACCS inside carpark control centre by simple means whenever required at any time.

ELE26.2.030.B OPERATION AT ENTRANCE CONTROL POINT

A. For PRH Development

1. Four types of incoming vehicles –private car, light goods vehicle (LGV), coach / bus & medium / heavy goods vehicle and motorcycle shall be identified by presence detection loop and VCA camera and then the ACCS Workstation automatically decide on which rate to be charged according to the pre-set fee structure;
2. For season and monthly parking of private car, LGV and coach / bus & medium / heavy goods vehicle, the operation is as follows:

   When the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The type of vehicle and the license plate shall be sent to the ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of license plate, car type, entry time with date and then the barrier arm will be raised. The license plate captured shall be verified based on the registered databased of monthly parking. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop.
3. For season and monthly parking of motorcycle, the operation is as follows:

When the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be activated. After motorcyclist taps the Octopus Card, the type of vehicle and the Octopus Card information shall be sent to the ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of car type and entry time with date of entry and then the barrier arm will be raised. The Octopus Card information shall be verified based on the registered databased of monthly parking. The barrier arm shall be raised and then lowered automatically after the motorcycle has passed the passage detection loop.

4. For hourly parking of private car, LGV and coach / bus & medium / heavy goods vehicle and loading and unloading area, the operation is as follows:

   When the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The type of vehicle and the license plate shall be sent to the ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of license plate, car type, entry time with date and then the barrier arm will be raised. The license plate captured shall be verified based on the registered databased of monthly parking. If the licence plate cannot be verified in registered database, the licence plates together with the entry time will be recorded under the hourly parking list. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of entry to the hourly user if a request button is being pressed. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop.

5. For hourly parking of motorcycle, the operation is as follows:

   When the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be activated. After motorcyclist taps the Octopus Card, the type of vehicle and the Octopus Card information shall be sent to the ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of car type and entry time with date of entry and then the barrier arm will be raised. The remaining balance of Octopus Card shall be shown on the LCD display inside the entrance control unit. The Octopus Card information shall be verified based on the registered databased of monthly parking. If the card information cannot be verified in registered database, the information together with the entry time will be recorded under the hourly parking list. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of entry to the hourly parker if a request button is being pressed. The barrier arm shall be raised and then lowered automatically after the motorcycle has passed the passage detection loop.

6. When any data or information found invalid, the reason of invalidity shall be shown on the LED monitor at the ACCS Workstation. An alarm signal shall pass to the ACCS Workstation to arouse the operator's attention. The barrier shall not be activated.

B. For SSF Development with HA Standalone Carpark

1. Four types of incoming vehicles – private car, light goods vehicle (LGV), coach / bus & medium / heavy goods vehicle and motorcycle shall be identified by presence detection loop and VCA camera at the entrance of SSF development and HA carpark respectively. The Incorporated Owners (IO) and HA ACCS Workstations automatically decide on which rate to be charged according to the pre-set fee structure;

2. For season and monthly parking of private car, LGV and coach / bus & medium / heavy goods vehicle, the operation is as follows:

a. At entrance of SSF development, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The type of vehicle, the license plate and entry time with date shall be sent to the IO's ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of license plate, car type, entry time with date and then the barrier arm will be raised. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop;

b. At entrance of HA's carpark, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The type of vehicle, the license plate and entry time with date shall be sent to the HA's ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of license plate, car type, entry time with date and then the barrier arm will be raised. The license plate captured shall be verified based on the registered databased of monthly parking. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop.

3. For season and monthly parking of motorcycle, the operation is as follows:

a. At entrance of SSF development, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be then activated. After motorcyclist taps the Octopus Card, the type of vehicle and the Octopus Card information shall be sent to the IO's ACCS Workstation. The Octopus Card information shall be verified based on the registered database of monthly parking. The 32" LCD display at the entrance control point shall display the information of car type and entry time with date. The barrier arm will be then raised. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop;

b. At entrance of HA's carpark, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be then activated. After motorcyclist taps the Octopus Card, the type of vehicle and the Octopus Card information shall be sent to the HA's ACCS Workstation. The Octopus Card information shall be verified based on the registered database of monthly parking. The 32" LCD display at the entrance control point shall display the information of car type and entry time with date. The barrier arm will be then raised. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop.

4. For hourly parking of private car, LGV and coach / bus & medium / heavy goods vehicle and loading and unloading area, the operation is as follows:

a. At entrance of SSF development, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The type of vehicle, the license plate and entry time with date shall be sent to the IO's ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of license plate, car type, entry time with date and then the barrier arm will be raised. The license plate captured shall be verified based on the registered databased of monthly parking. If the licence plate cannot be verified in registered database, the licence plates together with the entry time will be recorded under the hourly parking list. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of entry to the hourly user if a request button is pressed. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop;

b. At entrance of HA's carpark, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The type of vehicle, the license plate and entry time with date shall be sent to the HA's and IO's ACCS Workstations. The 32" LCD display at the entrance control point shall display the information of license plate, car type, entry time with date and then the barrier arm will be raised. The license plate captured shall be verified based on the registered databased of monthly parking. If the licence plate cannot be verified in registered database, the licence plates together with the entry time will be recorded under the hourly parking list. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of entry to the hourly user if a request button is pressed. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop.

5. For hourly parking of motorcycle, the operation is as follows:

   a. At entrance of SSF development, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be then activated. After motorcyclist taps the Octopus Card, the type of vehicle and the Octopus Card information shall be sent to the IO's ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of car type and entry time with date and then the barrier arm will be then raised. The Octopus Card information shall be verified based on the registered database of monthly parking. If the card information cannot be verified in registered database, the card information together with the entry time will be recorded under the hourly parking list. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of entry to the hourly user if a request button is pressed. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop;

   b. At entrance of HA carpark, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be then activated. After motorcyclist taps the Octopus Card, the type of vehicle and the Octopus Card information shall be sent to the HA's and IO's ACCS Workstations. The 32" LCD display at the entrance control point shall display the information of car type and entry time with date and then the barrier arm will be then raised. The Octopus Card information shall be verified based on the registered database of monthly parking. If the card information cannot be verified in registered database, the card information together with the entry time will be recorded under the hourly parking list. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of entry to the hourly user if a request button is pressed. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop.

6. At entrance of SSF development, when any data or information found invalid, the reason of invalidity shall be shown on the LED monitor at the IO's ACCS Workstation. An alarm signal shall pass to the IO's ACCS Workstation to arouse the operator's attention. The barrier shall not be activated;

7. At entrance of HA's carpark, when any data or information found invalid, the reason of invalidity shall be shown on the LED monitor at the HA's ACCS Workstation. An alarm signal shall pass to the HA's ACCS Workstation to arouse the operator's attention. The barrier shall not be activated;

8. The IO's ACCS shall be compatible with and connected to HA's ACCS to fulfil the required functions. The interface of IO's and HA's ACCS can be by-passed, disabled or isolated completely from ACCS inside HA carpark control centre by simple means whenever required at any time.

C. For SSF Development with HA Open Carpark

1. Four types of incoming vehicles – private car, light goods vehicle (LGV), coach / bus & medium / heavy goods vehicle and motorcycle shall be identified by presence detection loop and VCA camera at entrance of SSF development and then the IO's ACCS Workstation automatically decide on which rate to be charged according to the pre-set fee structure;

2. For season and monthly parking of private car, LGV and coach / bus & medium / heavy goods vehicle, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The type of vehicle, the license plate and entry time with date shall be sent to the IO's ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of license plate, car type, entry time with date and then the barrier arm will be raised. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop;

3. For season and monthly parking of motorcycle, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be then activated. After motorcyclist taps the Octopus Card, the type of vehicle and the Octopus Card information shall be sent to the IO's ACCS Workstation. The Octopus Card information shall be verified based on the registered database of monthly parking. The 32" LCD display at the entrance control point shall display the information of car type and entry time with date. The barrier arm will be then raised. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop;

4. For hourly parking at HA carpark of private car, LGV and coach / bus & medium / heavy goods vehicle, the operation is as follows:

    a. At entrance of SSF development, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The type of vehicle, the license plate and entry time with date shall be sent to the IO's ACCS Workstation. The 32" LCD display at the entrance control point shall display the information of license plate, car type, entry time with date and then the barrier arm will be raised. The license plate captured shall be verified based on the registered databased of monthly parking. If the licence plate cannot be verified in registered database, the licence plates together with the entry time will be recorded under the hourly parking list. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of entry to the hourly user if a request button is pressed. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop;

    b. When the driver parks at HA carpark, the driver parks the car and registers the starting time of parking by using Octopus Card at the HA Octopus Card reader in hourly parking pay station. When an Octopus Card is detected, the card information shall be transferred to the HA's ACCS Workstation. The LCD display panel in the hourly parking pay station shall display the information such as time and date of entry and remaining money value of Octopus Card. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of entry to the hourly parker.

5. At entrance of SSF development, when any data or information found invalid, the reason of invalidity shall be shown on the LED monitor at the IO's ACCS Workstation. An alarm signal shall pass to the IO's ACCS Workstation to arouse the operator's attention. The barrier shall not be activated;

6. At HA's hourly parking pay station, when any data or information found invalid, the reason of invalidity shall be shown on the LED monitor at the HA's ACCS Workstation. An alarm signal shall pass to the HA's ACCS Workstation to arouse the operator's attention. The barrier shall not be activated. The card reader shall be reset and ready for tapping of another new card;

7. The IO's ACCS shall be compatible with and connected to HA's ACCS to fulfil the required functions. The interface of IO's ACCS and HA's hourly parking pay station can be by-passed, disabled or isolated completely from ACCS inside HA carpark control centre by simple means whenever required at any time.

ELE26.2.040.B OPERATION AT EXIT CONTROL POINT

A. For PRH Development

1. The presence of a leaving vehicle is detected by the presence detection loop;

2. For season and monthly parking of private car, LGV and coach / bus & medium / heavy goods vehicle, the operation is as follows:

   When the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The license plate shall be sent to the ACCS Workstation. The 32" LCD display at the exit control point shall display the information of license plate, car type, leaving time with date. The license plate captured shall be verified based on the registered databased of monthly parking. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop.

3. For season and monthly parking of motorcycle, the operation is as follows:

   For motorcycle parking, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be activated. After motorcyclist taps the Octopus Card, the Octopus Card information shall be sent to the ACCS Workstation. The Octopus Card information shall be verified based on the registered databased of monthly parking. If the card information is in the registered database of monthly parking, the drop bar opens. The 32" LCD display at the exit control point shall display the car type and entry and leaving time with date. The barrier shall be raised and then lowered automatically after the vehicle has passed the passage detection loop.

4. For hourly parking of private car, LGV and coach / bus & medium / heavy goods vehicle and loading and unloading area, the operation is as follows:

   When the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The license plate and leaving time shall be sent to the ACCS Workstation. The license plate captured shall be verified based on the registered databased of monthly parking. If the licence plate is not in the registered database, the Octopus Card Reader shall be activated for hourly users to settle the parking fees prior to the drop bar opens. The 32" LCD display at the exit control point shall display the information of license plate, car type, entry and leaving time with date and the outstanding amount for hourly parking. The LCD display panel in the Exit Control Unit shall display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of exit and the parking fee paid to the hourly parker if a request button is pressed. The barrier shall be raised and then lowered automatically after the vehicle has passed the passage detection loop.

5. For hourly parking of motorcycle, the operation is as follows:

When the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be activated. After motorcyclist taps the Octopus Card, the Octopus Card information shall be sent to the ACCS Workstation. The Octopus Card information shall be verified based on the registered databased of monthly parking. If the card information is not in the registered database of monthly parking, the Octopus Card Reader shall be activated for hourly users to settle the parking fees prior to the drop bar opens. The 32" LCD display at the exit control point shall display the car type, entry and leaving time with date and the outstanding amount for hourly parking. The LCD display panel in the Exit Control Unit shall display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of exit and the parking fee paid to the hourly parker if a request button is pressed. The barrier shall be raised and then lowered automatically after the vehicle has passed the passage detection loop.

6. When any date or information found invalid, the reason of invalidity shall be shown on the LED monitor at the ACCS Workstation. An alarm signal shall pass to the ACCS Workstation to arouse the operator's attention. The barrier shall not be activated. The card reader shall be reset and ready for tapping of another new card.

B. For SSF Development with HA Standalone Carpark

1. For season and monthly parking of private car, LGV and coach / bus & medium / heavy goods vehicle, the operation is as follows:

   a. At exit of HA's carpark, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The license plate shall be sent to the HA's ACCS Workstation. The 32" LCD display at the exit control point shall display the information of license plate, car type and entry and leaving time with date. The license plate captured shall be verified based on the registered databased of monthly parking. If the car licence plate number is verified, the barrier arm will be raised. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop;

   b. At exit of SSF development, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The license plate shall be sent to the IO's ACCS Workstation. The 32" LCD display at the exit control point shall display the information of license plate, car type and entry and leaving time with date. The license plate captured shall be verified based on the registered databased of monthly parking. If the car licence plate number is verified, the barrier arm will be raised. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop.

2. For season and monthly parking of motorcycle, the operation is as follows:

   a. At exit of HA's carpark, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be then activated. After motorcyclist taps the Octopus Card, the Octopus Card information shall be sent to the HA's ACCS Workstation. The 32" LCD display at the exit control point shall display the information of car type and entry and leaving time with date. The Octopus Card information shall be verified based on the registered database of monthly parking. If the card information is verified, the barrier arm will be then raised. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop;

b. At exit of SSF development, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be then activated. After motorcyclist taps the Octopus Card, the Octopus Card information shall be sent to the IO's ACCS Workstation. The 32" LCD display at the exit control point shall display the information of car type and entry and leaving time with date. The Octopus Card information shall be verified based on the registered database of monthly parking. If the card information is verified, the barrier arm will be then raised. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop.

3. For hourly parking of private car, LGV and coach / bus & medium / heavy goods vehicle at HA carpark, the operation is as follows:

   a. At exit of HA's carpark, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The license plate and leaving time shall be sent to the HA's and IO's ACCS Workstations. The license plate captured shall be verified based on the registered databased of monthly parking. If the licence plate is not in the registered database, the Octopus Card Reader shall be activated for hourly users to settle the parking fees prior to the drop bar opens. The 32" LCD display at the exit control point shall display the information of license plate, car type, entry and leaving time with date and the outstanding amount for hourly parking. The LCD display panel in the Exit Control Unit shall display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of exit and the parking fee paid to the hourly parker if a request button is pressed. The barrier shall be raised and then lowered automatically after the vehicle has passed the passage detection loop;

   b. At exit of SSF development, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The license plate and leaving time shall be sent to the IO's ACCS Workstation for the calculation of free parking. The driver shall leave the SSF development directly within free parking period. Otherwise, the Octopus Card Reader shall be activated for settlement of the parking fees at IO's area. The 32" LCD display at the exit control point shall display the information of license plate, car type, entry and leaving time at SSF development with date and the outstanding amount for hourly parking; The LCD display panel in the Exit Control Unit shall display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of exit and the parking fee paid to the hourly parker if a request button is pressed. The barrier shall be raised and then lowered automatically after the vehicle has passed the passage detection loop.

4. For hourly parking of motorcycle, the operation is as follows:

a. At exit of HA's carpark, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be activated. After motorcyclist taps the Octopus Card, the Octopus Card information shall be sent to the HA's and IO's ACCS Workstations. If the card information is in the registered database of monthly parking, the drop bar opens. Otherwise, the Octopus Card Reader shall be activated for hourly users to settle the parking fees prior to the drop bar opens. The 32" LCD display at the exit control point shall display the car type, entry and leaving time with date and the outstanding amount for hourly parking. The LCD display panel in the Exit Control Unit shall display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of exit and the parking fee paid to the hourly parker if a request button is pressed. The barrier shall be raised and then lowered automatically after the vehicle has passed the passage detection loop;

b. At exit of SSF development, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be activated. After motorcyclist taps the Octopus Card, the Octopus Card information and leaving time shall be sent to the IO's ACCS Workstations for the calculation of free parking. Motorcyclist shall leave the SSF development directly within free parking period. Otherwise, the Octopus Card Reader shall be activated for settlement of the parking fees at IO's area. The 32" LCD display at the exit control point shall display the car type and entry and leaving time at SSF development with date and the outstanding amount for hourly parking at IO's area. The LCD display panel in the Exit Control Unit shall display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of exit and the parking fee paid to the hourly parker if a request button is pressed. The barrier shall be raised and then lowered automatically after the vehicle has passed the passage detection loop.

5. The free parking in SSF development with HA standalone carpark shall be calculated as followed:

   a. Entry time of HA's carpark minus entry time of SSF development shall be less than 30 min or other interval as required by the CM;

   b. Leaving time of SSF development minus the leaving time of HA's carpark shall be less than 30 min or other interval as required by the CM;

   c. The free parking time should be easily adjusted by the administrator with appropriate access right without the need to change the whole programme.

6. At exit of SSF development, when any date or information found invalid, the reason of invalidity shall be shown on the LED monitor at the IO's ACCS Workstation. An alarm signal shall pass to the IO's ACCS Workstation to arouse the operator's attention. The barrier shall not be activated;

7. At exit of HA's carpark, when any date or information found invalid, the reason of invalidity shall be shown on the LED monitor at the HA's ACCS Workstation. An alarm signal shall pass to the HA's ACCS Workstation to arouse the operator's attention. The barrier shall not be activated.

C. For SSF Development with HA Open Carpark

1. For season and monthly parking of private car, LGV and coach / bus & medium / heavy goods vehicle, the operation is as follows:

a. At exit of SSF development, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The license plate shall be sent to the IO's ACCS Workstation. The 32" LCD display at the exit control point shall display the information of license plate, car type and entry and leaving time with date. The license plate captured shall be verified based on the registered databased of monthly parking. If the car licence plate number is verified, the barrier arm will be raised. The barrier arm shall be lowered automatically after the vehicle has passed the passage detection loop.

2. For monthly parking of motorcycle, the operation is as follows:

   a. At exit of SSF development, when the presence of vehicle is detected at detection loop but VLRS cannot recognise any licence plate, Octopus Card Reader shall be then activated. After motorcyclist taps the Octopus Card, the Octopus Card information shall be sent to the IO's ACCS Workstation. The 32" LCD display at the exit control point shall display the information of car type and entry and leaving time with date. The Octopus Card information shall be verified based on the registered database of monthly parking. If the card information is verified, the barrier arm will be then raised. The barrier arm shall be lowered automatically after the vehicle passes the passage detection loop.

3. For hourly parking of private car, LGV and coach / bus & medium / heavy goods vehicle at HA carpark, the operation is as follows:

   a. When the driver leaves the HA carpark, the driver pays the hourly parking fee by using Octopus Card at the HA's Octopus Card reader in hourly parking pay station. When an Octopus Card is detected, the card information shall be transferred to the HA's and IO's ACCS Workstation. Hourly parking fee shall be deducted from the Octopus Card. The LCD display panel in the hourly parking pay station shall display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of exit and the parking fee paid to the hourly parker;

   b. At the exit of SSF development, when the presence of vehicle is detected at detection loop, the VLRS shall activate illumination and take image of the front car licence plate from the VLRS camera. The license plate and leaving time shall be sent to the IO's ACCS Workstation for the calculation of free parking. The driver shall leave the SSF development directly within free parking period. Otherwise, the Octopus Card Reader shall be activated for settlement of the parking fees at IO's area. The 32" LCD display at the exit control point shall display the information of license plate, car type, entry and leaving time at SSF development with date and the outstanding amount for hourly parking. The LCD display panel in the Exit Control Unit shall display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid. An automatic cutting-off thermal printer shall issue receipt indicating the date and time of exit and the parking fee paid to the hourly parker if a request button is pressed. The barrier shall be raised and then lowered automatically after the vehicle has passed the passage detection loop.

4. For hourly parking of motorcycle, no hourly parking for motorcycle inside SSF Development with HA Open Carpark unless such arrangement is agreed with local estate management. If hourly parking for motorcycle is inevitable in the HA Open Carpark inside SSF Development, the carpark control shall be by means of CCTV surveillance;

5. The free parking in SSF development with HA open carpark shall be calculated as followed:

a. The difference of SSF leaving time and SSF entry time minus the parking duration at HA carpark as record in the hourly parking pay station shall be less than 30 min or other interval as required by the CM;

b. The free parking time should be easily adjusted by the administrator with appropriate access right without the need to change the whole programme.

5. At exit of SSF development, when any date or information found invalid, the reason of invalidity shall be shown on the LED monitor at the IO's ACCS Workstation. An alarm signal shall pass to the IO's ACCS Workstation to arouse the operator's attention. The barrier shall not be activated;

6. At exit of HA's carpark, when any data or information found invalid, the reason of invalidity shall be shown on the LED monitor at the HA's ACCS Workstation. An alarm signal shall pass to the HA's ACCS Workstation to arouse the operator's attention.

ELE26.2.050.C ACCS WORKSTATION AND REVENUE COLLECTION PROVISION

A. For PRH Development

1. The ACCS Workstation and revenue collection provision shall include the following:

a. Central data station / cashier computer completed with a fully developed carpark management software, including VLRS and VCA system, and central database;

b. LED video monitor (24" or above);

c. Uninterrupted power supply unit (UPS) - for a back-up period of not less than 15 minutes for the computers for ACCS, real-time parking information system and Octopus Card System;

d. Octopus Card reader / validator;

e. Clearing institution (Octopus) communication interface;

f. Data point for broadband connection with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to the CM's approval in case of unavailability of broadband network with fixed IP);

g. Cash drawer;

h. Fee indicator;

i. Receipt printer;

j. Report printer.

2. The ACCS Workstation shall be capable of handling the following activities:

a. Processing of hourly parking and concessionary parking for transient parkers by means of license plate recognition or Octopus Card;

b. Processing of Season / Monthly parking for long term parkers by means of license plate recognition or Octopus Card;

c. Processing of complimentary parking for special parkers using by means of license plate recognition or Octopus Card;

d. Car type recognition for four different types of vehicles by means of video content analytic;

e. Automatic fee calculation;

f. Record of malfunctions of equipment and every transaction;

g. Daily accounting record and statistics;

h. Information on parking spaces;

i. Instant cash audit function;

j. Anti-pass-back control;

k. Independent control of the barriers;

l. Activation of the "FULL" sign;

m. Automatic printout and alarm message in case of faulty operation;

n. Manual adjustment of hourly parking space vacancy information indicated on the carpark vacancy display board and transmitted to TD in case of malfunction of car counting system.

3. The ACCS Workstation shall link up with the VLRS and all other components to monitor and proceed with the operations of the ACCS through an Ethernet network. It shall provide overall control of car parking activities, identification of possible reconciliation discrepancies from clearing institution and data collected, and comprehensive and efficient financial and statistical report generation;

4. The ACCS Workstation shall be able to allow reading, checking, debiting and archiving against usage of Octopus Cards, and process the access / exit requests at the Carpark and store the transaction information in the central database;

5. The ACCS Workstation shall be designed for registration of license plates or Octopus Cards for season / monthly users with simple operation of command code on the terminal keyboard. Parkers are free to enter and exit the carpark for a defined period of time, and the system shall be able to examine the validity of the Octopus Card at the entrance and exit reader;

6. The ACCS Workstation and the management software shall be able to handle several transactions in parallel and simultaneously;

7. The ACCS Workstation shall be able to monitor not less than six kinds of alterable fee rates with respect to different kinds of vehicles and settings of grace periods. Different fee structures shall be preset and altered at the control keyboard and be viewable at the LED video monitor;

8. Monthly carpark user can make payment in the carpark shroff office by cash. Provision shall also be allowed for addition of pay collection system by other common e-payment to be provided by others. Those common e-payment includes Credit Card (Visa, Mastercard and Union Pay), mobile application payment (Apple Pay, Google Pay and Samsung Pay), Alipay, AlipayHK, WeChat Pay, WeChat Pay HK, Faster Payment System (FPS), PayPal, etc.;

9. Hourly carpark user can make payment simply by Octopus at the exit or in the carpark shroff office by cash. Provision shall also be allowed for addition of pay collection system by other common e-payment to be provided by others. Those common e-payment includes Credit Card (Visa, Mastercard and Union Pay), mobile application payment (Apple Pay, Google Pay and Samsung Pay), Alipay, AlipayHK, WeChat Pay, WeChat Pay HK, Faster PaymentSystem (FPS), PayPal, etc.;

10. To enable payment for hourly carpark user to leave the carpark when shroff office is closed after office hour (for carpark at grade with 150 parking spaces or less), revenue collection provision is provided at the estate control room;

11. During ACCS breakdown, device shall be provided for keying in the Octopus Cards number to the ACCS system or allow the use of the card reader device to retrieve hourly carpark user the entering time to carpark in collection of revenue prior to the system resume normal;

12. The fee collection system shall be able to print official receipt, generate interface files to HA including daily transactions and monthly summary for reconciliation, as well as settle all transactions with HA directly.

B. For SSF Development with HA Standalone Carpark

(I) ACCS Workstation and revenue collection provision at IO's EMO

1. The ACCS Workstation and revenue collection provision shall include the following:
   a. Central data station / cashier computer completed with a fully developed carpark management software, including VLRS and VCA system, and central database;
   b. LED video monitor (24" or above);
   c. Uninterrupted power supply unit (UPS) - for a back-up period of not less than 15 minutes for the computers for ACCS and Octopus Card System;
   d. Octopus Card reader / validator;
   e. Clearing institution (Octopus) communication interface;
   f. Data point for broadband connection with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to the CM's approval in case of unavailability of broadband network with fixed IP);
   g. Cash drawer;
   h. Fee indicator;
   i. Receipt printer;
   j. Report printer.
2. The ACCS Workstation shall be capable of handling the following activities:
   a. Processing of hourly parking and concessionary parking for transient parkers by means of license plate recognition or Octopus Card ;
   b. Processing of Season / Monthly parking for long term parkers by means of license plate recognition or Octopus Card;
   c. Processing of complimentary parking for special parkers by means of license plate recognition or Octopus Card ;
   d. Car type recognition for four different types of vehicles by means of video content analytic;
   e. Automatic fee calculation;
   f. Record of malfunctions of equipment and every transaction;
   g. Daily accounting record and statistics;
   h. Information on parking spaces;
   i. Instant cash audit function;
   j. Anti-pass-back control;
   k. Independent control of the barriers;
   l. Automatic printout and alarm message in case of faulty operation.
3. The ACCS Workstation shall link up with VLRS and all other components to monitor and proceed with the operations of the ACCS through an Ethernet network. It shall provide overall control of car parking activities, identification of possible reconciliation discrepancies from clearing institution and data collected, and comprehensive and efficient financial and statistical report generation;

4. The ACCS Workstation shall be able to allow reading, checking, debiting and archiving against usage of Octopus Cards, and process the access / exit requests at the Carpark and store the transaction information in the central database;
5. The ACCS Workstation shall be designed for registration of license plates or Octopus Cards for season / monthly users with simple operation of command code on the terminal keyboard. Parkers are free to enter and exit the carpark for a defined period of time, and the system shall be able to examine the validity of the Octopus Card at the entrance and exit reader;
6. The ACCS Workstation and the management software shall be able to handle several transactions in parallel and simultaneously;
7. The ACCS Workstation shall be able to monitor not less than six kinds of alterable fee rates with respect to different kinds of vehicles and settings of grace periods. Different fee structures shall be preset and altered at the control keyboard and be viewable at the LED video monitor;
8. Hourly carpark user can make payment simply by Octopus Card at exit or in IO EMO by cash;
9. During ACCS breakdown, device shall be provided for keying in the Octopus Cards number to the ACCS system or allow the use of the card reader device to retrieve hourly carpark user the entering time to carpark in collection of revenue prior to the system resume normal.

(II) ACCS Workstation and revenue collection provision at HA's shroff office or remote office

1. The ACCS Workstation and revenue collection provision shall include the following:
    a. Central data station / cashier computer completed with a fully developed carpark management software, including VLRS and VCA system, and central database;
    b. LED video monitor (24" or above);
    c. Uninterrupted power supply unit (UPS) - for a back-up period of not less than 15 minutes for the computers for ACCS, real-time parking information system and Octopus;
    d. Octopus Card reader / validator;
    e. Clearing institution (Octopus) communication interface;
    f. Data point for broadband connection with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to the CM's approval in case of unavailability of broadband network with fixed IP);
    g. Cash drawer;
    h. Fee indicator;
    i. Receipt printer;
    j. Report printer.
2. The ACCS Workstation shall be capable of handling the following activities:
    a. Processing of hourly parking and concessionary parking for transient parkers by means of license plate recognition or Octopus Card;
    b. Processing of Season / Monthly parking for long term parkers by means of license plate recognition or Octopus Cards;
    c. Processing of complimentary parking for special parkers by means of license plate recognition or Octopus Cards;

d. Car type recognition for four different types of vehicles by means of video content analytic;e. Automatic fee calculation;

f. Record of malfunctions of equipment and every transaction;

g. Daily accounting record and statistics;

h. Information on parking spaces;

i. Instant cash audit function;

j. Anti-pass-back control;

k. Independent control of the barriers;

l. Activation of the "FULL" sign;

m. Automatic printout and alarm message in case of faulty operation;

n. Manual adjustment of hourly parking space vacancy information indicated on the carpark vacancy display board and transmitted to TD in case of malfunction of car counting system.

3. The ACCS Workstation shall link up with the VLRS and all other components to monitor and proceed with the operations of the ACCS through an Ethernet network. It shall provide overall control of car parking activities, identification of possible reconciliation discrepancies from clearing institution and data collected, and comprehensive and efficient financial and statistical report generation;

4. The ACCS Workstation shall be able to allow reading, checking, debiting and archiving against usage of Octopus Cards, and process the access / exit requests at the Carpark and store the transaction information in the central database;

5. The ACCS Workstation shall be designed for registration of license plate or Octopus Card for season / monthly users with simple operation of command code on the terminal keyboard. Parkers are free to enter and exit the carpark for a defined period of time, and the system shall be able to examine the validity of the Octopus Cards at the entrance and exit reader;

6. The ACCS Workstation and the management software shall be able to handle several transactions in parallel and simultaneously;

7. The ACCS Workstation shall be able to monitor not less than six kinds of alterable fee rates with respect to different kinds of vehicles and settings of grace periods. Different fee structures shall be preset and altered at the control keyboard and be viewable at the LED video monitor;

8. Monthly carpark user can make payment in the carpark shroff office by cash. Provision shall also be allowed for addition of pay collection system by other common e-payment to be provided by others. Those common e-payment includes Credit Card (Visa, Mastercard and Union Pay), mobile application payment (Apple Pay, Google Pay and Samsung Pay), Alipay, AlipayHK, WeChat Pay, WeChat Pay HK, Faster Payment System (FPS), PayPal, etc.;

9. Hourly carpark user can make payment simply by Octopus at the exit. Provision shall also be allowed for addition of pay collection system by other common e-payment to be provided by others. Those common e-payment includes Credit Card (Visa, Mastercard and Union Pay), mobile application payment (Apple Pay, Google Pay and Samsung Pay), Alipay, AlipayHK, WeChat Pay, WeChat Pay HK, Faster Payment System (FPS), PayPal, etc.;

10. To enable payment for hourly carpark user to leave the carpark when shroff office is closed after office hour (for carpark at grade with 150 parking spaces or less), revenue collection provision is provided at the estate control room;

11. During ACCS breakdown, device shall be provided for keying in the Octopus Cards number to the ACCS system or allow the use of the card reader device to retrieve hourly carpark user the entering time to carpark in collection of revenue prior to the system resume normal;

12. The fee collection system shall be able to print official receipt, generate interface files to HA including daily transactions and monthly summary for reconciliation, as well as settle all transactions with HA directly.

C. For SSF Development with HA Open Carpark

(I) ACCS Workstation and revenue collection provision at IO's EMO

1. The ACCS Workstation and revenue collection provision shall include the following:

   a. Central data station / cashier computer completed with a fully developed carpark management software, including VLRS and VCA system, and central database;

   b. LED video monitor (24" or above);

   c. Uninterrupted power supply unit (UPS) - for a back-up period of not less than 15 minutes for the computers for ACCS and Octopus Card System;

   d. Octopus Card reader / validator;

   e. Clearing institution (Octopus) communication interface;

   f. Data point for broadband connection with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to the CM's approval in case of unavailability of broadband network with fixed IP);

   g. Cash drawer;

   h. Fee indicator;

   i. Receipt printer;

   j. Report printer.

2. The ACCS Workstation shall be capable of handling the following activities:

   a. Processing of hourly parking and concessionary parking for transient parkers by means of license plate recognition or Octopus Card;

   b. Processing of Season / Monthly parking for long term parkers by means of license plate recognition or Octopus Card;

   c. Processing of complimentary parking for special parkers by means of license plate recognition or Octopus Card;

   d. Car type recognition for four different types of vehicles by means of video content analytic; e. Automatic fee calculation;

   f. Record of malfunctions of equipment and every transaction;

   g. Daily accounting record and statistics;

   h. Information on parking spaces;

   i. Instant cash audit function;

   j. Anti-pass-back control;

   k. Independent control of the barriers;

l. Automatic printout and alarm message in case of faulty operation.3. The ACCS Workstation shall link up with VLRS and all other components to monitor and proceed with the operations of the ACCS through an Ethernet network. It shall provide overall control of car parking activities, identification of possible reconciliation discrepancies from clearing institution and data collected, and comprehensive and efficient financial and statistical report generation;

4. The ACCS Workstation shall be able to allow reading, checking, debiting and archiving against usage of Octopus Cards, and process the access / exit requests at the Carpark and store the transaction information in the central database;

5. The ACCS Workstation shall be designed for registration of license plates or Octopus Cards for season / monthly users simple operation of command code on the terminal keyboard. Parkers are free to enter and exit the carpark for a defined period of time, and the system shall be able to examine the validity of the Octopus Card at the entrance and exit reader;

6. The ACCS Workstation and the management software shall be able to handle several transactions in parallel and simultaneously;

7. The ACCS Workstation shall be able to monitor not less than six kinds of alterable fee rates with respect to different kinds of vehicles and settings of grace periods. Different fee structures shall be preset and altered at the control keyboard and be viewable at the LED video monitor;

8. Hourly carpark user can make payment simply by Octopus Card at exit or in IO EMO by cash;

9. During ACCS breakdown, device shall be provided for keying in the Octopus Cards number to the ACCS system or allow the use of the card reader device to retrieve hourly carpark user the entering time to carpark in collection of revenue prior to the system resume normal.

(II) ACCS Workstation and revenue collection provision at HA's remote office

1. The ACCS Workstation and revenue collection provision shall include the following:

   a. Central data station / cashier computer completed with a fully developed carpark management software, including VLRS and VCA system, and central database;

   b. LED video monitor (24" or above);

   c. Uninterrupted power supply unit (UPS) - for a back-up period of not less than 15 minutes for the computers for ACCS, real-time parking information system, Octopus and hourly parking pay station;

   d. Octopus Card reader / validator;

   e. Clearing institution (Octopus) communication interface;

   f. Data point for broadband connection with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to the CM's approval in case of unavailability of broadband network with fixed IP);

   g. Cash drawer;

   h. Fee indicator;

   i. Receipt printer;

   j. Report printer.

2. The ACCS Workstation shall be capable of handling the following activities:

a. Processing of hourly parking and concessionary parking for transient parkers by means of license plate recognition or Octopus Card;

b. Processing of Season / Monthly parking for long term parkers by means of license plate recognition or Octopus Card;

c. Processing of complimentary parking for special parkers by means of license plate recognition or Octopus Cards;

d. Car type recognition for four different types of vehicles by means of video content analytic;e. Automatic fee calculation;

f. Record of malfunctions of equipment and every transaction;

g. Daily accounting record and statistics;

h. Information on parking spaces;

i. Instant cash audit function;

k. Anti-pass-back control;

l. Activation of the "FULL" sign;

m. Automatic printout and alarm message in case of faulty operation;

n. Manual adjustment of hourly parking space vacancy information indicated on the carpark vacancy display board and transmitted to TD in case of malfunction of car counting system.3. The ACCS Workstation shall link up with all other components to monitor and proceed with the operations of the ACCS through an Ethernet network. It shall provide overall control of car parking activities, identification of possible reconciliation discrepancies from clearing institution and data collected, and comprehensive and efficient financial and statistical report generation;

4. The ACCS Workstation shall be able to allow reading, checking, debiting and archiving against usage of Octopus Cards, and process the access / exit requests at the Carpark and store the transaction information in the central database;

5. The ACCS Workstation shall be so designed for registration of license plate or Octopus Card for season / monthly users with simple operation of command code on the terminal keyboard. Parkers are free to enter and exit the carpark for a defined period of time, and the system shall be able to examine the validity of the Octopus Cards at the entrance and exit reader;

6. The ACCS Workstation and the management software shall be able to handle several transactions in parallel and simultaneously;

7. The ACCS Workstation shall be able to monitor not less than six kinds of alterable fee rates with respect to different kinds of vehicles and settings of grace periods. Different fee structures shall be preset and altered at the control keyboard and be viewable at the LED video monitor;

8. Monthly carpark user can make payment in the carpark shroff office by cash (or future pay collection system by other common e-payment to be provided by others. Those common e-payment includes Credit Card (Visa, Mastercard and Union Pay), mobile application payment (Apple Pay, Google Pay and Samsung Pay), Alipay, AlipayHK, WeChat Pay, WeChat Pay HK, Faster Payment System (FPS), PayPal, etc.);

9. Hourly carpark user can make payment simply by Octopus (or future pay collection system by other common e-payment to be provided by others. Those common e-payment includes Credit Card (Visa, Mastercard and Union Pay), mobile application payment (Apple Pay, Google Pay and Samsung Pay), Alipay, AlipayHK, WeChat Pay, WeChat Pay HK, Faster Payment System (FPS), PayPal, etc.) at the exit;
10. To enable payment for hourly carpark user to leave the carpark when shroff office is closed after office hour (for carpark at grade with 150 parking spaces or less), revenue collection provision is provided at the estate control room;
11. During ACCS breakdown, device shall be provided for keying in the Octopus Cards number to the ACCS system or allow the use of the card reader device to retrieve hourly carpark user the entering time to carpark in collection of revenue prior to the system resume normal;
12. The fee collection system shall be able to print official receipt, generate interface files to HA including daily transactions and monthly summary for reconciliation, as well as settle all transactions with HA directly.

ELE26.2.060.A CAR COUNTING SYSTEM

Vehicles entering and leaving the carpark shall be counted in order to determine when it is full. The number of season / monthly parking should be automatically deducted from the total number of available spaces in the carpark. Season / monthly users entering or leaving the carpark will be counted under a separate category which will not affect the total car parking bays assigned to hourly parkers. When the spaces available for hourly parking are full according to the record of real-time parking information system, the carpark "FULL" Sign Box in English and Chinese characters at the carpark entrance lane and a "FULL" message at the LCD of Entrance Control Unit shall illuminate. The Entrance Control Unit shall not allow any entry of hourly parking vehicle. Management software shall be able to set tolerance to the total number of available spaces for hourly parking in the carpark in order to allow the entry of Taxi / Drop-off vehicles without charges within an adjustable period of time.

ELE26.2.070.A INTERCOM SYSTEM

1. The intercom system shall comprise master station(s) located at the carpark control centre and a slave station at each of the Entrance Control Unit(s), the Exit Control Unit(s) and hourly parking pay station(s) respectively;
2. The master station shall be designed for desk-top mounting and shall be capable of communicating with any one of the connected slave stations. Direct communication between the slave stations is not required;
3. To initiate a call at the master station, the operator shall press the slave selection button on the master station once. The respective slave station indicator shall light up automatically. When the "CALL" button at the master station is pressed a high note call alarm shall be heard at the selected slave station and communication between the operator at the master station and the visitor/parker at the slave station can be made via the corresponding microphone and loudspeaker unit. On completion of the call, the system shall be reset by pressing the selected slave station selection button again;
4. When the master station is being called by a slave station, the buzzer alarm at the master station shall sound and the corresponding slave station indication light shall flash and the operator can answer the call by pressing the slave selection button;

5. The master station shall be so designed that it can communicate with only one slave station at a time. When the master station is engaged with one slave station, call from other slave station shall cause the corresponding slave station indication light to flash only without activating the buzzer alarm. The operator shall follow the same procedure as described above in answering the waiting calls.

ELE26.2.080.A CARPARK CCTV SYSTEM

1. The carpark CCTV system shall be provided at the entrance and exit control points for monitoring and recording the traffic condition and over the car-parking area for carpark surveillance. It comprises the following equipment:
   a. 1 no. camera (colour) each at every entrance control point and every exit control point at middle level;
   b. cameras (colour) at strategic locations over the car-parking area as shown on Drawings;
   c. 24" LED video monitors as mentioned in ELE24.2.2;
   d. 16-channel colour Network Video Recorders (NVR) as mentioned in ELE24.2.4.
2. The Sub-contractor shall install LED video monitors on the working bench and NVRs inside a lockable equipment rack at the carpark control centre for the completion of the System;
3. For open carpark, the Sub-contractor shall supply and install CCTV cameras of fixed type encased in weatherproof casing suitable for outdoor use, cables and wirings and all necessary auxiliary devices and equipment in order to complete the system. The Sub-contractor shall supply and install all necessary mounting poles and devices for mounting of CCTV cameras and accessories. Depending on the site condition, the CCTV cameras over the open carpark can be mounted on the lamp poles of the landscape lightings;
4. The traffic condition at the entrance and exit control points and the parking condition over the car parking area can be monitored through the LED video monitors and recorded by the NVRs;

   Easy reading from recorded CCTV system as a proof to indicate the entering time of the hourly carpark user in case the ACCS is in total failure for the purpose of revenue collection prior to the system resume normal.
5. A proper signage shall be affixed on a prominent location to notify the public about the installation of CCTV system at the entrance control point(s);
6. The CCTV system including CCTV cameras, LED video monitors and NVRs for ACCS shall be an independent set of system separated from the CCTV system for car-parking area for carpark surveillance.

ELE26.2.090.9 INTERFACING REQUIREMENTS WITH OCTOPUS CLEARING SYSTEM

1. In case due connection to the HA data hub server as mentioned in ELE26.2.100 is not available at the time of handover, the Sub-contractor shall design and provide a system software for interfacing and exchanging electronic data with the Octopus Clearing System until the interfacing works mentioned in ELE26.2.100 is satisfactorily completed within the Maintenance Period. These electronic data include:
   a. Octopus Full/Interim Blacklist File (in Octopus proprietary format) from Octopus Clearing System for the ACCS to validate the Octopus card used;
   b. Octopus Data Exchange File(s) (in Octopus proprietary format) of the hourly income collected through Octopus devices.

2. The Sub-contractor shall be responsible for liaising with Octopus for the proper implementation of the interfaces, including the interface channel, frequency etc..

ELE26.2.100.A INTERFACING REQUIREMENTS WITH HA DATA HUB SERVER

1. The ACCS shall be automated with system interfaces to exchange electronic data with a HA's data hub server via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP). The Sub-contractor is responsible for implementing the processes to perform the following system interfaces between ACCS and the data hub server:

   a. Getting licensee information (in ASCII format) from the data hub server to control the entry and exit of season / monthly parking licensees at the carpark.

      The process is to get an interface file from the data hub server daily and import it into the ACCS for updating the monthly parking licensees authorized to facilitate validation. The licensee information from the data hub server includes:

      i. Carpark stock identifier;

      ii. Vehicle number;

      iii. Licence identifier;

      iv. Valid period from;

      v. Valid period to.

   b. Getting carpark information (in ASCII format) from the data hub server to update the number of carpark spaces allowed for parking on each parking space type.

      The process is to get an interface file from the data hub server daily and import it into the ACCS for updating parking space information. The output file will be provided by change trigger mechanism. The parking space information from the data hub server includes:

      i. Carpark stock identifier;

      ii. Type of parking space;

      iii. Number of parking spaces for monthly letting;

      iv. Number of parking spaces for hourly parking;

      v. Number of parking spaces for HD's self use;

      vi. Number of parking spaces for other use;

      vii. Effective date.

   c. Providing information (in ASCII format) of the total income collected through Octopus for reporting to HA, and sending it to the data hub server.

      The process is to produce and send an interface file to the data hub server daily for reporting the total hourly income collected through Octopus. The total hourly income information to be sent to the data hub server includes:

      i. Carpark stock identifier;

      ii. Octopus Card device identifier;

      iii. Transaction date and time;

      iv. Total hourly income amount collected through Octopus.

d. Providing information (in ASCII format) of the detailed transactions for reporting to HA, and sending it to the data hub server.

The process is to produce and send an interface file to the data hub server daily for reporting the detailed transactions. The information to be sent to the data hub server includes:

i. Carpark stock name;

ii. Transaction reference (ACCS reference);

iii. Transaction type;

iv. Vehicle number;

v. Type of vehicle;

vi. Carpark entry method;

vii. Transaction start date and time;

viii. Entry gate (device) ID;

ix. Transaction end date and time;

x. Exit gate (device) ID;

xi. Parking charge amount;

xii. Free parking start date and time;

xiii. Free parking end date and time;

xiv. Free parking amount;

xv. Amount collected;

xvi. Payment method;

xvi. Octopus Card identification number;

xvii. Smartcard identification number (if applicable).

e. Providing statistical information (in ASCII format) for management reporting to HA, and sending it to the data hub server.

The process is to produce and send an interface file to the data hub server monthly for management reporting. The information to be sent to the data hub server includes:

i. Carpark stock name;

ii. Records of hourly parking:

- Number of day passes sold;
- Amount of revenue collected for the sale of day passes;
- Number of other hourly parking tickets sold;
- Amount of revenue collected for the sale of other hourly parking tickets;
- Number of tickets issued for free parking;
- Amount of revenue waived for the free parking tickets issued.

iii. Records of redemption of discount parking coupons:

- Number of hourly parking coupons sold;
- Number of hourly parking coupons redeemed;

- Amount of discount for reimbursement.

iv. Records of monthly tickets sold:

- Number of reserved monthly tickets sold;
- Amount of revenue collected for the sale of reserved monthly tickets;
- Number of floating monthly tickets sold;
- Amount of revenue collected for the sale of floating monthly tickets.

v. Records of concessionary parking for disabled persons:

- Number of concessionary hourly tickets sold;
- Amount of revenue collected for the sale of concessionary hourly tickets;
- Number of concessionary monthly tickets sold;
- Amount of revenue received for the sale of concessionary monthly tickets.

vi. Records of letting of part-time parking:

- Number of part-time parking monthly tickets sold;
- Amount of revenue collected for the sale of part-time parking monthly tickets.

vii. Records of granting free parking for special vehicles (e.g. rehabilitation bus):

- Number of tickets issued to special vehicles for free parking;
- Number of hours waived due to free parking by special vehicles;
- Amount of revenue waived due to free parking by special vehicles.

viii. Records of granting privileged parking:

- Number of privileged parking tickets issued;
- Number of hours waived for privileged parking tickets issued;
- Amount of revenue waived for privileged parking tickets issued.

ix. Records of impounding, towing, storage charges, auction and others:

- Number of charging cases for impounding, towing, storage charges, auction and others;
- Amount of revenue collected for these charging cases.

x. Number of parking spaces reserved for disabled persons (as at month-end position);

xi. Obtaining waivers for letting to non-residents (for carparks in SSF courts only) [An indicator shows "Yes" or "No"]

xii. Records of monthly parking charging rates (if any):

- Monthly rate for full-time reserved covered parking space for private car;
- Monthly rate for full-time floating covered parking space for private car;
- Monthly rate for full-time reserved open parking space for private car;

- Monthly rate for full-time floating open parking space for private car.

xiii. Records of hourly parking charging rates (if any):

- Hourly normal rate for private car;
- Abolition of hourly reduced rate for private car [An indicator shows "Yes" or "No"];
- Hourly reduced rate for private car;
- Abolition of day-pass reduced rate for private car [An indicator shows "Yes" or "No"];
- Day-pass rate for private car;
- Adoption of hourly ascending scale for private car [An indicator shows "Yes" or "No"];
- Hourly rate under ascending scale for private car;
- Hourly rate for motor-cycle;
- Hourly rate for light goods vehicle;
- Abolition of hourly double charge rate for light goods vehicle [An indicator shows "Yes" or "No"];
- Hourly double charge rate for light goods vehicle;
- Abolition of hourly reduced rate for light goods vehicle [An indicator shows "Yes" or "No"];
- Hourly reduced rate for light goods vehicle.

f. Providing the Octopus Data Exchange File(s) (in Octopus proprietary format) of the hourly income collected through Octopus devices to the data hub server, for central submission to the Octopus Clearing System by the HA.

The process is to send all transaction file(s) collected daily on the Octopus Card device(s) to the data hub server;

g. Getting the Octopus Full Blacklist File / Interim Blacklist File (in Octopus proprietary format) from the data hub server for updating the Octopus Card devices.

The HA will get the Octopus Full Blacklist File / Interim Blacklist File from the Octopus Clearing System. The process is to get interface file(s) from the data hub server and update the Octopus Card devices.

2. The Sub-contractor shall develop all programs and / or scripts in ACCS to perform the system interface processes and automate these processes such that the interfaces can be performed with minimum human operation. The automation shall include:

a. To generate the file to the data hub server;

b. To connect to the data hub server by broadband network / 5G / 4G USB modem;

c. To provide Secure File Transfer Protocol (SFTP) username and password for authentication;

d. To make SFTP file transfer request to the data hub server to send / get the files as binary data;

e. To disconnect the SFTP session;

f. To import the file from the data hub server to update ACCS;

g. To log the progress of the automated processes during execution, and save the log in ACCS;

h. To display message in ACCS to show the result of the processes after execution.

3. The system interfaces shall be performed using web services through broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP);

4. The system interface processes shall be automated to run daily at regular timeslot. When required, ad-hoc execution of the automated processes shall be allowed;

5. The system interface files and the logs from the executed processes shall be kept in the ACCS for an adjustable period up to three months;

6. The Sub-contractor shall provide the user guide for operating and administering the system interfaces. The user guide shall include but not limited to:

   a. How to set the daily schedule of the automated processes for regular execution;

   b. How to launch the automated processes manually for ad-hoc execution;

   c. How to inspect the result of the automated processes after execution;

   d. The exception handling procedures when the execution of any automated process failed which include the reporting channel(s) for the failure, the steps to manually dispatch and receive the electronic data with alternative means (e.g. flash static memory, DVD-R, e-mail attachment, etc.) in case broadband network / 5G / 4G USB modem connection to the data hub server cannot be established, the steps to manually perform the failed system interface process, etc.;

   e. How to change the system interface parameters, such as the login username and password, the carpark stock identifier, the destination broadband network / 5G / 4G USB modem connection to the data hub server, etc.

7. The Sub-contractor is responsible for liaising with and providing assistance to HA staff for implementation of the system interfaces. The implementation will consist of the following tasks:

   a. To set up broadband network / 5G / 4G USB modem connection;

   b. To develop SFTP requests from ACCS;

   c. To develop programs and / or scripts in ACCS to automate the system interface processes;

   d. To prepare user guide for operating and administering the system interfaces;

   e. To participate in the acceptance testing of the system interfaces to prove that all automated system interface processes work properly, information to / from the data hub server is correct, and information from the data hub server is properly updated in ACCS;

   f. To provide proper training for the operation and administration of the system interfaces to the operators.

ELE26.2.110.A DATA REQUIREMENTS FOR ACCS

The Sub-contractor shall maintain a set of database for the ACCS comprising the following:

1. Carpark geographical zone - It shall maintain the geographical zone and the charging rate that the Carpark locate;

2. Carpark time table - It shall maintain the operating hours of the Carpark which specifies the opening time and closing time of the Carpark. It shall support the complicated charging scheme such as "Day parking" and "Night parking";
3. Carpark quota table - It shall maintain the quota of parking spaces available in the Carpark for controlling the entry of hourly parking;
4. Carpark charging rate table - It shall maintain the various charging rates of the Carpark. It is applicable to monthly parking spaces, hourly parking spaces and other miscellaneous income, such as Towing fee, impounding charge, etc.;
5. Carpark payment method - It shall maintain the payment methods that supported by the Carpark, e.g. Octopus, cash, free parking coupon, etc. Methods currently in use shall be allowed to change easily and new methods can be added;
6. Carpark entry method - It shall maintain the entry methods supported by the Carpark. The proposed methods include license plate recognition and Octopus Card (for motorcycle parking). Methods currently in use should be allowed to change easily and new methods can be added;
7. Carpark facility - It shall maintain the facilities provided by the Carpark. The information shall include:
    a. Type of parking space;
    b. Number of parking spaces for monthly letting;
    c. Number of parking spaces for hourly parking;
    d. Number of parking spaces for HD's self use;
    e. Number of parking spaces for other use.
8. Detailed parking transaction - It stores all the detailed information regarding the entry, exit and revenue collected from the vehicle. Relevant data should include:
    a. Carpark stock identifier;
    b. Vehicle number;
    c. Type of vehicle;
    d. Carpark entry method;
    e. Transaction reference (ACCS reference);
    f. Parking charge amount;
    g. Transaction start date and time;
    h. Entry gate (device) ID;
    i. Transaction end date and time;
    j. Exit gate (device) ID;
    k. Free parking amount;
    l. Free parking start time and end time;
    m. Payment method;
    n. Other relevant information (e.g. the Octopus Card identification, Smartcard / Licensee identification, etc. if any);
    o. Payment period start time and end time (for monthly parking).

9. Customer (licensee) - It shall store all personal information of a licensee who registers in ACCS for monthly parking; Personal information shall include but not limited to Carpark stock identifier, Vehicle number, Smartcard / Licence identifier, Valid period from, Valid period to, Driver name, contact number, Vehicle types, Parking charges, Image of vehicle, Image of driver and etc.;
10. Customer car information - It shall maintain the information of customer car.

ELE26.2.120.B REAL-TIME PARKING INFORMATION SYSTEM

1. The real-time parking information system shall be wired type among the ultrasonic sensors and workstation in control room;
2. The real-time parking information system shall comprise all necessary equipment including computer, LED video monitor (24" or above) and well developed software for the system to perform to the CM's satisfaction;3. LED-typed carpark vacancy display board at the carpark entrance lane and data interface with the parking vacancy information system of TD shall be provided to indicate the number of vacant hourly parking spaces with and without EV charging facilities respectively;
4. Wired type ultrasonic sensors shall be installed for each hourly parking space to identify the number of vacant parking spaces with and without EV charging facilities;
5. The real-time parking information system shall send the notification to car counting system when the spaces available for hourly parking are full.

ELE26.2.130.A DATA REQUIREMENTS FOR TRANSMISSION TO PARKING VACANCY INFORMATION SYSTEM OF THE TRANSPORT DEPARTMENT

1. The real-time information for the number of vacant hourly parking spaces with and without EV charging facilities shall be transmitted to the parking vacancy information system of TD via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to CM’s approval in case of unavailability of broadband network with fixed IP). All relevant cost of broadband network including any service fee required during Maintenance Period shall be borne by the Sub-contractor;
2. The Sub-contractor is responsible for implementing the processes to provide data file containing the parking vacancy information (in JSON format in accordance with the structure specified by TD) to TD’s data hub server for central monitoring of the parking vacancy information system of TD. The Sub-contractor shall design and provide a system software for interfacing and exchanging electronic data of parking vacancy information with TD;
3. The Sub-contractor shall be responsible for liaising with TD for the proper implementation of the interfaces, including the interface channel, frequency etc..

ELE26.2.140.A DATA REQUIREMENTS FOR TRANSMISSION TO PARKING VACANCY INFORMATION SYSTEM OF THE ENVIRONMENTAL PROTECTION DEPARTMENT

1. The real-time information for the number of vacant hourly parking spaces with EV charging facilities shall be transmitted to the parking vacancy information system for EV–Charging Easy APP to EPD on EPD’s request via broadband network with fixed IP (5G / 4G USB modem with fixed IP may be accepted subject to the CM’s approval in case of unavailability of broadband network with fixed IP). All relevant cost of broadband network including any service fee required during Maintenance Period shall be borne by the Sub-contractor;

2. The Sub-contractor is responsible for implementing the processes to provide data file containing the parking vacancy information for EV–Charging Easy APP (in format in accordance with the structure specified by EPD) to EPD's data hub server for displaying of the parking vacancy information for EPD's APP. The Sub-contractor shall design and provide a system software for interfacing and exchanging electronic data of parking vacancy information with EPD;
3. The Sub-contractor shall be responsible for liaising with EPD for the proper implementation of the interfaces, including the interface channel, frequency etc..

ELE26.2.150.N CAR TYPE RECOGNITION SYSTEM BY VIDEO CONTENT ANALYTIC (VCA) SYSTEM

1. The system shall leverage artificial intelligence and deep learning algorithms to analyse video streams, extract vehicle features, and automatically classify incoming vehicles into predefined categories of private car, light goods vehicle (LGV), coach / bus, medium / heavy goods vehicle and motorcycle with different carpark charges under various environmental conditions (day / night, different weather, and angles);
2. VAC cameras shall be provided at the entrance of the PRH development, entrance of SSF development and the entrance of HA standalone carpark inside SSF development;
3. The car type recognition system shall be compatible and connected to the automatic carpark control system for the calculation of parking fee;
4. The system shall be completed with edge-based processing unit with using deep learning models trained on large datasets;
5. The system shall have data logging and report, including vehicle count, type statistic and timestamped logs etc.

ELE26.2.160.N AUDIBLE AND VISUAL ALARM SYSTEM

1. Audible and visual alarms shall be provided at automatic drop gate barriers or the exit and entrance of the carpark as approved by the CM to ensure the safe crossing on driveway. When the presence detection loop detects the presence of vehicle, the audible and visual alarms shall be activated until the vehicle passes the passage detection loop;
2. A by-pass manual key switch and timer switch shall be provided for the audible and visual alarm system so that both audible and visual alarm could be turned off manually in case of operational need.

ELE26.3 MATERIALS AND EQUIPMENT

ELE26.3.010.A GENERAL

1. The system installations shall be suitable for use under Hong Kong climatic condition with relative humidity and ambient temperature as shown below:
   a. Relative Humidity : up to 0.99 saturation;
   b. Ambient Temperature : peak from minus 5°C to plus 40°C for 4 hours continuously with an average from 0°C to plus 35°C over 24 hours period.
2. All equipment provided shall be compatible with the system installation;
3. All equipment shall be entirely suitable for use in the intended locations. The material finishes and construction of the equipment shall be such that it can withstand the possibility of vandalism, tampering and impact from vehicles;
4. Unless otherwise Approved, all cabinets exposed to weather shall be corrosion-resistant, constructed of not less than 1.5 mm thick grade 304 stainless steel or better, or heavy gauge aluminium alloy with epoxy coating, or equivalent;
5. Alternative design proposal for various items of equipment hereinafter specified will be considered but subject to the submission of detailed technical information enclosed in the tender;
6. All carpark control equipment shall have not less than one year proven reliability and in-service record established in local application, and evidence shall be produced to the satisfaction of the CM upon request;
7. Unless otherwise Approved, the specification for CCTV video camera, LED video monitor, video distribution amplifier, network video recorder, cables, equipment rack, etc. shall be referred to ELE24.2 and the specification for UPS equipment (except the manual bypass switch which is not required for ACCS) and battery shall be referred to ELE24.2.15.020 and ELE24.2.15.030.

ELE26.3.020.D CENTRAL DATA STATION / CASHIER COMPUTER WITH LICENSE PLATE AND CAR TYPE RECOGNITION SYSTEMS

1. The central data / cashier computer shall comprise a main computing unit of sufficient processing speed to suit the intended purpose, standard USB style connector of latest version, a DVD-RW, a colour LED video monitor (24" or above) with built-in speakers, a mouse and a keyboard;
2. The central data / cashier computer shall contain duplex hard-disks of equal capacity of no less than 2 TB arranged in RAID 1 (mirroring) for data storage so that failure of any one hard-disk can be replaced by a new one without any permanent loss of data. History of financial transactions for two years shall be kept and easily be retrieved. Provision shall be incorporated in the system for short and long term data storage such that the archived data can be analyzed to produce results and reports on carpark occupancy, parking frequency, malfunctions etc.;
3. The central data / cashier computer shall be completed with a fully developed carpark management softwares including VLRS and VCA systems, and central database;
4. The central data / cashier computer shall be capable of computing the parking fee automatically based on the licence plates and car type identified by VLRS and VCA system;

5. The central data / cashier computer shall operate under a platform of the latest version of Windows or other operating system subject to the CM's approval;6. The central data / cashier computer shall be ready for broadband network / 5G / 4G USB modem connection;
7. The central data / cashier computer shall be backed up by UPS for a duration of not less than 15 minutes to prevent data loss in the event of power failure;
8. All softwares included shall be in free or full user licenses with no expiry date. Full set of system recovery diskettes, back up diskettes for the softwares shall be provided.

ELE26.3.030.B REAL-TIME PARKING INFORMATION COMPUTER

1. The computer shall comprise a main computing unit of sufficient processing speed to suit the intended purpose, standard USB style connector of latest version, a hard-disk of no less than 2 TB, a DVD-RW, a colour LED video monitor (24" or above) with built-in speakers, a mouse and a keyboard;
2. The computer shall operate under a platform of the latest version of Windows or other operating system subject to the CM's approval;
3. The computer shall be backed up by UPS for a duration of not less than 15 minutes to prevent data loss in the event of power failure;
4. All softwares included shall be in free or full user licenses with no expiry date. Full set of system recovery diskettes, back up diskettes for the softwares shall be provided.

ELE26.3.040.B ENTRANCE CONTROL UNIT

Entrance Control Unit shall be completed with a factory manufactured floor-mounted weatherproof stainless steel enclosure and as indicated on Drawings, comprise the following components:

1. An Octopus Card reader installed at not less than 900 mm or greater than 1,150 mm for hourly parking;
2. A slave station of the intercom system;
3. A min. 7" backlit LCD colour visual instruction display panel;
4. An automatic cutting-off thermal printer for issuing receipts showing date and time of entry at the Octopus Card reader and a button labelled "Press Button for Receipt" in both English and Chinese characters near the printer.

ELE26.3.050.B EXIT CONTROL UNIT

Exit Control Unit shall be completed with a factory manufactured floor-mounted weatherproof stainless steel enclosure and as indicated on Drawings, comprise the following components:

1. An Octopus Card reader installed at not less than 900 mm or greater than 1,150 mm for hourly parking ;
2. A slave station of the intercom system;
3. A min. 7" backlit LCD colour visual instruction display panel;
4. An automatic cutting-off thermal printer for issuing Octopus payment receipts showing parking fee paid and date and time of exit at the Octopus Card reader and a button labelled "Press Button for Receipt" in both English and Chinese characters near the printer;

5. Reserved space for contactless e-payment terminal for future addition of fee collection system by other common e-payment to be provided by others. Those common e-payment includes Credit Card (Visa, Mastercard and Union Pay), mobile application payment (Apple Pay, Google Pay and Samsung Pay), Alipay, AlipayHK, WeChat Pay, WeChat Pay HK, Faster Payment System (FPS), PayPal, etc.

ELE26.3.055.X DELETED

ELE26.3.060.A AUTOMATIC DROP GATE BARRIER

1. Automatic drop gate barrier shall be of straight rising arm type. Articulated arm shall be accepted if the headroom of the covered entrance / exit is not enough to allow the arm from 90 degree movement;
2. The arm shall be made from an Approved weather resistant material suitably treated to prevent corrosion. It shall be sufficiently strong to withstand vandalism. It shall be so fabricated that it will shear off under impact by a vehicle in order to minimize damage to the arm and prevent damage caused to the mechanism and the cabinet;
3. The arm when at low position shall be of an appropriate length to suit the corresponding width of the drive way and operation. The gap between the end of the arm and the edge of the driveway shall not exceed 200mm in width. The gap wider than 200mm may be acceptable subject to the CM's approval. The clearance from the drive way finished level to the top of arm when the barrier is raised shall be adjusted to suit the site condition;
4. When the barrier is at low position, the clearance between the bottom of the barrier and the drive way finished level shall be not less than 800 mm or greater than 1200 mm;
5. On receipt of an open signal from a card reader or ticket dispenser the barrier arm shall be raised and shall then be lowered on receipt of a closing signal from the passage loop detector. The barrier shall be raised again upon receiving another signal from a reader or dispenser;
6. Provision shall be made to enable the barrier to be manually operated (i) by holding down a Manual Control Barrier Button at carpark control centre, and (ii) by turning off the key switches at the corresponding Entrance / Exit control units in case of emergency;
7. The barrier shall have a "store vend" function which allows its barrier arm to reverse its downward motion immediately when a following vehicle has been accepted by an entrance control unit or an exit control unit.

ELE26.3.070.9 LOOP DETECTOR

1. Loop detector shall be inductive detection type suitable for placing in a slot cut on the drive way. The cables shall be waterproof and the slots shall be sealed with epoxy or an Approved sealant;
2. Loop detectors shall be installed as either presence detection loop or passing detection loop;
3. A presence detection loop shall pass an electric signal to the system when a vehicle is detected passing over it or stopped on it. The detector(s) at the entrance shall be capable of detecting any back-out vehicle;
4. A passing detection loop shall pass an electric signal to the system when a vehicle has passed over it. No electric signal shall be induced when a vehicle stops on it;

5. The loop detector provided shall be capable of detecting the presence and passing of three type of vehicles – vehicles with height below 2 m, vehicles with height 2 m or above and motorcycle;
6. Preventive measures of Electromagnetic Interference for detection loop shall be provided where applicable;
7. When no vehicle is detected passing over the loop detector within 30 seconds subsequent to the raising of a barrier arm, a signal shall pass to the ACCS Workstation to arouse operator's attention.

ELE26.3.080.X DELETED

ELE26.3.090.X DELETED

ELE26.3.100.X DELETED

ELE26.3.110.9 "FULL" SIGN

1. The "Full" sign box shall be housed in a cabinet made of not less than 1.5mm thick stainless steel;
2. The characters on the sign shall be in both English ("FULL") and Chinese ("滿") and arranged in bright LED matrix unless otherwise Approved. The shorter length on the effective illuminated area shall be not less than 250mm;
3. The Sub-contractor shall submit detailed drawings and samples of materials regarding the construction of illuminated signs for Contract Manager's Approval prior to the fabrication and installation;
4. The sign shall illuminate on receiving a signal from the central data station/cashier computer.

ELE26.3.120.9 INTERCOM SYSTEM MASTER AND SLAVE STATIONS

1. The master station(s) shall be designed for desk-top mounting;
2. Each master station shall comprise:
   a. A slave station selection panel;
   b. A microphone unit; and
   c. A built-in loudspeaker.
3. The number of master station(s) to be provided shall be sufficient for connection with each entrance and exit control points plus at least two spare ways;
4. A slave selection panel shall be provided to incorporate the following controls/indicators:
   a. 4 heavy duty Press-ON/Press-OFF slave station selection buttons;
   b. 4 slave station selection indicators;
   c. A heavy duty spring-loaded slave station "CALL" button;
   d. A loudspeaker volume control;
   e. A power supply status indicator;
   f. A lamp test button; and
   g. A buzzer alarm.

5. The slave stations shall be incorporated in the Entrance Control Unit and the Exit Control Unit. The slave station shall be integrated into the Control Units as a factory fitted product. Each slave station shall be completed with the following:

   a. A loudspeaker for hands free operation in a noisy environment;

   b. A heavy duty spring-loaded "CALL" button; and

   c. A buzzer alarm.

ELE26.3.130.A CARPARK VACANCY DISPLAY BOARD

1. The carpark vacancy display board shall be housed in a cabinet made of not less than 1.5 mm thick stainless steel with transparent plastic cover for showing the display board. The cabinet shall have an ingress protection of at least IP54 to BS EN 60529 or IEC 60529;

2. The display board shall display the number (in Arabic numeral format) of vacant hourly parking spaces with and without EV charging facilities using bright LED matrix (in green colour) unless otherwise approved;

3. Dot size of LED matrix shall be not less than 3mm and dot pitch shall be not more than 4 mm. The LED display area shall be not less than 160 mm(H) x 300 mm(W) for each module;

4. The characters of description in both English and Chinese ("EV Hourly Parking Spaces / 時租電動車位" and "Normal Hourly Parking Spaces / 時租普通車位") shall be provided on the front plate of display board above the LED display. The height of the characters shall not be less than 120 mm;

5. The Sub-contractor shall submit detailed drawings and samples of materials regarding the construction of carpark vacancy display board for CM's approval prior to the fabrication and installation;

6. The number of vacant hourly parking spaces shall be updated upon receiving signal from real-time parking information system or manual adjustment by the ACCS workstation.

ELE26.3.140.B ULTRASONIC SENSORS OF REAL-TIME PARKING INFORMATION SYSTEM

1. The ultrasonic sensor shall be all-in-one type with built-in red / green / amber colour LED indicator showing the following status:

   a. Red – Not available;

   b. Green – Available and can be parked;

   c. Amber – Available for disabled or other reserved purpose.

2. The ultrasonic sensor shall be installed above front of the parking space as shown on the Drawings and use ultrasonic pulse to detect presence of vehicle. The detection range shall be 200 mm to 3000 mm adjustable on Site;

3. The ultrasonic sensor shall be wired type. Ingress protection rating shall be at least IP65 for outdoor application. The Sub-contractor shall provide all necessary wiring, cable containment, power provisions and interfacing units e.g. zone controllers to connect the ultrasonic sensors to the ACCS workstation to perform the functions of real-time parking information system. The communication protocol shall be through RS485 or Ethernet;

4. Each zone controller shall be able to communicate with not less than 30 nos. of ultrasonic sensor. The zone controller shall collect the information of each single sensor, process them and send the corresponding real time information to the ACCS workstation via RS485 or Ethernet. The Sub-contractor shall at his own cost to provide sufficient zone controllers to ensure proper signal transmission between ultrasonic sensors and ACCS workstation in view of the distance limitation of signal transmission between sensors, zone controllers and workstation shall not be exceeded;
5. The Sub-contractor shall allow spare provisions of all necessary interfacing units, and spare capacity of ACCS workstation and real-time parking information system etc. to cater for connection of not less than 50% additional ultrasonic sensors in future additional hourly parking spaces.

ELE26.3.150.9 AUTOMATIC CUTTING-OFF THERMAL PRINTER

1. The printer shall be of kiosk type and adopt the printing method of direct thermal print and equipped with cutter;
2. The print speed shall not be less than 180mm/s and the resolution shall be more than 200 dots per inch (dpi).

ELE26.3.160.A HOURLY PARKING PAY STATION

Hourly parking pay station shall be completed with a factory manufactured weatherproof stainless steel enclosure and as indicated on Drawings, comprise the following components:

1. Octopus Card reader / validator(s) installed at not less than 900 mm or greater than 1,150 mm for hourly parking;
2. A slave station of the intercom system;
3. An automatic cutting-off thermal printer for issuing receipts showing date and time of entry, and the parking fee paid and date and time of exit at the Octopus Card reader. Pre-warning signal shall be transmitted to ACCS workstation in case of the thermal printer out of paper;
4. A min. 7” backlit LCD colour visual instruction display panel. The LCD display panel shall display the information such as time and date of entry and remaining money value of Octopus Card when an Octopus Card is detected when the driver parks at the hourly parking space and display the information such as time and date of exit and the remaining money value of Octopus Card and parking fee paid when the Octopus Card is detected when the driver leaves the hourly parking space;
5. Signage showing operation sequence of hourly pay station. Built-in LED illumination shall be provided for reading of signage at night;
6. Reserved space for contactless e-payment terminal for future addition of fee collection system by other common e-payment to be provided by others. Those common e-payment includes Credit Card (Visa, Mastercard and Union Pay), mobile application payment (Apple Pay, Google Pay and Samsung Pay), Alipay, AlipayHK, WeChat Pay, WeChat Pay HK, Faster Payment System (FPS), PayPal, etc.

ELE26.3.170.N VIDEO CONTENT ANALYTIC SYSTEM

1. The system shall consist of IP cameras with a minimum resolution of 1080p (Full HD) or higher, a frame rate of at least 25 frames per second. The camera shall be equipped with high-performance illuminators with white light and infrared (IR) function. The cameras shall be housed in weatherproof enclosures with ingress protection rating not less than IP65 for outdoor application.

2. The computer or edge processing unit shall contain high speed photo image processing and be completed with a fully developed software of video content analytic for car types;
3. Deep learning models shall be provided in the system with vehicle type recognition algorithms trained on extensive datasets. Vehicle type classification accuracy shall be no less than 90% across predefined categories, including private car, light goods vehicle (LGV), coach / bus & medium / heavy goods vehicle and motorcycle.

ELE26.3.180.N 32" LCD DISPLAY

1. The 32" LCD display board with mounting pole shall have an ingress protection of at least IP65 for outdoor application;
2. At entrance control point, the display board shall display the following information in both English and Chinese:
   a. Vehicle license plate;
   b. Car type, i.e. hourly parking and monthly parking;
   c. Entry time.
3. For exit control point, the display board shall display the following information in both English and Chinese:
   a. Vehicle license plate;
   b. Car type, i.e. hourly parking and monthly parking;
   c. Entry time;
   d. Leaving time;
   e. Outstanding amount of parking fee.
4. The characters of information in both English and Chinese with height not less than 120 mm or other design subject to the CM's approval;
5. The Sub-contractor shall submit detailed drawings and samples of materials regarding the construction of display board for CM's approval prior to the fabrication and installation.

ELE26.3.190.N AUDIBLE AND VISUAL ALARMS

1. The audible and visual alarms shall be wired type. Ingress protection rating shall be at least IP65 for outdoor application. The Sub-contractor shall provide all necessary wiring, cable containment, power provisions and interfacing units to connect the alarms to the detection loops to perform the safety alerts to pedestrians who crossing the driveway;
2. The visual alarms shall be red strobe lights;
3. The volume of audible units shall be flexibly adjustable by the operator in control centre any time. The audible devices shall have a night-time operation mode with lower sound output to minimize the noise nuisance to nearby residents;
4. The audible and visual alarms shall be consisted of controllers that allows for the modification of sound and light intensity based on real-time environmental conditions or user feedback.

ELE26.4 TESTING AND COMMISSIONING

ELE26.4.010.A TESTS

The Sub-contractor shall carry out the following tests for the installation in the presence of the CM:

1. Test of earth loop impedance of all relevant metallic parts of the equipment in compliance with the Electrical COP;
2. Continuous operation of the barrier and operating time as specified;
3. Testing and demonstration of all functions of the ACCS, VLRS, car type recognition, Car counting System, Octopus Card clearing, real-time parking information system, data exchange with HA's data hub server, intercom system and carpark CCTV system as mentioned in the Specification.

ELE26.4.020.9 TEST RECORD

The Sub-contractor shall record all the tests and submit to the Contract Manager for Approval.

ELE26.4.030.A TRAINING

1. The Sub-contractor shall provide not less than 40 hours training of the operation and maintenance for the carpark control and management facilities with a proposed training programme approved by the CM. The training shall be conducted during normal working hours for the estate management staff. The Sub-contractor shall record in 1080p video or better throughout one training session and hand over 2 copies of DVD-videos of the record to the CM;
2. The Sub-contractor shall provide sufficient copies of detailed training manuals for operation and maintenance for the estate management staff;
3. The Sub-contractor shall provide 2 sets of the recovery disks for system restoration and e-copies of operation and maintenance manuals to the CM before handover.

ELE26.5 MAINTENANCE

ELE26.5.010.9 GENERAL

1. The Sub-contractor shall provide free maintenance including labour and materials to the system installation for the entire Maintenance Period after completion of the installation;
2. During the Maintenance Period, the Sub-contractor shall attend to all faults and complaints, remedy all defects, replace all malfunction items and maintain the complete installation in a clean, tidy and functional condition to the satisfaction of the Contract Manager.

ELE26.5.020.9 24-HOUR ON-CALL SERVICE DURING MAINTENANCE PERIOD

1. The Sub-contractor shall provide 24-hour on-call service at any time during the Maintenance period. The Contract Manager may instruct the Sub-contractor, in the Maintenance Period via telephone, mobile phone, paging service or any other means as advised by the Sub-contractor and Approved by the Contract Manager, to attend the reported breakdowns, and the Sub-contractor shall dispatch competent technicians or such other suitable personnel, who shall arrive at site and shall carry out any necessary inspection testing and repair work as soon as practicable and under all weather conditions;
2. The Sub-contractor shall submit to the Contract Manager for this purpose at least two names of English speaking representatives, who can be reached at any time of the day, with contact telephone numbers of direct lines, mobile phones or paging service for Approval. Prior Approval shall also be obtained for any subsequent changes of representatives, contact telephone numbers etc. during the Maintenance Period at least two weeks before the change is effected;
3. The Sub-contractor shall attend to emergency calls within three (3) hours of receiving such calls out of normal working hours and a maximum time limit of two (2) hours during normal working hours. For other repair calls, they shall carry out repair work within twenty four (24) hours;
4. The maintenance and servicing works, as described above, form part of the Main Works described in Clause 8.3(2)(c) of the General Conditions of Main Contract.

ELE26.5.030.A PREVENTIVE MAINTENANCE

1. The Sub-contractor shall provide quarterly maintenance inspection and service to the ACCS, VLRS, car type recognition, Car Counting System, real-time parking information system and intercom system such as checking overall functioning of the system, cleaning of roller and magnetic heads, lubricating the mechanical part, adjusting inductive detection loops etc. The Sub-contractor shall submit a proposed maintenance programme, including the scope of maintenance activities, to the CM for Approval within 14 days after the commencement of the Maintenance Period. An inspection report should be submitted to the CM after each quarterly inspection;
2. The specification for maintenance inspection and service to the carpark CCTV System shall be referred to ELE24.4.3;
3. Upon request by the CM within the Maintenance Period, the Sub-contractor shall also provide free service to modify the computer programme to facilitate alteration of the system, such as change of tariff structure;

4. Four weeks before expiry of the Maintenance Period, the Sub-contractor shall carry out a hand / take-over inspection with the party taking up the on-going maintenance of the system in the presence of the representatives of the CM. Defects found should be rectified by the Sub-contractor to the satisfaction of the CM;

5. At the end of the Maintenance Period, the Sub-contractor shall execute all work of inspection, examination, and overhaul as required, to the complete installation to the satisfaction of the CM.

ELE28 MISCELLANEOUS ITEMS

ELE28.1 LABELS AND NOTICES 2

ELE28.1.010.9 INSCRIPTION OF LABELS AND ENGRAVING 2
ELE28.1.020.9 MATERIAL FOR LABELS 2
ELE28.1.030.9 FIXING OF LABELS 2
ELE28.1.060.9 ENGRAVING FOR ELECTRICAL ACCESSORIES 2
ELE28.1.070.9 LABELS AND WARNING NOTICES 2
ELE28.1.080.9 TREATMENT OF ELECTRIC SHOCK POSTER 3

ELE28.2 SPARE FUSES IN SWITCH ROOMS 4

ELE28.2.010.9 FUSE REQUIREMENTS 4
ELE28.2.020.9 MOUNTING 4
ELE28.2.030.9 HAND-OVER 4

ELE28.3 FIXINGS 5

ELE28.3.010.9 SCREWS AND BOLTS 5
ELE28.3.020.9 PLUGS 5

ELE28.4 INSULATING MATERIALS 6

ELE28.4.010.9 INSULATING TAPES 6
ELE28.4.020.9 RESTRICTED MATERIALS 6

ELE28.5 OPENINGS IN BUILDING STRUCTURE 7

ELE28.5.010.9 SLEEVES 7
ELE28.5.020.9 MAIN CONTRACTORS WORK 7
ELE28.5.030.9 SUB-CONTRACTOR'S WORK 7
ELE28.5.040.9 WATERPROOFING 7

ELE28.6 SHEET METALWORK 8

ELE28.6.010.9 CONSTRUCTION 8
ELE28.6.020.9 PROTECTION AGAINST CORROSION 8
ELE28.6.030.9 STAINLESS STEEL SHEET 8

ELE28.7 PAINTING METALWORK 9

ELE28.7.010.9 SCOPE 9
ELE28.7.050.9 GENERAL 9
ELE28.7.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 9

ELE28.1 LABELS AND NOTICES

ELE28.1.010.9 INSCRIPTION OF LABELS AND ENGRAVING

1. The labels shall be in both English and Chinese characters;
2. The labels shall be legible and durable such as by method of inscription or silk printing with transparent covering. Other methods giving legible and durable label are also acceptable;
3. Samples shall be submitted to the Contract Manager for approval prior to ordering.

ELE28.1.020.9 MATERIAL FOR LABELS

1. Labels shall be made of white plastic material with required letterings in red colour, unless otherwise specified;
2. Where equipment is fitted with labels provided by the manufacturer of the equipment, these labels may be used in lieu of the plastic material, provided that they are of equivalent quality and Approved.

ELE28.1.030.9 FIXING OF LABELS

Labels shall be fixed to switchgear and distribution board by screws. Where drilling and tapping of the equipment is impracticable, Approved adhesive means may be used subject to prior Approval.

ELE28.1.060.9 ENGRAVING FOR ELECTRICAL ACCESSORIES

1. Inscription is not required on front plate of control switches feeding fixed electrical appliances in domestic blocks;
2. For other building and/or occupied non-domestic premises, the front plate of each control switch, feeding a fixed electrical appliance, such as a wash boiler, water heater, cooker, wall-mounted fan, wall-mounted radiator, incinerator, exhaust fan, room cooler, etc., shall be engraved according to the appliance being controlled;
3. Details of the inscription shall be submitted for Approval;
4. Additional engraving to other electrical accessories will be as specified on the Drawings.

ELE28.1.070.9 LABELS AND WARNING NOTICES

1. Labels and warning notices as required by the Electricity Ordinance and the Electrical CoP shall be provided where appropriate;
2. Labels may be fixed in other positions specified or directed by the Contract Manager;
3. The following warning notices in English and Chinese shall be provided at the positions where appropriate:
    a. A label having a minimum size of 65 mm x 50 mm marked with the words "DANGER - HIGH VOLTAGE 危險 - 高壓" in lettering not less than 5 mm high to be fixed on every container on enclosure of ancillary equipment for discharge lighting installations operating at voltages exceeding "Low Voltage";

b. Where terminals or other fixed live parts between which a voltage exceeding 250 volts exists are housed in separate enclosures or items of equipment which, although separated, can be reached simultaneously by a person, a notice shall be secured in a position such that anyone, before gaining access to such live parts, is warned of the maximum voltage which exists between those parts.

ELE28.1.080.9 TREATMENT OF ELECTRIC SHOCK POSTER

The sub-contractor shall supply and fix an anodised aluminium frame with transparent plastic front plate of 3 mm minimum thickness and wooden backing board of 5 mm minimum thickness inside each main switch room and mount it with a "Treatment of Electric Shock" poster which may be obtained from the Labour Department free of charge. If the poster is not obtained from Labour Department, the sub-contractor shall ensure the poster supplied will have the same quality and size.

ELE28.2 SPARE FUSES IN SWITCH ROOMS

ELE28.2.010.9 FUSE REQUIREMENTS

The Sub-contractor shall provide in each switchroom of this project one complete set of spare fuses for each rating of fuse-switches or switchfuses installed.

ELE28.2.020.9 MOUNTING

Each set of spare fuses shall be hung on a wooden board with brass hooks. The wooden board shall be smoothed on both front and edges, painted and labelled.

ELE28.2.030.9 HAND-OVER

All the boards with fuses provided under this project shall be handed over to the Housing Manager.

ELE28.3 FIXINGS

ELE28.3.010.9 SCREWS AND BOLTS

1. Machine screws and nuts shall be to ISO/885;
2. Hexagon bolts, screws and nuts shall be to BS EN ISO 4016, BS EN ISO 4018 and BS EN ISO 4034;
3. Wood screws shall be to BS 1210 with countersunk head unless otherwise specified;
4. Bolts, nuts and washers shall be manufactured from non-ferrous materials;
5. Holes for bolts, screws and other fixings shall be drilled or stamped, and no larger than required for clearance of the bolt, screw, etc..

ELE28.3.020.9 PLUGS

1. Proper methods of fixing, such as expanding plugs of adequate size or other purpose-designed fixing devices approved by Contract Manager shall be used;
2. Screws shall not be fixed to wooden plugs unless otherwise specified.

ELE28.4 INSULATING MATERIALS

ELE28.4.010.9 INSULATING TAPES

Insulating tapes for low voltage applications shall comply with IEC 60454-3-1 pressure sensitive adhesive tape type F-PVCp (plasticized PVC) and have a minimum thickness of 0.21 mm.

ELE28.4.020.9 RESTRICTED MATERIALS

Non-impregnated paper, fabric, wood or press-hemp shall not be used for insulating purposes. Where synthetic resin bonded insulating boards are used, all cut edges shall be sealed with an Approved varnish.

ELE28.5 OPENINGS IN BUILDING STRUCTURE

ELE28.5.010.9 SLEEVES

1. Provide PVC sleeves for openings in walls within a fire compartment;
2. Provide galvanised mild steel sleeves for openings in walls and slabs connecting the fire compartment with other fire compartments/public areas.

ELE28.5.020.9 MAIN CONTRACTORS WORK

The holes, sleeves and slots reserved through walls/slabs/beams will be cleared and cleaned by the Main Contractor before hand-over to the Sub-contractor for use.

ELE28.5.030.9 SUB-CONTRACTOR'S WORK

The nails appertaining to concealed electrical boxes shall be cleared by the Sub-contractor subsequent to work completion and prior to execution of final painting work by the Main Contractor.

ELE28.5.040.9 WATERPROOFING

Where any work pierces the waterproofing including waterproof structure, the method of installation shall be as Approved.

ELE28.6 SHEET METALWORK

ELE28.6.010.9 CONSTRUCTION

Sheet metal boxes, meter chambers etc. shall be manufactured from plain steel sheets. The thickness of steel sheet shall be as specified in the relevant Worksection subject to a minimum of 1.0 mm. Where necessary, suitable stiffeners shall be provided to give adequate rigidity.

ELE28.6.020.9 PROTECTION AGAINST CORROSION

Protection against corrosion shall be achieved by means of hot-dip galvanising, anti-rust painting or enamel, or the use of stainless steel.

ELE28.6.030.9 STAINLESS STEEL SHEET

If stainless steel sheet is specified, it shall be to BS EN 10088-2, Symbol F9 for matt finish and F8 for polished finish.

ELE28.7 PAINTING METALWORK

ELE28.7.010.9 SCOPE

1. Exposed metal parts of the installation as specified in the Contract or as directed by the Contract Manager shall be painted by the Sub-contractor;
2. Wherever necessary, parts of the installation may be painted by the Main Contractor under the instruction of the Contract Manager. Under such circumstances, the Sub-contractor shall ensure that painting provided by the Main Contractor shall not cause any detrimental effects to the electrical installation.

ELE28.7.050.9 GENERAL

1. The Sub-contractor shall comply with the requirements on materials and workmanship for painting as specified in Worksection FIN7 of HKHA Architectural Works Specification unless otherwise specified;
2. Metalwork to be painted shall be cleaned, prime coated with the appropriate primer and completed with two coats of synthetic paint in accordance with the manufacturer's recommendation.

ELE28.7.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the country / place of manufacture and authenticity of the paints delivered to Site.

ELE29 STANDBY DIESEL GENERATING SETS

ELE29.1 GENERAL 4

ELE29.1.010.A SCOPE 4
ELE29.1.020.9 PURPOSE 4
ELE29.1.030.9 FACTORY ASSEMBLY 4
ELE29.1.040.9 FS CODE OF PRACTICE 4
ELE29.1.050.9 COMPATIBILITY OF COMPONENTS 4
ELE29.1.060.9 COMPONENTS 4
ELE29.1.070.9 OPERATING CONDITIONS 4
ELE29.1.080.9 IN-SERVICE RECORDS 5

ELE29.2 OUTPUT AND RATING 6

ELE29.2.010.9 OUTPUT 6
ELE29.2.020.9 ACCURACY OF OUTPUT 6
ELE29.2.030.9 RATING 6
ELE29.2.040.9 TIMING OF LOADS APPLICATION 7
ELE29.2.050.9 EXCESSIVE REGENERATIVE POWER AND NON-LINEAR LOADS 7

ELE29.3 DESIGN 8

ELE29.3.010.9 MANUFACTURER'S RECOMMENDATIONS 8
ELE29.3.020.9 SAFETY 8
ELE29.3.030.9 SPACE FOR MAINTENANCE 8
ELE29.3.040.9 VENTILATION 8
ELE29.3.050.9 AIR SUPPLY AND DISCHARGE 8
ELE29.3.060.9 EXHAUST SYSTEM 8
ELE29.3.070.A EXHAUST AIR PIPES 9

ELE29.4 ENGINE 10

ELE29.4.010.9 TYPE AND DESIGN 10
ELE29.4.020.9 COOLING SYSTEM 10
ELE29.4.030.9 SPEED GOVERNOR 10
ELE29.4.040.9 FILTERS 10
ELE29.4.050.9 EXHAUST CONNECTORS 10
ELE29.4.060.9 AUTOMATIC SAFETY CUT-OUT DEVICES 10
ELE29.4.070.9 INSTRUMENT PANEL 10
ELE29.4.080.9 STARTER UNIT 10

ELE29.5 ALTERNATOR 11

ELE29.5.010.9 TYPE 11
ELE29.5.020.9 PROTECTION 11
ELE29.5.030.9 INSULATION SYSTEM 11
ELE29.5.040.9 TERMINAL BOX 11
ELE29.5.050.9 RADIO INTERFERENCE SUPPRESSION 11

ELE29.6 BASEFRAME AND FUEL TANK 12

ELE29.6.010.9 BASEFRAME 12
ELE29.6.020.9 INTEGRAL FUEL TANK 12
ELE29.6.025.9 SEPARATE FUEL TANK 12
ELE29.6.030.9 FUEL LEVEL SWITCH 13
ELE29.6.040.9 CONTROL REQUIREMENT 14
ELE29.6.050.9 VERIFICATION OF FUEL LEVEL SETTINGS 14

ELE29.7 STARTING SYSTEM 15
ELE29.7.010.9 SPECIFICATION 15
ELE29.7.015.9 TYPE OF BATTERIES 15
ELE29.7.020.9 MOUNTING OF BATTERIES 15
ELE29.7.030.9 CAPACITY OF BATTERIES 15
ELE29.7.040.9 BATTERY CHARGER 15

ELE29.8 ENGINE EXHAUST SYSTEM 16
ELE29.8.010.9 SCOPE OF SYSTEM 16
ELE29.8.020.A EXHAUST AIR PIPES 16
ELE29.8.030.9 SIZING OF EXHAUST AIR PIPE 16
ELE29.8.040.A LAGGING EXHAUST AIR PIPES 16

ELE29.9 AIR DUCTWORK 18
ELE29.9.010.9 SCOPE 18
ELE29.9.020.9 CONSTRUCTION 18
ELE29.9.030.9 SUPPORTS 18
ELE29.9.040.9 SILENCERS 18

ELE29.10 CONTROL CUBICLE 19
ELE29.10.010.9 CONSTRUCTION 19
ELE29.10.020.9 PROTECTION DEVICES 19
ELE29.10.030.9 FRONT PANEL 19
ELE29.10.040.9 ALARMS 20
ELE29.10.050.9 ANTI-CONDENSATION HEATERS 20
ELE29.10.060.9 CONTROLLER 20

ELE29.11 OPERATION 21
ELE29.11.010.9 GENERAL 21
ELE29.11.020.9 WORK BY OTHERS 21
ELE29.11.030.9 APPROVAL OF CONTROL CIRCUIT 21
ELE29.11.040.9 PURPOSE 21
ELE29.11.050.9 PROVISIONS OF OPERATION 21
ELE29.11.060.9 REMOTE SHUT-OFF VALVE 22

ELE29.12 AUDIO AND VISUAL ALARMS 23
ELE29.12.010.9 ENGINE OVERSPEED PROTECTION 23
ELE29.12.020.9 STARTING FAILURE PROTECTION 23
ELE29.12.030.9 VOLTAGE FREE CONTACTS FOR FIRE CONTROL MAIN PANEL 23
ELE29.12.035.9 VOLTAGE FREE CONTACTS FOR LIFT CONTROL PANEL 24
ELE29.12.040.9 OPERATION 24
ELE29.12.050.9 TYPE OF INDICATOR LIGHTS AND METAL ENCLOSURE 24

ELE29.13 INSTALLATION 25
ELE29.13.010.9 COMPLIANCE WITH INSTRUCTIONS 25
ELE29.13.020.9 SUBMISSION FOR APPROVAL 25
ELE29.13.030.9 VIBRATION ISOLATION 25
ELE29.13.040.9 PAINTING 25

ELE29.14 ELECTRICAL WORK 26
ELE29.14.010.9 GENERAL 26
ELE29.14.020.9 OVERCURRENT PROTECTION 26

ELE29.14.030.9 EARTH FAULT PROTECTION....26
ELE29.14.040.9 INTERFACING WITH SWITCHBOARD CUBICLE....26

ELE29.15 PROVISION OF TECHNICAL INFORMATION....28

ELE29.15.010.9 LANGUAGE....28
ELE29.15.020.9 SUBMISSIONS FOR APPROVAL....28
ELE29.15.030.9 ADDITIONAL COPIES....28
ELE29.15.040.9 PRE SHIPMENT TEST EVIDENCE....29
ELE29.15.060.9 DISPLAY OF INSTRUCTIONS AND SCHEMATIC WIRING DIAGRAM....29

ELE29.16 ACCEPTANCE TESTING AND COMMISSIONING....30

ELE29.16.010.9 TESTING STANDARDS....30
ELE29.16.020.9 FACTORY TESTING....30
ELE29.16.030.9 SCOPE OF TESTING....31
ELE29.16.040.9 TESTING OPERATIONS....31
ELE29.16.050.9 LABOUR AND MATERIALS....31
ELE29.16.060.9 ACCURACY OF INSTRUMENTS....31

ELE29.17 MAINTENANCE AND FINAL TESTING....33

ELE29.17.010.9 ROUTINE MAINTENANCE....33
ELE29.17.020.9 MANUFACTURERS RECOMMENDATIONS....34
ELE29.17.030.9 MAINTENANCE OF BATTERIES....34
ELE29.17.040.9 PROVISION AND COMPLETION OF LOG BOOK....34
ELE29.17.050.9 FINAL TESTING....34
ELE29.17.060.9 LABOUR AND MATERIALS....34

ELE29.1 GENERAL

ELE29.1.010.A SCOPE

This specification covers the supply, installation, testing and commissioning, maintenance of standby diesel generating sets and associated accessories. The scope shall also include all necessary design and provisions of acoustic treatment associated with the installation for compliance with the Noise Control Ordinance, exhaust air pipes for compliance with the requirements in section 44 of the Building (Construction) Regulation (B(C)R) and all necessary submissions to the Authorities (such as EPD and BD/ICU) in connection with the installation and operation of generating sets.

ELE29.1.020.9 PURPOSE

A standby diesel generating set shall be provided as an emergency supply to comply with the Fire Services Department requirements and meet essential loads as specified or shown on the Drawings.

ELE29.1.030.9 FACTORY ASSEMBLY

1. Each generating set shall be a factory-assembled packaged unit and shall comprise a diesel engine directly coupled to an alternator, mounted on a common steel baseframe. Each generating set shall be provided with a control cubicle housing all control equipment. The generating set shall comply with all parts of ISO 8528 and the requirement of this specification;
2. The factory of generating set assembly shall comply with audited quality management system requirements of ISO 9001 and the certification shall be produced to the Contract Manager upon request.

ELE29.1.040.9 FS CODE OF PRACTICE

Standby diesel generating sets shall comply in all respects with Part V, Section 5.8 of The 'Code of Practice for Minimum Fire Service Installations and Equipment' issued by Fire Services Department (hereinafter referred to as F.S. Code of Practice). The generating sets shall be of proven reliability established in local application and evidence shall be produced to the satisfaction of the Contract Manager upon request.

ELE29.1.050.9 COMPATIBILITY OF COMPONENTS

The manufacturer of the various components to be used with the generating set shall be as recommended by the manufacturer to ensure compatibility of the components.

ELE29.1.060.9 COMPONENTS

The Sub-contractor shall ensure and verify to the satisfaction of the Contract Manager that all components employed in this installation conform to the relevant International and local Standards.

ELE29.1.070.9 OPERATING CONDITIONS

The generating set shall be capable of continuously operating under the appropriate site conditions which shall normally be a temperature range of 5°C to 40°C, relatively humidity 100% and the altitude of the actual site.

ELE29.1.080.9 IN-SERVICE RECORDS

Prior to the time of material submission for Approval, the generating set including its major components shall have proven record of reliability in local application for a minimum continuous period of 12 months to the satisfaction of the Contract Manager.

ELE29.2 OUTPUT AND RATING

ELE29.2.010.9 OUTPUT

The generating set shall be of 380V, 50Hz, 3 phase, 4 wire output.

ELE29.2.020.9 ACCURACY OF OUTPUT

Unless otherwise specified, the generating set shall comply with the operating limits of performance class G3 in accordance with ISO 8528-5.

ELE29.2.030.9 RATING

1. The generating set shall have a prime power rating sufficient to satisfy both the steady and transient states of the electrical loads detailed in this Specification and Drawings. The power output shall be rated as prime power in accordance with ISO8528-1 and the permissible average power output during a 24 hour period shall not exceed 70% of the prime power unless otherwise agreed by the engine manufacturer;
2. The generating set shall be capable of meeting the basic electrical load requirements and also the starting kVA and starting kW as shown on the drawings. The Sub-contractor shall verify the actual amount of electrical loads connected to the generating set and prove that the generating set selected can satisfy this specification under both starting and steady conditions for such connected loads;
3. Power rating shall be net, excluding all accessories and shall be taken as at ambient temperature 40ºC and at sea-level;
4. The Sub-contractor shall supply, install and commission a generating set of rating, 0.8 power factor lagging, not less than the minimum rating as specified in the drawings taking into account all de-rating factors as recommended by the generator manufacturer;
5. A sign made of at least 1.5 mm thick stainless steel plate shall be provided for each generator set and affixed in a prominent position inside the emergency generator room and main switch room to indicate the essential loading of fire service installations and fireman's lift(s) connected to the generator. The English and Chinese characters of the sign shall be at least 8 mm and 15 mm high respectively and the details are as follows:

EMERGENCY GENERATOR
應急發電機
LOADING OF FIRE SERVICE INSTALLATIONS AND FIREMAN'S LIFT(S)
消防裝置及消防升降機負荷
XXXX kVA/XXXX kW
WARNING: DO NOT OVERLOAD THE GENERATOR
警告：切勿引致發電機過量負荷

ELE29.2.040.9 TIMING OF LOADS APPLICATION

1. The generating set shall be designed for cold starting and be capable of supplying power for the full rated essential load in not more than 15 seconds from initiation of the starting procedure;
2. Unless otherwise specified, all essential loads other than non-fireman's lifts, will be started simultaneously. After an adjustable period up to 45 seconds, the non-fireman's lifts will be started sequentially to travel to the ground floor one at a time before the next non-fireman's lift is started and remains stationary.

ELE29.2.050.9 EXCESSIVE REGENERATIVE POWER AND NON-LINEAR LOADS

1. There will be high current harmonics from the variable voltage variable frequency controlled lift motors, light fittings with electronic ballasts, pump motors with soft starters, etc. and precautions shall be taken in the design of the generating set to guard against any adverse effects so caused;
2. The Sub-contractor shall provide appropriate dummy loads to absorb excessive regenerative power from the lifts as detailed on drawings, if necessary.

ELE29.3 DESIGN

ELE29.3.010.9 MANUFACTURER'S RECOMMENDATIONS

The complete installation shall be in accordance with the manufacturer's recommendation and to the satisfaction of the Contract Manager. Any design deviating from the manufacturer's recommendation shall be verified by the manufacture before being submitted to the Contract Manager for approval.

ELE29.3.020.9 SAFETY

All moving parts and bare exhaust manifolds and pipes shall be properly and completely guarded and/or insulated in accordance with the relevant International Standards and local regulations. The guards shall be of such design that will guard against the serviceman from coming into contact with any part which is likely to cause injury to personnel. All guards shall be detachable.

ELE29.3.030.9 SPACE FOR MAINTENANCE

Adequate space (not less than 600 mm) all round the set shall be provided for maintenance and cleaning.

ELE29.3.040.9 VENTILATION

Ventilation to the Approval of the Director of Fire Services shall be provided for both combustion and cooling air. If fans are necessary to provide this air they shall be provided by the Sub-contractor and shall operate at all times while the generator set is running.

ELE29.3.050.9 AIR SUPPLY AND DISCHARGE

The air supply and discharge shall be direct to outside air without any possible obstructions, i.e. no fire, smoke or regulating dampers shall be fitted, and shall not cause a public nuisance. However, silencers shall be provided at the air inlet and outlet apertures of the generator room as shown on the Drawings. Added pressure loss constituted by the silencers shall be kept to a minimum, and shall not affect the proper operation of the generator set.

ELE29.3.060.9 EXHAUST SYSTEM

Exhaust of combustion products shall be discharged through the exhaust system to the location as shown on the Drawings. The Sub-contractor shall ensure that the exhaust system meets the relevant requirements of the Air Pollution Control Ordinance. The Sub-contractor shall also ensure and verify, to the satisfaction of the Contract Manager, that the bends and the length of the exhaust pipe will not build up back pressure causing low efficiency and loss of engine power; otherwise, pipe bore will have to be increased.

ELE29.3.070.A EXHAUST AIR PIPES

Exhaust air pipes outside the generator room shall be mounted with stainless steel brackets. Should the exhaust air pipe be defined as a chimney or a flue per section 44 of the B(C)R, the design and construction of exhaust air pipes shall comply with the requirement of "Fire Safety and Heat Transmission", "Structural Design" and "Construction and Corrosion Protection" specified in PNAP APP-8. Shop drawings showing the details of mounting and fixing of cladding shall be submitted for Approval prior to material ordering and fabrication. Adequate fall and drain point shall be provided for the exhaust pipe so that no water can enter into the engine through the exhaust outlet. The exhaust pipe outlet shall also be fitted with a stainless steel wire mesh to prevent ingress of birds or debris.

ELE29.4 ENGINE

ELE29.4.010.9 TYPE AND DESIGN

The engine shall be a four stroke, multi-cylinder, direct injection, naturally aspirated or turbo-charged, water-cooled diesel engine and shall be of industrial type complying with ISO 8528-2. The shaft speed shall not exceed 25rev/s. The fuel used shall be diesel fuel complying with EPD's requirement. The engine shall be designed to comply with the Air Pollution Control Regulations such that the emissions there from will not create an air pollutant nuisance.

ELE29.4.020.9 COOLING SYSTEM

The engine cooling system shall comprise a set-mounted radiator with engine or electric driven cooling fan, water circulating pump, water temperature regulating device, etc., and in addition to the operating conditions specified in ELE29.1.070, shall be suitable for operating at ambient temperatures up to 50°C.

ELE29.4.030.9 SPEED GOVERNOR

The engine speed governor shall provide governing in accordance with the relevant requirements for Performance Class G2 of ISO 8528-2.

ELE29.4.040.9 FILTERS

Filters shall be provided for the fuel oil and lubricating oil systems as well as the air intake and shall be of replacement element.

ELE29.4.050.9 EXHAUST CONNECTORS

The engine exhaust shall be provided with flexible connectors and tubular absorption type silencer.

ELE29.4.060.9 AUTOMATIC SAFETY CUT-OUT DEVICES

Automatic safety cut-out devices shall be provided for engine overspeed, high cooling water temperature and low lubricating oil pressure. An electric fuel stop solenoid valve as well as a manual fuel shut-off valve shall be provided.

ELE29.4.070.9 INSTRUMENT PANEL

An instrument panel, incorporated with lubricating oil pressure and temperature gauges, cooling water temperature gauge, tachometer and individual fault indicating lamps for low lubricating oil pressure, high-cooling water temperature & engine overspeed, shall be provided. Fuel level gauge shall be provided on the panel when the fuel tank is not located in the same room with the generating set. The panel with supporting stand shall be floor mounted on plinth adjacent to the generating set and properly isolated from vibration.

ELE29.4.080.9 STARTER UNIT

The engine shall be equipped with a D.C. electric starter motor, fly-wheel, flexible couplings, etc. to form a complete working unit.

ELE29.5 ALTERNATOR

ELE29.5.010.9 TYPE

The alternator shall be of salient pole, self-exciting, self-regulating, brushless type and shall comply with ISO 8528-3. The alternator shall be of basic continuous rating (BR) based on duty type S1 according to IEC 60034-1.

ELE29.5.020.9 PROTECTION

The alternator shall be screen protected and drip proof in accordance with IEC 60034-5 to degree IP21. Anti-condensation heaters of 220V shall be provided, connected to the mains, and shall be arranged to be switched off when the alternator is in operation. All exposed moving parts shall be provided with protection screens.

ELE29.5.030.9 INSULATION SYSTEM

The insulation system shall be IEC 60085 Class F or Class H.

ELE29.5.040.9 TERMINAL BOX

A terminal box of sufficient size shall be provided for cabling.

ELE29.5.050.9 RADIO INTERFERENCE SUPPRESSION

The alternator shall be fully equipped for radio interference suppression to BS EN 55014-1 or BS EN 55011 or BS EN 61000-6-4.

ELE29.6 BASEFRAME AND FUEL TANK

ELE29.6.010.9 BASEFRAME

The baseframe of the generating set shall be of prefabricated, structural steel type of all welded construction. The baseframe shall be provided with lifting points for transportation.

ELE29.6.020.9 INTEGRAL FUEL TANK

1. Whenever specified, a fuel tank shall be integral within the base frame and shall be complete with filler, vent, drain, feed and return connections, fuel content gauge, flexible fuel lines between tank and engine connections;
2. The capacity of the tank shall be sufficient for sustaining operation of the connected loads for a period of not less than 6 hours but shall have a minimum capacity of 490 litres. If the minimum tank capacity required exceeds 500 litres, the tank shall be installed in a separate fuel tank room in accordance with FSD's requirement.

ELE29.6.025.9 SEPARATE FUEL TANK

1. Unless otherwise specified, a separate fuel tank shall be installed inside the standby generator room and shall complete with cover, drip tray, fuel hand pump, fuel content gauge, vent pipe, control valves, fuel supply and return pipes between the tank and engine connections, etc.;
2. The capacity of the tank shall be sufficient for sustaining operation of the connected loads for a period of not less than 6 hours but shall have a minimum capacity of 490 litres. If the minimum tank capacity required exceeds 500 litres, the tank shall be installed in a separate fuel tank room in accordance with FSD's requirement;
3. A Surveyor's Report shall be submitted to certify that the fuel tank has been properly constructed, installed and tested and the fuel tank is in sound condition and is suitable for the storage of fuel oil without any leakage;
4. The tank shall be fabricated from mild steel plates welded on to a mild steel frame. Mild steel flat bars shall be welded on the inside of the tank to stiffen the tank when required;
5. All parts of the exterior surfaces of the tank shall be thoroughly cleaned to remove all rust, mill scale, grease and other foreign matters to achieve a bright, rust free and dry surface and then painted with one cost of zinc rich primer, one coat of epoxy based under coat and two finishing coats of approved paint. The interior surface of the tank shall be thoroughly dried out and applied with a thick coat of linseed oil to prevent rusting;
6. A semi-rotary double acting hand pump shall be provided for the fuel tank and consist of 25 mm diameter inlet, outlet and flexible oil resistant inlet pipe of adequate length to suit Site condition;
7. The Sub-contractor shall submit shop drawings showing all installation details of the fuel tank, pipe routing and associated builder’s works for approval before commencement of works.

ELE29.6.030.9 FUEL LEVEL SWITCH

The fuel tank shall be fitted with two stages fuel level switches to alert the caretaker when the remaining fuel capacity falls to a level adequate for 7.5 hours and 6.5 hours continuous running of the fire services equipment. In addition, if non-fire services equipment is connected to the generator power supply, the fuel level switches shall also shut down this non-fire services equipment when the remaining fuel capacity falls to a level adequate for 6.5 hours continuous running of the fire services equipment. The fuel level switch shall comply with the following requirements:

For Immersed Type Level Sensor:

1. The fuel level switch shall be suitable for measurement of fuel level in the integral tank;
2. The fuel level switch shall consist of two major components - a fuel level sensor and a switch unit. The fuel level sensing element shall be installed in a tube of stainless steel and places inside the fuel tank. The switch unit shall be mounted on the tank and with the fuel level sensor to form an integral set. The unit shall be housed inside a casing made of cast iron or aluminium alloy and shall be capable of detecting the signal from the sensor and transmitting it to control the on/off operation of the non-fire services equipment supply;
3. The level switch shall be manufactured to IEC 60079 Explosive Atmospheres or BS EN 60079 Explosive Atmospheres;
4. The level switch shall be at least of Group IIA and Temperature Class T1 in accordance with IEC 60079-0 or BS EN 60079-0;
5. The electrical components of the level switch installed in the vapour space above fuel and inside the fuel tank shall be of the type of protection of Ex ia which is suitable for installation in Zone 0 Hazardous Area as classified in IEC 60079-10-1 or BS EN 60079-10-1;
6. The electrical components of the level switch installed outside of the fuel tank shall be of the type of protection of Ex ib or Ex d which are all suitable for installation in Zone 1 Hazardous Area;
7. A copy of certificate to prove the apparatus rating shall be submitted for checking;

For Ultrasonic Type Level Sensor:

8. The fuel level switch shall consist of two major components - a fuel level sensor and a control unit;
9. The level sensor shall have non-contacting liquid level transmitter utilising ultrasonic pulses technology for measurement and suitable for the application of fuel tank;
10. The control unit shall connect with the fuel level sensor and contain a digital display showing fuel level information and system alarms. The control unit shall be equipped with output relays for external interface to control the on/off operation of the non-fire services equipment supply. The control unit shall be housed inside the control cubicle as stipulated in ELE29.10;
11. The fuel level switch shall be manufactured to IEC 60079 Explosive Atmospheres or BS EN 60079 Explosive Atmospheres;
12. The fuel level sensor shall be at least of Group IIA and Temperature Class T1 in accordance with IEC 60079-0 or BS EN 60079-0;
13. The electrical components of the fuel level switch installed in the vapour space above fuel and inside the fuel tank shall be of the type of protection of Ex ia which is suitable for installation in Zone 0 Hazardous Area as classified in IEC 60079-10-1 or BS EN 60079-10-1;

14. A copy of certificate to prove the apparatus rating shall be submitted for checking.

ELE29.6.040.9 CONTROL REQUIREMENT

The fuel level switches and the associated control shall be capable to control on/off operation of the non–fire services equipment supply as shown on Drawings. When the remaining fuel capacity falls, at or below a level adequate for 7.5 hours continuous running of the fire services equipment, the alarm connecting to the FS alarm panel shall be activated. When the remaining fuel capacity further falls, at or below a level adequate for 6.5 hours continuous running of the fire services equipment, the corresponding alarm connecting to the FS alarm panel shall also be activated and a signal shall be provided to trip the non-fire services equipment if connected to generator power supply, automatically.

ELE29.6.050.9 VERIFICATION OF FUEL LEVEL SETTINGS

1. A test report shall be submitted to substantiate that the fuel capacity inside the fuel tank according to each level settings as mentioned in ELE29.6.040 are accurately shown on the fuel level sensor;
2. The accuracy of the fuel level settings shall be demonstrated to FSD's officer during FSD's inspection;
3. For demonstration in sub-clause 2, the integral fuel tank shall be emptied for refilling in the presence of the FSD's officers to demonstrate the readings of the fuel level sensors be consistent with various settings and the capacity of fuel inside.

ELE29.7 STARTING SYSTEM

ELE29.7.010.9 SPECIFICATION

Engine starting shall be electric. The starting system shall be of 12V or 24V and shall comprise batteries, charger, contactors, wiring, etc.

ELE29.7.015.9 TYPE OF BATTERIES

The batteries shall be of nickel-cadmium type with plastic cases complied with IEC 60623. The batteries shall be suitable for engine starting application.

ELE29.7.020.9 MOUNTING OF BATTERIES

The batteries shall be mounted on a hardwood floor stand adjacent to the starter motor. A double pole D.C. battery switch shall be provided between the batteries and the starter. When the switch is turned to 'open' positing, the "auto-starting of generator disabled" alarm, as stated in Clause ELE29.12.020, shall be activated.

ELE29.7.030.9 CAPACITY OF BATTERIES

The batteries shall have sufficient capacity for 4 operations of engine cranking each 15 seconds duration with 5 seconds intervals between each operation without permanent damage nor reduction in the rated life.

ELE29.7.040.9 BATTERY CHARGER

The battery charger shall be of trickle/boost type and shall be connected to the essential power supply socket/connection unit located at the generator room. The battery charger shall have sufficient capacity to maintain the batteries in fully charged condition at all times. The charger shall be capable of automatically recharging the discharged batteries to 75% of its rated capacity within 6 hours. Current limiting device shall be provided to limit the charging current as recommended by the battery manufacturer.

ELE29.8 ENGINE EXHAUST SYSTEM

ELE29.8.010.9 SCOPE OF SYSTEM

The engine exhaust system comprising silencers, flexible connectors, rain hoods, expansion joints, hangers, pipes & accessories etc., shall be provided as shown on the Drawings.

ELE29.8.020.A EXHAUST AIR PIPES

1. Exhaust air pipes shall be black steel pipes to BS EN 10255 medium grade for pipe diameters up to and including 150 mm, or comply to BS EN 10216 or BS EN 10217 for larger pipe diameters and jointed by welding. Pipes shall be adequately supported and provided with flexible / expansion joints to allow for expansion / contraction and for vibration isolation;
2. Should the exhaust air pipe be defined as a chimney or a flue per section 44 of the B(C)R, it shall comply with all requirements in PNAP APP-8, which include but not limited to the following:
    a. Its design and construction including the position where exhaust air pipe terminates shall comply with the fire safety requirements set out in section 44(2) to (4) of the B(C)R;
    b. The structural design for installation and material of exhaust air pipes shall be in accordance with the Code of Practice for the Structural Use of Steel 2011 (Steel Code). Calculation and justification certified by a Registered Structural Engineer or an equivalent competent personal shall be submitted to CM for checking;
    c. For construction and corrosion protection of exhaust air pipes, the relevant parts of the Steel Code, BS EN 1856-1:2009 and BS 5854:1980 should be followed, and justification certified by a Registered Structural Engineer or an equivalent competent personal which shall be submitted to CM for checking.

ELE29.8.030.9 SIZING OF EXHAUST AIR PIPE

The exhaust pipe shall be sized so that the back pressure created will not exceed the amount recommended by the manufacturer and the output power of the engine will not be derated.

ELE29.8.040.A LAGGING EXHAUST AIR PIPES

1. The exhaust pipes outside the generator room, where exposed, shall be lagged with non-combustible and non-water-absorption type insulating materials complying with BS 476. The lagging shall be protected by a stainless steel cladding of 2 mm thick constructed in sections;
2. The thermal insulation material provided shall have a thickness of not less than 50 mm and maintain the external cladding temperature not exceeding 50ºC. Calculation to substantiate the adequacy of insulation thickness and to verify compliance with the requirement of “Fire Safety and Heat Transmission” specified in PNAP APP-8 shall be submitted to CM for checking;
3. The exhaust pipe in the generator room shall also be properly lagged in order to protect against any harmful thermal effects to personnel in carrying out operation and maintenance. The lagging shall be protected by a stainless steel cladding of 0.8 mm thick constructed in sections;

4. Each section of the cladding shall be removable for replacement of the insulating materials;
5. No flanged joint shall be used and the end product of the cladding shall be of a plain surface stainless steel pole;
6. Asbestos shall not be used for lagging.

ELE29.9 AIR DUCTWORK

ELE29.9.010.9 SCOPE

Air ducts, if required, shall be provided to connect the radiator to the metal louvre provided by others at the generator room as shown on the Drawings.

ELE29.9.020.9 CONSTRUCTION

Air ducts shall be constructed of 1 mm thick galvanised mild steel sheets and shall be adequately sized to deliver the required cooling air through the radiator.

ELE29.9.030.9 SUPPORTS

Air ducts shall be adequately supported and provided with connection flanges and flexible connections for vibration isolation.

ELE29.9.040.9 SILENCERS

Silencers shall be provided to attenuate the noise from the generating set through the intake and exhaust air louvers. The silencer shall consist of an outer casing fabricated from galvanised steel sheet not less than 1.6 mm thick and a number of splitters made from 0.8 mm perforated galvanised steel sheets which divide the silencer into separate longitudinal airways. All acoustic infill materials shall be inert, non-combustible, vermin proof, non-hygroscopic, wrapped in an acoustically transparent polyester membrane and sealed with polyester sealant to the approval of FSD.

ELE29.10 CONTROL CUBICLE

ELE29.10.010.9 CONSTRUCTION

1. The control cubicle shall be constructed of sheet steel not less than 2 mm thick;
2. The cubicle shall preferably be floor mounted;
3. If set mounted, the cubicle shall be effectively isolated from vibration to prevent damage;
4. Gaskets shall be fitted on doors and removable covers and shall be continuous without joints around corners;
5. The cubicle shall be treated with an Approved rust inhibitive priming coat and then two stoved finish coats of gloss paint of an Approved colour.

ELE29.10.020.9 PROTECTION DEVICES

The cubicle shall contain programmable controller (if provided), delay timers, indicators, etc. necessary fulfil the operation requirements as stipulated in ELE29.11. The dry contacts for detection of main supply voltage should be obtained from the main switchboard cubicle and the lift supply switchboard respectively. The automatic voltage regulator unit shall be contained within the generator set.

ELE29.10.030.9 FRONT PANEL

The following shall be provided on the front panel of the control cubicle unless prior Approval has been obtained for some instruments/indicators to be located on the instrument panel in ELE29.4.070:

1. Hour run meter;
2. Auto/off/manual selector switch;
3. "Start" & "Stop" push buttons for manual operation;
4. Battery charger ammeter and voltmeter;
5. "Mains On" indicating lamps - 3 phase;
6. "Generator On" indicating lamps - 3 phase;
7. "Engine Fault" indicating lamp & audible alarm;
8. "Fail to Start" indicating lamp & audible alarm;
9. "Auto Starting of Generator Disabled" indicating lamp & audible alarm;
10. "Fuel level at or below 7.5 hours operation of fire services equipment" indicating lamp & audible alarm;
11. Either (a) or (b) of the following:
    a. "Fuel level at or below 6.5 hours operation of fire services equipment and non–fire services equipment supply tripped" indicating lamp & audible alarm (applicable for non-fire services equipment connected to generator power supply as approved by FSD); or
    b. "Fuel level at or below 6.5 hours operation of fire services equipment" indicating lamp & audible alarm.
12. Reset push button;
13. "Simulate mains failure" key switch;

14. Lamp Test Button;
15. Fuel level display of fuel level control unit (for ultrasonic type fuel level switch only).

ELE29.10.040.9 ALARMS

Remote visible & audible alarms shall also be provided as shown on the Drawings

ELE29.10.050.9 ANTI-CONDENSATION HEATERS

The control cubicle shall be provided with thermostat controlled anti-condensation heaters, connected to the mains.

ELE29.10.060.9 CONTROLLER

Programmable controller if provided in the control cubicle to control the automatic start and stop of the engine shall comply with the following requirements:

1. The controller shall have local job reference and shall operate satisfactorily for at least 12 months;
2. Details of the controller including operation instruction, software for programming and the data set in the controller, etc. shall be included in the O&M manual and soft copy of programme together with data loaded in the controller shall be submitted upon project completion;
3. One set of all necessary computer interfacing connection cable & associated accessories shall be provided;
4. Training on data entry and configuration of a new controller suitable for replacement shall be provided to the maintenance staff before expiry of the defects liability period. A video in DVD disc showing the details shall be submitted upon completion of the training.

ELE29.11 OPERATION

ELE29.11.010.9 GENERAL

The operation of the generating set shall be fully automatic and shall comply with the requirements stipulated in the F.S. Code of Practice. Manual start/ testing facilities shall be provided.

ELE29.11.020.9 WORK BY OTHERS

One pair of normally open dry contacts will be provided by others at the location as shown on the Drawings for the purpose of giving a signal to override all automatic shut down features on fault.

ELE29.11.030.9 APPROVAL OF CONTROL CIRCUIT

The control circuit shall be submitted for Approval.

ELE29.11.040.9 PURPOSE

The generator set shall be provided as the standby supply for the essential loads of the building as shown on the Drawings.

ELE29.11.050.9 PROVISIONS OF OPERATION

The essential loads shall normally be fed from the mains supply and be switched automatically to the generating set through a changeover contactor in accordance with the following provisions:

1. A mains sensing device shall be provided to detect condition of the mains supply at the mains supply incoming terminals of the changeover switch, located in the main cubicle switchboard and at other location as shown drawings;
2. When failure of one or more phases of the mains supply or a reduction of voltage to less than 70% of normal is detected, a timing device having an adjustable setting from 0.5 to 2.0 seconds shall be initiated;
3. If the mains failure persists for the pre-set period, the generator set starting sequence shall be initiated automatically;
4. Within 15 seconds from the commencement of the starting sequence, the set shall be stabilised at its rated speed and full load transfer shall take place automatically;
5. Should the generating set fail to start after a period of 15 seconds, the sequence shall be interrupted for a period of 5 seconds and a further attempt to start, of 15 seconds duration, shall then be made. If it again fails to start, the starting sequence shall be locked out, an audio visual alarm given as described in ELE29.12 and it shall remain in this locked out condition until manually reset;
6. If the mains supply is restored during the starting period, the starting sequence shall not be interrupted but the operation of load transfer shall be prevented. After starting, the set shall continue to run on no-load for an adjustable period of 0 - 15 minutes and then stop if no further mains failure;
7. Subsequent failure of the mains supply while the set is running on no-load under provision (6) above shall, after expiration of the 0.5 - 1.0 second delay, cause load transfer to take place;

8. On restoration of the mains supply the set will continue to run and supply essential loads for an adjustable period of 0 - 10 minutes. Thereafter automatic transfer of essential load to mains supply shall take place as soon as the adjusted period has expired;

9. At the end of the adjustable period in provision (8) above the set shall continue to run on no-load for an adjustable period of 0 - 30 minutes;

10. If the mains supply fails again during the adjustable period specified in provision (8) above the control timer setting of the adjustable period (0 - 10 minutes) shall be cancelled in order to prevent the sequence of load transfer. When the mains power is restored again, the operating sequence will start again from sub-clause (8) above;

11. If the mains fails again during the adjustable period specified in provision (9) above the essential loads shall be connected automatically back to the set and the operating sequence will continue as if the connection had been made in the manner as described in provision (7) above;

12. In order to give a signal for lift control, the Sub-contractor shall provide one pair of normally open voltage free contacts terminated inside an adaptable box in each lift machine room. The contacts shall be closed upon load transfer to the generating set.

ELE29.11.060.9 REMOTE SHUT-OFF VALVE

1. A remote shut-off valve shall be installed in the supply pipe linking the fuel tank to the engine. The actuation of such a valve shall also actuate the audio and visual alarm outside the generator room and the 'auto starting of generator disabled' alarm as stated in ELE29.12.020;

2. The pull handle of the remote shut-off valve shall be housed inside a breakglass unit installed at the entrance of the generator room;

3. An operation instruction notice, made of white plastic material engraved with the the following wordings in English and Chinese characters of at least 5 mm high in red colour, shall be provided and affixed adjacent to the breakglass unit.

GENERATING SET EMERGENCY STOP SWITCH

IN CASE OF EMERGENCY

BREAK GLASS AND
PULL HANDLE TO FULL EXTENT

發電機停機掣

如須要緊急停機
打碎玻璃並盡拉此手掣

ELE29.12 AUDIO AND VISUAL ALARMS

ELE29.12.010.9 ENGINE OVERSPEED PROTECTION

1. In the event of a fault arising from engine overspeed, high water temperature or low oil pressure, the set shall initiate a 2-stage engine protective device;
2. The first stage shall be arranged to initiate both audio and visual alarm at the control cubicle and also at the remote indicator above the door outside the generator room as shown on the Drawings;
3. The audio alarm shall be cancelled by an acknowledge push button. The second stage shall be arranged to shut down the engine;
4. The setting of the two stages, for each system being monitored, shall be as specified by the manufacturer.

ELE29.12.020.9 STARTING FAILURE PROTECTION

1. However, for failure of starting under the condition as stated in ELE29.11.050 (5), the local and remote audio and visual alarms shall initiate immediately at the control cubicle and the remote indicator above the door outside the generator room. The indicator shall be of colour RED;
2. In addition, remote audio and visual alarms above the door outside the generator room to indicate "generating set supply disabled" by the following shall be provided:
    a. Pressing of the emergency stop switch of the generating set;
    b. Tripping of the main MCCB/ACB or any outgoing MCCBs of the switchboard cubicle inside the generator room;
    c. Switching off of the main MCCB/ACB or any outgoing MCCBs of the switchboard cubicle inside the generator room;
    d. Turning the "manual/auto" switch to "manual" or "off" position;
    e. Switching off of the battery supply switch;
    f. Actuation of remote shut-off valve.
3. The indicator shall be of colour RED.

ELE29.12.030.9 VOLTAGE FREE CONTACTS FOR FIRE CONTROL MAIN PANEL

The following pairs of voltage-free contacts, terminated inside a surface mounted box next to the Fire Control Main Panel, shall be provided from the Generator Room via concealed conduit system:

1. A pair of normally close dry contacts which shall be opened only when the generating set is running;
2. A pair of normally close dry contacts which shall be opened only when the generating set fails to start;
3. A pair of normally close dry contacts which shall be opened when the generating set supply is disabled under conditions as stated in ELE29.12.020 (2);
4. A pair of normally close dry contacts which shall be opened when the generating set is on fault;
5. A pair of normally close dry contacts which shall be opened when the generating set having fuel level at or below 7.5 hours operation of fire services equipment;
6. Either (a) or (b) of the following:

a. A pair of normally close dry contacts which shall be opened when the generating set having fuel level at or below 6.5 hours operation of fire services equipment and non-fire services equipment tripped (applicable for non-fire services equipment connected to generator power supply as approved by FSD); or

b. A pair of normally close dry contacts which shall be opened when the generating set having fuel level at or below 6.5 hours operation of fire services equipment.

ELE29.12.035.9 VOLTAGE FREE CONTACTS FOR LIFT CONTROL PANEL

The following pair of voltage-free contacts, terminated inside a surface mounted box near one of Lift Control Panels inside Lift Machine Room, shall be provided from the Generator Room via fire resistant cables in concealed conduit system to facilitate the subsequent control mechanism by Lift Sub-contractor for the activation of lift homing upon absence of normal power supply:

1. A pair of normally open dry contacts which shall be closed only when the generator supply is available based on both conditions as stated below are fulfilled

   a. The generating set is running; and

   b. The contactor or circuit breaker of essential power supply of lift cubicle switchboard is closed.

ELE29.12.040.9 OPERATION

Whenever the generating set is started, an audio and visual alarm, at the control cubicle and at the remote indicator above the door outside the generator room, shall be actuated and shall remain in operation until reset manually. The indicator light shall be of colour AMBER. The voltage-free contacts next to the Fire Control Main Panel, as mentioned in ELE29.12.030, shall be actuated to indicate that the generating set is running.

ELE29.12.050.9 TYPE OF INDICATOR LIGHTS AND METAL ENCLOSURE

The above remote indicator shall be mounted on a Grade 304 stainless steel enclosure with a thickness of not less than 1.2 mm and installed outside the generator room. The indicator lights shall be of flashing type.

ELE29.13 INSTALLATION

ELE29.13.010.9 COMPLIANCE WITH INSTRUCTIONS

The generating set shall be installed in accordance with the instructions of the manufacturer.

ELE29.13.020.9 SUBMISSION FOR APPROVAL

Details of the installation shall be submitted for Approval.

ELE29.13.030.9 VIBRATION ISOLATION

1. Suitable vibration isolators shall be provided to prevent the transmission of vibration to the building structure;
2. The completed installation, when in operation, shall not cause any noticeable or objectionable vibration to any part of the building structure or unacceptable level of structure-borne noise in accordance with the Noise Control Ordinance;
3. In the event that undue vibration or excessive structure-borne noise occurs, the Sub-contractor shall rectify the installation or replace the equipment as necessary at his own expense to the satisfaction of the Contract Manager.

ELE29.13.040.9 PAINTING

1. All exposed ferrous metal surfaces of the generating set, pipes and accessories, air ducts, etc. shall, where applicable, be treated with a primer coat of rust resistant paint, followed by two coats of high gloss enamel;
2. Painting of the generating set shall be done at the place of manufacture, before despatch;
3. Touching up, when required on site, shall be carried out to the satisfaction of the Contract Manager.

ELE29.14 ELECTRICAL WORK

ELE29.14.010.9 GENERAL

1. All electrical work shall comply with the relevant sections of this specification;
2. All cables used at the engine shall be heat and oil resisting cables suitable for this purpose;
3. The earthing system & neutral connection for the generating set shall be as shown on the Drawings;
4. All exposed metal work inside the generator room shall be effectively bonded and earthed in accordance with the Electrical CoP;
5. The Sub-contractor shall ensure that the part of the installation which comprises of the essential loads shall be protected in accordance with the Electrical CoP when the installation is fed by the generating set. Protection shall include overcurrent and earth fault as detailed in this Section;
6. The Sub-contractor shall also provide a reverse power sensing device which shall initiate a visual indicator on the control panel and actuate the connection of the dummy load if the reverse power exceeds the regenerative power absorption limit of the generating set.

ELE29.14.020.9 OVERCURRENT PROTECTION

1. The rating and the tripping characteristics of the air circuit-breaker/MCCB in the switchboard cubicle shall be coordinated with the characteristics of the generating set to provide proper protection of the generating set and its associated power cables;
2. The Sub-contractor shall ensure, and verify to the satisfaction of the Contract Manager, that the essential loads, when fed by the generator, are also protected against short circuit in accordance with the Electrical CoP under that particular fault level of the generating set.

ELE29.14.030.9 EARTH FAULT PROTECTION

1. The Sub-contractor shall supply and install an earthing system independent of any other earthing system for the neutral connection and earthing of the generator;
2. The Sub-contractor shall ensure that the generating set installation is solidly and effectively earthed in accordance with the Electrical CoP, and BS 7430;
3. When the plant is subject to vibration, or where circumstances necessitate, the earthing connections shall be made of flexible copper conductor having a green-and-yellow PVC sheath;
4. Earth fault protection shall be provided at the switchboard cubicle inside the generator room to disconnect the supply from the generator to the connected installation within 5 seconds when earth fault occurs at any part of the connected installation other than the final circuits.

ELE29.14.040.9 INTERFACING WITH SWITCHBOARD CUBICLE

1. The Sub-contractor shall coordinate the interfacing signal required between the generating set control panel and the switchboard cubicles for the control and protection of the generating set;

2. The generator set starting sequence in the event of mains failure shall be initiated from the signals provided from voltage sensing devices used for detection of supply incoming terminals located in the main cubicle switchboard, lift cubicle switchboards and at other location as shown in drawings;
3. For current signals to be connected from the switchboard cubicles, the Sub-contractor shall ensure the current transformers be properly selected with adequate burden and accuracy to suit the requirement of control equipment of the generating set;
4. The signal cables shall be coded with ferrules and clearly shown on the control wiring diagram;
5. The signal cables shall be of 1-core PVC surface mounted. The size of cable shall be provided according to the requirement of the generator control equipment but in any case shall not be less than 1.5 mm^2.

ELE29.15 PROVISION OF TECHNICAL INFORMATION

ELE29.15.010.9 LANGUAGE

All technical information provided shall be in English.

ELE29.15.020.9 SUBMISSIONS FOR APPROVAL

Within six weeks from the date of acceptance of tender the Sub-contractor shall forward the following drawings etc. for all items of work to the Contract Manager for approval:

1. Confirmation by the manufacturer that the size of the generating set offered satisfies the specified loads, with relevant supporting document for verification;
2. A general arrangement drawing of the generating set and controls with leading dimensions, weights, foundation details, oil and water drains, air intake and exhaust arrangement, etc.;
3. Complete schematic and wiring diagrams of the electrical systems;
4. One set of instruction manuals which shall cover the following aspects:
    a. Data Sheet which shall include the basic technical data appertaining to the engine, alternator, battery, etc.;
    b. Description which shall give a brief description of the equipment supplied including instrumentation, lifting arrangement, operation of control circuitry, etc.;
    c. Installation which shall state the basic principles to be observed when installing the plant;
    d. Commissioning;
    e. Operating Instructions which shall cover starting, stopping, protective circuits, automatic controls, battery charging, etc. method of adjustment, safety precaution requirements and performance parameters including the relevant nominal values and acceptable limits, etc. shall be detailed;
    f. Maintenance Instructions, which shall include the schedules for maintenance and the maintenance procedures for servicing, major overhaul and corrective maintenance. This section shall also give the guidance with respect to selection of fuel oil, lubricating oil, use of water treatment additives and anti-freeze as necessary;
    g. Fault finding guidance;
    h. Spares ordering information which shall give details of each item of plant and ancillaries including the name and address of the manufacturer and type and model serial number, etc..

ELE29.15.030.9 ADDITIONAL COPIES

Subject to the Approval of the above information submitted, the Sub-contractor shall supply the Contract Manager with a further three sets of all the information required above except item in ELE29.13, bound in durable hard covers.

ELE29.15.040.9 PRE SHIPMENT TEST EVIDENCE

The Sub-contractor shall submit, in triplicate, before shipment, test certificates for all plant, equipment and major components of the generating set.

ELE29.15.060.9 DISPLAY OF INSTRUCTIONS AND SCHEMATIC WIRING DIAGRAM

1. Detailed instructions for operation, manual testing and shut down of the generating set and the schematic wiring diagram shall be clearly displayed in a separate anodised aluminium frame with transparent plastic front plate of 3 mm minimum thickness and wooden backing board of 5 mm minimum thickness adjacent to the control panel in each generator room;

2. A warning sign shall be provided with a prominent red notice on white ground, of durable material, with a size of not less than 300 x 300 mm inscribed in English and Chinese characters as follows:

DANGER 危險
THIS GENERATING SET IS AUTOMATICALLY CONTROLLED AND MAY START WITHOUT WARNING
此發電機組乃自動操作並會隨時起動

Lettering shall be at least 25 mm high. The notice shall be displayed adjacent to each generating set.

ELE29.16 ACCEPTANCE TESTING AND COMMISSIONING

ELE29.16.010.9 TESTING STANDARDS

1. The generating set shall be tested and maintained in accordance with this Section, the F.S. Code of Practice, the relevant F.S.D. circular letters and the standard forms for commissioning tests and routine monthly tests prepared by the Housing Department;
2. The engine shall be tested in accordance with ISO 3046-1, ISO 3046-3 and ISO 15550 and the alternator shall be tested in accordance with IEC 60034-1 and IEC 60034-2-1. The test report shall consist of measurements in ISO 15550 Table 6 - List A, items A1 – barometric pressure, humidity and ambient temperature, A2 – engine speed or cycle frequency & A5 – fuel consumption only and in Table 7 - List B – brake power and specific fuel consumption and IEC 60034-1 – basic tests or routine check tests. The results of earlier basic tests on a similar machine shall be provided to the satisfaction of Contract Manager upon request.

ELE29.16.020.9 FACTORY TESTING

1. The assembled generating set shall be conducted with a factory acceptance test (FAT) at the place of manufacture according to the acceptance test requirement of ISO 8528-6, before despatch. The tests shall also comprise insulation resistance tests, starting load acceptance capability test, voltage dip test, starting system test, fuel consumption test and full connected load test. Certified records of the above full operation tests and the manufacturers' test reports of engine and alternator at time of delivery to factory for assembly shall be submitted to the Contract Manager before installation of the set;
2. The Sub-contractor shall directly employ an independent Generator Inspection Body (GIB) to witness the FAT at the place of assembling generating set. The GIB shall be one of the following:
    a. an organisation / company listed under Hong Kong Inspection Body Accreditation Scheme (HKIAS) operated by the Hong Kong Accreditation Service (HKAS) or an inspection body recognized by the country where the generator set is assembled and recognized by HKAS under Mutual Recognition Arrangement (MRA); or
    b. an organisation / company listed under Hong Kong Certification Body Accreditation Scheme (HKCAS) operated by the Hong Kong Accreditation Service (HKAS) or an accreditation body recognized by the country where the generator set is assembled and recognized by HKAS under Multilateral Recognition Arrangement (MLA); or
    c. a consultant company listed under the Architectural and Associated Consultants Selection Board's (AACSB) List of Building Services Engineering Consultants.
3. The selected GIB shall appoint a competent person (CP) to witness the FAT. The CP shall possess the following qualifications as minimum:
    a. The CP shall possess not less than 10 years' experience in conducting testing and commissioning for electrical installations;
    b. The CP shall also be a direct employee of the GIB for the past consecutive 6 months at the time of witness; and

c. The proof of qualifications of the CP together with evidences to support the compliance with this clause shall be submitted to CM's approval. The Sub-contractor shall obtain CM's approval for the proposed GIB and CP before conducting the FAT.

4. The GIB shall witness every FAT of all the generator sets supplied under the Sub-contract. The generator manufacturer shall prepare and submit the test report to the CM for approval;

5. The GIB shall ensure every single test result of the FAT, including those in failed attempts, be properly and accurately recorded in the FAT test report prepared by the generator manufacturer. The GIB, upon completion of the FAT, shall sign on each item of the test report as a witness. The completed test report shall be submitted to the CM before dispatch of generator set from factory;

6. The Sub-contractor and the generating set manufacturer shall declare no conflict of interest with the GIB and the CP;

7. The Sub-contractor shall bear all costs and expenses including transportation, accommodation, etc. in relation to the appointment of the GIB and the CP;

8. The Sub-contractor shall seek CM's approval if there is any subsequent change of the GIB or the CP during the course of services.

ELE29.16.030.9 SCOPE OF TESTING

When the installation is completed, commissioning of the installation and performance tests shall be carried out for all equipment's and systems at site and witnessed by an authorised representative of the Contract Manager. The on-site tests shall include insulation resistance test, electrical circuit protection test, control function test, load acceptance capability test, dummy load test, on-load test, noise & vibration test and phase sequence test.

ELE29.16.040.9 TESTING OPERATIONS

The acceptance testing shall include the satisfactory operation of the following:

1. The normal supply shall be switched off in order to start the generating set;

2. When the generating set is ready to accept the Fire Services Installation load, each fire service installation shall be switched on until all installations are in operating conditions. A "simultaneous running" test shall then take place and shall last for a continuous period of one hour;

3. After one hour of testing the generating set shall be examined and all instruments, safety devices, etc. shall indicate "normal" running of the generator;

4. Noise measurement shall be made during the test to ascertain that the noise level emitted during the period of generator operation shall not exceed the limits imposed by Environmental Protection Department and in accordance with the Noise Control Ordinance.

ELE29.16.050.9 LABOUR AND MATERIALS

The Sub-contractor shall provide all labour, apparatus, instruments, tools, fuel, water, lubricants, cable connections etc. required for the testing and commissioning and shall fill up the fuel tank after testing to ensure that the set is in proper order prior to the handover of the installation to the Contract Manager.

ELE29.16.060.9 ACCURACY OF INSTRUMENTS

1. All instruments required for testing of the installation shall be supplied by the Sub-contractor;

2. The instruments used shall be of accurate type and calibrated;
3. The Sub-contractor may be required to produce calibration records and to verify the declared accuracy;
4. The Contract Manager may reject any instrument which, in his opinion, is not suitable for the test and the Sub-contractor shall replace the instruments when required.

ELE29.17 MAINTENANCE AND FINAL TESTING

ELE29.17.010.9 ROUTINE MAINTENANCE

Routine maintenance work shall include:

1. Regular monthly visits to inspect, clean, lubricate and necessary adjustments to maintain optimum operating conditions;
2. All repairs and replacements necessary to maintain optimum operating conditions;
3. Immediate answering of all emergency calls both during and out of working hours, and attendance at site within one (1) hours after receiving emergency calls from any place other than the outlying islands (Note: With the opening of the North Lantau Expressway, Lantau Island is not considered as an Outlying Island if it can be accessed by vehicle.) and within two (2) hours from receipt of such calls from outlying islands;
4. Recording all site attendances, on arrival and departure, whether regular service visit or emergency breakdown call, together with details of the work carried out, in the Emergency Generator record book held at the estate office. Note comments inserted in the record book and take suitable action accordingly;
5. On-load testing all sets once monthly for a period of not less than 30 minutes as below:
    a. Coordinate with the Building Management in advance and take every necessary step to ensure the testing can be carried out effectively with minimum disturbance to the tenants;
    b. Obtain necessary keys such as those of the generator rooms, switch rooms, and lift machine room, etc. from the estate office and have them returned after use;
    c. Before changing over the essential load to the generating set supply, discharge all passengers from all lifts including the fireman's lifts. During the changing over operation, ensure that no passenger is using any of the lifts. However, such lifts shall be in normal operation during the on-load testing of generating set;
    d. Simulate the normal supply failure by switching off the normal supply switches at the upstream of the changeover contactors of the essential supply at the main switch cubicle and of the fireman's lift supply inside the lift machine room. The generating set shall be automatically started up to supply the essential load of fireman's lifts and essential lighting and power. After testing, the electrical system shall be switched back to normal condition.
6. During this on-load testing period, all operating conditions shall be checked and recorded. Following the on-load testing, functional tests shall be carried out on all automatic and manual starting devices and safety controls. The monthly running and functioning tests shall be in accordance with the F.S. Code of Practice;

7. Annual on-load testing shall be performed on all generating set once every 12-months. During the testing, all connected load, including fireman's lifts, essential lighting and power and other fire services installations shall be operated on the generator set supply for a period of not less than 30 minutes. The procedures as stated in (1) to (6) above shall be followed. The Sub-contractor shall coordinate with the Main contractor in advance to arrange annual on-load testing together with F.S. & Water Pump Sub-contractor for on-load running of the fire services installation. The testing shall be in accordance with the requirement as stipulated in the Fire Services COP.

ELE29.17.020.9 MANUFACTURERS RECOMMENDATIONS

1. The Sub-contractor shall also provide the following maintenance as recommended by the manufacturer and to the satisfaction of the Contract Manager:
   a. Necessary maintenance for period longer than one month;
   b. Necessary maintenance on an hour run basis.
2. Fully detailed maintenance and testing instructions shall be provided in a permanent form adjacent to the sets.

ELE29.17.030.9 MAINTENANCE OF BATTERIES

Care and maintenance, if necessary, of any batteries shall be based on the relevant Standard but shall incorporate the manufacturer's specific recommendations for operation under Hong Kong conditions.

ELE29.17.040.9 PROVISION AND COMPLETION OF LOG BOOK

A log book shall be provided, be retained in the generator room and be kept up to date, recording, at the time of occurrence, all operations, faults occurrences and corrective actions taken, routine servicing, maintenance and periodic operation, etc. including dates, times, hour meter readings, worker/supervisors names and signatures, etc. for the set, batteries, compressors, etc.

ELE29.17.050.9 FINAL TESTING

At the end of the Maintenance Period the Sub-contractor shall repeat the tests including the insulation resistance test, electrical circuit protection test, control function test and the annual on-load test to the satisfaction of the Contract Manager.

ELE29.17.060.9 LABOUR AND MATERIALS

The Sub-contractor shall provide all labour, apparatus, instruments, tools, fuel, water, lubricants, fuses, lamps etc., during maintenance and final testing to ensure that the set is in proper order after each operation during the Maintenance Period including filling fuel tanks after each testing.

ELE30 TESTING AND MAINTENANCE

ELE30.1 TESTING 2

ELE30.1.010.9 GENERAL 2
ELE30.1.020.9 INSTRUMENTS 2
ELE30.1.030.9 VISUAL INSPECTION 3
ELE30.1.040.9 TESTING SEQUENCE 3
ELE30.1.045.9 TESTING ARRANGEMENTS 4
ELE30.1.160.9 RECORDING OF TEST RESULTS 4
ELE30.1.170.9 LIGHTNING PROTECTION SYSTEM 4
ELE30.1.180.9 FIRE SERVICE (F.S.) INSTALLATION 4
ELE30.1.190.9 EMERGENCY GENERATOR INSTALLATION 4

ELE30.2 MAINTENANCE 5

ELE30.2.010.9 24-HOUR ON-CALL SERVICE DURING MAINTENANCE PERIOD 5
ELE30.2.020.9 SUB-CONTRACTORS OBLIGATIONS 5
ELE30.2.030.A REPLACEMENT OF DEFECTIVE LED LAMP BULBS / TUBES AND FUSES 5
ELE30.2.040.9 EMERGENCIES 6
ELE30.2.050.9 ELECTRICITY SHUT-DOWN 6
ELE30.2.060.9 PREVENTIVE MAINTENANCE 6
ELE30.2.070.9 REPAIR, CORRECTIVE AND POST-FAULT MAINTENANCE 6
ELE30.2.080.9 FINAL INSPECTION 6

ELE30.1 TESTING

ELE30.1.010.9 GENERAL

1. Inspection and testing shall be carried out on all new installations and alterations to an existing installation in accordance with the requirements of this Section;
2. During the construction stage, the Sub-contractor shall submit test report for conduit continuity test executed prior to concreting of the concealed steel conduit work as specified in the ELE11.3.010;
3. The Sub-contractor shall be responsible for the electrical conductivity testing on samples of aluminium window frames submitted by Main Contractor on Site;
4. The Sub-contractor shall ensure the bonding for extraneous conductive parts is sound and the result complies with the Electrical CoP and BS 7671 by proper measurement with records at good time. For those parts for equipotential bonding system found not electrical conductive, the Main Contractor and the Sub-contractor shall be responsible for rectification of their own works at early as possible;
5. Upon the completion of the sample flats and the sample wing, the Sub-contractor shall carry out the equipotential bonding test to extraneous conductive parts as directed by Contract Manager and to his satisfaction. Test results shall be submitted to the Contract Manager for record purposes;
6. The whole installation shall be tested on completion by the Sub-contractor in compliance with the relevant clauses in this Section. In particular, the earth fault loop impedance shall be tested when the permanent electricity supply is available. The test reports, which shall be verified and endorsed by the Supervising Engineer and registered electrical worker of appropriate grade in accordance with ELE1.8.020, together with the Inspection and Completion Certificates as prescribed in the Electrical CoP for the whole installation shall be submitted to the Contract Manager for Approval before acceptance of the installation;
7. The Sub-contractor shall take account of the accuracy of the instruments when verifying the compliance of the installation. Appropriate safety margin shall be achieved on Site to ensure that the safe and proper functioning of the installation is within the specified safety and performance limits.

ELE30.1.020.9 INSTRUMENTS

1. In addition to PRE.BS1.630 which specifies the provision of a set of measuring instruments for BSPASS and Contract Manager's Representatives' use, which will be under the custody of the CMR, the Sub-contractor shall provide all necessary instruments used for measurement and testing of the installation. The instruments shall be capable of carrying out the measurement and testing with the necessary accuracy. Except for dummy resistive load bank given in sub-clause (1)(r) below, the instruments shall be calibrated with traceability to internationally or nationally recognized standards. Each instrument shall carry an indelible identification and, except where calibration is specified not necessary, be attached with a label showing the due date for calibration. The instruments shall include, but are not limited to, the following:
    a. Low resistance ohmmeter;
    b. Insulation resistance tester;
    c. Earth-fault loop impedance tester;
    d. Earth electrode resistance tester;

e. RCCB tester;

f. Voltmeter;

g. Clamp-on ammeter;

h. Measuring tape;

i. Vernier calliper;

j. Frequency meter;

k. Sound Level Meter;

l. Lux meter;

m. Luminance meter;

n. Equipment for measurement of total harmonic distortion;

o. Multi-function electronic meter for measurement of current, voltage, power factor, kW, kVA, kVAr and KWh;

p. Primary current injection tester;

q. Secondary current injection tester;

r. Phase sequence tester / meter;

s. Dummy resistive load bank;

t. Digital stop watch;

u. Thermometer;

v. Pressure gauge.

2. Upon requested by the Contract Manager, the Sub-contractor shall submit calibration certificates or other evidence of calibration and records of calibration results for inspection. The Contract Manager may reject any instrument(s) which in his opinion are not suitable for the measurement or testing, and the Sub-contractor shall replace them with Approved types immediately when required.

ELE30.1.030.9 VISUAL INSPECTION

A visual inspection should be made to verify the electrical equipment as installed is correctly selected, erected and there is no apparent damage. The visual inspection should include a check on items as stipulated in the Electrical CoP Code 21A.

ELE30.1.040.9 TESTING SEQUENCE

Where relevant, the following items are to be tested preferably in the sequence indicated below:

1. Continuity of protective conductors, including main and supplementary equipotential bonding;
2. Continuity of ring final circuit conductors;
3. Insulation resistance;
4. Polarity;
5. Earth electrode resistance;
6. Earth fault loop impedance;
7. Functions of all protective devices;
8. Functions of all items of equipment.

ELE30.1.045.9 TESTING ARRANGEMENTS

1. The details and arrangements for each of the aforesaid tests shall refer to relevant clauses stipulated in Code 21B of the Electrical CoP;
2. In the event of any test indicating failure to comply, that test and those preceding, the results of which may have been influenced by the fault indicated, shall be repeated after the fault has been rectified.

ELE30.1.160.9 RECORDING OF TEST RESULTS

The test results of electrical work shall be recorded in the format be approved by CM. The test reports, together with Work Completion Certificates shall be certified by registered electrical worker of appropriate grade and registered electrical contractor, as prescribed in the Electrical CoP for the whole installation shall be submitted before acceptance of the installation.

ELE30.1.170.9 LIGHTNING PROTECTION SYSTEM

Every lightning protection system shall be tested in accordance with ELE14.

ELE30.1.180.9 FIRE SERVICE (F.S.) INSTALLATION

1. All plants, equipment and systems included in the scope of the Sub-contract and classified as fire services installations under F.S. Regulations/Code of Practices shall be installed, tested, certified and maintained in accordance with the relevant F.S. Regulations/Fire Services COP. The fire services installations included in the scope of the Sub-contract shall consist of, but are not limited to, the following:
    a. Emergency Lighting;
    b. Exit Signs and Directional Signs;
    c. Emergency Generator;
    d. Ventilation/air conditioning control system (as shown on the Drawings or Specifications).
2. The emergency lighting shall include all essential lighting points along the escape route within the building such as lift lobbies, staircase, corridor, etc. and self-contained emergency lighting inside the switch/service/plant rooms, non-domestic premises etc. as shown on the Drawings;
3. For the F.S. installations mentioned above, the Sub-contractor shall produce Completion Certificates (i.e. FSI/501a) upon completion of installation and Maintenance Certificates (FS 251) at the end of the Maintenance Period in accordance with F.S. Regulations/Fire Services COP. These certificates shall be duly signed by an appropriate Registered F.S. Contractor. The Maintenance Certificate shall be submitted to FSD and copied to the Contract Manager within 14 days after a final acceptance test has been carried out. The Maintenance Certificate together with a list of fire services installation and equipment shall also be copied, framed and displayed in a prominent area of each building concerned under the direction of the Contract Manager.

ELE30.1.190.9 EMERGENCY GENERATOR INSTALLATION

Testing, commissioning and maintenance of the standby diesel generating sets shall be carried out as specified in ELE29.

ELE30.2 MAINTENANCE

ELE30.2.010.9 24-HOUR ON-CALL SERVICE DURING MAINTENANCE PERIOD

1. The Sub-contractor shall provide 24-hour on-call service at any time during the Maintenance Period;

2. The Contract Manager may instruct the Sub-contractor, in the Maintenance period via telephone, mobile phone, paging service or any other means as advised by the Sub-contractor and Approved by the Contract Manager, to attend to reported breakdowns, and the Sub-contractor shall dispatch competent technicians or such other suitable personnel, who shall arrive at site, carry out any necessary inspection, testing and repair work for service resumption within the time stipulated under the Performance Pledge of the Employer as listed below and under all weather conditions. In the event that it being impossible to perform the requirement as stipulated in the Performance Pledge, the Sub-contractor shall explain immediately to the Contract Manager or his or her representatives the reason for such non-conformance;

   Performance Pledge of the Employer

Description	Requirements
Arrival for maintenance during office hours	Within 1 hour
Arrival for maintenance after office hours	Within 2 hours
Resumption of power supply	Within 8 hours after inspection for power interruption that affects more than one domestic flat and/or the common areas of the domestic block

3. The Sub-contractor shall submit to the Contract Manager, for this purpose, at least two names of English speaking representatives, who can be reached at any time of the day, with contact telephone numbers of direct lines, mobile phones or paging service for Approval;

4. Prior Approval shall also be obtained for any subsequent changes of representatives, contact telephone numbers, etc., during the Maintenance Period at least two weeks before the change is effected;

5. The maintenance and servicing works, as described above, form part of the Main Works described in Clause 8.3(2)(c) of the General Conditions of Main Contract.

ELE30.2.020.9 SUB-CONTRACTORS OBLIGATIONS

During the Maintenance Period, the Sub-contractor shall attend to all faults and complaints, remedy all defects, replace all malfunctional items and maintain the complete installation in a clean, tidy and functional condition to the satisfaction of the Contract Manager unless otherwise specified.

ELE30.2.030.A REPLACEMENT OF DEFECTIVE LED LAMP BULBS / TUBES AND FUSES

1. For all domestic buildings during the Maintenance Period, the Sub-contractor shall supply LED lamp bulbs / tubes and fuses for replacing defective ones by others;

2. For all non-domestic buildings during the Maintenance Period, the defective LED lamp bulbs / tubes and fuses shall be supplied and replaced by the Sub-contractor.

ELE30.2.040.9 EMERGENCIES

If any work is, in the opinion of the Contract Manager, required to avoid danger or to restore supply and the Sub-contractor is not available immediately and/or fails to arrive on site within the time required, the Contract Manager may instruct any other contractor, workman or person to carry out the work immediately and the responsibility of the Sub-contractor to fulfil the contractual obligations shall not be relieved under such circumstances, in which case the Sub-contractor shall be liable for all the cost incurred as if such work has to be carried out by the Sub-contractor.

ELE30.2.050.9 ELECTRICITY SHUT-DOWN

Should shut-down of electricity to buildings be required for the execution of the work, the duration should be kept to a minimum and prior agreement of the Contract Manager shall be sought except for emergency operation.

ELE30.2.060.9 PREVENTIVE MAINTENANCE

At the end of the Maintenance Period, the Sub-contractor shall execute all work of inspection, examination, and overhaul as required, to the complete installation, other than the installation inside domestic flats, to the complete satisfaction of the Contract Manager.

ELE30.2.070.9 REPAIR, CORRECTIVE AND POST-FAULT MAINTENANCE

1. The Sub-contractor shall carry out all repair, corrective and post-fault maintenance as soon as practicable after receiving instruction from the Contract Manager;
2. Such work shall be carried out by the Sub-contractor at his own cost if the necessity for the work shall, in the opinion of the Contract Manager, be due to the use of materials or workmanship not in accordance with the contract, or due to failure on the part of the Sub-contractor to comply with any obligation expressed or implied in the Contract;
3. If, in the opinion of the Contract Manager, the necessity of such work is due to other causes for which the Sub-contractor is not responsible, the value of the work will be ascertained by the Contract Manager and paid for;
4. Post-fault maintenance of switching devices, distribution boards and switchboards shall be carried out in accordance with BS 6423.

ELE30.2.080.9 FINAL INSPECTION

1. At the end of the Maintenance Period, the Sub-contractor shall carry out the visual inspection of the whole electrical system except the installations inside the domestic flats, and shall submit the inspection reports to the Contract Manager for record;
2. Should the inspection results indicate that the equipment or system not in full compliance with this specification, the Sub-contractor shall carry out, at his own expense, any alterations, replacements, or adjustment, as may be required to correct the faulty work;
3. The Contract Manager's decision as to what constitutes a satisfactory inspection shall be final.

ELE31 MECHANICAL VENTILATION SYSTEMS

ELE31.2 EQUIPMENT & MATERIALS 2

ELE31.2.010.A VENTILATION FANS 2
ELE31.2.020.A DUCTWORK 2
ELE31.2.030.A DUCTWORK ACCESSORIES 4
ELE31.2.040.A GRILLES AND DIFFUSERS 5
ELE31.2.050.A FILTERS 5
ELE31.2.060.9 ACTIVATED CARBON/CHEMICAL FILTERS (FOR REFUSE COLLECTION POINT/JUNK COLLECTION POINT, REFUSE STORAGE & MATERIAL RECOVERY CHAMBERS AND REFUSE CHUTES) 5
ELE31.2.070.9 ACTIVATED CARBON/CHEMICAL FILTERS (FOR REFUSE STORAGE & MATERIAL RECOVERY ROOMS) 7
ELE31.2.080.N EQUIPOTENTIAL BONDING TO AIR DUCT SUPPORTING BRACKETS 7

ELE31.3 SYSTEM REQUIREMENTS 11

ELE31.3.010.A VENTILATION FAN CONTROL 11
ELE31.3.020.9 EXTRACTION SYSTEM FOR VEHICLE EXHAUST 13
ELE31.3.030.9 NOISE AND VIBRATION CONTROL 13
ELE31.3.040.A TESTING AND COMMISSIONING 15
ELE31.3.040.9 TESTING AND COMMISSIONING 15

ELE31.4 ROOM AIR COOLERS & OUTDOOR AIR PRE-CONDITIONER 17

ELE31.4.010.N GENERAL REQUIREMENTS OF ROOM AIR COOLERS 17
ELE31.4.020.N INSTALLATION REQUIREMENTS OF ROOM AIR COOLERS 19
ELE31.4.030.A DIRECT EXPANSION TYPE PRIMARY AIR HANDLING UNIT 20
ELE31.4.040.N THERMAL INSULATION 23
ELE31.4.050.N TESTING AND COMMISSIONING 24
ELE31.4.060.N MAINTENANCE REQUIREMENTS OF ROOM AIR COOLERS AND DIRECT EXPANSION TYPE PRIMARY AIR HANDLING UNIT 25

ELE31.2 EQUIPMENT & MATERIALS

ELE31.2.010.A VENTILATION FANS

1. This section should be read in conjunction with relevant clause in Section 6.1 and 6.2 of the General Specification for Building Services Installation in Government Buildings (BS GS) of the Hong Kong Special Administrative Region published by Architectural Services Department, Hong Kong;
2. Fan capacities, heads, working pressures, minimum efficiencies and motor powers indicated are for reference and tendering purposes only. Any modifications to the system or any of its components such as fans, ductwork, motors, cables, switchgear etc. which may be required to meet the scheduled duties and space limitations shall be carried out at the Sub-contractor's expenses, except where modification is brought about by the written instruction of the CM. Notwithstanding this, no modification to any system shall be carried out where such modification may result in a reduction in system performance and efficiency, without the prior approval of the CM;
3. Sound power rating curves shall be certified by the manufacturer for the complete fan and drive assemblies and tested in accordance with BS EN ISO 5136 or Parts 1 to 4 of BS ISO 13347 or other equivalent standard;
4. The Sub-contractor shall be responsible for checking the actual data before ordering of equipment. It shall be supported with full fan duty calculations.

ELE31.2.020.A DUCTWORK

1. General:
    a. Ductwork shall generally comply with relevant clause in Section 6.1 and 6.2 of the BS GS;
    b. The flat steel sheet shall be manufactured in a process conforming to the relevant quality assurance standard ISO 9001:2015 and the zinc coating mass shall be tested to BS EN 10346:2015, ISO 1460:1992 or equivalent standards. Valid manufacturer’s certificate of accreditation to the recognised Quality Assurance System issued within three years before the material delivery to site shall be submitted. Material inspection certificate of the steel sheet showing the compliance with the above standard, issued by an organisation accredited under HOKLAS of HKAS, or an organisation accredited by an accreditation body mutually recognised by HKAS, shall be submitted. The test results / material inspection certificate shall be traceable with clear identification in the Delivery Note and marked on the ductwork indicating that the material tested is of the same batch as material used for the project;
    c. On-site non-destructive sample tests by coating thickness gauge as specified in BS EN ISO 2178:2016 shall be conducted by the Sub-contractor in the presence of the CM or his representatives as part of the inspection and acceptance procedures for coating of air ductwork. Three (3) numbers of air duct / air duct fitting shall be randomly selected from each batch for non-destructive sample test. In case the air ductworks are divided into sub-batches during delivery, three (3) numbers of air duct / air duct fitting shall be randomly selected on the first day of delivery of each batch. Five (5) test points evenly distributed along the air duct / air duct fitting shall be tested. All test points shall comply with the range of coating thickness as required in the coating designation of Z275 according to BS EN 10346:2015;

d. Additional two (2) samples for the second round non-destructive test shall be tested if the material failed in the first round of non-destructive tests. Five (5) test points on each selected air duct/air duct fitting shall be tested by calibrated coating thickness gauge and five (5) measurements shall be taken within a circle of 1cm diameter at each test point. The arithmetic mean of these five (5) measurements for each test point shall satisfy the range of coating thickness as required in coating designation of Z275 according to BS EN 10346:2015. The Sub-contractor may arrange destructive test, from one (1) out of two (2) air duct / air duct fitting selected for the second round of non-constructive test, at their own cost for verification if the results in both rounds of non-destructive tests do not comply with the coating requirements, otherwise the whole batch of material would not be accepted;

e. Duct sizes given on the Drawings are clear internal dimensions and allowance shall be made for both internal and external insulation where applicable;

f. All ductwork shall be fabricated as far as practicable according to site dimensions taken by the Sub-contractor. The Sub-contractor shall make suitable provision to accommodate any discrepancies that may occur between the Drawings and site dimensions. The Sub-contractor shall also note the obligations pertaining to coordination of services on site;

g. The air leakage limit on ductwork shall conform and be tested to the requirements as stipulated in the AC Energy Code;

h. This Specification and the Drawings only indicate the extent and general arrangement of the ducting system. If any departure from the Drawings is deemed necessary, details of such departure and reasons shall be submitted by the Sub-contractor to the CM for approval. Approved departures shall be made at no extra cost. Preferential changes arising from the Sub-contractor's processing and / or fabrication methods where approved shall be made at no extra cost.

2. Material:

Unless otherwise specified on the Drawings or elsewhere in this Specification, air ducts shall be fabricated from good quality full sized zinc coated hot dipped galvanised steel sheet to BS EN 10346:2015, Grade DX51D+Z, coating type Z275 and any damage to the galvanised finish shall be made good with three coats of aluminium zinc rich paint or other approved corrosion resistant paint to the satisfaction of the CM in addition to painting as specified. Uninsulated ductwork running exposed to view shall be painted as specified in relevant sections of the BS GS and in white or another colour as directed by the CM.

3. Construction and standard:

a. All sheet metal ductwork described in this part of Specification and shown on the Drawings shall be constructed to the recommendation of the Building Engineering Services Association in the latest editions of their Publication DW/144 and the additional requirements of this part of Specification;

b. Circular and flat-oval ductwork shall be spirally-wound and shall be suitable for medium pressure applications;

c. Pressure rating of rectangular ductwork shall be classified as per DW/144 according to the associated fan duty or as specified in other parts of this Specification;

d. Where ductwork passes through or connects to concrete and / or masonry walls and air shafts, ducts shall be collar flushed with metal angle flushing pieces, effectively sealed air tight and neatly finished. The annular space around the duct shall be caulked tight with approved gasket or sealant;

e. Flanged joints shall be provided for duct connections to plants and where removable sections are required to provide access for cleaning and maintenance;

f. Where duct bends or joints occur in ceiling spaces and flanges may foul ceiling suspension members, slip joints may be used and the duct stiffened locally, if necessary, to avoid duct vibration;

g. Test holes shall be provided where necessary for effective balancing and testing. Test holes shall be 25 mm diameter and fitted with removable sealed cap. Test points shall be provided for all dampers and equipment to enable fan duties and other items to be assessed and for commissioning of the system. Location of test holes shall be at a point of minimum turbulence;

h. Regulating dampers or split dampers shall be provided in every branch-off;

i. All intake and discharge openings to the building shall be fitted with 10 mm grid stainless steel wire mesh. This requirement is additional to any grilles or louvres indicated on the Drawings;

j. Open ends of ducts shall be covered with plastic sheets during erection to prevent ingress of dirt and rubbish. All ductwork shall be cleaned internally before the system is tested, commissioned and put into operation;

k. Side inspection and access panels for the purpose of cleaning duct interior shall be provided. The cleaning point shall in general be installed at a maximum distance of 4 metres between centres in fully accessible locations and subject to CM's approval. Stainless steel drain points complete with plugs and caps shall be provided at all low points of the air ducts.

4. Identification

a. All ductwork shall be legibly marked with black or white letters and triangles of at least 150 mm side to show the type of service and the direction of air flow.

Services shall be shown as follows:

Supply air	SA
Exhaust air	EA

ELE31.2.030.A DUCTWORK ACCESSORIES

1. General:

Ductwork accessories shall generally comply with relevant clause in Section 6.1 and 6.2 of the BS GS.

2. Volume control dampers:

The Sub-contractors shall provide all necessary volume control dampers whether shown on the Drawings or not so that airflow rates specified can fully be achieved. Ductwork regulating dampers shall be of the opposed blade type with low pressure drop and noise regeneration characteristics.

3. Access doors and panels:

a. Access doors shall be hinged type and of double skin sandwich construction each having a cam-lock action retaining lock and complete with gaskets. Multiple screw fixings shall not be acceptable. Access openings shall be adequately reinforced. Insulation thickness in the door shall be equal to that of the duct or cabinet into which it is installed;

b. Access doors shall not be removable unless no larger than 300 mm x 300 mm or essential for access or maintenance purpose, in which case approval shall be sought from the CM;

c. Access doors shall be provided at all fire/smoke dampers, silencers, fans, duct probe type smoke detectors and where necessary for maintenance and other purposes whether or not they are specifically shown on the Drawings.

4. Turning vanes:

   Wherever DW/144 requires the use of bend splitters, proprietary tuning vanes and square bends shall be provided whether detailed on the Drawings or not. Turning vanes shall be of aerofoil using proprietary vane rails.

ELE31.2.040.A GRILLES AND DIFFUSERS

1. This section shall be read in conjunction with relevant clause in Section 6.1 and 6.2 of the BS GS;
2. All air supply, return, exhaust and dummy fittings shall be provided according to the types and duties shown on the Drawings;
3. All aluminium or steel louvres, grilles, diffusers, unless otherwise stated, shall have phosphate treatment with baked enamel finish to colours approved by the CM;
4. Before any diffusers, grilles, etc. are ordered or manufacture of fittings commences, confirmation must be obtained from the CM in respect of the exact finishes of fittings required. Samples of every type of grilles, diffusers, etc. shall be submitted to the CM for approval before orders are placed;
5. Supply grilles and diffusers shall be of aluminium construction with concealed fixings and shall incorporate rear opposed blade volume control damper with front accessible adjustment screw. Grilles shall have horizontal and vertical adjustable blades to suit the particular application;
6. Exhaust/return grilles shall be of aluminium construction with concealed fixings and square neck connection as indicated on the Drawings. The vanes shall be of extruded aluminium sections fixed at an inclined angle of 45 degrees. An opposed blade damper with front accessible adjustment screw shall be fitted to the neck for volume control.

ELE31.2.050.A FILTERS

1. Filters shall in general comply with relevant clause in Section 6.1 and 6.2 of the BS GS;
2. Filter media shall be of FSD approved type;
3. Washable panel fitter shall have the minimum efficiency reporting value (MERV) by ANSI/ASHRAE Standard 52.2 and initial resistance at 2.5 m/s face velocity as shown below. The filter shall operate to a final resistance of 150, 100 or 75 Pa for 50, 25 or 12.5 mm thick panels respectively.

   MERV and Initial resistance of washable panel filter

Thickness	MERV Not Less Than	Initial Resistance Not Exceeding
50 mm	5	50 Pa
25 mm	4	30 Pa
12.5 mm	3	25 Pa

ELE31.2.060.9 ACTIVATED CARBON/CHEMICAL FILTERS (FOR REFUSE COLLECTION POINT/JUNK COLLECTION POINT, REFUSE STORAGE & MATERIAL RECOVERY CHAMBERS AND REFUSE CHUTES)

1. General:

a. The activated carbon/chemical filters shall be Underwriters Laboratories (UL) Class 1 listed and FSD approved;

b. The filter unit shall consist of housing, modules and filtering media. The complete unit shall be manufactured by the same manufacturer with well-proven experience in construction of similar filter units;

c. All filtering media shall be recognised by FSD as complying with the non-combustible requirement;

d. Four sets of spare module with filtering media and pre-filter shall also be provided at completion stage.

2. Housing:

a. Housing shall be constructed of AISI type 304 stainless steel sheet. Extruded luminous filter slide tracks shall be bolted to vertical formed channel supports at 610 mm intervals across the width of the housing;

b. Filter tracks shall include nylon pile seal to match with the sealing face of all filters. Doors, on both sides, shall be hinged with stainless steel hinges and pins, and shall include permanently attached positive locking door latches. Gaskets shall be provided to prevent air leakage around doors and between the doors and the filters;

c. Housing shall consist of two sections, first section for housing 50 mm pre-filters, second section for housing modules;

d. The Sub-contractor is responsible for calculating the actual size of filter sections required for sizing of housing. The Sub-contractor shall also size the filter sections with face air velocity across the filter section not more than 2.5 m/s.

3. Modules:

Modules shall be constructed of disposable paperboard or ABS (acrylo-nitrile butadiene styrene terpolymer) grade DFA-R thermoplastic. Modules shall have V-shape cross sections containing media. The modules shall be nominally 152 mm x 610 mm x 457 mm overall. Perforated plastic portion shall have 53% open area. Modules shall carry an Underwriters Laboratories (UL) Class 2 listing when filled with media. The modules shall be disposable, no separate handling of media to reduce the time of maintenance.

4. Filtering media:

a. Media in the modules shall be mixture of 50% Medium A and 50% Medium B. Media should be able to absorb organic and inorganic gases;

b. Medium A:

i. Medium A shall consist of manufactured, generally spherical, porous pellets (nominal pellet diameter is 3 mm). Pellets shall be formed from a combination of powered activated alumina and other binders, suitably impregnated with potassium permanganate (minimum 4%) to provide optimum absorption and oxidation of a wide variety of gaseous contaminants. The potassium permanganate shall be applied during pellet formation, such that the pellet volume is totally available for reaction. The media shall be inorganic, non-toxic, non-flammable and shall not support bacterial or fungal growth;

ii. Medium shall meet the following removal capacities:

- Hydrogen sulphide: 8.0% minimum by weight

- Sulphur dioxide: 3.5% minimum by weight

- Nitric oxide: 2.5% minimum by weight

- Nitrogen dioxide: 1.0% minimum by weight

iii. Medium shall operate normally at temperature -20°C to 51°C with 10 to 95% R.H. Medium shall have a scrubbing efficiency of not less than 99.95% at air velocities of 0.3 to 2.5 m/s.

c. Medium B:

Medium B shall be manufactured from a combination of coconut shells, bituminous coal and contain elemental sulphur less than 0.005%. The hardness of medium shall be 97 determined by ASTM D3802-79. The absorptive capacity for carbon tetrachloride shall be minimum 50% according to ASTM D3467-04.

d. Amount of media provided in the modules shall be capable of removing offensive smell in the exhaust air such that replacement of media is required not more than once every six months.

5. Pre-filter:

a. Pre-filter shall be 50 mm thick washable panel type with average efficiency of 20% tested in accordance with ASHRAE 52.1 or ASHRAE 52.2. Pre-filter shall be of FSD approved type;

b. Air resistance when clean shall not exceed 80 Pa. Design final resistance shall be 150 Pa.

6. Replacement of Filters:

Dirty filters will be cleaned or replaced by others during the Maintenance Period.

ELE31.2.070.9 ACTIVATED CARBON/CHEMICAL FILTERS (FOR REFUSE STORAGE & MATERIAL RECOVERY ROOMS)

1. The activated carbon/chemical filters for refuse storage & material recovery rooms shall be 50 mm thick panel type with proven local job installation records and approved by the Contract Manager;

2. Filter shall be housed in the same galvanised steel cabinet that houses the exhaust fan or as otherwise specified. Filter track shall be provided to facilitate secure filter fixing and easy filter removal.

ELE31.2.080.N EQUIPOTENTIAL BONDING TO AIR DUCT SUPPORTING BRACKETS

1. General:

a. The Sub-contractor shall comply with the Code of Practice (CoP) for the Electricity (Wiring) Regulations for necessary bonding provision for the air duct supporting brackets;

b. The Sub-contractor who supply and install the air duct and its supporting brackets shall be responsible for providing the equipotential bonding to the air duct supporting brackets;

c. The air duct supporting brackets shall be bonded and earthed thoroughly in order to maintain the earth continuity for equipotential bonding;

d. All bonding conductors shall be supplied and installed for connection to earth terminal points near the air duct supporting brackets or adjacent bonded extraneous conductive parts in the same equipotential zone. The Sub-contractor shall allow for and co-ordinate on exact locations of each termination point;

e. Conditions of air duct supporting brackets required for application of equipotential bonding should be made:

i. The supporting brackets are installed within 2m from any exposed conductive parts or other extraneous conductive parts;

ii. The supporting brackets can be gripped or contacted by a major surface of human body in excess of 50mm x 50mm.

2. Air duct without insulation:

a. Equipotential bonding shall be solidly and effectively connected between the air duct and its supporting brackets either by bonding conductor in the form of Y/G color-coded single core cable or an approved type suitable for this application. All bonding surface for electrical contact shall be cleaned and free from non-conducting materials, such as grease or paint before connection.

3. Air duct with insulation:

There are two approaches to comply with the CoP, either

a. to ensure the equipotential of the supporting brackets by installing bonding conductors to the nearest earth terminal or adjacent bonded extraneous conductive parts in the same equipotential zone; or

b. to make supporting brackets electrically isolated (i.e. bracket insulation resistance $\geqq$ 45,000 Ohm).

The Sub-contractor shall submit method statement with drawing(s) to illustrate the installation detail for the CM's approval. If the Sub-contractor choose to make the supporting brackets as non-extraneous conductive parts, the following sub-clauses shall be complied with:

i. All supporting brackets for insulated air duct shall be applied with the Approved coatings to achieve the measured insulation resistance between the air duct supporting brackets and the nearby earth terminal points or the adjacent bonded extraneous conductive parts in the same equipotential zone at not less than 45,000 Ohm even under the worst conditions of high moisture such that the air duct supporting brackets can be considered as a non-extraneous conductive part for effective insulation in accordance with the CoP requirements;

ii. Acrylic paint or alternative paints having equivalent functions or performance for insulated air duct supporting brackets:

- At sample submission and approval stage, the Sub-contractor shall submit a sample of the proposed paint coating for the CM's approval together with catalogue, brand name, model, job reference and manufacturer's method statement for the application of the material for the CM's information;
- Water based acrylic paint in accordance with the table in this sub-clause comprising one sealer or primer coat and minimum two finishing coats;
- Compatible with and shall not adversely affect the physical property of the air duct supporting brackets;
- The quality and performance requirements are as follows:

Items	Method	Acceptance Standards

Preliminary examination of paint	Surface skin	BS EN ISO 1513: 2010	-No surface skin
	Consistency		-Normal without gelling
	Colour separation into layers		-No colour separation
	Visible impurities		-No visible impurities
Drying times	Surface drying (mins)	BS EN ISO 9117-3: 2010	≤ 2 hours for primer ≤ 40 mins for finishing coat
	Hard drying (hours)	BS EN ISO 9117-1: 2009	≤ 4 hours for primer ≤ 2 hours for finishing coat
Mandrel Bending Test		BS EN ISO 1519: 2011	No coating crack at 3mm mandrel
Adhesion test (cross hatch method)		BS EN ISO 2409: 2013	Class 1 The dried film should show no failure on a cross cut test when applied to stainless steel bracket and dried for 7 days.
Water resistance		ASTM D870-15 (2020)	≥ 100 hours
Resistance to fungal and algal growth of paint		FIN7.APPEND1	Resistance Index ≤ 1 at Day 28 for fungal resistance Resistance Index = 0 at Day 28 for algal resistance
Accelerated weathering		ASTM G154-16 ('Cycle 2" in Table X2.1 – Common Exposure Conditions" to be adopted except that UVA-340 lamp should be used in place of UVB-313)	≥ 500 hours After specified hours of testing there shall be no signs of checking, blistering, or cracking, and the loss of gloss shall not be more than 30% of the original gloss. In addition, there shall be little change in colour, and any change in colour shall be equivalent to a degree of contrast of not less than grade four of the grey scale conforming to BS EN 20105-A02:1995.

- VOC content in compliance with the Air Pollution Control (Volatile Organic Compounds) Regulation.

c. Coating application:

i. Apply the Approved coatings on the air duct supporting brackets in the workshop;

ii. Test each coated air duct supporting bracket in the workshop by applying 500V D.C. test voltage using a suitably calibrated D.C. insulation tester to verify compliance with the minimum insulation resistance of 45,000 Ohm prior to installation.

d. Prior to mass application of coatings to the air duct supporting brackets, the Sub-contractor shall submit the following for approval by the CM:

i. A sample of the insulated air duct supporting bracket with the Approved coatings applied in accordance with the paint manufacturer's recommendations;

ii. Insulation Resistance Test Report for the submitted sample of insulated air duct supporting bracket in sub-clause (d)(i), demonstrating a measured insulation resistance of not less than 45,000 Ohm.

e. Sub-contractor's On Site Delivery Verification:

i. For each batch of insulated air duct supporting brackets required to achieve the insulation resistance performance, submit a confirmation letter to declare that the insulated air duct supporting brackets delivered complied with sub-clause (c) requirements;

ii. Carry out testing with a suitably calibrated D.C. insulation tester in the presence of the CM or his representatives on random samples of one in every 100 for each batch of delivered supporting brackets to verify that the measured insulation resistance achieved not less than 45,000 Ohm;

iii. When any of the verifications fail to meet the acceptance standards, the Sub-contractor shall either:

- Remove the representative batch off-site; or
- When agree by the CM, repeat all verification items on three separate samples selected by the CM. In case of failure of any verification to any one sample, the Sub-contractor shall remove the representative batch off-site, bear all associated costs and any extra time required.

f. Sub-contractor's Verification at Sample Areas:

i. Carry out verification testing with a suitably calibrated D.C. insulation tester in the presence of the CM or his representatives on mock up installations for all insulated air duct supporting brackets at sample area(s) or other locations selected by the CM or his representatives to verify that the measured insulation resistance achieved not less than 45,000 Ohm even under the worst conditions of high environmental moisture, prior to mass installation;

ii. The testing method for measurement in sub-clause (f)(i) shall be proposed by the Sub-Contractor and agreed by the CM;

iii. The measurement results shall be recorded in the testing and commissioning report and submit to the CM for retention.

g. The Sub-Contractor is also required to read in conjunction with Section 17 of the Electrical specification;

h. If there is any damage to the coatings due to transportation from workshop to Site, improper handling or storage on Site and improper installation, which necessitates subsequent touching up works with Approved paint or replacement works and re-measurement of the insulation resistance, the Sub-contractor shall bear all associated costs and any extra time required.

ELE31.3 SYSTEM REQUIREMENTS

ELE31.3.010.A VENTILATION FAN CONTROL

1. Where a supply fan is specified in addition to an exhaust fan for a room, the operations of the two fans shall be interlocked;
2. Exhaust fans for refuse storage & material recovery rooms (RS&MRRs) shall be group controlled by battery backup type 24 hour time switches installed in a weatherproof enclosure in the refuse storage & material recovery chamber (RS&MRC) at ground floor as shown on the Drawings. The enclosure shall be constructed from minimum 1.5 mm thick sheet steel, rust proofed and epoxy powder painted or baked enamel finished for the inside and outside surfaces. The enclosure opening shall be rolled up with curled edges in order to stop water ingress slip into inner side of the panel. The front panel shall be of double-door construction. The outer doors of the front panel shall be hinged permitting not less than 110 degree opening, inserted with a durable clear transparent panel sealed by rubber gaskets, and fitted with watertight handle. The dimensions of the clear transparent panel shall be as large as practicable to view all the components and operational features inside. The edges of the door shall be fitted with neoprene rubber gaskets which at closing position, shall be tightly rested on the curled edges of the panel opening. The enclosure shall have an index of protection not less than IP42 to BS EN 60529 or IEC 60529;
3. For ventilation fans for refuse chute, refuse storage & material recovery chambers (RS&MRCs), pump rooms and lift machine rooms, the ventilation fan(s) in each room shall be operated by manual control and a battery backup type 24 hour time switch;
4. In addition, thermal control device shall be used to control the ventilation fans in lift machine rooms and roof fresh water booster pump rooms;
5. A by-pass switch shall be provided for the manual control of each time switch;
6. The time switch shall be submitted for approval prior to installation;
7. Local control panels:
    a. Local control panels shall be provided for individual or each group of fans for (RS&MRCs), refuse collection point (RCP) and where specified;
    b. The whole enclosure of the local control panels shall be constructed from minimum 1.5 mm thick sheet steel, rust proofed and epoxy powder painted or baked enamel finished for all inside and outside surfaces. The panel opening shall be rolled up with curled edges in order to stop water ingress slip into inner side of the panel. The panel door shall be hinged permitting not less than 90 degree opening and recessed in the panel with indication lights, selector switches, isolating switches etc. fitted on. The back sides of the panels shall be fitted with insulation boards to prevent direct exposure of live parts when opened. At closing position, the panel doors shall be fastened onto the panel by stainless steel screws. The panels shall be of a robust design, capable of withstanding the mechanical, electrical and thermal stresses under all working conditions including fault conditions. The enclosure shall have an index of protection not less than IP42 to BS EN 60529 or IEC 60529;

c. For panel installed at RS&MRCs, RCP and pump rooms, in addition to the requirements in item b above, the front panel of the local control panel shall be of double-door construction. The outer doors of the front panel shall be hinged permitting not less than 110 degree opening, inserted with a durable clear transparent panel sealed by rubber gaskets, and fitted with watertight handle. The dimensions of the clear transparent panel shall be as large as practicable to view all the components and operational features inside. The edges of the outer doors shall be fitted with neoprene rubber gaskets which at closing position, shall be tightly rested on the curled edges of the panel opening. The inner doors of the front panel shall be hinged permitting not less than 90 degree opening and recessed in the panel with indication lights, selector switches, isolating switches etc. fitted on. The back sides of the inner panels shall be fitted with insulation boards to prevent direct exposure of live parts when opened. At closing position, the inner doors shall be fastened onto the panel by stainless steel screws;

d. Panels shall include all necessary components and accessories to form a complete assembly. Components and accessories shall be firmly fixed in position in the panel and shall be assembled in such a way that it shall be possible to remove or replace any component parts and to carry out cable connections from the front;

e. Permanently engraved labels in both English and Chinese shall be provided on the panel for identifying each piece of instrument and equipment such as push buttons, signal lights etc.. The labels shall be engraved with white lettering on a black background. In addition to the aforesaid, each control panel shall have an identity label showing its designation as indicated on the Drawings;

f. Panels having equipment requiring three phase feed shall be complete with HRC fuses and individual on-load door interlocked isolators. Panels having equipment requiring only a single phase feed may be isolated by means of a switch mounted within the panel but in such circumstances every item inside shall be fully shrouded and the panel door shall be provided with barrel lock and keys. Alternatively, the Sub-contractor can propose alternative means of isolation, switching and/or emergency switching which satisfies safety requirements of users, occupants and maintenance personnel for approval by the Contract Manager;

g. Control panel for each refuse storage & material recovery chamber shall at least include the following operational features:

   i. Local start/stop push buttons and manual/off/auto switch;

   ii. Status and alarm indicating lamps (supply healthy, on, trip, overload, etc.);

   iii. Panel-mount time switch with a removable clear plastic front cover and its by-pass switch;

   iv. Isolating switch interlocked with the panel door, or isolating switch with door lock.

h. Control panel for each refuse collection point shall at least include the following operational features:

   i. Local start/stop push buttons;

   ii. Status and alarm indicating lamps (supply healthy, on, trip, overload, etc.);

   iii. Isolating switch interlocked with the panel door, or isolating switch with door lock.

i. The Sub-contractor shall submit full details of each type of control panel for approval before fabrication.

8. Motors under automatic control shall be provided with a warning notice, which shall be a prominent red notice on white background of durable material, displayed adjacent to each fan or each pair of fans, and inscribed in English letters and Chinese characters of at least 15 mm high as follows:

DANGER
THIS MOTOR IS AUTOMATICALLY CONTROLLED AND MAY START WITHOUT WARNING – ISOLATE BEFORE INSPECTION
危險
此機乃自動操作 – 維修前請先關掣

9. In each refuse storage & material recovery chamber, motorised shut-off dampers shall be provided to the intake air external louvres and interlocked with the exhaust fan operation as shown on Drawings;

10. In refuse collection point, a prominent notice of durable material shall be provided and inscribed in English and Chinese characters of at least 25 mm high as follows:

PLEASE KEEP DOOR OPEN WHEN EXHAUST FAN IS IN OPERATION
抽氣扇運行時請保持房門開啟.

ELE31.3.020.9 EXTRACTION SYSTEM FOR VEHICLE EXHAUST

1. Extraction fan shall be of centrifugal type and shall meet the demands and duties for conveying vehicle exhaust gases. Construction shall be compatible with both petrol and diesel engine emissions and capable of withstanding high temperature (at least 125°C continuously) and corrosive nature of the exhaust gases. The induction motor to IP 44 shall be directly coupled to the fan and shall be designed to give long and continuous service;

2. The whole system shall be designed for use by heavy refuse collection vehicles of up to 24 tonnes gross vehicle weight with engine capacity of 15,000 c.c.;

3. The extraction unit shall be fitted with chained cap adaptors to suit the vehicles using the refuse collection point. The following accessories are to be provided:

   a. 12 m length of minimum 100 mm diameter crush proof metallic flexible hose;

   b. High and low point inlets to suit the overhead and under-chasis exhaust discharges of the vehicles;

   c. Exhaust funnels to fit tail pipe from 63.5 mm to 127 mm in diameter;

   d. Hose brackets, plugs and fitted kit as required.

4. Hose reel shall be of electric motor driven type with waterproof control panel at low level to the approval of the Contract Manager.

ELE31.3.030.9 NOISE AND VIBRATION CONTROL

1. General:

   a. The Sub-contractor shall supply and install noise and vibration control equipment to ventilation fans, ductwork silencers, flexible duct connections and acoustical enclosures to noise generated equipment where specified and where necessary;

b. The Sub-contractor shall be responsible for checking and calculating the noise level generated by the ventilation equipment and providing suitable acoustic treatment to comply with the Noise Control Ordinance, requirements of Environmental Protection Department, the Drawings and General AC Specification. Such calculations shall be submitted to the Contract Manager for approval;

c. All noise absorbing materials shall be inert, non-hygroscopic, verium proof and fire retardant. All materials installed outside building or uncovered shall be suitable for outdoor use;

d. For evaluation of vibration standard and measuring techniques, BS ISO 3334 shall be applied;

e. When ductwork or conduit crosses structural movement joints, flexible connection must be installed;

f. The Sub-contractor shall be responsible for ensuring that all penetrations in walls, floors and ceilings provided for ducts, conduits, etc. are isolated and sealed around the penetrations. In all cases, masonry and other structure surrounding the plant shall not be in direct contact with the equipment;

g. The Sub-contractor shall be responsible for selecting vibration isolators, ductwork supports, ductwork acoustic insulation, silencers etc. where appropriate and taking into account the manufacturers' recommendations to ensure that the noise and vibration generated from the system could be effectively isolated in accordance with the requirements in Section B8 and C8 of the General AC Specification;

h. Suspended equipment shall be supported on Type "F" spring and double deflection neoprene hangers;

i. Flexible connectors shall also be provided at ductwork connections to the ventilation equipment and at all building movement joints.

2. Duct silencers/sound attenuators:

a. Duct silencers/sound attenuators where shown on the drawings shall be provided for all ducted ventilation fans. Additional attenuators shall be provided where necessary to meet relevant statutory requirements;

b. Duct silencers/sound attenuators shall be factory constructed and tested;

c. The duct silencers/sound attenuators shall be selected in accordance with the requirements of the General AC specification. The maximum pressure drop across the selected silencer shall not exceed 50 Pa;

d. All acoustic infill materials shall be inert, non-combustible, vermin proof, non-hygroscopic, wrapped in an acoustically transparent polyester membrane and sealed with polyester sealant to the approval of FSD;

e. All attenuators shall be fitted with end plates and packed in sealed bags at factory prior to shipment.

3. Acoustic enclosures:

a. The Sub-contractor shall supply and install ventilation fan acoustic enclosures where shown on the Drawings and where necessary to satisfy the noise criteria specified. The arrangement shall be submitted to the Contract Manager for approval prior to installation;

b. Construction of the enclosures shall generally be in accordance with the General AC Specification. Enclosure panel thickness shall be as recommended by the acoustic specialist but not less than 25 mm. Access panel shall be provided so that all removable and serviceable parts can be accessed for maintenance;

c. All acoustic infill materials shall be inert, non-combustible, vermin proof and non-hygroscopic. The infill shall be wrapped in an acoustically transparent polyester membrane and sealed with polyester sealant to the approval of FSD except where detachment of fibres into the air stream is prevented by solid double wall construction.

ELE31.3.040.A TESTING AND COMMISSIONING

1. All tests shall be carried out in accordance with this Specification and the following documents where applicable:
   a. Section 6.3 of the BS GS;
   b. Testing and Commissioning Procedure for Air conditioning, Refrigeration, and Mechanical Ventilation and Central Monitoring & Control System Installation in Government Buildings of the Hong Kong Special Administrative Region published by Architectural Services Department, Hong Kong;
   c. Relevant CIBSE Commissioning Code;
   d. Relevant British Standard or British Standard Code of Practice;
   e. Sample Test of Galvanized Coating of Air Ductwork:

   Details of these tests shall be in accordance with relevant clauses as stipulated in ELE31.2.
2. All costs associated with the testing and commissioning procedures including materials, labour, instruments and provisions of all necessary test points shall be borne by the Sub-contractor. Such costs shall also include the cost of making good any defects arising out of such tests and having the work re-tested. In the case of off-site, all other incidental costs shall also be included;
3. Testing and commissioning shall also be required for all temporary works;
4. All tests shall be carried out to the satisfaction of the CM and shall be witnessed by the CM or his representatives;
5. At least two months prior to the testing or commissioning of any system or process, the Sub-contractor shall furnish the following information to the CM for approval:
   a. Type of instrument to be used;
   b. Manufacture of instrument;
   c. Calibration methods for instrument;
   d. Operating instructions for instrument;
   e. Accuracy and tolerances of instrument;
   f. Proposed formats of testing and commissioning reports;
   g. Schedule and programme of testing and commissioning activities.
6. The Sub-contractor shall submit in triplicate the testing and commissioning reports / certificates for each system to the CM on work completion.

ELE31.3.040.9 TESTING AND COMMISSIONING

1. All tests shall be carried out in accordance with this Specification and the following documents where applicable:
   a. Section A9 of the General AC Specification;

b. Testing and Commissioning Procedure for Air conditioning, Refrigeration, Ventilation and Central Monitoring & Control System Installation in Government Buildings of the Hong Kong Special Administrative Region published by Architectural Services Department, Hong Kong;

c. Relevant CIBSE Commissioning Code;

d. Relevant British Standard or British Standard Code of Practice.

2. All costs associated with the testing and commissioning procedures including materials, labour, instruments and provisions of all necessary test points shall be borne by the Sub-contractor. Such costs shall also include the cost of making good any defects arising out of such tests and having the work re-tested. In the case of off-site, all other incidental costs shall also be included;

3. Testing and commissioning shall also be required for all temporary works;

4. All tests shall be carried out to the satisfaction of the CM and shall be witnessed by the CM and / or his representative;

5. At least two months prior to the testing or commissioning of any system or process, the Sub-contractor shall furnish the following information to the CM for approval:

   a. Type of instrument to be used;

   b. Manufacture of instrument;

   c. Calibration methods for instrument;

   d. Operating instructions for instrument;

   e. Accuracy and tolerances of instrument;

   f. Proposed formats of testing and commissioning reports;

   g. Schedule and programme of testing and commissioning activities.

6. The Sub-contractor shall submit in triplicate the testing and commissioning reports / certificates for each system to the CM on work completion.

ELE31.4 ROOM AIR COOLERS & OUTDOOR AIR PRE-CONDITIONER

ELE31.4.010.N GENERAL REQUIREMENTS OF ROOM AIR COOLERS

1. The refrigerant used in the room air coolers shall be non-HCFCs type;
2. Application of flammable refrigerants on newly installation Room Air Coolers (RACs) in HA Buildings is not allowed;
3. For room coolers using mildly flammable refrigerants (e.g. R-32), the Sub-contractor shall take all necessary safety precautions including but not limited to the following:
    a. Flammable refrigerants should only be used on suitably designed system;
    b. Extra training is required for workers engaged in installation, repair and demolition of refrigeration system using flammable refrigerants;
    c. For indoor refrigeration system, the amount of flammable refrigerants used shall be restricted;
    d. All related facilities and materials must be free from any potential source of ignition;
    e. Tips on “Safe Use of Mildly Flammable R32 Refrigerant Air-conditioners” at EMSD’s website;
    f. Valid certificate of safety compliance in order to satisfy the requirements of the Electrical Products (Safety) Regulation.
4. For room coolers using mildly flammable refrigerants, particular attention to comply with the requirement of product marking, labelling, flame symbol and safety instructions, as detailed in Guidance Note on Household Air-conditioners Using Mildly Flammable Refrigerant issued by EMSD including but not limited to the followings:
    a. A flame symbol of “Risk of fire / Flammable materials” or “low burning velocity material” shall be provided on all indoor, outdoor units and single package units where applicable;
    b. An additional flame symbol shall be placed on the nameplate of the unit near the declaration of the refrigerant type and charge information;
    c. Safety instruction shall be shown in the user manual including the following basic safety requirements:
        i. The flame symbol in Clause 4 (a) & 4 (b) above to alert users and service personnel that the room cooler is using mildly flammable refrigerant;
        ii. Minimum installation height and minimum room area;
        iii. The maximum refrigerant charge of the room cooler;
        iv. Instruction on how to determine the additional refrigerant charge and how to complete the refrigerant charge;
        v. The instructions shall include information pertaining to the handling, installation, cleaning, servicing and disposal of refrigerant and the room cooler;
        vi. The room cooler shall not be installed near ignition sources or open flames;

vii. Serving shall be performed only as recommended by the manufacturer;

viii. In case the refrigerant circuit is damaged, do not use any electric or gas appliance, ensure no source of ignition (e.g. lighter, matches) nearby, and open all windows to provide good ventilation, and should contact supplier / supplier's agent / maintenance agent to follow up;

ix. The markings mentioned in sub-clauses 4(a) and 4(b) shall be kept throughout the life cycle of the room cooler. The user manual should be handed over to any person who use or handle the room cooler whenever the room cooler would be transferred to another location and delivered to a recycling plant.

5. All room air coolers shall be designed for operation on 50 Hz, 220 Volts ±6% single phase A.C. electricity supply. All accessible metal parts of the unit together with the case and core shall be earthed and all end connections soldered. All plugs shall be of 3-pin fused type, in compliance with BS 1363 and its amendments from time to time. All electrical components, cabling etc., shall conform to the appropriate British Standard Specifications of the latest edition, or shall be of fully equivalent quality and capacity;

6. All room air coolers shall have a power factor of not less than 0.85 at full load;

7. All room air coolers shall be arranged for straight cooling type with minimum two fan speeds available. Equipment catalogues showing the performance of the room air coolers under specific conditions shall be submitted to the CM for approval;

8. An adjustable thermostat control shall be provided for each room air cooler. The thermostat shall be built into the case of the unit. Touch button control or adjusting knob is acceptable;

9. All room air coolers shall comply with the Electrical Products (Safety) Regulation (Cap. 406G). The Sub-contractor shall submit all relevant information and supporting documents for the CM's approval upon request by the CM;

10. The maximum noise level emitted by the room air cooler operating at high cool and high fan setting shall be as follows:

    a. For split type room air coolers, the noise level must not exceed 55 dB(A) and 60 dB(A) when measured at indoor and outdoor respectively at a position 1.5 metre from the unit under a background noise level of less than 50 dB(A);

    b. For window type room air coolers, the noise level shall be measured at a distance of 1.5 metre from the cool air discharge and at 1.2 metre above the ground under a background noise level of less than 50 dB(A).

Cooling Capacity	Noise Level
Up to 4,400 Watt (15,000 Btu/hr)	Not exceeding 60 dB(A)
Above 4,400 Watt (15,000 Btu/hr)	Not exceeding 65 dB(A)

11. The room coolers shall be supplied with appropriate radio interference suppressor to meet the requirements prescribed in relevant sections of the Telecommunication (Control of Interference) Regulations (Cap. 106);

12. The supplied room air coolers shall be of Energy Efficiency Grade 1 under Mandatory Energy Efficiency Labelling Scheme (MEELS) for Room Coolers administered by the Electrical and Mechanical Services Department;

13. The split type room air coolers are wireless remote control type.

ELE31.4.020.N INSTALLATION REQUIREMENTS OF ROOM AIR COOLERS

1. All installations shall be materially, structurally and electrically safe and shall be carried out to ensure satisfactory operation of the units under all conditions;
2. The Sub-contractor shall submit installation drawing(s) of the manufacturer's recommended method of installation for approval according to the installation programme;
3. Openings for the installation work, the essential equipment supporting members (such as the basic supporting layer of plinth and / or metal framework), metal cages, service platforms (if any), master drain pipe shall be provided by the Main Contractor. The Sub-contractor shall submit in good time to the CM for approval any specific builder's work provisions so that the plinths, openings, recesses, etc. can be provided;
4. The Sub-contractor shall be responsible for the supply and installation of mounting brackets and supports and all other necessary materials for fixing the room air cooler in position. Aluminium angles and glass panels shall be used. The Sub-contractor shall provide power and control cables enclosed in G. I. conduits for the evaporator and condensing unit for split type room air cooler installation. The Sub-contractor shall seal up the gaps left around the unit after the installation work;
5. All on-site installations including cables, conduits, etc. shall comply with the Code of Practice for the Electricity (Wiring) Regulations, Electricity Ordinance (Cap. 406), relevant British Standards, power company Supply Rules and the latest IET Wiring Regulations;
6. Every window-type room cooler shall be installed in such a manner as to prevent the spraying or dripping of moisture to areas beneath the unit and shall meet every requirement of Section 12 of the Public Health and Municipal Services Ordinance. Where the unit is designed to dispose of all the condensate by re-evaporation on the condenser surfaces, the unit shall be correctly levelled to ensure proper operation and the supporting framework shall be so fixed as to allow the unit to be removed for maintenance and service, and replaced without disturbing the correct operation level. The installation shall include a full size drip tray of minimum 0.6 mm thickness stainless steel (Grade 304) with drain pipe and shall be installed underneath the condenser. The condensation drain hose shall be installed from the drip tray to the designated drainage connection point;
7. Noise generated from any components of each room cooler shall not cause any nuisance to the public. The room coolers shall comply with the requirements as stipulated by the updated Noise Control Ordinance and the Sub-contractor is required to rectify any defects found to suit EPD's requirements at his own cost;
8. The Sub-contractor shall be required to make good or rectify any defects or faults in the installation that may develop or come to light during the Maintenance Period;
9. Hot dipped galvanised steel support frame works, hangers, bracket, washer screw, bolt and nut and association materials (except the items of works specified in clause 3 of the Particular Specification) for split type room cooler installation shall be provided by the Sub-Contractor;
10. The condensing unit and the evaporator unit should preferably be mounted on the same level;
11. The interconnecting cables (power and control cables) between the evaporator and condensing unit shall be enclosed in G. I. conduit. Electrical double pole switches and connection units for evaporator unit shall be installed while electrical weather-proof type isolator switches and emergency stop switches for condensing unit shall be installed;

12. The refrigerant pipe and conduit between the evaporator and condensing unit shall be fixed with saddles at intervals of not more than one metre. The Sub-contractor shall seal up the gap left around the refrigerant pipe and conduit after installation;
13. Exact location of the installation shall be decided on site;
14. Size of drain pipe:
    a. 20 mm dia. for one unit;
    b. 32 mm dia. for two units or above.
15. Opening through wall for refrigerant piping shall be submitted for the CM's approval and provided by the main contractor;
16. All insulation for refrigerant pipe and condensate drain pipe installed at indoor exposed to view or at external shall be properly protected with mechanical means such as aluminium sheet cladding or slim duct cover with all joints sealed;
17. Refrigerant Pipes

    Refrigerant pipes shall be of coiled copper to BS EN 12735-1:2016 or equivalent standard. The copper piping and fittings shall be particularly suitable for use with the corresponding refrigerant.
18. Condensate Drain Pipe

    In general, condensate drain pipe passing through non-fire rated structure shall be of UPVC pipes to BS 3505. Condensate drain pipe passing through fire rated structure shall be Galvanized steel pipes to BS 1387, Medium Grade where is suitable and complying with the fire separation requirement.

ELE31.4.030.A DIRECT EXPANSION TYPE PRIMARY AIR HANDLING UNIT

1. General
    a. The Sub-contractor shall supply and install direct expansion type primary air units (DX PAUs), air duct, air plenums, air grilles, air diffusers, fire dampers and all necessary accessories as shown on the Drawings, Equipment Schedule and in accordance with this Specification;
    b. All DX PAUs shall have the highest operation efficiency. Demonstrate performance improvement against the latest edition of Building Energy Code (BEC) that improve 2% of code specified minimum coefficient of performance (COP) for air-conditioning equipment;
    c. The Sub-contractor shall install the DX PAUs so as to allow adequate space for filter replacement, installation of air duct / plenum and maintenance of the unit. A straight duct at the supply side shall be allowed prior to connecting to elbows and air duct / plenum;
    d. The Sub-contractor shall well co-ordinate the DX PAUs with the services installed in the ceiling level and inside the bulkheads / ceiling void. The Sub-contractor shall check the sizes of the spaces for the installation of the DX PAUs and shall select the DX PAUs of appropriate dimensions capable of installing in the bulkhead / false ceiling void without any major modification of the bulkhead / false ceiling system provided by the Main Contractor;
    e. The condensing units shall be installed on anti-vibration mountings fixed to the stainless steel angle or channel frame provided by the Sub-contractor. The matched DX PAUs shall each consist of direct expansion cooling coil, blower and motor, air filters, return air chamber, control valves and all operational accessories. All control equipment and wiring, refrigerant pipes and fittings, drain pipes, etc., necessary for completing a functional air conditioning system shall be provided;

f. The Sub-contractor is required to size, detail, supply and install the interconnecting refrigerant pipework including accessories to match characteristics of his equipment. Care must be taken to avoid high pressure drop, noise, vibration or oil return problem;

g. A mechanical or electronic type room thermostat shall be provided for on-off control of the liquid line solenoid valve in order to maintain the room temperature on setting. An on-off switch shall be provided as part of the thermostat for start-stop of the air conditioning unit.

2. Selection of Air Cooled Condensers and Condensing Units

a. Air-cooled condensers and condensing units of DX PAUs shall be selected to give full output with condensing temperature not exceeding 52^{o}C when the entering air temperature is 35^{o}C.

3. Refrigerant

a. Refrigerant shall be of environmental friendly type with zero ozone depleting potential (ODP) and a low global warming potential (GWP) to comply with Environment and Ecology Bureau's requirements;

b. The refrigerant used in the refrigeration machine shall be non-HCFCs type;

c. Application of refrigerants with Class 2L, Class 2 and Class 3 flammability, or refrigerants with Group B toxicity according to ASHRAE 34 / ISO 817 on newly installation DX PAUs in HA Buildings is not allowed. Non-flammable Class 1 refrigerants shall be adopted.

4. Cooling and Condensing Coils

a. Cooling and condensing coils shall be of copper tubes with aluminium fins, mechanically bonded to the tubes. Coils shall be cleaned, dehydrated and tested for leakage at factory and shall be coated with anti-corrosion treatment provided by the manufacturer in the factory. On site anti-corrosion application shall not be allowed;

b. Coil connections shall be by flare joints. The cooling coils shall have sufficient number of rows of tubes to provide efficient dehumidification. Each cooling coil shall be controlled by a separate thermal expansion valve.

5. Direct Expansion Primary Air Indoor Units

a. DX PAUs shall be ceiling mounted as indicated on Drawing or specified in the equipment schedule;

b. The DX PAUs shall be of draw-through, concealed ceiling mounting type, unless otherwise specified or indicated on the Drawings;

c. Fan wheels shall be statically and dynamically balanced. Fans shall be directly driven by high efficiency motor with thermal overload protection;

d. The DX PAUs shall be completely fabricated and assembled in factory as the corresponding condensing unit. All of its components and accessories shall be designed and selected as to match in characteristic, function and duty as the respective condensing unit so as to achieve an overall optimum system performance under all operation conditions;

e. All ducts connected to the DX PAUs shall be completed with flexible connection;

f. In selecting the DX PAUs, the Contractor shall allow for the actual resistance imposed on the air flow of the units due to air ducts, air grilles. The external static pressure of the unit is to be taken as a minimum of 150 Pa and suit the system pressure characteristics. The Contractor shall submit calculations to prove the selection is correct;

g. Air filters shall be non-combustible and of the washable type.

6. Air-Cooled Condensing Units

a. Air-cooled condensing units shall be suitable for outdoor installation. The condensing unit shall include compressors, air-cooled condensing coils, fans and motors, control and safety devices, piping and all necessary accessories factory assembled in a weather-proof casing;

b. Compressors shall be scroll / rotary and semi-hermetic / hermetically sealed type. Compressors shall be completed with internal motor protection, positive lubrication, mufflers, and internal and external vibration isolation. Each condensing unit shall connect to one or two direct expansion indoor units;

c. Condenser coil shall be of the non-ferrous finned tube type and fans shall be of the propeller / centrifugal type arranged for horizontal / vertical discharge as specified in the Equipment Schedules. The refrigerant circuits shall be field connected to the matched DX PAUs completed with refrigerant driers of the renewable cartridge type together with isolating valves and bypass circuit for split A/C of 5 h.p. or above.

7. Automatic Control

a. The DX PAUs shall be operated automatically via 7-day 24-hour timer with manual override bypass switch.

8. Casing

a. Casing of indoor units and DX PAUs shall be constructed of sheet steel and suitably reinforced with channels and sections to form a robust cabinet;

b. Casings for outdoor installation shall be weatherproof finish. Removable panels shall be provided to give access to all working components, parts, and connections for installation and service. The compartment housing the direct expansion coil and blower shall be adequately insulated to prevent sweating and shall contain a suitable drip pan with a drain connection. The compartment housing the compressor shall be treated for sound insulation. The drain pan of outdoor unit shall be sealed up to avoid water dripping.

9. Refrigerant Pipes

a. Refrigerant pipes for DX PAUs shall be of coiled copper to BS EN 12735-1: 2016 or equivalent standard and no joint shall be provided between indoor and outdoor unit. The copper piping and fittings shall be particularly suitable for use with the corresponding refrigerant.

10. Condensate Drain Pipe

a. In general, condensate drain pipe passing through non-fire rated structure shall be of UPVC pipes to BS 3505. Condensate drain pipe passing through fire rated structure shall be Galvanized steel pipes to BS 1387, Medium Grade where is suitable and complying with the fire separation requirement.

11. Installation Particulars

a. All installation shall be materially, structurally, electrically and otherwise safe and shall be carried out to ensure satisfactory operation of the units under all conditions and in accordance with the manufacturer recommended method unless otherwise approved;

b. The mounting material for the DX PAUs shall match with the builder's works and approved by the CM;

c. All on-site installations including cables, cable clips, etc. shall comply with the relevant British Standards, the power company Supply Rules, the latest IET wiring regulations and the Electricity Ordinance Cap. 406;

d. Equipment and appurtenance shall be fitted to the space provided and made readily serviceable;

e. The supporting framework, brackets, hangers, bolts, and nuts for condensing units shall be made of stainless steel (Grade 304) in outdoor areas;

f. The Sub-Contractor shall be responsible for design, supply and install the supporting framework for the DX PAUs. The supporting framework shall be provided to achieve satisfactory installation, operation and maintenance of the condensing units under all condition and in according to the manufacturer recommendation unless otherwise approval;

g. Hot dip galvanised steel support beams, legs and hangers, anchor bolts, vibration isolator, ductworks, silencers, etc., for the proper installation of the DX PAUs as recommended by the manufacturer shall be installed;

h. After completion of testing on piping and accessories, the system shall charge with refrigerant in accordance with the manufacturer's published data;

i. Unit shall be adjusted so that it will operate without noticeable vibration after installation.

12. Noise Level

a. The manufacturers' test report on noise level shall be submitted to the CM for approval;

b. Noise measurement shall be made during the test to ascertain that noise level emitted during the period of DX PAUs system operation. It shall not exceed the limits imposed by Environment Protection Department and in accordance with the Noise Control Ordinance.

13. Control of DX PAUs System

a. The refrigerant pipes and control wirings linking the outdoor and indoor units shall be carried out by the Sub-contractor according to the Manufacturer's recommendations. The electrical part of the outdoor unit shall be of weatherproof type;

b. The remote controller for the indoor units shall be wall mounted type with liquid crystal display (LCD). The controller shall consist of an on-off switch, operational features including fan speed selection, timer setting, temperature setting, self-diagnosis function, auto-swing and auto restart function.

14. Other requirement

a. Pressure gauge, valve set, sight glass and dryer shall be provided to DX PAUs.

ELE31.4.040.N THERMAL INSULATION

1. General

a. Comprehensive insulation shall be provided for the MVAC system, refrigerant pipes, condensate drainage system, conditioned supply air system;

b. Insulation for pipework shall be of sufficient thickness to avoid occurrence of condensation. The Sub-contractor shall ensure that all the insulation supplied and installed in this project shall not use any CFC and HCFC in the entire process of manufacturing. Certificate and guarantee and proof from the manufacturer to substantiate that the products are non-CFC related and the CM shall reserve the right to inspect the factory and the product will be rejected if CFC and HCFC is found to be used during the manufacturing process;

c. Insulation shall be provided for all valves and accessories.

2. Thermal insulation - air ducts

a. Minimum 25 mm thick 32 kg/m^3 density long fibre fibreglass or meeting the requirements in the latest edition of the Code of Practice for Energy Efficiency of Building Services Installation whichever is greater;

b. Comply with B.S.476: Part 6 and approved by local FSD, including the associated fasteners, adhesives, tapes, etc.;

c. Provided with moisture resistant facing with glass fibres bonded together with thermosetting resin;

d. With air stream surface protected by black pigmented, fire resistant coating tightly bonded to the surface fibres to resist damage for an air velocity up to 30 m/second;

e. Of maximum thermal conductivity 0.035 W/m°K at 25°C mean temperature and maximum moisture absorption 0.2% by volume;

3. Thermal insulation – refrigerant pipework and condensate drain pipe

a. Type "D" – flexible closed cell elastomeric insulation to General BS Specification or meeting the requirements in the latest edition of the Code of Practice for Energy Efficiency of Building Services Installation whichever is greater;

b. Comply with BS 476: Part 7 Class 0 surface spread of flame and approved by local FSD, including the associated fasteners, adhesives, tapes, etc.;

4. The refrigerant pipes (liquid line and gas line) shall be insulated separately and the thickness and material of the insulation shall comply with the latest edition of the Code of Practice for Energy Efficiency of Building Services Installation, issued by the Electrical and Mechanical Services Department and the latest FSD circular letters, with a minimum thickness of 25mm;

5. All insulation for refrigerant pipe and condensate drain pipe installed at indoor exposed to view or at external shall be properly protected with mechanical means such as aluminium sheet cladding or slim duct cover with all joints sealed.

ELE31.4.050.N TESTING AND COMMISSIONING

1. All tests shall be carried out in accordance with this Specification and the following documents where applicable:

a. Section 6 of the General Specification for Building Services Installation in Government Buildings of the Hong Kong Special Administrative Region published by Architectural Services Department, Hong Kong;

b. Testing and Commissioning Procedure for Air conditioning, Refrigeration and Mechanical Ventilation Installation in Government Buildings of the Hong Kong Special Administrative Region published by Architectural Services Department, Hong Kong.

2. Bear all costs associated with the testing and commissioning procedures including materials, labour, instruments and provisions of all necessary test points by the Sub-contractor. Such costs shall also include the cost of making good any defects arising out of such tests and having the work re-tested. In the case of off-site, all other incidental costs shall also be included;
3. Testing and commissioning shall also be required for all temporary works;
4. All tests shall be carried out to the satisfaction of the CM and shall be witnessed by the CM or his representatives;
5. At least two months prior to the testing or commissioning of any system or process, the Sub-contractor shall furnish the following information to the CM for approval:
    a. Type of instrument to be used;
    b. Manufacture of instrument;
    c. Calibration methods for instrument;
    d. Operating instructions for instrument;
    e. Accuracy and tolerances of instrument;
    f. Proposed formats of testing and commissioning reports;
    g. Schedule and programme of testing and commissioning activities.
6. The Sub-contractor shall submit in triplicate the testing and commissioning reports / certificates for each system to the CM on work completion.

ELE31.4.060.N MAINTENANCE REQUIREMENTS OF ROOM AIR COOLERS AND DIRECT EXPANSION TYPE PRIMARY AIR HANDLING UNIT

1. The Works to be carried out under this Sub-contract shall comprise, but not be limited to the following:
    a. Routine operation and maintenance works;
    b. Repair and replacement work;
    c. Call out service.

    Details of these works are stipulated in the following clauses:

    i Routine Operation and Maintenance Works

    - The Sub-contractor shall carry out Tri-monthly routine operation and maintenance works as follows:
        - Clean the filters and check the filters in good condition. The cleansing of the air filters shall include soaking and disinfecting the air filters in a 1:99 diluted household bleach solution. No extra amount will be paid for the household bleach solution;
        - Paintwork is well maintained;
        - Check the room air coolers and DX PAUs in good and safe working condition.
    - The Sub-contractor shall, at least one month prior to commencement of the Maintenance Period, submit a Maintenance Schedule indicating the calendar weeks during which the routine services will be carried out;
    - After each visit, the Sub-contractor shall record the work on the "Maintenance and Service Record", which shall be certified by the officer-in-charge of the user's office.

    ii Repair and Replacement Works

- Pursuant to sub-clause 1, unless directed by the CM or his representatives, the Sub-contractor is obliged to repair the defective room coolers and DX PAUs. The repairs shall include any replacement needed for a satisfactory repair and any work that may be necessary to maintain the efficient performance and satisfactory condition of the room coolers and DX PAUs including the supply of materials, labour and transportation;
- Should the Sub-contractor find it necessary to remove faulty room cooler(s) and DX PAU(s) to his workshop for repair or should the repair work be unable to be carried out pending the delivery of spare parts, the Sub-contractor shall at the request of the CM or his representatives supply and install temporary serviceable room cooler(s), free of charge to the Employer, in order to avoid prolonged interruption of air-conditioning supply to the users;
- In addition, the Sub-contractor may at his own cost and at the request of the CM or his representatives install temporary room cooler(s) supplied by the Employer for emergency use while waiting for the repair of the faulty room cooler(s);
- Immediately after the checking of the defective room coolers and DX PAUs, the Sub-contractor should immediately report to the CM or his representatives the status of the room coolers and DX PAUs whether they can be repaired or not. If affirmative that they are beyond repair, the Sub-contractor under the directives of the CM or his representatives shall immediately provide and install new room coolers and new DX PAUs for replacement of the defectives room coolers and DX PAUs free of charge. Under this condition, provision of temporary room coolers shall not be required.

iii Call Out Services

- The Sub-contractor may be ordered by the CM or his representatives or the user to attend fault / breakdown calls at no cost to the Employer. The call shall be attended by the Sub-contractor not later than the midday of the following day;
- For air-conditioning supply, it should be resumed within 3 working days (including the day of the call) from the day of fault attendance; otherwise, temporary room cooler(s) should be provided when required by the CM. After each visit, the Sub-contractor shall record the work on the “Maintenance and Service Record” which shall be certified by the officer-in-charge of the user’s office.

ELE32 GREEN ISSUE

ELE32.1 GREEN ISSUE REQUIREMENTS 2

ELE32.1.010.9 GENERAL REQUIREMENTS 2

ELE32.1 GREEN ISSUE REQUIREMENTS

ELE32.1.010.9 GENERAL REQUIREMENTS

The general requirements on green issues are specified in the Project Specific Specification.

ELE33 GRID-CONNECTED PHOTOVOLTAIC SYSTEM

ELE33.1 SCOPE OF WORKS AND GENERAL REQUIREMENTS 2

ELE33.1.010.9 GENERAL 2
ELE33.1.020.9 SCOPE OF WORK 2
ELE33.1.030.A STANDARDS 3
ELE33.1.040.9 SUBMISSION FOR TENDER ASSESSMENT 5
ELE33.1.050.A INFORMATION TO BE SUBMITTED BEFORE INSTALLATION AND UPON COMPLETION 5
ELE33.1.060.9 ARCHITECTURAL REQUIREMENTS 6
ELE33.1.070.9 STRUCTURAL REQUIREMENTS 6

ELE33.2 PHOTOVOLTAIC MODULES AND DC SOURCE CIRCUITS 7

ELE33.2.010.9 GENERAL REQUIREMENTS 7
ELE33.2.020.A TECHNICAL REQUIREMENTS 7
ELE33.2.030.A WARRANTY 8

ELE33.3 SOLAR CONVERSION SYSTEMS 10

ELE33.3.010.9 GENERAL REQUIREMENTS 10
ELE33.3.020.A TECHNICAL REQUIREMENTS 10
ELE33.3.030.X DELETED 12

ELE33.4 MONITORING & MANAGEMENT SYSTEMS 13

ELE33.4.010.9 GENERAL 13
ELE33.4.020.9 INDIVIDUAL MONITORING SYSTEM 13
ELE33.4.030.9 CENTRAL MONITORING & MANAGEMENT SYSTEM 13

ELE33.5 TESTING AND COMMISSIONING 15

ELE33.5.010.9 TESTING AND COMMISSIONING 15

ELE33.6 ANALYSIS SOFTWARE AND REPORT FOR SYSTEM OPERATION AND PERFORMANCE 16

ELE33.6.010.9 ANALYSIS SOFTWARE FOR SYSTEM OPERATION AND PERFORMANCE 16
ELE33.6.020.9 HALF-YEARLY REPORT ON SYSTEM OPERATION AND PERFORMANCE 16
ELE33.6.030.9 DOCUMENTATION & NOTICES 16
ELE33.6.040.A HAND-OVER DOCUMENTS 17
ELE33.6.050.A SCOPE OF WORKS DURING MAINTENANCE PERIOD 17

ELE33.1 SCOPE OF WORKS AND GENERAL REQUIREMENTS

ELE33.1.010.9 GENERAL

1. The works under this part of the Sub-contract shall include the whole of the materials and the labour as prescribed or as necessary for the design, supply and installation of the entire grid-connected photovoltaic system (hereinafter refer to as PV System) and training of personnel nominated by the Contract Manager. The photovoltaic (PV) modules shall be installed at the location(s) as shown on the Drawings or described hereafter;
2. The PV System shall include not only the plant and equipment shown on the Drawings or specified, but also include all the incidental sundry components, software and licences necessary for the complete execution of the works and for the proper operation and maintenance of the PV System;
3. The Sub-contractor shall employ a specialist contractor with proven experience in the design, installation and maintenance of PV system of a scale similar to that required by this Specification to carry out the works. Local qualified technical service team shall be available for maintenance and backup service after completion of works;
4. Manufacturers of major components of the PV System including PV modules and inverters shall be implementing quality and environmental management systems in accordance with ISO 9001 and ISO 14001 or other internationally recognized standards in the design, procurement and manufacturing processes.

ELE33.1.020.9 SCOPE OF WORK

The scope of works shall include:

1. Design, supply and installation of the PV System complete with PV modules as described in sub-clause (2) below, solar conversion systems, monitoring & management systems, interconnection & power distribution wirings and all other necessary equipment and accessories;
2. Provision of a total capacity of _____kWp (rated at Standard Testing Conditions according to IEC 60904) mono-crystalline silicon PV modules at the following location(s) (i.e. PV sub-system(s)) with respective capacities (kWp) as shown inside brackets:
   a. Upper roof of Block __ (____kWp);
   b. ……;
   c. ……;
   d. ……;
   e. …….

   The Sub-contractor should seek the CM's approval to install an alternative type of PV modules, other than mono-crystalline silicon PV modules, which shall comply with the specified capacity (kWp) mentioned above and ELE33.2;

3. Submission of schematic wiring diagrams of the PV System and all necessary equipment, which have been accepted by Power Company, for the CM's approval. Shop drawings indicatingsizes of PV modules, their mounting details, orientation, spacing and a calculation to demonstrate the monthly and annual power output profiles of the system shall be provided for the CM's approval before fabrication and installation;
4. Providing all necessary design drawings and technical data of the offered equipment including the synchronisation and de-coupling procedure of the PV System prior to installation;
5. Liaison with the power supply company for assessment and approval of the PV System design and equipment, and grid connection of the PV System. The Sub-contractor shall allow sufficient time in his programme for all necessary submissions and testing, and make modifications to the PV System as required by the power supply company before connection to the grid;
6. Payment of charges levied by the power supply company for the assessment of the PV System and connection to the grid for joining Feed-in Tariff (FiT) Scheme;
7. Testing, commissioning and putting the PV System into operation, and facilitating to join FiT Scheme to the satisfaction of the CM;
8. Except general cleansing of photovoltaic modules, the Sub-contractor shall provide servicing and maintenance of all equipment of the PV System including regular calibration of sensors and measurement equipment as recommended by the manufacturers during the Maintenance Period. Temporary replacement shall be provided for sensors / equipment removed for off-site calibration;
9. Provision of half-yearly maintenance servicing as required in ELE33.6. 050;
10. Provision of training to the CM's Representatives, estate management staff or other personnel as instructed by the CM for a total duration of six working days, on the testing & commissioning, operation and maintenance of the PV System. The training shall be conducted in three sessions, one before and one after commissioning of the PV System, and the remaining session shall be at the end of the Maintenance Period. Each training session shall be approved by the CM to cover any or all of the following topics:
    a. Testing & commissioning procedures;
    b. Operation and maintenance of the complete system including PV modules, Solar-energy Conversion System (SCS), etc.;
    c. Use of all software programmes of the monitoring & management system(s) and SCS for daily operation and monitoring of the PV System and the analysis of data collected.

ELE33.1.030.A STANDARDS

The International System of Units (SI) shall be used. The PV System shall be designed and installed in compliance with the Specification and the latest editions of the following standards and codes, including all latest amendments:

1. General Requirement for Electronic Contracts Specification No. ESG01 issued by the Electronics Division, Electrical and Mechanical Services Department;
2. Technical Guidelines on Grid Connection of Renewable Energy Power Systems issued by the Electrical and Mechanical Services Department;
3. BS EN 50618: Electric cables for photovoltaic systems;
4. BS EN 61140: Protection against electric shock. Common aspects for installation and equipment;

5. EN-ISO 4892: Plastics — Methods of exposure to laboratory light sources;
6. IEC 60364-7-712: Low Voltage Electrical Installations - Part 7-712: Requirements for Special Installations or Locations – Solar Photovoltaic (PV) Power Supply Systems;
7. IEC 60754: Test on gases evolved during combustion of materials from cables;
8. IEC 60891: Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics;
9. IEC 60904-1: Photovoltaic devices Part 1: Measurement of photovoltaic current-voltage characteristics;
10. IEC 60904-2: Photovoltaic devices Part 2: Requirements for photovoltaic reference devices;
11. IEC 60904-3: Photovoltaic devices Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data;
12. IEC 60904-4: Photovoltaic devices Part 4: Photovoltaic reference devices – Procedures for establishing calibration traceability;
13. IEC 60904-5: Photovoltaic devices – Part 5: Determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit voltage method;
14. IEC 60904-7: Photovoltaic devices – Part 7: Computation of the spectral mismatch correction for measurement of photovoltaic devices;
15. IEC 60904-8: Photovoltaic devices – Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device;
16. IEC 60904-8-1: Photovoltaic devices – Part 8: Measurement of spectral responsivity of multi-junction photovoltaic (PV) devices;17. IEC 60904-9: Photovoltaic devices – Part 9: Classification of solar simulator characteristics;
18. IEC 60904-10: Photovoltaic devices – Part 10: Methods of linear dependence and linearity measurement;
19. IEC 61034: Measurement of smoke density of cables burning under defined conditions;
20. IEC 61215-1: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: test requirements;
21. IEC 61215-1-2: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1-2: special requirements for testing of thin-film cadmium telluride (CdTe) based photovoltaic (PV) modules;
22. IEC 61215-1-3: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1-3: special requirements for testing of thin-film amorphous silicon based photovoltaic (PV) modules;
23. IEC 61215-1-4: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1-4: special requirements for testing of thin-film Cu(In, Ga)(S, Se)2 based photovoltaic (PV) modules;
24. IEC 61215-2: Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: test procedures;
25. IEC 61558: Safety of transformers, reactors, power supply units and combinations;
26. IEC 61683: Photovoltaic systems – Power conditioners – Procedure for measuring efficiency;
27. IEC 61701: Photovoltaic (PV) modules - Salt mist corrosion testing;
28. IEC 61724-1: Photovoltaic system performance – Part 1: Monitoring;

29. IEC 61727: Photovoltaic (PV) systems – Characteristics of the utility interface;
30. IEC 61730-1: Photovoltaic (PV) module safety qualification Part 1: Requirements for construction;
31. IEC 61730-2: Photovoltaic (PV) module safety qualification Part 2: Requirements for testing;
32. IEC 61829: Photovoltaic (PV) array – On-site measurement of current - voltage characteristics;
33. IEC TS 61836: Solar photovoltaic energy systems – Terms, definitions and symbols;
34. IEC 62109-1: Safety of power converters for use in photovoltaic power systems – Part 1: General requirements;
35. IEC 62109-2: Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters;
36. IEC 62116: Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures;
37. IEEE 519: Standard for harmonic control in electrical power systems;
38. IEEE 1547 & P1547: Standard for interconnection and interoperability of distributed energy resources with associated electric power system interfaces;
39. ISO 9050: Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors;
40. UL 1703: Standard for Flat-plate photovoltaic modules and panels;
41. UL 1741: Standard for Safety inverters, converters, controllers and interconnection system equipment for use with distributed energy resources;
42. VDEW Guideline for operating in-plant generating units in parallel with the power company's low voltage main.

ELE33.1.040.9 SUBMISSION FOR TENDER ASSESSMENT

The following information shall be submitted in the "Information to be Supplied by Tenderer" for tender assessment purpose:

1. Technical information of the proposed equipment for the PV System;
2. Schematic diagrams of the PV system;
3. A schedule of spare parts and tools required for servicing the installation after the expiry of the 2-year Maintenance Period;
4. The proposed specialist contractor for the design, supply, installation and maintenance of the PV System including his job references with details of system rating, installation completion dates, etc.

ELE33.1.050.A INFORMATION TO BE SUBMITTED BEFORE INSTALLATION AND UPON COMPLETION

1. The Sub-contractor shall submit the following information for the CM’s approval prior to the commencement of installation work on site:
    a. 3 copies of complete set of detailed shop drawings and calculation including the sizes and types of the proposed PV modules, mounting details, connection diagram, heat dissipation of equipment and simulated monthly and annual power output profiles of the PV System taking into account any shadowing effect due to nearby modules / structures / buildings;

b. 3 copies of shop drawings and specifications of the equipment / materials;

c. 3 sets of method statement of installation;

d. 3 copies of Manufacturer's Certificates of Origin, sensor / measurement equipment calibration certificates, test reports, reports for wind load withstanding capabilities of the PV modules and other relevant documents showing compliance with the Specification;

e. 3 sets of draft certificates of product warranty specified in ELE33.2.030;

f. 1 set of approved materials and accessories samples to be kept in the site office.

2. The Sub-contractor shall submit the PV System design and equipment for approval by the power supply company and shall program the submissions in such way as to allow sufficient time for both the power supply company and the CM to check and approve the design and equipment before installation;

3. The Sub-contractor shall submit upon completion of installation work on site:

a. 2 sets of all equipment / system software in CD-ROMs or DVDs and relevant software licences;

b. 3 sets of approved operation and maintenance manual including servicing and maintenance requirements recommended by equipment manufacturers, test reports with all equipment settings, name(s) of staff responsible for 24 hours on call service, schedule of spare parts and tools with indicative unit prices, etc. in both hard copy and electronic "pdf" format;

c. 3 sets of training manual in both hard copy and electronic "pdf" format.

ELE33.1.060.9 ARCHITECTURAL REQUIREMENTS

The design of the PV System shall take into consideration the various architectural characteristics including but not limited to the following:

1. The PV System shall be designed to fit into the designated areas with due regard for the visual appeal and green image;

2. The shapes, sizes, surface finishes and colours of the PV System elements, which constitute the main aesthetic characteristics of the PV System, shall be proposed by the Sub-contractor for approval by the Contract Manager.

ELE33.1.070.9 STRUCTURAL REQUIREMENTS

1. The supports and holding frames for the PV modules shall be of hot-dip galvanized steel and fixed by stainless steel bolts and nuts with spring washers supplied and installed by the Sub-contractor who shall also be responsible for the corresponding calculations to demonstrate the structural adequacy. The structural calculations shall be endorsed by a Registered Structural Engineer employed by the Sub-contractor and be submitted for approval by the Contract Manager prior to installation of the PV System supports / holding frames;

2. The supports / holding frames shall be designed and installed in such a way that any of the PV modules can be replaced without the need of dismantling any structural member or adjacent module;

3. Flat concrete plinths shall be provided by the Main Contractor above structural beams/columns for fixing of the PV module supports / holding frames by the Sub-contractor. The Sub-contractor shall be responsible for providing relevant information to the Contract Manager for the design of the concrete plinths.

ELE33.2 PHOTOVOLTAIC MODULES AND DC SOURCE CIRCUITS

ELE33.2.010.9 GENERAL REQUIREMENTS

1. The design and choice of photovoltaic (PV) modules and their mounting angle and/or direction shall be made in such way as to maximize the possible solar energy gain at their respective fixing locations;
2. The Sub-contractor shall design, supply and install PV modules, array combiners, circuit breakers, fuses, connectors, power cables, conduits, and other necessary equipment and accessories for integration with the solar conversion system(s) and monitoring & management system(s) to complete the PV System;
3. The Sub-contractor shall review the Drawings and conduct site visit to evaluate any possible shadowing effect due to nearby modules/structures/buildings, and to design the PV arrays and circuits in such way as to avoid/minimize interruption of power output from the PV strings due to shading between 9:00 a.m. and 3:00 p.m;
4. The PV arrays shall also be designed to avoid/minimize possible glare to occupants of nearby buildings;
5. The Sub-contractor shall submit for Approval his proposed lightning protection system to protect personnel and the PV System from lightning stroke and transient over-voltage;
6. Mounting holes on the PV modules shall be fully utilized for fixing the PV modules onto the supports and holding frames as recommended by the manufacturer using stainless steel bolts and nuts with spring washers. All mounting holes on the PV modules shall be of factory-made. Nevertheless, each PV module shall be fixed to the supports and holding frames by at least eight points. Should there be less than eight factory-made mounting holes on the PV module, additional panel fixing clamps shall be provided to ensure not less than eight points for fixing each PV module. The adoption of these fixing clamps should be endorsed by the manufacturer. The fixing method shall facilitate subsequent removal and reinstallation whenever necessary;
7. The Sub-contractor shall submit loading calculation (including wind load) endorsed by a Registered Structural Engineer to substantiate that the proposed PV module assembly (including the supports and holding frames, bolts and nuts with spring washers and fixing clamps for fixing PV module onto the supports and holding frames at the mounting points) can withstand any adverse weather conditions likely occurring in Hong Kong for CM's approval as required in ELE33.1.070 & ELE33.2.020;
8. Manufacturer(s) of the offered PV modules shall have proven experience in the production of the respective products and have an annual production capacity of 25MW or above. Manufacturer(s) shall also be member(s) of the PV Cycle Association.

ELE33.2.020.A TECHNICAL REQUIREMENTS

1. Mono-crystalline silicon PV modules complying with the following requirements shall be provided:
    a. PV module shall consist of tempered / heat-strengthened glass panel with solar factor greater than 0.91, solar cells and back supporting sheet with proper binding agent;

b. The front glass panel of PV module shall be appropriately treated to ensure solar light reflection of not more than 4% as determined by ISO 9050. For locations where specified in the Drawings and / or where the PV modules will produce glare to nearby building occupants upon completion of works, the front glass panels shall be of textured surface;

c. PV cells shall be of dark colour with optimised surface treatment;

d. PV module shall be sealed to protect against ingress of moisture and to ensure UV stability and electrical isolation;

e. The solar conversion efficiency of PV module shall be not less than 20% at Standard Testing Conditions in accordance with IEC 61215 and with a power tolerance not exceeding ± 3%;

f. The temperature coefficient for the power output of PV module shall not exceed -0.40% per ºC.;

g. The guaranteed performance of PV module shall be not less than:

i. linear degradation to 80% of the rated power output for 25 years.

h. PV modules assembly (including the supports and holding frames, bolts and nuts with spring washers and fixing clamps for fixing PV modules onto the supports and holding frames at the mounting points) shall be capable of withstanding the wind load at the location of installation, estimated according to the latest edition of the Code of Practice on Wind Effects in Hong Kong published by the Buildings Department;

i. Testing for wind load withstanding capability of PV modules such as wind tunnel test etc., if required by the Buildings Department / ICU, shall be in accordance with relevant national / international standards;

j. Wiring connection for PV modules shall be located at the back of each module using manufacturer's factory assembled cable connector.

2. Exposed wiring cables shall be of low smoke zero halogen and UV resistant type complying with IEC 61034, IEC 60754 and EN-ISO 4892 or other relevant national / international standards, suitable for an operation temperature of up to 90ºC and complete with weatherproof type prefabricated plug and socket cable connectors. Wiring cables in conduit or the like shall also be suitable for operation up to 90ºC;

3. All array combiners / junction boxes to be installed in external areas shall be of weatherproof type to IP55 minimum and shall complete with surge arresters. Detailed arrangement and sample of the junction boxes shall be submitted to the CM for approval;

4. Sizing of DC source circuit conductors and over-current protection devices shall take into account appropriate de-rating factors (e.g. peak module operating temperatures, grouping of conductors in conduit, etc.). Over-current device shall have trip rating not greater than the de-rated ampacity of the conductor that it protects;

5. The overall loss in the PV array DC source circuits due to losses across conductors, all fuses / circuit breakers, blocking diodes, termination points and other factors such as normal dust accumulation on PV modules shall be limited to not more than 10%.

ELE33.2.030.A WARRANTY

1. The Sub-contractor shall provide the following within 4 weeks from the date of completion of the Works:

a. A certificate of product warranty from each of the manufacturers of the Approved PV modules in favour of the Employer to warrant that their said respective products shall be free from any defect, failure, imperfection or fault and be capable of carrying out its functions for the respective periods of warranty as specified below:

Warranty aspects	Period of warranty
i. Free from any defect, failure, imperfection or fault	Ten years
ii. Capable of carrying out the power output and performance in accordance with ELE33.2.020 sub-clause 1(g)	Twenty-five years

2. Each of the periods of warranty stated above shall commence from the date of completion of the Works as certified by the CM in the certificate of completion but in the event of there being more than one certificate of completion, then from the date of completion of the Section of the Works in which the respective PV modules are situated as certified by the CM in the certificates of completion issued pursuant to Clause 53 of the General Conditions of the Main Contract. The Sub-contractor shall submit the content and format of the manufacturers' certificate(s) of product warranty for Approval as required in ELE33.1.050.

ELE33.3 SOLAR CONVERSION SYSTEMS

ELE33.3.010.9 GENERAL REQUIREMENTS

1. Solar-energy Conversion Systems (SCS) comprising grid connection type PV inverters, isolation transformer, AC and DC circuit breakers, sensor, wiring and other required equipment shall be provided for the PV System as shown on the Drawings. The installation shall comply with the prevailing requirements of the power supply companies. Separate SCS shall be installed to serve the PV sub-systems on the roofs of individual blocks and to provide a balanced 3-phase AC supply;
2. The SCS and other required equipment shall be located in the PV control rooms of individual blocks as shown on the Drawings. The Sub-contractor shall coordinate with other parties concerned and provide all necessary equipment, materials, protection / monitoring devices, control and wiring, etc. for integration of the PV System with the building power distribution system;
3. Where equipment are exposed to weather and subject to vandalism, proper enclosure complete with venting and weather sealing shall be provided to protect the equipment;
4. The Sub-contractor shall also supply and install equipment, such as energy meters and harmonic meters, etc. as required by the power supply company, to measure / monitor the generated solar power.

ELE33.3.020.A TECHNICAL REQUIREMENTS

1. Grid connection type SCS inverter shall comply with UL1741 or IEC62109, IEC61727 and IEC62116 or other equivalent international standards on grid connection requirements, and be capable of continuous operation over the range of voltage, current, and power output of the PV array connected;
2. SCS inverter shall have a "Mean Time Between Failure Index" of minimum 10 years and have separate provisions for power on / off, system reset and for communication with other equipment and monitoring system. The SCS inverter shall have a power management system to automatically control the power supply to the connected load;
3. SCS inverter shall possess the following:
    a. True sinusoidal output voltage of low harmonic distortion;
    b. Maximum Power Point Tracking (MPPT) function which shall be accurate and stable, and the adaptation efficiency shall be higher than 99%;
    c. Anti-islanding function;
    d. Capability of automatic adaptation to the solar power generation of PV modules so that no range selection by the installer shall be required.
4. The following protection shall be incorporated in SCS inverter:
    a. Continuous self-diagnosis by internal microprocessor;
    b. Monitoring of the grid and the PV string voltages;
    c. Monitoring of temperature of power switches and the output isolation transformer;
    d. Prevention of injection of direct current into the grid;

e. Supervision of all power stage transistors which shall be automatically switched off within a few milliseconds under fault condition. Fast response over-current detection for all transistors shall be used to guarantee maximum reliability in operation.

5. SCS inverter shall be self-commutated utilizing power electronics in a circuit topology suitable for meeting the specification with 3-phase or single-phase AC output. If three identical single-phase SCS inverters are offered for each PV sub-system, the design shall be such that supply currents are balanced over the three phases. The rating of each offered SCS inverter shall be capable of handling the available DC power input and other design requirements;

6. Characteristics of SCS inverter:

   a. Controller Type: Step-down converter;

   b. Bi-directional Sine-wave Inverter: IGBT-based pure-sinewave BI-modal inverter;

   c. Nominal output voltage: 380V 3-phase or 220V 1-phase; ± 6%;

   d. Utility service: Grounded wye;

   e. Output frequency: 50Hz (49.5 – 51Hz);

   f. Inverter efficiency: Minimum 97% EURO efficiency;

   g. Power factor shall be unity (1) at rated output;

   h. The total harmonic distortion (THD) of the normalized output current shall not exceed 5% at the point of the output of the PV system;

   i. Losses in the READY or STANDBY modes shall not be more than 10% of the total useful power output;

   j. Voltage fluctuation at the supply point due to the variation of PV system input shall not exceed 1%;

   k. Voltage fluctuation at the connection point of the Grid during synchronization operation shall be limited to below 3%;

   l. The negative phase sequence voltage at the supply point shall not exceed 1.3% of the positive sequence voltage in a 3-phase supply system;

   m. Voltage ride through capability to IEEE1547;

   n. Voltage-Reactive power and Voltage-Active power control mode to IEEE1547.

7. SCS inverter shall include the following modes of operation:

   a. On;

   b. Off;

   c. Standby.

8. SCS inverter shall automatically go to the standby mode if a fault occurs. If the fault is cleared, the SCS inverter shall automatically restart after a programmed time delay. The hardware protection shall include the following:

   a. AC surge protection;

   b. DC surge protection;

   c. Over-current protection and PV string isolation;

   d. Over-voltage and under-voltage protection.

9. The instrumentation and control of SCS inverter shall include the following:

   a. MPPT;

b. Automatic start-up when there is sufficient solar power;

c. Automatic turn-off when there is insufficient solar power.

10. SCS inverter shall possess connectivity in Modbus Protocol and provide the following signals for monitoring:

    a. Inverter On / Off / Standby;

    b. Power supply Normal / Fault;

    c. DC input current, voltage and instantaneous power;

    d. Instantaneous AC output current and voltage per phase, supply frequency, instantaneous output power and harmonics;

    e. MPPT status.

11. If any of the signals stipulated in sub-clauses (10.c) and (10.d) above is / are not available, separate meter(s) shall be provided to fulfil such requirements;

12. Anti-islanding protection shall be provided to ensure there is no supply of solar power to the building electrical distribution system in case of abnormality. The SCS shall be automatically disconnected from the electrical distribution system of the building concerned in the event that the utility supply voltage and / or frequency deviate outside the allowable limits persistently for a pre-determined period as agreed by both the CM and the power supply company, or when there is a fault or malfunction of the SCS. The SCS shall be completely isolated within 0.2 second or such period as required by the power supply company upon occurrence of the said abnormality / fault;

13. Overall circuit loss of the SCS other than those through the SCS inverters shall be not more than 2%;

14. Isolation Transformer

    Isolation transformers in compliance with IEC 61558 or equivalent shall be provided to avoid direct current flowing into the grid;

15. Sensors

    Sensors for global irradiation and PV module operating temperature shall be provided for PV System diagnostic. The sensors shall be connected to a sensor gateway (virtually a Pulse to Modbus Converter) which can transform pulses to signals in Modbus protocol for connecting to the data gathering unit;

16. PV string cables, PV array cables and PV DC main cables shall be reinforced or double-insulated cables to BS EN 50618 or equivalent. DC connectors to IEC 61140 Class II or equivalent shall be used to protect against electric shock.

ELE33.3.030.X DELETED

ELE33.4 MONITORING & MANAGEMENT SYSTEMS

ELE33.4.010.9 GENERAL

1. The data of energy generation from the grid-connected PV sub-system on each block shall be monitored and recorded. A monitoring system consists of multi-function electronic meter as specified in ELE4.4.5.040, sensor gateway, SCS inverter, data gathering unit (DGU), communication network and necessary accessories shall be provided for the PV sub-system of each individual block;
2. The data collected by DGU on each block shall be transmitted to the central monitoring & management workstation of the Smart Meter Monitoring and Energy Information Display System in the Estate Management Office (EMO) as specified in ELE35.2. The operation data of each PV sub-system shall be collected for analysis and the energy information shall be displayed on the LED TV display panel at the main entrance lobby of each domestic block as specified in ELE35.3;
3. The Sub-contractor shall provide all necessary equipment, wiring and accessories to complete and interconnect the SCS inverter, sensor gateway and multi-function electronic meter at each PV sub-system to the DGU via RS485 in Modbus protocol for data collection;
4. Provisions shall be allowed to prevent interruption of signal/data transmission of the monitoring & management systems through underground cables under adverse weather conditions.

ELE33.4.020.9 INDIVIDUAL MONITORING SYSTEM

1. Measurement equipment with good accuracy and reliability shall be provided and appropriately sited to collect the following data for performance monitoring:
   a. Global irradiation at inclined angle of PV modules;
   b. PV module operating temperature.
2. Multi-function electronic meters shall be provided for each PV sub-system to record its cumulative power output at the point of grid connection to transmit to the DGU;
3. Operation data including alarm/fault statuses of the SCS inverters of each PV sub-system shall be transmitted to the DGU which shall be capable of capturing all the data required at a sampling frequency of 15 minutes;
4. Data collected by the DGU shall be transmitted to the central monitoring and management workstation via network. Each data shall be time stamped and processed by the System software in the central monitoring and management workstation as specified in ELE35.2.010;
5. The information of the individual PV sub-system shall be displayed in both Chinese and English in the LED TV display panel as specified in ELE35.3.030;
6. All equipment exposed to weather shall be of weatherproof type to IP55 minimum.

ELE33.4.030.9 CENTRAL MONITORING & MANAGEMENT SYSTEM

1. The operation data and signals of the individual PV sub-system shall be transmitted to the central management and monitoring workstation as specified in ELE35.2.010;

2. The operation data and signals shall be collected from each PV sub-system for storage and analysing by the System software in the central monitoring & management workstation. The System software as specified in ELE35.2.030 shall also be capable of producing reports for:

    a. Operation conditions and alarms of each PV sub-system and respective trend histories including:

        i. On/Off/Standby status;

        ii. Power supply Normal/Fault condition;

        iii. DC input current, voltage and instantaneous/cumulative power;

        iv. Instantaneous AC output current and voltage per phase, supply frequency, instantaneous/cumulative output power and harmonics;

        v. Total output power each day;

        vi. Maximum output power each day;

        vii. Minimum output power each day;

        viii. Total running time;

        ix. Sun Hour of each day;

        x. Cumulative Sun Hour;

        xi. Maximum Power Point Tracking (MPPT) status.

    b. Performance indicators of each PV sub-system and respective trend histories including:

        i. Daily, weekly, monthly and yearly yield;

        ii. Daily, weekly, monthly and yearly performance ratio;

        iii. Cumulative output power, corresponding electricity cost saving.

    c. Sensor data collected by each PV sub-system and respective trend histories including:

        i. Global irradiation at horizontal level;

        ii. PV module operating temperature.

ELE33.5 TESTING AND COMMISSIONING

ELE33.5.010.9 TESTING AND COMMISSIONING

1. The Sub-contractor shall carry out all necessary testing and commissioning work upon completion of the installation of the PV System;
2. Verification tests shall be performed in the presence of the CM or his representatives and if necessary, with the power supply company's representatives on all metering, protection, communication and control equipment/system. The harmonic voltage, current distortion and voltage fluctuation as a result of the connection and isolation of the PV System shall be measured. Testing of protection and synchronising systems shall include individual device settings and function. A copy of the test results and all protection settings shall be submitted to the CM for further transmission to the power supply company for approval;
3. The Sub-contractor shall prepare itemized and detailed testing and commissioning schedules for the CM's approval prior to commencing the tests;
4. The Sub-contractor shall carry out preliminary tests to his own satisfaction before arranging for any formal witness test;
5. Unless otherwise indicated, the Sub-contractor shall be responsible for the cost of necessary instrument, plant and labour for all tests, including those witness tests in the presence of the representatives from the power supply company;
6. The Sub-contractor shall carry out all such tests as required by the CM to demonstrate that each item of equipment meets the requirements of the Specification;
7. Valid calibration certificates of testing instruments shall be produced upon request by the CM. The accuracy of testing instruments shall also be demonstrated if directed by the CM irrespective of whether valid calibration certificate is available;
8. Any defects of workmanship/materials, mal-adjustments or other irregularities which become apparent during tests and may affect the test results shall be rectified by the Sub-contractor and the tests shall be repeated at the Sub-contractor’s expense before acceptance by the CM.

ELE33.6 ANALYSIS SOFTWARE AND REPORT FOR SYSTEM OPERATION AND PERFORMANCE

ELE33.6.010.9 ANALYSIS SOFTWARE FOR SYSTEM OPERATION AND PERFORMANCE

1. The Sub-contractor shall enable the System software as specified in ELE35.2.030 for generating reports on the PV System operation and performance basing on the data downloaded from data gathering unit (DGU). The reports shall cover information required in ELE33.4.030 for a rolling period of 12 months;
2. The System software shall be capable of automatically capturing the data downloaded from the DGU for generating the required reports;
3. Format of report shall be submitted to the CM for approval before completion of the PV System installation.

ELE33.6.020.9 HALF-YEARLY REPORT ON SYSTEM OPERATION AND PERFORMANCE

1. The Sub-contractor shall submit reports generated by the System software as specified in ELE35.2.030 to the CM on half-yearly basis for the 24 months after completion of installation and grid connection of the PV System;
2. Each report shall cover a rolling period of the past 12 months and shall be submitted within one month from the last day of the 6-month period concerned.

ELE33.6.030.9 DOCUMENTATION & NOTICES

1. Labelling of Cables:
   a. Machine-printed, self-laminating vinyl for cabling and patch cords;
   b. Backbone cables shall be labelled at each end. The cable or its label shall be marked with its identifier;
   c. All cables shall be labelled with numbered markers at both ends.
2. Labelling of Faceplates:
   a. An unique identifier shall be marked on each faceplate to identify it as connecting hardware;
   b. Each port on the connecting hardware shall be labelled with its identifier.
3. Notices & Circuit Diagrams:
   a. Appropriate warning notices shall be displayed near DC switchgears and at all electrical equipment with dual power supply according to 17G of the Electrical CoP;
   b. Notice showing the name and registration number of the registered electrical contractor for maintaining each PV sub-system shall be displayed according to 17G of the Electrical CoP;
   c. The PV sub-system circuit diagrams to ELE 1.10.030 shall be displayed near the main switch of the PV sub-system.

ELE33.6.040.A HAND-OVER DOCUMENTS

The Sub-contractor shall provide all necessary documents and software required for the operation and maintenance of the grid connected PV System and shall include but not be limited to the following:

1. Certification and warranties from manufacturers of all major equipment, devices and materials;
2. As-fitted drawings of PV panel installation and PV equipment room;
3. As-fitted schematic diagram of the PV System and sub-systems;
4. Cabling inventory record and connection details;
5. 3 sets of approved Operation and Maintenance manuals including servicing and maintenance requirements recommended by equipment manufacturers and the PV specialist contractor, full test reports of the PV System and sub-systems and all equipment, system settings, all routine operation procedures, reports and graphics generation procedures, maintenance and inspection schedules, necessary tools, system diagnosis, system reset and restoring operation procedures, etc. in both hard copy and electronic "pdf" format;
6. Company name, responsible persons, email addresses and telephone contacts of the PV specialist contractor;
7. Form WR1 for PV System;
8. The connection cable and software for data retrieval via multi-function electronic meter as stipulated in ELE4.4.5.040;
9. As-built record of supporting frame and design calculation with responsible RSE's endorsement.

ELE33.6.050.A SCOPE OF WORKS DURING MAINTENANCE PERIOD

The Sub-contractor shall carry out all necessary routine maintenance work of the grid connected PV System and sub-systems in accordance with the requirements as specified in ELE30.2 where applicable and shall include but not be limited to the following:

1. To despatch competent and specially trained workmen to attend any requirement for an emergency inspection and repair;
2. To carry out, at half-yearly intervals, routine servicing and maintenance to maintain the PV System and sub-systems in proper working condition within the Maintenance Period;
3. To provide repairs and replacement parts at no additional cost to the Employer for the correct operation of the PV System;
4. To clean the PV modules with water to remove dust, debris and other contaminants on the module surface on a quarterly basis;
5. Half-yearly Maintenance Servicing

   At six month intervals or otherwise specified, the following works shall be carried out and the Sub-contractor shall log and submit a report to the CM after each servicing:

   a. Check proper functioning, cable connections and structural stability of the PV panels and array combiner boxes at each PV sub-system on roofs of domestic blocks and proper functioning and cable connections of the SCS inverters, isolation transformer, sensors and sensor gateway, multi-function electronic meter and AC and DC switchgears for each PV sub-system at PV equipment rooms in accordance with the following list of maintenance work:

Components / equipment	Description	Action
PV Modules	Warning notice inspection	Check for warning signs and labels and replace if necessary
	PV module inspection	Check PV modules, junction boxes, cables and connectors for damage, such as burn marks, bubble formation, cracking, broken glass, discoloration, corrosion, etc.
		Check for any loose cable connection
Supporting Frames and Structures	Supporting system inspection **(Remark 1)**	Check integrity of the penetration, physical connections and fixing components to make sure each PV module is securely fixed
	Corrosion inspection	Check all hardware for signs of corrosion and remove rust; re-paint and replace if necessary
PV Arrays	Array inspection **(Remark 1)**	Check for abnormal position and movement of PV arrays
DC Side of System	Warning notice inspection	Check for warning signs and labels and replace if necessary
	Cable inspection	Check cable for signs of cracks, defects, pulling out of connections, loose connections, overheating, arcing, short or open circuits, and earth faults
	DC disconnect switch / circuit breakers inspection	Check position of disconnect switches and circuit breakers and fuse status
	Combiner box inspection	Check for corrosion, intrusion of water or insects
Inverters	Warning notice inspection	Check for warning signs and labels and replace if necessary
	Dust removal from heat rejection fins and ventilation fan if provided	Check ventilation conditions and clean the dust of inverter cabinet
	Cable wiring inspection	Check for loose cable connections
	Functional test	Check functionality such as automatic disconnection upon loss of grid power supply
AC Side of System	Warning notice inspection	Check for warning signs and labels and replace if necessary
	Cable inspection	Check cable for signs of cracks, defects, pulling out of connections, loose connections, overheating, arcing, short or open circuits, and earth faults
	Distribution board inspection	Check for corrosion, intrusion of water or insects

Components / equipment	Description	Action
	AC disconnect switch / circuit breakers inspection	Check position of disconnect switches and circuit breakers and fuse status
Isolation Transformer	Warning notice inspection	Check for warning signs and labels and replace if necessary
	Isolation transformer inspection	Inspect the conditions of isolation transformers and clean the dust from heat rejection fin
	Functional test	Check the primary and secondary voltage / current / power / frequency, carry outinsulation test
Earthing Protection System	Warning notice inspection	Check for warning signs and labels and replace if necessary
	Visual inspection	Check earthing conductor conditions and any loose connections
Lightning Protection System	Warning notice inspection	Check for warning signs and labels and replace if necessary
	Visual inspection	Check bonding conductor conditions and any loose connection
Instrument	Instrument inspection	Check the monitoring devices to make sure they are operational
	Instrument calibration	Calibrate or replace sensors and meters

Remark 1:

Precautionary measures against damage to PV system, when there is any type of typhoon signal raised by Hong Kong Observatory, visual inspection before and after typhoon shall be carried out by the Sub-contractor to make sure the system is in safe conditions.

b. Rectify / replace any defective or mal-functioning parts;

c. Print half-yearly report on system operation and performance as specified in ELE33.6.020.

ELE34 GRID-BACKUP SOLAR POWERED LIGHTING

ELE34.1 SCOPE OF INSTALLATION 2
ELE34.1.010.9 SCOPE OF WORK 2
ELE34.2 REQUIREMENTS 3
ELE34.2.010.9 GENERAL REQUIREMENTS 3
ELE34.2.020.9 TECHNICAL REQUIREMENTS 3

ELE34.1 SCOPE OF INSTALLATION

ELE34.1.010.9 SCOPE OF WORK

1. Grid-backup solar powered pole top lighting(s) shall be provided at the location(s) as shown on the Drawings for general lighting purpose;
2. Training shall be provided to the Contract Manager's representatives, estate management staff or other personnel as instructed by the Contract Manager for the proper operation and maintenance of the grid-backup solar powered lighting.

ELE34.2 REQUIREMENTS

ELE34.2.010.9 GENERAL REQUIREMENTS

1. Each pole top lighting shall consist of a hot-dip galvanized lighting pole, lamp source, photovoltaic (PV) module(s), battery set and charger, inverter, changeover contactor and other necessary equipment and accessories to ensure proper functioning of the lighting at the time required under all weather conditions;
2. Electrical power generated by the PV module(s) shall be used for charging the battery set and powering the lamps. If power of the battery set has dropped to a low level, normal supply shall automatically cut in to power the lamps;
3. Lighting pole shall be painted to colour matching with the surrounding and as approved by the Contract Manager;
4. PV module shall be mounted on lighting pole top as far as practicable to receive the most amount of sunlight;
5. Pole top lighting shall be switched on and off through the timer or photocell control of other outdoor lightings in its vicinity;
6. Battery set and charger, inverter, changeover contactor and other necessary equipment shall be housed in a well ventilated stainless steel box of grade 316, integrated with or separated from the lighting pole, with adequate access for maintenance and suitable for outdoor use;
7. The Sub-contractor shall submit all relevant details including proposed lighting pole mounting arrangement for Approval before fabrication and installation of the pole top lighting(s);
8. The Sub-contractor shall submit, upon completion of the installation work, 3 sets of approved operation and maintenance manual including servicing and maintenance requirements recommended by manufacturers and schedule of spare parts and tools with indicative unit prices, etc. in both hard copy and "pdf" format.

ELE34.2.020.9 TECHNICAL REQUIREMENTS

1. Lamp source of each pole top lighting shall be of _____ type rated at ___W and shall comply with relevant requirements in other parts of the Specification;
2. PV module(s) of each pole top lighting shall be of mono-crystalline silicon type with a total capacity of ___Wp minimum. Specifications of the PV module(s) shall comply with the requirements in ELE33.2;
3. Battery set shall be of sealed (valve regulated), maintenance-free, lead acid type to IEC 61427 or other relevant national/international standards and with a capacity, when fully charged, to power continuously the lamp source for 18 hours;
4. Lighting pole shall be of __m high and shall comply with relevant requirements in other parts of the Specification;
5. Anti-glare provision shall be included to prevent possible nuisance to occupants of nearby domestic flats in accordance with relevant requirements of BEAM-Plus.

ELE35 SMART METER MONITORING AND ENERGY INFORMATION DISPLAY SYSTEM FOR DOMESTIC BLOCKS

ELE35.1 SCOPE OF WORKS AND GENERAL REQUIREMENTS 2

ELE35.1.010.9 GENERAL 2
ELE35.1.015.9 SPECIALIST SERVICE PROVIDER 2
ELE35.1.020.9 SCOPE OF WORKS 2
ELE35.1.030.A FUNCTIONAL REQUIREMENTS 3

ELE35.2 SMART METER MONITORING AND MANAGEMENT SYSTEM. 5

ELE35.2.010.A CENTRAL MONITORING AND MANAGEMENT WORKSTATION 5
ELE35.2.020.9 DATA GATHERING UNIT 6
ELE35.2.030.9 SYSTEM SOFTWARE 7
ELE35.2.040.9 COMMUNICATION NETWORK AND CABLING SYSTEM 8
ELE35.2.050.A DEDICATED BROADBAND LINE 9
ELE35.2.060.9 DIGITAL WATER FLOW METER 9

ELE35.3 ENERGY INFORMATION DISPLAY SYSTEM 10

ELE35.3.010.A GENERAL 10
ELE35.3.020.A LED TV DISPLAY PANEL 10
ELE35.3.030.A DISPLAY REQUIREMENTS 10
ELE35.3.040.9 SIGNAGE CONTENT MANAGEMENT 11

ELE35.4 MISCELLANEOUS 13

ELE35.4.010.9 DOCUMENTATION 13
ELE35.4.020.9 TESTING AND COMMISSIONING 13
ELE35.4.030.9 HAND-OVER DOCUMENTS 13
ELE35.4.040.9 TRAINING 14
ELE35.4.050.9 SCOPE OF WORKS DURING MAINTENANCE PERIOD 14

ELE35.5 DATA COLLECTION POINT SCHEDULE AND DATA REPORT 16

ELE35.5.010.9 DATA COLLECTION POINT SCHEDULE 16
ELE35.5.020.9 DATA REPORT 17
ELE35.5.030.9 MULTI-FUNCTION ELECTRONIC METER DATA REPORT FOR ENERGY MEASUREMENT FOR COMMUNAL AREA OF DOMESTIC BLOCK 18

ELE35.1 SCOPE OF WORKS AND GENERAL REQUIREMENTS

ELE35.1.010.9 GENERAL

1. The works under this part of the Sub-contract shall include the whole of the materials, the labour and necessary software as prescribed or as necessary for the design, supply, delivery, installation, testing, commissioning and maintenance of the entire Smart Meter Monitoring and Energy Information Display System (hereinafter refer to as the System); putting the whole system into full operation as stipulated on the Drawings and the Specification; and training of personnel nominated by the CM. The System shall be capable of receiving, monitoring and processing the parameters of the power supply systems of domestic blocks and their communal facilities including, but not limited to, power distribution to tenants, lift systems, water supply system, lighting system, grid-connected photovoltaic (PV) system, water and gas consumptions etc.;
2. The Sub-contractor shall design, supply and install the System and the selection of proper, correct and compatible equipment, components and interfacing unit to achieve the performance specified. Any equipment necessary for achieving the performance specified shall be provided by the Sub-contractor. Detailed design layouts and full technical information of the System shall be submitted for approval by the CM;
3. The System shall include not only the plant, equipment and software specified, but also include all the incidental sundry components, conduit / wiring system, data/communication networks and licences necessary for the complete execution of the works and for the proper operation and maintenance of the whole System.

ELE35.1.015.9 SPECIALIST SERVICE PROVIDER

1. The Sub-contractor shall employ a specialist service provider with proven experience in the design and installation of systems of similar functions and scale to that required by this Specification to carry out the works;
2. The specialist service provider shall have a local qualified technical services team for maintenance and backup after completion of works;
3. The specialist service provider shall be a System Integrator certified by the supplier / authorised local dealer of the proposed Data Gathering Unit (DGU) as specified in ELE35.2.020;
4. The Sub-contractor shall submit the specialist service provider's relevant information related to their technical capability, working experience on the System to the CM for approval. Whenever necessary, the Sub-contractor shall also submit documents and drawings of the specialist service provider’s completed jobs to the CM for consideration. Inspection of their completed jobs and /or visiting of the proposed specialist service provider's office and workshop may be conducted, if deemed necessary;
5. At the time of submission for approval of specialist service provider and in the operation and maintenance manual, the Sub-contractor shall provide company names, responsible persons, email addresses and telephone contacts of at least three (3) System Integrators, certified by the supplier / authorized local dealer of the proposed DGU, who are able to provide system operation and programming of the DGU utilizing the System Software as specified in ELE35.2.030.

ELE35.1.020.9 SCOPE OF WORKS

The scope of works shall include:-

1. Design, supply, and installation of the System complete with the following:
   a. Central monitoring and management workstation, completed with monitor, UPS and printer;
   b. Data Gathering Units (DGU);
   c. LED TV display panels and display interfacing units;
   d. Digital water flow meters;
   e. Communication network and cabling system;
   f. Dedicated broadband line wherever necessary, and;
   g. All necessary softwares including lifetime licenses.
2. The central monitoring and management workstation shall be located at the Estate Management Office (EMO) of the estate or as shown on Drawings, and shall include but not be limited to the following features:
   a. Dynamic graphic monitoring and control of operation parameters;
   b. Dynamic trend history report function;
   c. Utility cost management;
   d. Real time alarm management;
   e. Full password and user name protection;
   f. Set point archiving, retrieval and printing.
3. Design, supply and commission a customized System software and a tailored made signage content management software to perform all the required functions as described in the Specification;
4. Submission of schematic wiring diagrams of the System and all equipment for the CM's approval. Shop drawings indicating the design of the display arrangement of display panel shall be provided for the CM's approval before placing order and installation;
5. Testing, commissioning and putting into operation of the System to the satisfaction of the CM;
6. Provision of quarterly servicing including submission of data reports on the System operation and performance in the 24 months Maintenance Period;
7. Provision of training to the CM's Representatives, estate management staff and other personnel as instructed by the CM;
8. The System in this Sub-contract shall be independent of other smart meter monitoring and information display system(s) as installed or to be installed in other phases of the Estate, if so existed. The System will not provide connection or integration to other system(s) in other phase(s) of the Estate.

ELE35.1.030.A FUNCTIONAL REQUIREMENTS

1. The System shall be designed to perform the following functions in outline terms:
   a. To collect, store, monitor and analyse the electrical parameters of communal area and domestic flats of each domestic block as illustrated in ELE35.5.010, with a minimum of once every 15 minutes, for data processing and display purpose. These electrical parameters includes:
      i. Currents (three phases and neutral);
      ii. Total energy consumption (kWh);
      iii. Total energy generation (kWh);
      iv. Voltages (all phase-to-phase and phase-to-neutral);
      v. Maximum demand (kVA);
      vi. Total power factor;

vii. Total harmonic distortion of current (capable of measuring 31st and lower harmonic order) (%), etc..

b. To collect, store and monitor fresh water consumption data of each domestic block for data processing and display purposes;

c. To allow manual input of gas consumption data of tenants for analysis and display purposes;

d. To collect, store, monitor and analyse the electrical parameters of the power generated and the operational data and signals from the grid-connected PV sub-systems at the PV equipment rooms in each domestic block where provided as specified in ELE33.1, for data processing and display purposes;

e. To select and integrate the information / data as specified in ELE35.3 and transmit the video / media signals via communication network to the LED TV display panel located at main entrance floor lobby of each domestic block;

f. To provide a Uniform Resource Locator (URL), with access right to authorised person only by password protection, for viewing the energy information display output via web browsers and integration with the E-notice board system (by others) such that display sequence on the LED TV display panel could be modified at cloud services provided by the E-notice board system vendor;

g. To generate audio and visual alarms automatically in the event of major alarms, system faults and errors, communication line fault and failure of DGU etc. at the central monitoring and management workstation inside EMO of the estate;

h. To consolidate energy consumption data of tenant supply, water supply, public lighting, lifts, and low energy use systems as shown in ELE35.5.020 and ELE35.5.030;

i. To analyse the collected data and present the data in table, spread sheet and graph formats for energy monitoring and energy audit exercise in compliance with BEAM Plus, Buildings Energy Efficiency Ordinance (BEEO), Energy Measurement of ISO 50001 and others as required by the CM.

2. The Sub-contractor shall liaise with the Main Contractor and Fire Services and Water Pump (FSWP) Installation Sub-contractor on the installation of digital water flow meter at the fresh water pump room.

ELE35.2 SMART METER MONITORING AND MANAGEMENT SYSTEM

ELE35.2.010.A CENTRAL MONITORING AND MANAGEMENT WORKSTATION

1. The central monitoring and management workstation shall include server hardware equipped with full network connectivity and installed with softwares for database server, report generating, signage content management and firewall protection, etc., necessary for the proper operation of the System. An uninterruptible power supply, as specified in ELE24.3.9.050, capable of backing up the central monitoring and management workstation for a minimum of one hour operation upon failure of normal power supply shall be included, the Sub-contractor shall be responsible for the subscription and maintaining of the internet services for the entire period starting from testing and commissioning phase of the Works till the expiry of Maintenance Period;
2. The central monitoring and management workstation shall be capable of keeping the System operation and daily logged data from all blocks for a minimum of three years in Microsoft Excel format or equivalent for subsequent processing and analysis. 100% data backup capacity shall be provided by dual harddisks. The capacity of each hard disk shall be able to store all softwares and the three years data with at least 25% spare capacity or 2 TB total capacity whichever is larger. The system shall automatically store the logged and processed data in the harddisk and the backup to prevent accidental loss of data;
3. The central monitoring and management workstation shall generate audio and visual alarms in the event of system faults and errors, communication line fault, and failure of DGUs, digital water flow meter and multi-function electronic meters, as specified in ELE4.4.5.040, etc.;
4. The central monitoring and management workstation shall allow inputting and retrieving of various data for record, monitoring, processing, reporting, display, change of system settings, system diagnosis and all other necessary operations by system operators;
5. The central monitoring and management workstation shall possess with the following minimum hardware requirements whichever is higher:

Processor:	Four Core Chip minimum
CPU Speed:	3.4 GHz or above
Memory:	16 GB RAM or above
Storage harddisk:	Dual harddisks each with a 125% capacity for the required operation, or not less than 2 TB each whichever is higher
Monitor:	Minimum 22” 1920 x 1080 full High Definition LED display
Communications:	Ethernet 10 / 100 BaseT connection or equivalent
Accessory:	USB 3.0 or above port
Operating System and Software	MS Windows Servers and MS Office (Traditional Chinese) of latest versions

6. A laser colour printer shall be provided which can be shared with the printer requirement of other electrical system such as the central alarm and door monitoring system as specified in ELE24.3.5.020, provided that the workstations of both systems are located closely;

7. The System software and signage content management software installed in the workstation shall be compatible for use with the latest version of MS Windows Servers and be able to generate reports in MS Excel format basing on the data automatically downloaded from the DGUs;
8. All recorded data shall write to both hard disks for back up;
9. The central monitoring and management workstation shall connect to the DGUs and LED TV display panels at all domestic blocks in this Sub-contract via the communication network as specified in ELE35.2.040.

ELE35.2.020.9 DATA GATHERING UNIT

1. Data gathering unit (DGU) shall have its own microprocessor, memory and communication units. It shall be able to collect all data from digital water flow meters, multi-function electronic meters and PV system via RS 485 communication port in Modbus protocol, and then upload them to the central monitoring and management workstation via Local Area Network (LAN). Upon failure of the communication with the central monitoring and management workstation, it shall function autonomously and provide at least 7 days' data storage at the first-in first-out basis for all monitoring electrical parameters. All setup parameters and accumulated energy data such as total energy consumption (kWh), maximum demand (kVA), total power factor, usage time quantities shall be stored in non-volatile memory and retained in the event of a control power interruption;
2. All DGUs shall be linked together through a LAN bus. The LAN shall be Ethernet IEEE 802.3u 100BASE-TX, 100BASE-FX or equivalent latest version with data switch located inside EMO of the estate. The LAN bus shall allow equal transfer of data between each DGU on the bus. All DGUs shall be operated in parallel and have equal access to all data in the System;
3. Each DGU shall have a built-in display or tools to allow for direct-access to the DGU for local adjustment of all set points and display of all input and output values and status;
4. To ensure reliable communication between the central monitoring and management workstation and DGUs, a ring circuit wiring arrangement shall be adopted for the LAN;
5. DGUs shall be provided in each block for collecting data from multi-function electronic meters and digital water flow meter and located in the main switch room of each block;
6. DGUs for the System and for the grid connected PV system where provided as specified in ELE33.1, shall be of the same manufacturer;
7. All operation data of the grid connected PV system where provided as specified in ELE33.1, shall be collected, stored, monitored, and analysed by the central monitoring and management workstation. The analysed information of the PV system as described in ELE33.4 shall be displayed at the LED TV display panels at each block and monitored at the central monitoring and management workstation;
8. The supplier / local authorized agent of the DGU shall provide at least three (3) certified local System Integrators who are authorised to compose programming of the DGU and its associated System software as specified in ELE35.2.030.

ELE35.2.030.9 SYSTEM SOFTWARE

1. This section details the performance criteria for the System software and serves as a guideline for the System capabilities to be implemented. The customized System software for the entire System in the form of prototype specifically designed and prepared for the development shall be completed with demonstration to the satisfaction of the CM upon 6 months after the award of the Sub-contract. The Sub-contractor shall provide the System software to support all command functions and application programmes and shall satisfy the requirements as stipulated in the Drawings and Specification;
2. The System software, which shall be user friendly multi-tasking/multi-user allowing multi-terminal operation and concurrent execution of multiple real time programs, shall be an energy information system offering monitor capabilities, comprehensive power quality and reliable analysis for energy consumption. It shall create a database for analysing the electrical data transmitted from the DGUs connected to the network. It shall be flexible, scaleable and compatible with industry-standard Modbus protocol and the data protocols of the meters connected to the DGUs;
3. The System software for retrieving data from DGUs shall be an integrated product of the DGU by the same manufacturer. Lifetime license of the System software shall be available to the Employer;
4. The System software shall exercise all features of central monitoring and management workstation, DGUs, all associated devices/equipment and report all detected failures;
5. The System software shall perform a scanning test for proper operation of all connected DGUs at interval of not more than one hour. Devices not functioning properly or responsively shall be annunciated with alarm signal and noted on the log;
6. There shall be a minimum of three security levels of operator access. Each operator's identifier can be up to twenty (20) characters, and associated with a field programmable password of a minimum of six characters;

   The three levels of access shall be generally according to the following basic principles:

   a. Level 1: Display only;
   b. Level 2: Display plus download of designated data;
   c. Level 3: Display, download of any data, reset and amend passwords, etc. plus full program and data base editing.

   Operator inputs executed under valid system request shall be logged. This record shall contain the operator command and the time and date of input execution.
7. The System software shall include but not be limited to the following features/software capabilities:
   a. Human-machine interface (HMI) graphical display or equivalent in which user can insert any prevalent picture and photo formats, high definition video formats, icons, flash, html, etc. to design the user interface;
   b. Device configuration software to allow operators to add or deduct the quantity of energy meters and digital water flow meters in future;
   c. Data collection from DGU and data conversion to Microsoft Excel format or equivalent for subsequent processing, analysis and report generation;
   d. Trending: Graphical representation of user-selected data values as a function of time (data trending displays). The System software shall allow users to obtain accumulated figures (e.g. kWh etc.), average figures (e.g. kW, current etc.), line charts of the variation of kW, current, voltage, power factor, harmonic contents for any arbitrarily selected period;
   e. The ability to manage event and alarm information using the following features:

i. Display system, energy meter and PV system events stored in the system database;

ii. Display events sorted according to time stamp, source meter, PV system, priority level, cause or effect;

iii. Display events within a range of time stamps, source meters, priority levels, causes or effects.

f. Allowing manual input of user defined data such as tenants' gas consumption data for analysis and display purposes.

8. Dynamic data shall be automatically logged and updated at a pre-programmed interval of minimum 15 minutes;
9. The reports shall provide but not be limited to the following information on regular intervals such as daily, weekly, monthly, half-yearly, yearly and etc. as required:
   a. Monthly and annual electrical energy consumption of all tenants of each domestic block;
   b. Monthly and annual electrical energy consumption of communal area;
   c. Monthly and annual electrical energy generation of the grid-connected PV system of each block;
   d. Monthly and annual water consumption of each block;
   e. Monthly and annual gas consumption of each block.
10. The record format of the collected and processed data should be similar to the sample formats as shown in ELE35.5 and shall be submitted for approval by the CM;
11. All collected and processed data as described in ELE35.5 shall be tabulated, stored and able to be retrieved in excel format for manual processing if required;
12. The System software shall be capable of generating pop-up graphics in the event of major faults and failures as described in ELE35.2.010 sub-clause (3);
13. The System software shall able to be restored to its original conditions and settings by means of a rescue disk or appropriate backup in the event of system software breakdown, such that the whole system could be resumed to normal operation.

ELE35.2.040.9 COMMUNICATION NETWORK AND CABLING SYSTEM

1. A Local Area Network (LAN) providing connectivity between the central monitoring and management workstation, the DGUs and the LED TV display panels shall be set up and conform to the following network standards: Ethernet IEEE 802.3u 100BASE-TX and 100BASE-FX. The network shall comprise all necessary devices and components including Ethernet switches, routers, Cat-5e or Cat. 6 to fibre-optic patch panel, etc. and all interfaces and accessories as necessary which shall be commonly available in the market with good compatibility and connectivity among different brands or manufacturers;
2. For the interface of shielded twisted pair signal cables installation between the DGUs and multi-function electronic meters or digital water flow meters, the Sub-contractor shall provide interfacing termination boxes inside main switch room, PV equipment room and fresh water pump room where multi-function electronic meters and digital water flow meter are installed. Different specialist service providers shall terminate the required signal cables from their respective system to the above interfacing termination boxes;
3. The cabling system shall include fibre-optic cables, Cat-5e or Cat-6 cables, shielded twisted pair cables, cable containments equipment rack and all accessories as necessary for the System;
4. The cabling system shall generally conform to ANSI/EIA/TIA-569B Commercial Building Standard for Telecommunications Pathways and Spaces and ISO/IEC 11801 Information technology - Generic Cabling for Customer Premises;

5. The cables run in underground cable duct environment shall be with armoured protection and be manufactured by ISO Certified Manufacturers;
6. For each LAN connection with a cable length over 90 m, fibre-optic cables shall be employed.

ELE35.2.050.A DEDICATED BROADBAND LINE

1. The Sub-contractor shall provide dedicated broadband line subscribed from a Broadband Internet Service Provider (BISP) to provide a URL of energy information display output for future integration with E-notice board system;
2. For those blocks that cannot be connected to the communication network via cables as described in ELE35.2.040 due to the obstruction by a barrier, such as a public road inaccessible for cabling work, or other site constraint that disallow cabling work, the connection to these blocks shall be provided by dedicated broadband line subscribed from a Broadband Internet Service Provider (BISP). If dedicated broadband lines are provided for the central security system as mentioned in ELE24.3.5, the connection for the Smart Meter Monitoring and Energy Display System shall share the same dedicated broadband lines via routers;
3. Each broadband line shall conform to the following, unless otherwise specified:
   a. Minimum 8 Mbps bandwidth for both uploading and downloading;
   b. Single fixed IP;
   c. IP access right within estate between central monitoring and management workstation and DGUs / LED display panels;
   d. All Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) ports of broadband line shall be opened.
4. The Sub-contractor shall be responsible for the subscription and maintaining of the services at the EMO and the blocks for the entire period starting from testing and commissioning phase of the Works till the expiry of Maintenance Period. The details of the broadband connection services and the BISP shall be approved by the CM;
5. For all communication via broadband line, adequate data security shall be provided.

ELE35.2.060.9 DIGITAL WATER FLOW METER

1. Digital water flow meter shall be provided as shown on the Drawings. The installation of the digital water flow meter shall follow the manufacturer's recommendation and requirements such as the upstream and downstream pipe conditions;
2. The digital water flow meter shall be of clamp-on ultrasonic type, and of the cumulative type, i.e. a cumulative volume of water passing through the device in litre or cubic meter, and shall be suitable for both horizontal and vertical installations;
3. The digital water flow meter shall consist of flow transducers and integral signal transmitter cum digital display unit. The flow transducers shall be installed on the water pipework without obstructing the flow. The protection class of the transducers and transmitter shall be at least to IP 65;
4. The digital water flow meter shall have an accuracy to ±1.0% of the actual flow at a flow velocity of 0.5 m/s or above;
5. The digital water flow meter shall have network connectivity in Modbus protocol;
6. The transmitter cum digital display unit shall be enclosed in a lockable metal box.

ELE35.3 ENERGY INFORMATION DISPLAY SYSTEM

ELE35.3.010.A GENERAL

1. The energy information display shall include a LED TV display panel of minimum 43 inches with integrated stereo speakers, display interfacing unit and all peripheral devices and connections necessary for the proper operation of the display on LED TV display panel at the main entrance lobby of a domestic block;
2. The display panels shall display information, video and / or audio signals originated from the central monitoring and management system in the EMO of the estate;
3. The display panel shall be protected by a ventilated stainless steel / aluminium metal box with a front acrylic plastic. The stainless steel / aluminium metal box is shown in Standard Details Drawing no. STD/B/EL-229;
4. Installation details and shop drawings shall be submitted to the CM for approval prior to installation.

ELE35.3.020.A LED TV DISPLAY PANEL

1. The LED TV Display Panel shall be of the minimum requirements as below:

a.	Screen Size	43 inches minimum
b.	Aspect Ratio	16:9
c.	Resolution	High Definition1920 x 1080 p minimum
d.	Screen Enhancement	Anti-reflective coating
e.	Intensity	High display intensity
f.	Accessory	HDMI input

ELE35.3.030.A DISPLAY REQUIREMENTS

1. Information and signals in both Chinese and English to be displayed for each individual block shall include, but not be limited to, the following items:
   a. Average energy consumption (kWh/flat), water consumption (m^3/flat) and gas consumption (MJ/flat) by tenants in last month, and compared with data of same month of last year for each block, the whole estate, and / or average of all public rental housing estates in Hong Kong (subject to data availability);
   b. Average energy consumption (kWh/flat) for communal area in last month and same month of last year for each block;
   c. Monthly electricity, water and gas consumption by tenants of each block in past 12 months to be displayed in bar chart or curve format, etc.;
   d. Output power and energy generation information of PV system, where provided, include but not be limited to:
      i. Instantaneous output power of individual PV sub-systems;
      ii. Total output energy of the day;
      iii. Historical highest system output power;
      iv. Accumulated energy output.
   e. Date and time;
   f. Green information and / or video of various format provided by HA according to programmed schedule;

g. Green and educational information and/ or video of various format provided by other environmental organizations and bodies according to programmed schedule;

h. Input text signals;

i Weather forecast information obtained from the Hong Kong Observatory via internet.

2. The above information could be arbitrarily selected for display in each of the LED TV Display Panel with the aid of a tailor-made signage content management software to enhance the attractiveness of presentation to the tenants;

3. The proposed Energy Information Display Layouts on the LED TV Display Panel in horizontal and vertical formats are shown in Standard Details Drawings nos. STD/B/EL-230 and 231 respectively. The display format could be arbitrarily selected to suit the installation of the LED TV Display Panel with the aid of signage content management software by end-users. The Sub-contractor shall submit the design of the display arrangement to the CM for prior approval;

4. The above displayed information shall be linked with the output data as shown in the reports on the System operation and performance as described in ELE35.5. The energy and water consumption, PV and weather information could be retrieved automatically whereas the gas consumption shall be retrieved from monthly Towngas bill manually;

5. The LED TV Display Panel shall also be utilized for display of the estate management information from HA's E-notice board system (by others). The details of interfacing are as follows:

   a. upon completion of the Works before interfacing with E-notice board system, only the energy information display content shall be shown on the LED TV via HDMI cable connected to display interfacing unit;

   b. the Sub-contractor shall provide a URL for viewing the energy information display output via web browsers and integration with the E-notice board system (by others);

   c. The E-notice board system supplier shall be responsible for the integration of energy information provided by the Sub-contractor and estate management information via sequential playing, and then transmit the combined video signal via its own HDMI cable to LED TV Display Panel;

   d. The Sub-contractor shall be responsible for providing necessary power points and data points for E-notice board system (by others) as shown on Drawings.

6. The Timer control screen on / off function shall be provided for the LED TV Display Panel.

ELE35.3.040.9 SIGNAGE CONTENT MANAGEMENT

1. Signage content management shall comprise display interfacing units connecting to the LED TV display panels and a tailor-made signage content management software with lifetime license fulfilling the display requirements as specified in ELE35.3.030;

2. Each display interfacing unit shall be a data processing unit (a Windows based barebone computer or equivalent) with full set of I/O connectivity, enclosed in a ventilated metal box and mounted adjacent to the LED TV display panel, receiving data from the central monitoring management workstation and receive the signals of corresponding IP address for video display on respective LED TV display panel;

3. The tailor-made signage content management software shall be installed in the central monitoring and management workstation which can feed in data from the database generated by the System software;

4. The signage content management software shall be able to produce human-machine interface video display in which users can insert any prevalent picture and photo formats, high definition video formats, icons, flash, html, etc. for displaying on the LED TV display panels;
5. At the central monitoring and management workstation, users can preview the display content on every LED TV display panel at respective domestic block.

ELE35.4 MISCELLANEOUS

ELE35.4.010.9 DOCUMENTATION

1. Labelling of Cables:
   a. Machine-printed, self-laminating vinyl for cabling and patch cords;
   b. Backbone cables shall be labelled at each end. The cable or its label shall be marked with its identifier;
   c. All cables shall be labelled with numbered markers at both ends.
2. Labelling of Faceplates:
   a. An unique identifier shall be marked on each faceplate to identify it as connecting hardware;
   b. Each port on the connecting hardware shall be labelled with its identifier.

ELE35.4.020.9 TESTING AND COMMISSIONING

1. The Sub-contractor shall carry out all necessary testing and commissioning work upon completion of the installation of the Smart Meter Monitoring and Energy Information Display System in accordance with ELE30.1 where applicable;
2. Verification tests shall be performed in the presence of the CM's representatives. A copy of the test results and all protection settings shall be submitted to the CM;
3. The Sub-contractor shall prepare itemized and detailed testing and commissioning schedules for the CM's approval prior to commencing the tests;
4. The Sub-contractor shall carry out preliminary tests to his own satisfaction before arranging for any formal witness test;
5. The Sub-contractor shall be responsible for the cost of necessary instrument, plant and labour for all tests;
6. The Sub-contractor shall carry out all such tests as required by the CM to demonstrate that each item of equipment meets the requirements of this Specification;
7. Valid calibration certificates of testing instruments shall be produced upon request by the CM. The accuracy of testing instruments shall also be demonstrated if directed by the CM irrespective of whether valid calibration certificate is available;
8. Any defects of workmanship/materials, mal-adjustments or other irregularities which become apparent during tests and may affect the test results shall be rectified by the Sub-contractor and the tests shall be repeated at the Sub-contractor's expense before acceptance by the CM.

ELE35.4.030.9 HAND-OVER DOCUMENTS

The Sub-contractor shall provide all necessary documents required for the operation and maintenance of the Smart Meter Monitoring and Energy Information Display System and shall include but not be limited to the following:

1. Certification from manufacturer of all major equipment, devices and materials;
2. As-fitted layout shop drawings of backbone cabling distribution;
3. As-fitted schematic diagram of the System and all sub-systems;
4. Cabling inventory record and connection details;

5. 3 sets of approved Operation and Maintenance manuals including servicing and maintenance requirements recommended by equipment manufacturers and the specialist service provider, full test reports of the System and all equipment, system settings, all routine operation procedures, reports and graphics generation procedures, maintenance and inspection schedules, necessary tools, system diagnosis, system reset and restoring operation procedures, etc. in both hard copy and electronic "pdf" format;
6. A rescue disk or other appropriate backup means for restoring the System software to original conditions and settings. Detailed step-by-step procedures for using the rescue disk or backup means to restore the System shall be included in the Operation and Maintenance manual;
7. License of all software programs including dongle keys, serial numbers, etc.;
8. 3 sets of software programs in DVD±RW;
9. Passwords at various levels of the System Software;
10. Company names, responsible persons, email addresses and telephone contacts of at least three (3) System Integrators certified by the supplier / local authorized agent of the DGU.

ELE35.4.040.9 TRAINING

The Sub-contractor shall provide training to the CM's representatives, estate management and technical staff or other personnel as instructed by the CM for a total duration of six working days, on the testing & commissioning, operation and maintenance of the System. The training shall be conducted separately for technical and management staff in three sessions, one before and one after commissioning of the System, and the remaining session shall be at the end of the Maintenance Period. Each training session shall be approved by the CM to cover any or all of the following topics and items:

1. Testing & commissioning procedures;
2. Operation and maintenance of the complete system including data gathering units, workstation etc.;
3. Use of all software programmes of the System for daily operation and monitoring of the System, including but not limited to storage and retrieval of data, generation of reports, spread sheets and graphics, analysis of data collected, and restoring the whole system by a system rescue disk or backup means, as described in ELE35.2.030 and ELE35.3.040;
4. Hands-on training of all operations for technical staff;
5. Training video showing step-by-step operation;
6. Training manuals with extracted screen front panels showing step-by-step procedures of all operations.

ELE35.4.050.9 SCOPE OF WORKS DURING MAINTENANCE PERIOD

The Sub-contractor shall carry out all necessary routine maintenance work of the Smart Meter Monitoring and Energy Information Display System in accordance with the requirements as specified in ELE30.2 where applicable and shall include but not be limited to the following:

1. To despatch competent and specially trained workmen to attend any requirement for an emergency inspection and repair;
2. To carry out, at three months intervals, routine servicing and maintenance to maintain the System, including both hardware and software, in proper working condition within the Maintenance Period;
3. To provide repairs and replacement parts at no additional cost to the Employer for the correct operation of the System;

4. Quarterly Servicing

   At three months intervals, the following works shall be carried out and the Sub-contractor shall log and submit a report to the CM after each quarterly servicing:

   a. Check proper functioning and cable connections and restart the central monitoring and management workstation at EMO;

   b. Check proper functioning and cable connections of the communication network, DGUs, multi-function electronic meters and digital water meters at various locations;

   c. Check proper functioning and cable connections of the display interfacing unit and the LED TV display panel at the main entrance lobby of each domestic block;

   d. Update software installed when service pack has been launched;

   e. Rectify / replace any defective or mal-functioning parts; and

   f. Print data reports on the System operation and performance of a rolling period of the past 12 months as specified in ELE35.5 and submit them to the CM within one month from the last day of the 3-month period concerned.

ELE35.5 DATA COLLECTION POINT SCHEDULE AND DATA REPORT

ELE35.5.010.9 DATA COLLECTION POINT SCHEDULE

Data Collection Point Schedule

Data to be collected for each Domestic Block
Date-month-year: _____
Estate Name: _____
Block Name/No. : _____

Electrical

Point summary / Measured

Multi-Function Electronic Meter no.	Load connection	Location of signal interfacing points	Circuit Procedure Device Rating (A)	Category for Energy Measurement	Total energy consumption (kWh)	Total energy generation by PV system (kWh)	Maximum demand (kVA)	Currents (three phase and neutral) (A)	Voltage (all phase-to-phase and phase-to-neutral) (V)	Total Power Factor	Total Harmonic Distortion of current (%)
1	Customer main circuit breaker no. 1	Main Switch Room	2250	-	1		1	4	6	1	1
2	Customer main circuit breaker no. 2	Main Switch Room	2250	-	1		1	4	6	1	1
3	Cable rising main no.1 for tenant	Main Switch Room	>= 400	-	1		1	4		1	1
4	Cable rising main no.2 for tenant	Main Switch Room	>= 400	-	1		1	4		1	1
5	Cable rising main no.3 for tenant	Main Switch Room	>= 400	-	1		1	4		1	1
6	Cable rising main no.4 for tenant	Main Switch Room	>= 400	-	1		1	4		1	1
7	Cable rising main no.5 for tenant	Main Switch Room	>= 400	-	1		1	4		1	1
8	Cable rising main no.6 for tenant	Main Switch Room	>= 400	-	1		1	4		1	1
9	Cable rising main no.7 for tenant	Main Switch Room	>= 400	-	1		1	4		1	1
10	Cable rising main no.8 for tenant	Main Switch Room	>= 400	-	1		1	4		1	1
11	Landlord	Main Switch Room	>= 400	-	1		1	4		1	1
12	Public Lighting	Main Switch Room	< 400	PL	1		1	4			
13	External lighting (sub-meter of public lighting)	Main Switch Room	>= 400	-PL	1		1	4			
14	Small power	Main Switch Room	< 400	LE	1		1	4			
15	Ventilation system for G/F RSMRC	Main Switch Room	< 400	LE	1		1	4			
16	Fresh Water booster pump room	Main Switch Room	< 400	WS	1		1	4			
17	Fresh & flush water upfeed pump room	Main Switch Room	< 400	WS	1		1	4			
18	Lift machine room	Main Switch Room	>= 400	LT	1		1	4		1	1
19	Essential power supply	Main Switch Room	>= 400	-	1		1	4		1	1
20	Essential - F.S. water pumps room	Main Switch Room	< 400	LE	1		1	4			
21	Essential - public lighting	Main Switch Room	< 400	PL	1		1	4			
22	Essential - non-FSI power supply	Main Switch Room	< 400	LE	1		1	4			
23	Essential - Plant room lighting (sub-meter of non-FSI power supply)	Main Switch Room	< 400	PL LE	1		1	4			
24	Essential - F.S. booster pump room	Main Switch Room	< 400	LE	1		1	4			
25	Power supply by PV system	R/F PV equip. room	< 400	-		1	1	4			
	Sampling rate				daily			15 mins		hourly	

Data report shall be submitted at three months intervals

Time interval of measured data to be indicated in data report can be hourly (if available)/ daily/ monthly/ annually

Water

Point Summary		Measured
Digital water meter no.	Load connection	Location of signal interfacing points	Accumulated water consumption (m^3)
1	G/F fresh water upfeed pump	G/F fresh water pump room	1
	Sampling rate		daily

Gas

Point Summary		Measured
Data from Towngas	Load connection	Location of signal interfacing points	Accumulated gas consumption (MJ)
1	Gas consumption for the whole block	Manual input at EMO	1
	Sampling rate		Monthly

Abbreviation for the category for Energy Measurement for communal area of domestic block

PL	Public Lighting
-PL	Public Lighting (deduction)
LT	Lift
WS	Water Supply
LE	Low Energy Use Systems (include Security, CABD, A/C & Ventilation and Fire Services system)
-LE	Low Energy Use Systems (deduction)

ELE35.5.020.9 DATA REPORT

Data report
Year: _____
Estate Name: _____

Block no.	Block Name	No. of Flats	CFA of the block (m^2) (A)	Total IFA of domestic premises (m^2) (B)	Total IFA of non-domestic premises (m^2) (C)	Calculated communal areas (m^2) (D)=(A)-(B)-(C)
1						
2						

Electricity energy consumption (kWh)															
Area	Unit	Block no.	Month 1	2	3	4	5	6	7	8	9	10	11	12	Annual total
Domestic Flats	per flat	1													
		2													
	per block	1													
		2													
	whole Estate	-													
Communal Area	per block	1													
		2													
	per calculated communal area	1													
		2													

Electricity energy generation (kWh)															
PV system	Unit	Block no.	Month 1	2	3	4	5	6	7	8	9	10	11	12	Annual total
	per block	1													
		2													

Water consumption (m^3)															
Area	Unit	Block no.	Month 1	2	3	4	5	6	7	8	9	10	11	12	Annual total
Domestic Flats	per flat	1													
		2													
	per block	1													
		2													
	whole Estate	-													

Gas consumption (MJ)															
Area	Unit	Block no.	Month 1	2	3	4	5	6	7	8	9	10	11	12	Annual total
Domestic Flats	per flat	1													
		2													
	per block	1													
		2													
	whole Estate	-													

Remark: This report shall cover a rolling period of the past 12 months where applicable.

ELE35.5.030.9 MULTI-FUNCTION ELECTRONIC METER DATA REPORT FOR ENERGY MEASUREMENT FOR COMMUNAL AREA OF DOMESTIC BLOCK

Multi-Function Electronic Meter Data Report for Energy Measurement
for communal area of domestic block
Estate Name: _____
Block Name/No.: _____
Date-month-year: _____
Communal Area: _____ m^2

Multi-Function Electronic Meter no.	Description	Category for Energy Measurement	Measurement Period				Annual energy consumption (kWh)	Annual energy consumption per unit Communal Area (kWh/m^2)
			Start Date	Start Time	End Date	End Time		
	Public lighting							
12	Public lighting	PL						
13	External lighting (sub-meter of public lighting)	-PL						
21	Essential – public lighting	PL						
23	Essential – Plant room lighting	PL						
	Sub-total of Public lighting:							
	Lift							
18	Lift machine room	LT						
	Sub-total of Lift							
	Water Supply							
16	Fresh water booster pump room	WS						
17	Fresh & flush water upfeed pump room	WS						
	Sub-total of Water Supply:							
	Low Energy Use Systems							
14	Small power	LE						
15	Ventilation system for G/F RSMRC	LE						
20	Essential – Fire services water pumps	LE						
22	Essential – non-FSI power supply	LE						
23	Essential – Plant room lighting (sub-meter of non-FSI power supply)	-LE						
24	Essential – F.S. booster pump room	LE						
	Sub-total of Low Energy Use System:							
						Total:		

Remark: This report includes data measured by multi-function electronic meter only and provides supportive information for the Energy Measurement Report. PBSI and PBSE should add/deduct data measured by other kWh meters in each category item, as appropriate, for the submission of formal Energy Measurement Report.

Abbreviation for the category for Energy Measurement for communal area of domestic block

PL	Public Lighting
-PL	Public Lighting (deduction)
LT	Lift
WS	Water Supply
LE	Low Energy Use Systems (include Security, CABD, A/C & Ventilation and Fire Services system)
-LE	Low Energy Use Systems (deduction)

ELE36 AUTOMATIC METER READING (AMR) OUTSTATION FOR WATER SUPPLIES

ELE36.1 SCOPE OF WORK 2

ELE36.1.010.9 GENERAL 2
ELE36.1.020.9 SCOPE OF WORK 2

ELE36.2 SYSTEM DESCRIPTION 4

ELE36.2.010.9 AUTOMATIC METER READING (AMR) SYSTEM 4

ELE36.3 MATERIALS AND EQUIPMENT 5

ELE36.3.010.9 GENERAL 5
ELE36.3.020.9 SMART WATER METERS AND METER INTERFACING UNITS (MIUS) 5
ELE36.3.030.9 M-BUS NETWORK 6
ELE36.3.040.9 AUTOMATIC METER READING (AMR) PANEL 7
ELE36.3.050.9 PANEL ENCLOSURE 8
ELE36.3.060.9 DATA CONCENTRATION UNIT (DCU) 8
ELE36.3.070.9 PROGRAMMABLE LOGIC CONTROLLER (PLC) UNIT 8
ELE36.3.080.9 ROUTER AND SWITCH 9
ELE36.3.090.9 CABLES 10
ELE36.3.100.9 POWER SUPPLY UNIT 10
ELE36.3.110.9 MINIATURE CIRCUIT BREAKERS (MCB) UNIT 10
ELE36.3.120.9 24V DC TO 220V AC INVERTER 10
ELE36.3.130.9 SELECTOR SWITCH 10
ELE36.3.140.9 BACKUP BATTERY UNIT 10
ELE36.3.150.9 BATTERY CHARGER PANEL 11
ELE36.3.160.9 BATTERY PANEL 11
ELE36.3.170.9 CABLING FACILITIES AND SITE INSTALLATION 11
ELE36.3.180.9 DATA TRANSMISSION EQUIPMENT AND NETWORK 12
ELE36.3.190.9 INTELLECTUAL PROPERTY AND PROPRIETARY RIGHTS 13
ELE36.3.200.9 BUILDING SERVICES PROVSION FOR AMR EQUIPMENT ROOM 13

ELE36.4 TESTING AND COMMISSIONING 14

ELE36.4.010.9 INSPECTION AND EQUIPMENT TEST 14
ELE36.4.020.9 TESTING AND COMMISSIONING (T&C) 14
ELE36.4.030.9 SYSTEM TRANSFER FOR OPERATION AND MAINTENANCE 15
ELE36.4.040.9 TRAINING 15

ELE36.5 MAINTENANCE 16

ELE36.5.010.9 GENERAL 16
ELE36.5.020.9 24-HOUR ON-CALL SERVICE DURING MAINTENANCE PERIOD 16

ELE36.6 CHECKLIST ON DOCUMENTS FOR INCLUSION IN THE AMR OUTSTATION PROPOSAL 17

ELE36.6.010.9 CHECKLIST ON DOCUMENTS FOR INCLUSION IN THE AMR OUTSTATION PROPOSAL 18

ELE36.1 SCOPE OF WORK

ELE36.1.010.9 GENERAL

1. This specification stipulates the requirements of the Automatic Meter Reading (AMR) Outstation which shall be read in conjunction with the "Typical Drawings for the Supply and Installation of AMR Outstation" issued by the WSD and the following Water Supplies Department (WSD) standard specifications:-
   a. E-89-01 Automatic Meter Reading (AMR) Outstation
   b. E-11-03 Electrical and Instrumentation Panels and Cubicles
   c. E-78-04 Programmable Logic Controller
   d. E-80-01 Instrumentation Equipment – General
   e. E-88-05 Power Supply Equipment for Telemetry Systems
   f. E-30-01 Electrical Cables
2. The Sub-contractor shall design, supply and install the AMR Outstation as shown on the Drawings and Specification. The Sub-contractor shall coordinate with all parties concerned, in particular to the Main Contractor and other Sub-contractors to cope with the construction programme; and
3. An AMR Outstation proposal detailing the design, layout and equipment for building up the AMR Outstation shall be submitted by the Sub-contractor to the WSD for approval prior to commencement of installation work. The sample for the "Checklist on documents for inclusion in the AMR Outstation proposal" is shown in ELE36.6.

ELE36.1.020.9 SCOPE OF WORK

The scope of work shall include the following:

1. Design, supply, installation, testing and commissioning of the AMR Outstation with the number of AMR Outstation(s) as shown on the Drawings;
2. Preparation and submission of AMR Outstation proposal, testing and commissioning (T&C) procedure, operation and maintenance (O&M) manual complete with all necessary documentation and test certificates to the WSD for approval;
3. Coordination, communication and attending meetings with project team and WSD in building up the AMR Outstation from time to time;
4. Design, supply and installation of all infrastructures for AMR equipment and network including concealed conduits, cabling and junction boxes;
5. Provision of site works for laying, connection and termination of associated cables for all equipment and smart water meters including power cables, signal cables, control cables and communication network cables;
6. Provision of site works for the programming and configuration of AMR Outstation(s) including programmable logic controller (PLC), data concentration unit (DCU), meter interfacing unit (MIU), pulse-to-M-Bus converter and communication equipment. Configuration details of MIU will be provided by the WSD;
7. Detailed design and requirements of data and alarm transmission between (a) smart water meters and DCU; (b) PLC/DCU and Master Station shall be proposed by the Sub-contractor in accordance with the specification and drawings. The Sub-contractor's proposal shall be agreed by WSD prior the site installation;
8. Provision of electricity power supply at all necessary locations for operation of AMR Outstation(s);

9. Supply, installation, connection and termination of a complete system of power cables, control cables, M-Bus cables and communication network cables to all equipment, instrument and ancillaries supplied, modified and installed;
10. Supply and installation of all necessary earthing system to form a complete, neat and safe installation as required to comply with the relevant wiring regulations;
11. Provision of the broadband (3G network services may be accepted subject to CM's approval in case of unavailability of broadband network) to enable the AMR Outstation(s) to securely communicate with the AMR Master Station prior to handing over of the system to the WSD;
12. Provision of pulse-to-M-Bus converter for Electromagnetic (EM) water meter (if any) for interfacing of metering data in pulses with DCU in M-Bus protocol;
13. Preparation and submission of operation and maintenance (O&M) manuals, including all approved drawing, documents, test records / certificates and submit to WSD for approval prior to handing over of the system; and
14. Even not explicitly specified, all required works arising from execution of the AMR System works shall be deemed to have included.

ELE36.2 SYSTEM DESCRIPTION

ELE36.2.010.9 AUTOMATIC METER READING (AMR) SYSTEM

1. The AMR System of the WSD shall collect metering data remotely and automatically, manage and analyse metering data, provide output for billing and water supplies management and disseminate useful information to customers;
2. The infrastructure of the system shall consist of AMR Outstations and AMR Master Station;
3. The AMR Outstation(s) shall comprise smart water meters equipped with meter interfacing units (MIU) compatible with hard-wired Meter-Bus (M-Bus) communication protocol, an M-Bus network, -AMR panel comprising programmable logic controller (PLC), data concentration unit (DCU), communication router and the associated networking equipment as well as 24V battery, battery charger and other associated power supply equipment. The AMR Outstation shall be interfaced with the AMR Master Station at the WSD and utilize broadband/3G networks as deemed appropriate by the WSD;
4. The AMR Master Station shall be supplied and installed by the WSD. The AMR Master Station shall comprise necessary hardware and software, equip with the required network communication and security equipment, together with all AMR Outstations to form a complete AMR System; and
5. The smart water meters equipped with MIUs for building up AMR Outstation shall be supplied by the WSD and installed by Main Contractor. The Sub-Contractor shall supply (except the smart water meters), install and commission the AMR Outstation according to this specification and the requirements as specified by the WSD from time to time.

ELE36.3 MATERIALS AND EQUIPMENT

ELE36.3.010.9 GENERAL

1. An AMR Outstation shall be designed to collect metering data from smart water meters and transmit them to the AMR Master Station at the WSD. The requirements of the components composing the AMR Outstation shall be as follows:
   a. Smart Water Meters and Meter Interfacing Units (MIU)
      - Mechanical water meters and MIUs
      - Electromagnetic (EM) water meters
   b. M-Bus Network
   c. Automatic Meter Reading (AMR) Panel
      - Panel Enclosure
      - Data Concentration Unit (DCU)
      - Programmable Logic Controller (PLC) Unit
      - Router and Switch
      - Cables
      - Power Supply Unit
      - MCB Unit
      - 24V dc to 220V ac Inverter
      - Selector
      - Communication Networks (Broadband/3G)
   d. Backup Battery Unit
      - Battery Charger Panel
      - Battery Panel
   e. Cabling Facilities and Site Installation
   f. Data Transmission Equipment and Network

ELE36.3.020.9 SMART WATER METERS AND METER INTERFACING UNITS (MIUS)

1. Smart water meters shall be provided by the WSD for installation by the Main Contractor. The meters shall be of mechanical, electromagnetic type or other types as deemed appropriate by the WSD. The maximum distance between the terminal box to either of the smart water meter shall be 1.5 metres.
   a. Mechanical water meters and MIUs

      The mechanical water meters provided by the WSD for installation by the Main Contractor shall be equipped with MIUs which read the meter register and transfer the meter reading via a wired M-Bus communication protocol to a DCU. Each MIU is equipped with a connecting cable complying with the M-Bus protocol EN 13757 and EN 1434 for connection to the bus-wire of the M-Bus network. The Sub-contractor shall be responsible for the cable connection and termination between the MIUs and the bus-wire of the M-Bus network.

      The MIU shall serve as an interface between the water meter and the M-Bus network. It shall record the meter readings and store in its internal memory with date and time stamps and to transmit the stored data to the DCU via the M-Bus bus-wire once a data interrogation request is initiated by the DCU.

      The data and alarm required to transmit from mechanical meter with MIU to DCU shall include, but not limited to, the following:

- Data required: Meter Count, Date &Time, Primary & Secondary address and other data as required by WSD; and
- Alarm required: Low Battery, Leakage, Tampering detection and other alarm as required by WSD.

b. Electromagnetic (EM) water meters

The EM water meters provided by the WSD for installation by the Main Contractor shall be equipped with a flow converter capable of generating electric pulse output for AMR application and the flow converter shall be installed by the Sub-contractor.

A pulse-to-M-Bus converter together with IP54 panel for interfacing of metering data in pulses with DCU in M-Bus protocol shall be supplied and installed by the Sub-contractor. The pulse-to-M-Bus converter shall be housed in the panel with a degree of protection of IP54 and shall be properly fixed or mounted on the secured location. The Sub-contractor shall be responsible for the cable connection and termination between the EM water meters and pulse-to-M-Bus converter and also the converter to the M-Bus network.

The pulse-to-M-Bus converter shall consist of an electronic unit that collects meter pulses which are converted into physical units. The data is transmitted via Meter-Bus protocol (EN 13757) to a data concentration unit. The converter shall equip with the following characteristics:

- Physical unit and medium programmable for the pulse counter input;
- Power supply via M-Bus / Backup battery to ensure pulse counting if M-Bus fails;
- Support external power supply;
- Minimum 1.5m cable length for connecting pulse transmitter.

The data and alarm required to transmit from EM water meter to DCU shall include, but not limited to, the following:

- Data required: Volume flow from pulse to M-Bus and any other data as required by WSD; and
- Alarm required: Low Battery alarm any and other alarm as required by WSD.

ELE36.3.030.9 M-BUS NETWORK

1. The M-Bus is a European Standard EN 13757 and EN 1434 which is developed for the remote reading of utility meters. The M-Bus network shall supply the power necessary for interrogation of metering data from the MIUs installed on the smart water meters;
2. The M-Bus network shall be composed of a 4-core 1.5mm^2 copper cable with two cores to serve as the bus-wire for the M-bus system, while reserving the remaining two cores as spare cores. The cable shall be laid inside at least 25mm diameter concealed conduits. The spur cables from the MIUs shall be connected to the main bus cable via terminal blocks inside the terminal box. Spare cores shall be terminated to the terminal blocks. The specification for the wiring system in conduits/trunking shall be referred to ELE11, 12 and 13;
3. The specification of the copper cable shall refer to the “Standard Specification E-30-01, Electrical Cables” from WSD;
4. The M-Bus shall be reverse-polarity protected and used for both data transmission and power supply from the DCU to the MIUs. The M-Bus shall be short-circuit proof and no bus failure shall be resulted in case of faults in any MIU;

5. The M-Bus shall support various bus topologies, including linear, star and tree configuration with any given segment, up to 250MIUs. For each AMR Outstation, the M-bus network shall provide 10% spare capacity for domestic flats and 20% spare capacity for non-domestic units for connection of additional MIUs in future expansion at each DCU. Network cascading with additional DCUs shall also be acceptable for provision of the required spare capacity. The maximum cable length and cable capacitance shall be 350 metres and 180nF respectively;
6. The M-Bus shall adopt a master-slave communication protocol, which shall facilitate bi-directional data transmission from DCU to MIU triggered by changing voltage in the M-Bus bus-wire. The nominal bus voltage shall be around 36V at the master's output. Communication requests shall be activated by change of voltage to the input circuits of the MIU by the DCU, while the data transmission from MIU to DCU shall be triggered by changing current demand at the MIU. The transmission rate shall be adjustable from 300 to 2400 baud (bits per second) supporting automatic error detection by means of parity and checksum to enable repetition of data transmission in the event of an error;
7. All softwares included shall be in free or full user licenses with no expiry date. Full set of system recovery diskettes, back up diskettes for the softwares shall be provided;
8. Terminal blocks shall be used for the connection of all external cables. Power supply terminals of all equipment and terminals within fabricated panels or cubicles shall comply with IEC 60947-7-1. It shall be single-level feed-through, screw or screwless type connection, DIN rail-mounted, vibration and corrosion resistant and modular design suitable for harsh industrial environment;
9. Terminals shall be permanently identified by number or letter, and shall be so positioned as to permit convenient access for wiring. Adjacent rows of terminals shall not be closer than 150mm. Power supply terminals shall be segregated from signal terminals and shall be shielded to prevent accidental contact. Access to the terminals of instruments shall not expose internal components, require the disassembly of the instruments or removal of the instruments from the installation as a whole; and
10. Internal panel wiring shall be coloured black for a.c. connections, grey for d.c. connections and green/yellow for earth connections. At least 10% spare terminals shall be provided.

ELE36.3.040.9 AUTOMATIC METER READING (AMR) PANEL

1. AMR panel shall be installed in the water meter room / AMR equipment room / AMR equipment cabinet on the ground floor, or near the ground floor, so as to facilitate ease communication network connection and maintenance works. Particular attention should be paid on the maximum length of M-Bus cable from smart water meters to the AMR panel;
2. The AMR panel shall be designed for housing the PLC, DCU, communication router, communication networking equipment, terminal blocks for power supply, control wiring connection and associated equipment; and
3. The AMR panel is supplied by both 220V a.c. and 24V d.c. supplies. Most of the equipment, except DCU, inside the AMR panel is running on 24V d.c. which is provided by 24V d.c. power supply unit inside the panel and the external 24V d.c. from battery charger. As the DCU inside the AMR panel is operating on 220V a.c., an inverter is required to convert secured 24V d.c. to 220V a.c. supply for the DCU only.

ELE36.3.050.9 PANEL ENCLOSURE

The panels shall be designed for indoor wall-mounted installation and fabricated with 1.5mm thick stainless steel. The size of the panels shall be not larger than 600(h) x 400(w) x 300(d) mm. The panels shall be designed to the degree of protection of IP54. The design and construction of the panels shall be in compliance with the WSD Standard Specification E-11-03. The circuit and connection diagrams shall be provided inside the panel.

ELE36.3.060.9 DATA CONCENTRATION UNIT (DCU)

1. The DCU shall serve as the M-Bus master of the M-bus network, which is designed to collect metering data at a programmable interval from the MIUs of meters and store the meter readings to its non-volatile memory for transmission to the AMR Master Station via the communication network;
2. The DCU shall be able to exchange data with the existing application server in the AMR Master Station;
3. The DCU shall be able to automatically transmit the metering data via internet connection using integrated LAN interface and shall be equipped with at least one Ethernet RJ45 port for data transmission;
4. The DCU shall be capable of connecting all the M-Bus devices of the AMR Outstation with 10% spare capacity for domestic flats and 20% spare capacity for non-domestic units at each DCU. Additional DCU shall be provided if necessary;
5. The DCU shall be programmable to initialise retrieval of meter reading data from the MIUs at an interval of 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12 hours or 24 hours;
6. The DCU shall have an internal non-volatile memory of capacity sufficient to store 500,000 meter readings;
7. The DCU shall be equipped with at least one USB 2.0 port and one Ethernet RJ45 port for firmware upgrading, parameter configuration and diagnosis by a notebook computer installed with the DCU configuration and diagnosis software. The software shall be provided together with the DCU;
8. The DCU shall be cascadable for connecting more devices to build up larger M-Bus networks;
9. The DCU shall use FTP protocol to transmit XML metering data to the AMR Master Station while the PLC will use TCP Client to transmit AMR panel status to the AMR Master Station;
10. The DCU shall be suitable for operating at ambient conditions of temperature 0 to 50°C; and
11. The DCU shall operate on 220V 50 Hz a.c. power supply or a 24V d.c. power supply either from the battery charger output or from the 24V battery.

ELE36.3.070.9 PROGRAMMABLE LOGIC CONTROLLER (PLC) UNIT

The PLC Unit shall be provided to facilitate automatic, remote control and monitoring of equipment such as DCU, power supply, battery, communication equipment, etc.

1. The PLC Unit shall be of compact design housing embedded inputs, outputs, power supply and communication ports and equipped with an embedded LCD or indicating lights for showing modes of PLC operation, e.g. program mode, run mode and diagnosis mode etc.;
2. The PLC Unit shall operate on 24V d.c. power supply and possess battery backed up internal memory for user program and data with a minimum memory size of at least 64 kbyte for data logging;

3. The PLC Unit shall have at least one (1) RS232/RS485 port and one (1) Ethernet port supporting serial protocols including DH-485 and TCP/IP for connection of router, programming tools for data communication, on-line programming and diagnosis;
4. The PLC Unit shall be equipped with at least six (6) nos. of digital input and six (6) digital output with volt-free contacts. The digital input channels shall be fast enough to catch pulse input up to 100kHz;
5. The PLC shall be programmed to force a reset to the router and/or DCU upon detection of cessation of data communication for a period of time;
6. All input / output channels shall be adequately programmed to relay the required alarm signals such as power supply failure, battery low, battery fault, etc.;
7. Twenty per cent (20%) of readily available spare channels for each type of digital, analogue counter input / output channels of the PLC Unit shall be provided. The Sub-contractor shall be responsible for providing all the labour, equipment, cabling, materials, programming and engineering costs for the utilization of the spare channels when any additional site signals are considered necessary by the WSD;
8. The PLC Unit shall accept program downloaded locally via their communication ports from a notebook or tablet computer. The Sub-contractor shall be responsible for providing the programming software for the PLC Unit;
9. The PLC Unit shall have provisions for communicating with the AMR Master Station on a report-by–exception manner in order to reduce network traffic and shall be capable of stand-alone operation in the event of communication link and the AMR Master Station failure;
10. The PLC shall be suitable for operating at ambient conditions of humidity 10 to 90% and temperature 0 to 50°C; and
11. The specification of the PLC shall be read in conjunction with the "Standard Specification E-78-04, Programmable Logic Controller" from WSD.

ELE36.3.080.9 ROUTER AND SWITCH

The communication equipment shall facilitate the communication and data transmission between the AMR Outstation and the AMR Master Station. The metering data collected by the DCU shall be transmitted to the AMR Master Station at the WSD via Ethernet router through broadband, 3G network or other means as deemed appropriate by the WSD.

1. The router shall be designed for enterprise or industrial use capable of serving a high speed, high availability and high reliability performance. The router shall support the features of firewall support, VPN security and SNMP management;
2. The router shall provide broadband network interface, 3G/4G network interface via SIM card and wi-fi interface for data transmission;
3. The router shall provide VPN security encryption feature with VPN tunnelling protocol IPSec with AES 256;
4. The router shall provide the feature of Dyn DNS client which support the access to the router with a dynamic IP address;
5. The router shall be integrated with Ethernet switch which shall provide at least 1 number of Ethernet WAN 10/100Mbps port (RJ45) and 4 numbers of Ethernet LAN 10/100mb port (RJ45), or a separated Ethernet switch with same port numbers shall be provided; and
6. The router shall be suitable for operating at ambient conditions of humidity 10 to 90% and temperature 0 to 50°C.

ELE36.3.090.9 CABLES

1. The M-Bus network shall be composed of a 4-core 1.5mm^2 copper cable with two cores to serve as the bus-wire for the M-bus system, while reserving the remaining two cores as spare cores. The maximum cable length shall be 350 metres (from MIU to a DCU). All M-Bus cable maximum cable capacitance is 180nF;
2. PVC insulated power and control cables shall comply with IEC 60502-1;
3. PVC insulated cables for panel wiring shall comply with IEC 60227-3 or BS 6004;
4. The conductor shall be of stranded, plain, annealed copper complying with IEC 60228. Four-core cables shall have full size neutral conductors;
5. The specification of the copper cable shall refer to the "Standard Specification E-30-01, Electrical Cables" from WSD;
6. Ethernet cable shall transmit digital signal among AMR Panels in a form of Ethernet network;
7. Ethernet cable shall be Cat 5e cable complying ANSI/TIA-568-C.2 and IEC 61156-5; and
8. The maximum Ethernet copper cable length shall be 100 metres. In case the cable distance exceeded 100 metres, ethernet to optical fiber converter and the associated equipment/power supplies shall be supplied and installed by the Sub-contractor.

ELE36.3.100.9 POWER SUPPLY UNIT

The power supply unit shall comply with EN/IEC 60950 and support the power supply of the AMR panel.

ELE36.3.110.9 MINIATURE CIRCUIT BREAKERS (MCB) UNIT

1. The rating of the MCB unit shall be determined by the power requirement of the overall components of the AMR panel; and
2. The specification for the MCB shall be referred to ELE3.5.

ELE36.3.120.9 24V DC TO 220V AC INVERTER

It shall transform 24V d.c. supply to 50 Hz (+/-0.1%) 220V (+/-3%) a.c. sinusoidal supply for the consumption of a.c. loading(s) in AMR Panel. The rating of the inverter shall be 125% of that of the a.c. loading(s). The output efficiency of the inverter shall be 88% or above at 50-100% loading condition. The inverter shall comply with EN/IEC 60950.

ELE36.3.130.9 SELECTOR SWITCH

1. Selector switches shall be of rotary, independently manual operated action with double break air-break contacts complying with the following requirements:-
   a. Rated insulation voltage: 600V 50 Hz a.c. or 300V d.c.;
   b. Rated thermal current of contacts: Not less than 15A at 220V 50Hz a.c.;
   c. Endurance: 1 million mechanical operations and 0.1 million on-load electrical operational cycles.
2. The specification of the selector switch shall refer to the "Standard Specification E-11-03, Electrical & Instrumentation Panels and Cubicles" from WSD.

ELE36.3.140.9 BACKUP BATTERY UNIT

1. A battery charger and backup battery unit shall provide the backup power to the system when the input power source is interrupted;
2. In general, the equipment shall include the following:
   a. Maintenance free battery
   b. Battery charger with both float and boost charging facilities
   c. Panel enclosure for both a. and b.

d. Interconnecting cables between a. and b.

3. The system shall operate from a 220V 50Hz a.c. power supply. Unless otherwise specified, the output voltage of the battery supply shall be 24V d.c.. The equipment supplied shall include all sub-units and components to form a complete system. The equipment shall be suitable for operation from 0 to 50°C with a relative humidity up to 90%.

ELE36.3.150.9 BATTERY CHARGER PANEL

The Battery Charger Panel for housing the 24V battery charger shall comply with the following requirements:

1. The enclosure shall be fabricated with 1.5mm thick stainless steel to IP54;
2. Unless otherwise approved by WSD, the size of the panel shall be not larger than 400(h) x 300(w) x 210(d) mm;
3. It shall be designed for housing a 24V battery charger and the associated control board and terminal blocks for power supply and control wiring connection;
4. The 24V battery charger shall be incompliance with the WSD Standard Specification E-88-05; and
5. The front panel shall be installed with a voltmeter and an ammeter of appropriate ranges for load output voltage and current and LED alarm indications.

ELE36.3.160.9 BATTERY PANEL

The Battery Panel for housing the 24V battery shall comply with the following requirements:

1. The enclosure shall be fabricated with 1.5mm thick stainless steel to IP54;
2. Unless otherwise approved by WSD, the size of the panel shall be not larger than 380(h) x 380(w) x 210(d) mm;
3. It shall be designed for housing the battery cells and the associated terminal blocks for power supply and control wiring connection;
4. The 24V battery charger shall be incompliance with the WSD Standard Specification E-88-05; and
5. The battery cell capacity shall be able to support operation of the AMR Outstation for six (6) hours with 20% safety margin taking into account all various derating factor under a.c. power failure condition.

ELE36.3.170.9 CABLING FACILITIES AND SITE INSTALLATION

1. A complete cabling system shall consist of power cables, control cables, M-Bus cables and communication network cables including associated conduits to all equipment;
2. Except for surface mounted conduit which shall be of G.I. type, a system of concealed PVC conduit and steel trunking together with accessories for the AMR system of water suppliers shall be provided as shown on the Drawings;
3. The cabling work shall include the provision of conduits, cable trays, ladders, mounting brackets, supports, channels, cleats, ties, lugs, glands, shrouds, tapes, markers, ferrules, joints, terminations etc., as necessary and required to form a complete, neat and safe installation. All conduits and equipment boxes shall be marked for identification;
4. The Sub-contractor shall prepare a complete cable list for the power, control, M-Bus and communication network cables shown on the Drawings; and

5. Terminal boxes with size of 150mm(h) x 150mm(w) x 75mm(d) complete with the associated connectors and connection terminal blocks on the concealed junction boxes shall be supplied and installed on each floor to facilitate connection of the signal cables of the MIUs to the M-bus wires. The bus-wires shall be terminated to the DCU for data concentration and temporary storage.
6. At least two 25mm cable conduits shall be provided to run through the water meter room/cabinet of each floor and water meter room/AMR equipment room/AMR equipment cabinet and terminate with a 150mm(h) x 150mm(w) x 75mm(d) adaptable box in each of the water meter rooms /cabinets for installing M-Bus cables and network communication cables;
7. A 220V 50Hz a.c. power supply with a 13A fuse spur unit for each AMR panel and the required wall space for mounting AMR panel(s) shall be provided;
8. A 25mm cable conduit running through the AMR equipment room / AMR equipment cabinet to the telecommunication room/TBE room shall be provided and to be terminated with 100mm(h) x 100mm(w) x 50mm(d) adaptable boxes;
9. For cases with more than one AMR equipment room within a development, a 25mm cable conduit running through those of the AMR equipment rooms / AMR equipment cabinets for network communication cables shall be provided and to be terminated with 100mm(h) x 100mm(w) x 50mm(d) adaptable boxes;
10. If master meter and check meter positions are provided, two 25mm cable conduits running through the master meter room and check meter room to the AMR equipment room shall be provided and to be terminated with 150mm(h) x 150mm(w) x 75mm(d) adaptable boxes, or individual AMR panel with associated electricity power supply point and telecommunication cable conduit shall be provided at each of the water meter rooms/cabinets; and
11. If the cables run across the access or without proper supports, suitable fixed cable conduits and flexible conduit shall be provided for cable protection.

ELE36.3.180.9 DATA TRANSMISSION EQUIPMENT AND NETWORK

The AMR Outstation communication equipment and all required network shall be provided to enable the AMR Outstation to securely communicate with the AMR Master Station for data transmission through broadband/3G communication networks as deemed appropriate by the WSD.

1. The data transmission from smart water meters to the AMR Master Station shall be initiated by the DCU. The time for data transmission of the AMR Outstation shall be preset by the AMR Master Station, in which clock synchronisation of the DCU with the AMR Master Station shall be carried out;
2. TCP/IP communication protocol shall be adopted, in which a broadband account or a 3G mobile data services account as deemed appropriate by the WSD with dynamic IP address shall be assigned to the AMR Outstation;
3. The communication network shall be capable of forming a connection established by the AMR Master Station to obtain AMR data, diagnostic information or programming the DCU of the AMR Outstation on an ad hoc basis;
4. The metering operation shall be handled by the AMR Master Station, which shall respond to the pre-scheduled data transmission requests initiated by the AMR Outstations. The AMR Master Station can also initiate ad-hoc polling to particular AMR Outstation on need basis;
5. Communication network service from ISP shall be provided to enable effective data transmission from the AMR Outstation to the AMR Master Station during testing and commissioning (T&C) and before handing over of the system to WSD; and

6. The Sub-contractor shall be responsible for the subscription and maintaining of the communication network services between AMR Outstation(s) and the AMR Master Station at WSD for the entire period starting from testing and commissioning phase of the Works till the expiry of Maintenance Period. The details of the broadband/3G connection services shall be approved by the Contract Manager.

ELE36.3.190.9 INTELLECTUAL PROPERTY AND PROPRIETARY RIGHTS

1. If the supplied equipment required intellectual property rights, appropriate licences shall be obtained from the relevant rights owners and copies of which shall be furnished to the WSD prior to handing over of the system;
2. All technical information, documents and manuals furnished to the WSD shall have the license, copyright or written permission from the proper rights holder for using of these materials by the WSD; and

3 Documentary evidence of all licences of all software for the Works shall be provided prior to handing over of the system to the WSD.

ELE36.3.200.9 BUILDING SERVICES PROVSION FOR AMR EQUIPMENT ROOM

1. The Sub-contractor shall supply and install mechanical ventilation, lighting and power for the AMR equipment as shown on the Drawings.

ELE36.4 TESTING AND COMMISSIONING

ELE36.4.010.9 INSPECTION AND EQUIPMENT TEST

1. The Sub-contractor shall inspect the supplied equipment for verification of the brand, model, capacity, clock speed, ratings specifications, serial numbers of the hardware as well as the brand, version, serial number, licence keys, licence documents of all hardware, software and firmware supplied;
2. The Sub-contractor shall carry out equipment test including, but not limited to, the following procedures:
   a. Verify the correct inventory of hardware including software licences, authentication certificates, cables, etc.;
   b. Demonstrate that all spare memory, equipment capacity and system expansion requirements;
   c. Demonstrate that all input and output expansion requirements have been met, including wiring and signal isolation, and verify that power supplies are capable of supporting the increased load for this expansion;
   d. Demonstrate all hardware and software boot-up and diagnostics;
   e. Verify all power supply voltages are within tolerance;
   f. Verify proper earth connections and isolation of instrumentation earth for all equipment;
   g. Demonstrate that all preloaded software and firmware have been properly installed and are operating correctly;
   h. Verify the connectivity and speed of the communications network equipment; and
   i. Demonstrate the systems to full functioning.

ELE36.4.020.9 TESTING AND COMMISSIONING (T&C)

1. A testing and commissioning procedure shall be proposed by the Sub-contractor and submitted to the WSD for approval prior to commencement of testing and commissioning work;
2. After completing the installation of the AMR Outstation and prior to setting to work, individual equipment shall be tested to ensure that it performs in accordance with the specified requirements and is in satisfactory working conditions;
3. Before carrying out the required site test, the Sub-contractor shall ensure the following:
   a. The AMR Outstation is installed in accordance with all relevant drawings, circuit diagrams and the specified requirements;
   b. All cables and individual conductors are labelled and ferruled as per the relevant drawings;
   c. All items of the AMR Outstation are adequately and correctly labelled and identified;
   d. The insulation resistance and continuity of all conductors of cables, etc. are acceptable; and
   e. The earthing arrangements are complete and a satisfactory value of earth loop impedance has been achieved.
4. The test procedures and format of test records shall be submitted to the WSD for approval prior to the scheduled commencement of testing and commissioning;
5. All measuring instruments, indicators, testing computers, network testing instruments and other apparatus necessary for carrying out the tests shall be provided by the Sub-contractor and accepted by the WSD;

6. The Sub-contractor shall submit a comprehensive T&C procedure including, but not limited to, the following items for approval:
   a. Integrity of the AMR data on the DCU;
   b. Integrity of the AMR data on the Router/Modem;
   c. Integrity of the AMR data on the AMR Master Station;
   d. Configuration and operation check on the MIUs;
   e. Operation check on the PLC;
   f. Change over test on the backup battery unit;
   g. Operation check on the AMR Outstation upon a.c. power supply failure;
   h. 6-hour discharge test on the battery of the AMR Outstation;
   i. Demonstration of remote programming and diagnosis of the AMR Outstation.
7. Final acceptance test full function of the AMR Outstation including successful data transmission to the AMR Master Station shall be conducted by the Sub-contractor to the satisfaction of the WSD.

ELE36.4.030.9 SYSTEM TRANSFER FOR OPERATION AND MAINTENANCE

1. Upon successful commissioning of the AMR Outstation by the Sub-contractor to the satisfaction of the WSD, when requested by the WSD, the whole system including communication network shall be handed over to the WSD for operation and maintenance;
2. An Operation and Maintenance manual complete with all necessary documentation, catalogues, drawings, reports, test certificates and T&C records shall be submitted to the WSD for approval prior to handing over of the system. Four (4) complete sets of hardcopy of the final O&M manual with softcopy in pdf format in a CD-ROM shall be provided; and
3. Upon requested by the WSD for handing over of the AMR Outstation, the Sub-contractor shall arrange a joint inspection with the WSD to check and confirm the AMR Outstation for the purpose of system handing over.

ELE36.4.040.9 TRAINING

1. The Sub-contractor shall provide not less than 40 hours training of the operation and maintenance for the AMR system with a proposed training programme approved by the Contract Manager / WSD. The training shall be conducted during normal working hours for the estate management staff/WSD. The Sub-contractor shall record in 720p video or better throughout one training session and hand over 2 copies of DVD-videos of the record to the Contract Manager; and
2. The Sub-contractor shall provide sufficient copies of detailed training manuals for operation and maintenance for the estate management staff and WSD.

ELE36.5 MAINTENANCE

ELE36.5.010.9 GENERAL

1. The Sub-contractor shall provide free maintenance including labour and materials to the system installation for the entire Maintenance Period after completion of the installation; and
2. During the Maintenance Period, the Sub-contractor shall attend to all faults and complaints, remedy all defects, replace all malfunction items and maintain the complete installation in a clean, tidy and functional condition to the satisfaction of the Contract Manager and WSD.

ELE36.5.020.9 24-HOUR ON-CALL SERVICE DURING MAINTENANCE PERIOD

1. The Sub-contractor shall provide 24-hour on-call service at any time during the Maintenance period. The Contract Manager may instruct the Sub-contractor, in the Maintenance Period via telephone, mobile phone, paging service or any other means as advised by the Sub-contractor and Approved by the Contract Manager, to attend the reported breakdowns, and the Sub-contractor shall dispatch competent technicians or such other suitable personnel, who shall arrive at site and shall carry out any necessary inspection testing and repair work as soon as practicable and under all weather conditions;
2. The Sub-contractor shall submit to the Contract Manager for this purpose at least two names of English speaking representatives, who can be reached at any time of the day, with contact telephone numbers of direct lines, mobile phones or paging service for Approval. Prior Approval shall also be obtained for any subsequent changes of representatives, contact telephone numbers etc. during the Maintenance Period at least two weeks before the change is effected;
3. The Sub-contractor shall attend to emergency calls within three (3) hours of receiving such calls out of normal working hours and a maximum time limit of two (2) hours during normal working hours. For other repair calls, they shall carry out repair work within twenty four (24) hours; and
4. The maintenance and servicing works, as described above, form part of the Main Works described in Clause 8.3(2)(c) of the General Conditions of Main Contract.

ELE36.6 CHECKLIST ON DOCUMENTS FOR INCLUSION IN THE AMR OUTSTATION PROPOSAL

ELE36.6.010.9 CHECKLIST ON DOCUMENTS FOR INCLUSION IN THE AMR OUTSTATION PROPOSAL

[Extracted from the appendix of WSD's standard specification: E-80-01, "Automatic Meter Reading (AMR) Outstation"]

Appendix

[August 2017]

Check List on Documents for Inclusion in
Automatic Meter Reading (AMR) Outstation Proposal

Part I – General Information

Address of Premises: _____

_____

Name of Consumer: (In English) _____

(In Chinese) _____

Contact Tel No.: _____

Email address: _____

ASN No. / CCID No. (if applicable): _____

WSD Reference No. (if applicable): _____

Part II – Documents to be included

The AMR Outstation proposal/supplementary information includes:

Please tick the appropriate boxes

		Enclosed in the proposal	Not Applicable
(1)	Site location plan - showing the location and boundary of the development	☐	☐
(2)	Building floor layout plan - showing the meter room(s)/box(es) for housing the AMR panel(s)	☐	☐
(3)	Meter room/box layout - indicating typical meter room/box - showing the detailed layout of the meter room/box with dimensions	☐	☐

P.1

		Enclosed in the proposal	Not Applicable
	- showing the meter positions including the associated fittings - showing the position of M-Bus adaptable boxes with dimensions - showing the distance between adaptable box to either of meter shall not be more than 1.5m - showing the layout and routing of cable conduits - indicating the meter room/box shall be lockable		
(4)	AMR equipment room (meter room/box for housing the AMR panel) layout - showing the position of AMR panel with dimensions - showing the positions of adaptable boxes for M-Bus cable and telecommunication cable and 13A fuse spur unit with dimensions - showing the layout of cable conduits - showing the distance between adaptable box to either of meter shall not be more than 1.5m - indicating the length of M-Bus cable (shall not be more than 350m)	☐	☐
(5)	Meter schedule - showing the address of each premises in the building that requires individually metered water supply - showing the numbers, sizes and types of meters	☐	☐
(6)	Design of the AMR Outstation Including: - detail drawings - schematic diagram - general arrangement of AMR panel - wiring diagram of PLC - power supply circuit diagram including backup battery and battery charger - schematic diagram of communication network showing the application of broadband/3G - indicating the numbers of meters connected to each DCU and the max. no of devices that can be connected - indicating the pulse-to-M-Bus converter for EM water meter if applicable	☐	☐
(7)	Equipment details - showing the list and details of equipment for AMR Outstation including the brand and model of equipment	☐	☐

P.2

		Enclosed in the proposal	Not Applicable
	- showing the numbers of M-Bus devices supported by the DCU and the capacity of internal memory - showing by calculation the battery size is capable for supporting the backup operation in specified hours - indicating the panels' dimensions, material and the degree of protection		
(8)	Installation Programme - indicating the Building Covenant date - showing the detail installation programme - indicating the installation date of the smart water meters	☐	☐
(9)	Other information required by the Water Supplies Department (WSD). Please specify: _____	☐	☐

Remarks:

a. The submission and approval of AMR Outstation proposal shall be separated from the submission and approval of plumbing proposal for application of water supply. The information submitted for the above purposes shall be self-contained and shall not be mixed up.

b. Information (e.g. meter room/box layout, meter schedule, etc.) related to the application of water supply shall be approved under the plumbing proposal. Such information provided in the AMR Outstation proposal is for reference only.

c. Catalogues of equipment are not required to be submitted at the Proposal Stage. However, such catalogues shall be submitted to the WSD for information together with the submission of operation and maintenance manual.

P.3

ELE37 ELECTRIC VEHICLE CHARGING FACILITIES

ELE37.1 GENERAL REQUIREMENTS 3

ELE37.1.010.A SCOPE OF WORKS 3
ELE37.1.020.A WIRING CONNECTION 3
ELE37.1.030.9 EXECUTION OF THE WORK 3
ELE37.1.040.A STATUTORY REGULATIONS 3
ELE37.1.050.A STANDARDS 3

ELE37.2 SYSTEM DESCRIPTION 4

ELE37.2.010.A GENERAL 4

ELE37.3 MATERIALS AND EQUIPMENT 5

ELE37.3.1 MODE 3(LITE) MEDIUM CHARGER 5
ELE37.3.1.010.A GENERAL 5

ELE37.3.2 MODE 3 MEDIUM CHARGER 6
ELE37.3.2.010.A GENERAL 6
ELE37.3.2.020.A INTERFACE WITH PAYMENT CONSOLES FOR FEE COLLECTION SYSTEM 8
ELE37.3.2.030.A INTERFACING REQUIREMENTS WITH CENTRAL WORKSTATION 9

ELE37.3.3 32A DOUBLE POLE ISOLATOR 9
ELE37.3.3.010.9 GENERAL 9

ELE37.3.4 CENTRAL WORKSTATION 9
ELE37.3.4.010.A GENERAL 9
ELE37.3.4.020.N INTERFACING REQUIREMENTS WITH HA DATA HUB SERVER 12
ELE37.3.4.030.N INTERFACING REQUIREMENTS WITH EPD EV-CHARGING EASY APP 13
ELE37.3.4.040.N RADIO FREQUENCY IDENTIFICATION (RFID) CARD 14

ELE37.3.5 MODE 4 QUICK CHARGER 14
ELE37.3.5.010.N GENERAL 14
ELE37.3.5.020.N INTERFACE WITH PAYMENT CONSOLES FOR FEE COLLECTION SYSTEM 17
ELE37.3.5.030.N INTERFACING REQUIREMENTS WITH CENTRAL WORKSTATION 18

ELE37.3.6 LOAD MANAGEMENT SYSTEM 18
ELE37.3.6.010.N GENERAL 18

ELE37.3.7 FEE COLLECTION SYSTEM 19
ELE37.3.7.010.N GENERAL 19

ELE37.4 INSTALLATION REQUIREMENTS 23

ELE37.4.1 EV CHARGING FACILITIES 23
ELE37.4.1.010.A GENERAL 23

ELE37.4.2 MODE 2 MEDIUM CHARGER 23
ELE37.4.2.010.X DELETED 23

ELE37.4.3 PAYMENT CONSOLES, MODE 3 (LITE), MODE 3 MEDIUM CHARGER AND MODE 4 QUICK CHARGER 23
ELE37.4.3.010.A GENERAL 23

ELE37.4.4 32A DOUBLE POLE ISOLATOR 23
ELE37.4.4.010.A GENERAL 23

ELE37.4.5 DOCUMENTATIONS AND SOFTWARE LICENSE 24
ELE37.4.5.010.N GENERAL 24

ELE37.5 TESTING AND COMMISSIONING 25

ELE37.5.010.A TESTS....25
ELE37.5.020.9 TEST RECORD....25
ELE37.5.030.9 TRAINING....25

ELE37.6 MAINTENANCE....26

ELE37.6.010.9 GENERAL....26
ELE37.6.020.9 24-HOUR ON-CALL SERVICE DURING MAINTENANCE PERIOD....26
ELE37.6.030.A PREVENTIVE MAINTENANCE....26

ELE37.1 GENERAL REQUIREMENTS

ELE37.1.010.A SCOPE OF WORKS

The Sub-contractor shall provide the following electric vehicles (EV) charging facilities as shown on the Drawings:

1. Mode 3 medium charger (MC) and Mode 3 (Lite) MC with Type 2 32A socket outlet to IEC 62196;
2. Mode 4 quick charger (QC) with connector to Combined Charging System (CCS) Combo 2 to IEC 62196-3;
3. EV charging enabling facilities;
4. Central workstation;
5. System Interfaces to exchange electronic data with a HA data hub server via broadband network with fixed IP (4G/5G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP);
6. Load management system (LMS) where required;
7. Fee collection system including payment consoles;
8. All necessary wiring and accessories.

ELE37.1.020.A WIRING CONNECTION

The Sub-contractor shall provide all necessary cable wiring for data and power connection for , Mode 3 MC, Mode 3 (Lift) MC, Mode 4 QC, EV charging enabling facilities, LMS, central workstation and fee collection system.

ELE37.1.030.9 EXECUTION OF THE WORK

1. Electrical work on EV charging facilities including installation, testing and commissioning, and maintenance works shall be carried out by registered electrical contractors and registered electrical workers of the appropriate grade under the Electricity (Registration) Regulations (Cap.406);
2. All proposed equipment shall have a guarantee of spare parts supply of at least five years.

ELE37.1.040.A STATUTORY REGULATIONS

The EV charging facilities shall comply with the following statutory regulations:

1. Code of Practice for the Electricity (Wiring) Regulations and its subsidiary code 26S - Charging Facilities for Electric Vehicles;
2. Technical Guidelines on Charging Facilities for Electrical Vehicles issued by the Electrical and Mechanical Services Department;
3. Technical Guidelines for Electric Vehicle (EV) Charging-enabling for Car Parks of New Building Developments issued by the Environment and Ecology Bureau;
4. Guidance Note on Fault Protection for Direct Current Electric Vehicle Charging Facilities issued by Electrical and Mechanical Services Department;
5. Other Statutory Regulations as detailed in ELE1.4.010.

ELE37.1.050.A STANDARDS

1. The EV charging facilities shall comply with IEC 61851-1;
2. The Mode 4 QC shall comply with IEC 61851-23.

ELE37.2 SYSTEM DESCRIPTION

ELE37.2.010.A GENERAL

1. EV charging facilities shall be provided for monthly and hourly parking spaces respectively as shown on Drawings;
2. For monthly parking spaces with completed set of EV charging facilities, the Sub-contractor shall provide the fixed electrical installations including, but not limited to switchboards, distribution boards, cabling, cable containment and a Mode 3 (Lite) MC at each parking space as indicated on the Drawings. Wooden meter board shall be provided inside electric meter room or other locations as specified on Drawings for future installation of electricity meter by power company;
3. For hourly parking spaces with completed set of EV charging facilities, the Sub-contractor shall provide the fixed electrical installations including, but not limited to switchboards, distribution boards, cabling, cable containment, fee collection system and a Mode 3 MC or Mode 4 QC at each parking space as indicated on the Drawings;
4. The EV medium chargers and / or quick chargers for hourly parking spaces shall be connected to the central workstation(s) and fee collection system at Shroff office or other locations as specified on Drawings for central monitoring of EV medium charger, and / or quick charger and remote control of the charger operation. The Sub-contractor shall provide all necessary data cabling and network equipment for the installation;
5. The fee collection system shall be provided for EV charging facilities. The Sub-contractor shall allow necessary provision in the Mode 3 MC and Mode 4 QC to interface with the fee collection system as specified in ELE37.3.2.020. The payment consoles are allowed at designated location as shown on Drawings and the Sub-contractor shall provide all necessary data cabling, network equipment for the installation and power points for the payment consoles and allow cable containment facilities from each payment consoles to the Mode 3 MCs and Mode 4 QCs, LMS, and / or central workstation for communication of fee collection system;
6. EV charging facilities for hourly parking spaces shall be connected to the payment consoles adjacent to the parking spaces or at designated location as shown on Drawings. The payment consoles shall then be connected to the central workstation at Shroff office or other locations as confirmed by CM for central monitoring of EV MC and / or QC and remote control of the charger operation:
    a. The central workstation shall be automated with system interfaces to exchange electronic data with an HA's data hub server after implementation, to perform fee collection (e.g. Octopus online payment), and to control and monitor remotely the EV chargers via broadband network with fixed IP (4G/5G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP);
    b. For project with remoted site, the central workstation shall be exchanged electronic data with equipment on Site such as EV chargers and payment consoles via broadband network with fixed IP (4G/5G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP);
    c. All relevant cost of broadband network including any service fee required during Maintenance Period shall be borne by the Sub-contractor.

ELE37.3 MATERIALS AND EQUIPMENT

ELE37.3.1 MODE 3(LITE) MEDIUM CHARGER

ELE37.3.1.010.A GENERAL

1. The Mode 3 (Lite) MC shall be designed for Mode 3 Charging as specified in IEC 61851-1. The Sub-contractor shall provide relevant type test certificates to substantiate compliance with this standard. The Mode 3 (Lite) MC shall be able to deliver rated power output of not less than 7kW, 220V single phase. All the fixed installation shall comply with the relevant requirements of the Electricity Ordinance (Cap.406) and its subsidiary Regulations;
2. The Mode 3 (Lite) MC shall comprise a wall-mounted or floor-mounted pole fitted with an IEC 62196 type 2 32A socket, and integrated with all required power, control and communication system for safe and satisfactory charging of an electric vehicle complying with the relevant IEC charging standards. A 32A double pole isolator shall be provided at the proximity of the Mode 3 (Lite) MC for maintenance purpose;
3. The Mode 3 (Lite) MC casing shall provide protection against a minimum impact severity of AG2;
4. Covers shall be provided for protection of the 32A socket;
5. The Mode 3 MC (Lite) shall be provided with an electrical or mechanical system to prevent the plugging / unplugging of the charging plug unless the socket outlet or the vehicle connector has been switched off from the supply. The Mode 3 (Lite) MC shall be designed to ensure the inserted charging plug will be automatically unlocked to allow removal from the charging socket after normal stopping of the charging process or when the charger is faulty or under failure of the electricity supply to the Mode 3 (Lite) MC;
6. The Mode 3 (Lite) MC shall be protected from ingress of dust and water to an index of protection of IP54 in accordance with IEC 60529;
7. Indication light(s) with instruction notice to show each colour / flashing from indication light represented the charger status or display screen shall be provided for each charger in order to show the charger status including out of services, ready for charging, charging and charging completed;
8. Local job reference for installation of the Mode 3 (Lite) MC, and with at least 12 months in-service record upon completion of the installation shall be provided;
9. The Mode 3 (Lite) MC shall be suitable for the following operation flow by RFID card to initiate the start / stop of the charging process at monthly parking space is as follow for reference:
    a. The driver parks the EV at the designated parking area and switch off the power of EV;
    b. The driver connects the charging cable into EV charging inlet and Mode 3 (Lite) MC socket. Once the charging cable is plugged into the EV and Mode 3 (Lite) MC, the EV is ready for charging;
    c. The driver taps the RFID card over the card reader on Mode 3 (Lite) MC. Once it is validated, the charging process will be activated. The charging cable shall be locked up automatically;

d. After the charging process is completed, the charger will stop automatically. Charging is completed and the charging cable can be unlocked by tapping the RFID card over the card reader on Mode 3 (Lite) MC. If the driver would like to terminate the charging process during charging, the driver stops the charging process by tapping the RFID card over the card reader on Mode 3 (Lite) MC. Once it is validated, the driver can stop the charging process and unlock the charging cable from charger.

ELE37.3.2 MODE 3 MEDIUM CHARGER

ELE37.3.2.010.A GENERAL

1. The Mode 3 MC shall be designed for Mode 3 Charging as specified in IEC 61851-1. The Sub-contractor shall provide relevant type test certificates to substantiate compliance with this standard. The Mode 3 MC shall be able to deliver rated power output of 7kW, 220V single phase. All the fixed installation shall comply with the relevant requirements of the Electricity Ordinance (Cap.406) and its subsidiary Regulations;
2. The Mode 3 MC shall comprise a wall-mounted or floor-mounted pole fitted with an IEC 62196 type 2 32A socket, and integrated with all required power, control and communication system for safe and satisfactory charging of an electric vehicle complying with the relevant IEC charging standards. A 32A double pole isolator shall be provided at the proximity of the Mode 3 MC for maintenance purpose;
3. The Mode 3 MC casing shall provide protection against a minimum impact severity of AG2;
4. The payment consoles and RFID card reader shall be provided for the Mode 3 MC to initiate the start / stop of the charging process;
5. Covers shall be provided for protection of the 32A socket;
6. Indication light(s) with instruction notice to show each colour / flashing from indication light represented the charger status or display screen shall be provided for each charger in order to show the following charger status or equivalent in both English and Chinese description:
   a. Out of Services 暫停服務
   b. Ready for Charging 準備充電
   c. Charging 充電中
   d. Charging Completed 充電完成
7. The Mode 3 MC shall be compliant with the Open Charge Point Protocol (OCPP) 1.6J or later version;
8. The Mode 3 MC shall be provided with an electrical or mechanical system to prevent the plugging / unplugging of the charging plug unless the socket outlet or the vehicle connector has been switched off from the supply. The Mode 3 MC shall be designed to ensure the inserted charging plug will be automatically unlocked to allow removal from the charging socket after normal stopping of the charging process or when the charger is faulty or under failure of the electricity supply to the Mode 3 MC;
9. The Mode 3 MC shall be protected from ingress of dust and water to an index of protection of IP54 in accordance with IEC 60529;
10. The Mode 3 MC shall have built-in power meter being capable of providing real time electrical data. The real time data captured includes but not limited to start / stop charging time and charging duration, voltage, ampere, power factor, kVA, real power (kWh) and other additional real time data as required by the CM. The Sub-contractor shall submit proposal regarding output format of the real time electrical data to the CM for approval;

11. The Mode 3 MC shall have appropriate input / output sockets at a convenience position, using Ethernet LAN or similar socket and plug as approved by the CM, for communication with central workstation for central energy monitoring purpose and fee collection system. The connection cable with the appropriate plug shall be provided. The data shall be in a common excel format or raw data with software for converting the raw data into excel format, as approved by the CM. In case a proprietary made software for data retrieval is being used, free license for the software shall be provided. The Sub-contractor shall demonstrate the function with a portable PC during testing and commissioning;
12. Local job reference for installation of the Mode 3 MC with central management system, and with at least 12 months in-service record upon completion of the installation shall be provided;
13. The Mode 3 MC shall be suitable for the following operation flow by RFID card at hourly parking space in by-pass mode upon failure of central workstation and / or fee collection system is as follow for reference:
    a. The driver parks the EV at the designated parking area and switch off the power of EV;
    b. The driver connects the charging cable into EV charging inlet and Mode 3 MC socket. Once the charging cable is plugged into the EV and Mode 3 MC, 'Ready for Charging' display or change of indication light colour will be shown on the charger;
    c. The carpark operator taps the RFID card over the card reader on Mode 3 MC. Once it is validated, the charging process will be activated. The display on charger will be changed to 'Charging' or change of indication light and the charging cable shall be locked up automatically;
    d. After the charging process is completed, the charger will stop automatically. The display will change to 'Charging Completed' or change of indication light colour and the charging cable can be unlocked by tapping the RFID card over the card reader on Mode 3 MC. If the driver would like to terminate the charging process during charging, the carpark operator stops the charging process by tapping the RFID card over the card reader on Mode 3 MC. Once it is validated, the charging process will be stopped and the charger cable will be unlocked from the charger.
14. The Mode 3 MC shall also be suitable for the following operation flow by remote on / off of central workstation at hourly parking space in by-pass mode upon failure of fee collection system is as follow for reference:
    a. The driver parks the EV at the designated parking area and switch off the power of EV;
    b. The driver connects the charging cable into EV charging inlet and Mode 3 MC socket. Once the charging cable is plugged into the EV and Mode 3 MC, 'Ready for Charging' display or change of indication light colour will be shown on the charger;
    c. The driver goes to Shroff office to inform the carpark operator the respective parking space number. The carpark operator then activates the charging process via the central workstation. The display on charger will be changed to 'Charging' or change of indication light colour and the charging cable shall be locked up automatically;

d. After the charging process is completed, the charger will stop automatically. The display will change to 'Charging Completed' or change of indication light colour and the charging cable can be unlocked by carpark operator via the central workstation as requested by the driver. If the driver would like to terminate the charging process during charging, the driver should go to the Shroff office to inform the carpark operator. The carpark operator then stops the charging process via the central workstation and unlocks the charging cable from charger.

15. For normal operation mode, the Mode 3 MC shall also be suitable for fee collection. One of the possible operation flow by paying the selected duration first before start charging with fee collection system is as follow for reference:
    a. The driver parks the EV at the designated parking area and switch off the power of EV;
    b. The driver connects the charging cable into EV charging inlet and Mode 3 MC socket. Once the charging cable is plugged into the EV and Mode 3 MC, 'Ready for Charging' display or change of indication light colour will be shown on the charger;
    c. The driver goes to the payment console and selects the respective parking space number in the touch screen. The driver selects the charging duration and presents the payment card or device to the reader to start the charging process. The display on charger will be changed to 'Charging' or change of indication light colour and the charging cable shall be locked up automatically;
    d. After the charging process is completed, the charger will stop automatically. The display will change to 'Charging Completed' or change of indication light colour and the driver presents the same payment card or device which is used to start the charging process to the reader of payment console to pay the charging fee and unlock the charging cable. If the driver would like to terminate the charging process during charging, the driver should go to the payment console and present the same payment card or device which is used to start the charging process to the reader to pay the charging fee and press the 'stop' selection on the payment console to stop charging and unlock the charging cable from charger.
16. Mode 3 MC shall be either with front or side entry socket. The Sub-contractor shall select the suitable type of Mode MC to suit site installation requirement, in which the Mode 3 MC with charging cable being plugged shall not occupy additional space inside the parking space;
17. The Mode 3 MC shall be designed to enable adoption of fee collection system, LMS and HA data hub server.

ELE37.3.2.020.A INTERFACE WITH PAYMENT CONSOLES FOR FEE COLLECTION SYSTEM

1. The payment consoles shall exchange electronic data with the Mode 3 MC with the fee collection system and central workstation. The Mode 3 MC shall be designed in OCPP as specified in ELE37.3.2.010, and equipped with all necessary facilities including Ethernet LAN ports or other equivalent communication ports that supports electric charging, networking, payment gateway and remote monitoring such that it has the capability of serving as an online Mode 3 MC.

ELE37.3.2.030.A INTERFACING REQUIREMENTS WITH CENTRAL WORKSTATION

1. The fee collection system, Mode 3 MC shall be designed with communication protocol in compliance with the OCPP as specified in ELE37.3.2.010, and equipped with Ethernet LAN port or other suitable communication ports as approved by the CM and application programme interface to allow data logging, data transmission to central workstation for central monitoring and analysis of fee collection system data, the Mode 3 MC data. The payment console, Mode 3 MC shall be equipped with Ethernet LAN port or other provision to enable adoption of a smart system with features including fee collection system, dissemination of real-time information including availability status, capturing of usage data, reporting of utilization, smart phone interface and apps, load management, etc. The Mode 3 MC On / Off status and output signal for disconnection of charging plug from the charger shall be available and readable such that the EV medium and quick charger availability status can be relayed to the remote server for on-line display;
2. The fee collection system, Mode 3 MC shall be designed with time synchronization feature to synchronise with the clock time of the central workstation;
3. The Mode 3 MC should be designed with different operation modes including:
   a. By-pass mode for local start / stop operation;
   b. Control terminal mode for connection of the EV medium charger(s) to the central workstation for centralized management / fee collection, which will override the stand-alone mode automatically.

ELE37.3.332A DOUBLE POLE ISOLATOR

ELE37.3.3.010.9 GENERAL

1. The 32A double pole isolator shall comply with the requirement as mentioned in ELE3.8;
2. Isolators mounted outdoors, or in positions where they may be exposed to rain or water, shall be weatherproof with ingress protection of at least IP55 to BS EN 60529 or IEC 60529.

ELE37.3.4CENTRAL WORKSTATION

ELE37.3.4.010.A GENERAL

1. The Central Workstation shall include the following:
   a. Central workstation completed with a fully developed EV charging facilities management software and central database. The central workstation shall possess with the following minimum hardware requirements whichever is higher for the computer OCPP server and computer workstation:

Computer OCPP Server	
Processor:	Intel i7 and Four Core Chip minimum or equivalent
CPU Speed:	3.4 GHz or above
Memory:	16GB DDR4 RAM or above
Storage harddisk:	Dual harddisks each not less than 4TB SSD in RAID each whichever is higher
Monitor:	Minimum 22” 1920 x 1080 full High Definition LED display
Communications:	Ethernet 10/100BaseT connection or equivalent

Drive:	DVD ± RW / Multi-media player
Accessory:	Internal card reader with USB port
Operating System and Software	MS Windows Server or Linux Server or equivalent
Computer Workstation	
Processor:	Four Core Chip minimum
CPU Speed:	3.4 GHz or above
Memory:	16GB DDR4 RAM or above
Storage harddisk:	Dual harddisks each not less than 1TB SSD in RAID each whichever is higher
Monitor:	Minimum 22" 1920 x 1080 full High Definition LED display
Communications:	Ethernet 10/100BaseT connection or equivalent
Drive:	DVD ± RW / Multi-media player
Accessory:	Internal card reader with USB port
Operating System and Software	MS Windows and MS Office (Traditional Chinese) of latest versions

b. Uninterrupted power supply unit (UPS) - for a back-up period of not less than 15 minutes;

c. Communication interface for fee collection system, LMS and Mode 3 MC and Mode 4 QC;

d. Data point for broadband connection with fixed IP (4G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP);

e. Report printer.2. The Central Workstation shall be capable of handling the following activities:

a. Processing of charging for Mode 3 MC and Mode 4 QC;

b. Record of malfunctions of equipment and every transaction;

c. Daily charging record and statistics;

d. Information on Mode 3 MC and Mode 4 QC;

e. Activation and deactivation of the Mode 3 MC and Mode 4 QC;

f. Automatic alarm message in case of faulty operation;

g. Display graphical mapping with individual charger and power consumption status;

h. Real time swap tariff schemes: Time charging or Energy charging subject to setting of tariff scheme;

i. Charging unit rate pre-set and re-adjustable.

3. The Central Workstation shall link up with all other components to monitor and proceed with the operations of the EV charging facilities through an Ethernet LAN network. It shall provide overall control of EV charging activities, and data collected, and comprehensive and efficient financial and statistical report generation;

4. The Central Workstation shall be able to allow reading, checking, debiting and archiving against usage of Mode 3 MC, Mode 4 QC and process the activation / deactivation requests of the Mode 3 MC, Mode 4 QC and store the charging information in the central database;

5. All software included shall be in free or full user licenses with no expiry date. Full set of system recovery diskettes, back up diskettes for the software shall be provided. The administration right of the EV charging facilities management software shall be vested to the estate management staff;
6. Spare capacity shall be allowed in the central workstation for future addition or change of Mode 3 MC and Mode 4 QC to all parking spaces;
7. All data shall be provided in a file format for data exchange subject to the approval by the CM. The data of individual EV charger charging history shall be exported to different file format, e.g. Excel, subject to the approval by the CM. The Sub-contractor shall install programme in the OCPP server so that the file can be opened directly;
8. The availability of EV parking spaces as well as the Mode 3 MC and Mode 4 QC status & charging status of car parks with chargers shall be stored in a file that is updated in a time interval as the default setting subject to the approval by the CM. The update interval shall be user configurable;
9. The software shall be reliable and robust (fault-tolerant) such that the system would maintain reliable operation even in presence of hardware faults and software errors;
10. The OCPP Server shall be included featuring ports and communication hardware as needed;
11. The live data such as charger status log according to OCPP 1.6J or latest version of EV chargers shall be collected (in every 15 minutes interval) and kept in the OCPP Server for at least 12 months, but not limited to the following:
    a. Parking Space ID (unique ID for each parking space);
    b. Charger Availability (Unavailable, Available);
    c. Charger Status (available, charging, preparing, finishing or suspended);
    d. Start Time with meter reading (kWh) (the last starting time of the MC and QC to charge an EV) with meter reading (kWh);
    e. Stop Time with meter reading (kWh) (the stop time of the MC and QC with reference to its start time. If the charger is still charging an EV, a dashed line will be displayed.);
    f. Charging Duration (hh:mm) (the duration between start and stop time. If the charger is still charging an EV, a dashed line will be displayed.);
    g. Start Reading (kWh) (the accumulated power of the smart meter captured by start charging time.);
    h. Stop Reading (kWh) (the accumulated power on smart meter captured by stop charging time. A dashed line will be displayed when the MC and QC are engaged.);
    i. Charging Energy (kWh) (accumulated real power between “Start Reading (kWh)” and “Stop Reading (kWh)”;
    j. Live Reading(kWh) (current reading of accumulated real power on smart meter);
    k. Voltage(V) (current reading of voltage of smart meter);
    l. Current(A) (current reading of current of smart meter);
    m. Power Factor (current reading of power factor of the smart meter);
    n. Real Power (current reading of output power of the smart meter);
    o. Charger Last Update Time (last updated time of the charger);
    p. Meter Last Update Time (last updated time of the smart meter);
    q. Pulse Width Modulation (PMW) Voltage Level;
    r. The live data shall be displayed in the OCPP Server and exported in Excel format.

12. The Central Workstation shall be suitable for exchanging Octopus Data Exchange File(s) (in Octopus proprietary format) with Octopus Clearing System and fee collection system;
13. Software provision in the Central Workstation for future installation of other payment devices such as online or mobile apps shall be allowed;
14. Computer workstation shall only be used in daily operation and monitoring by the operator.

ELE37.3.4.020.N INTERFACING REQUIREMENTS WITH HA DATA HUB SERVER

1. The Central Workstation shall be automated with system interfaces to exchange electronic data with a HA's data hub server via broadband network with fixed IP (4G/5G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP). The Contractor is responsible for implementing the process to perform the following system interfaces between Central Workstation and the data hub server:
    a. Providing information of the detailed transactions for reporting to HA, and sending it to the data hub server;

        The process is to produce and send an interface file to the data hub server for reporting the detailed transactions. The information to be sent to the data hub server includes but not limited to the following:

        i. Payment Console ID;
        ii. Transaction Reference (Payment Console reference);
        iii. Transaction Type;
        iv. Charging Start Date and Time;
        v. Charging End Date and Time;
        vi. Charging Duration (hh:mm) (the duration between start and stop time);
        vii. Charging Energy (kWh);
        viii. EV-Charger ID;
        ix. Amount collected;
        x. Parking Space ID;
        xi. Amount Collected;
        xii. Payment Method;
        xiii. RFID Card ID (if applicable).

    b. Providing statistical information for management reporting to HA, and sending it to the data hub server;

        The process is to produce and send an interface file to the data hub server daily for reporting the detailed transactions. The information to be sent to the data hub server includes but not limited to the following:

        i. EV-Charger ID;
        ii. Parking Space ID;
        iii. Total Charging Duration;
        iv. Total Amount Collected.

2. The Sub-contractor shall develop all programs and / or scripts in Central Workstation to perform the system interface processes and automate these processes such that the interfaces can be performed with minimum human operation. The automation shall include:
    a. To generate the file to the data hub server;
    b. To connect to the data hub server by broadband network / 4G/5G USB modem;

c. To provide Secure File Transfer Protocol (SFTP) username and password for authentication;

d. To make SFTP file transfer request to the data hub server to send / get the files as binary data;

e. To disconnect the SFTP session;

f. To log the progress of the automated processes during execution, and save the log in Central Workstation;

g. To display message in Central Workstation to show the result of the processes after execution.

3. The system interface processes shall be automated to run daily at regular timeslot. When required, ad-hoc execution of the automated processes shall be allowed;

4. The system interface files and the logs from the executed processes shall be kept in the Central Work Station for an adjustable period up to three months;

5. The Sub-contractor shall provide the user guide for operating and administering the system interfaces. The user guide shall include but not limited to:

   a. How to set the daily schedule of the automated processes for regular execution;

   b. How to launch the automated processes manually for ad-hoc execution;

   c. How to inspect the result of the automated processes after execution;

   d. The exception handling procedures when the execution of any automated process failed which include the reporting channel(s) for the failure, the steps to manually dispatch and receive the electronic data with alternative means (e.g. flash static memory, DVD-R, e-mail attachment, etc.) in case connection to the data hub server cannot be established, the steps to manually perform the failed system interface process, etc.;

   e. How to change the system interface parameters, such as the login username and password, the carpark stock identifier, the destination broadband network / 4G USB modem connection to the data hub server, etc..

6. The Sub-contractor is responsible for liaising with and providing assistance to HA staff for implementation of the system interfaces. The implementation will consist of the following tasks:

   a. To set up broadband network / 4G/5G USB modem connection;

   b. To develop SFTP requests from Central Workstation;

   c. To develop programs and / or scripts in Central Workstation;

   d. To prepare user guide for operating and administering the system interfaces;

   e. To participate in the acceptance testing of the system interfaces to prove that all automated system interface processes work properly, information to the data hub server is correct;

   f. To provide proper training for the operation and administration of the system interfaces to the operators.

ELE37.3.4.030.N INTERFACING REQUIREMENTS WITH EPD EV-CHARGING EASY APP

1. The Central Workstation shall be automated with system interfaces to exchange electronic data with a EPD's data hub server via broadband network with fixed IP (4G/5G USB modem with fixed IP may be accepted subject to CM's approval in case of unavailability of broadband network with fixed IP). The Contractor is responsible for implementing the process to perform the following system interfaces between Central Workstation and the data hub server;

2. The Sub-contractor is responsible for implementing the processes to provide data file containing for EV-Charging Easy APP information (the format in accordance with the structure specified by EPD) to EPD's data hub server for display information in EV-Charging Easy APP on EPD's request. The Sub-contractor shall design and provide a system software for interfacing and exchanging electronic data of information with EPD;
3. The Sub-contractor shall be responsible for liaising with EPD for the proper implementation of the interfaces, including the interface channel, frequency etc..

ELE37.3.4.040.N RADIO FREQUENCY IDENTIFICATION (RFID) CARD

1. The RFID card shall be made of durable plastic with size to ISO/IEC7810 ID-1. The card shall be a type commonly used in the EV charging system;
2. The central workstation with software tool shall be designed to permit RFID cards to be issued with online simple operation of command code on the Mode 3 MC and Mode 4 QC. The software tool shall be provided or manual operation on EV charger's card reader to input the RFID card's code on the Mode 3 (Lite) MC for offline operation. The RFID card shall be unique coded that the administrator can transmit the RFID card's code to the EV charger for access control of the EV charger;
3. Each driver of monthly parking control locally of the designated EV charger by the RFID card to initiate the start / stop of the charging process;
4. The Sub-contractor shall provide 5 nos. of RFID card for each Mode 3 (Lite) MC or Mode 3 MC with LMS for monthly parking;
5. The carpark operator control all of the EV chargers by the RFID card to initiate the start / stop of the charging process in case for by-pass mode for hourly parking and / or monthly parking;
6. The Sub-contractor shall provide 5 nos. of RFID card in total for Mode 3 MC and Mode 4 QC for hourly parking;
7. The Housing Authority logo, charger reference number and the name of the corresponding estate shall be clearly shown on the RFID cards. The Sub-contractor shall submit the charger reference number for printing in the card to the CM for approval.

ELE37.3.5 MODE 4 QUICK CHARGER

ELE37.3.5.010.N GENERAL

1. The Mode 4 QC shall be designed for Mode 4 Charging as specified in IEC 61851-1, and IEC 61851-23. The Sub-contractor shall provide relevant type test certificates to substantiate compliance with this standard. All the fixed installation shall comply with the relevant requirements of the Electricity Ordinance (Cap.406) and its subsidiary Regulations. The Mode 4 QC shall possess with the following minimum hardware requirements whichever is higher:

Charging Mode	Mode 4 Charging (IEC 61851-23:2014 compliance)
Input Voltage	380±10%, 3-phase
Input Frequency	50Hz±2%
Phase	3-phase 4-wire
Power Factor	0.96 equal or above
Ground Fault Protection	Residual current protective device at least Type A having the characteristic specified in Code 11J of the Electrical CoP

Output Power	Min. 100kW equal or up to Max.120kW
Output Voltage	200Vdc to 1,000Vdc for CCS Combo 2
Overall Conversion Efficiency	0.94% equal or above
Ambient Temperature	-10^{o}C to +50^{o}C or larger range
Harmonic	Total 5% equal or less
Cooling Method	Forced air-cooled / liquid-cooled or any appropriate cooling method
Noise Level	65dB equal or less (while charging)

2. The Mode 4 QC shall comprise a floor standing cabinet fitted with the following:
   a. The display screen with Minimum 7" inches touch LED monitor screen with the user interface (UI) displaying the operation information of the quick charger on a screen should be bilingual, i.e. both English and traditional Chinese are available for drivers;
   b. DC quick charger with charging cable;
   c. All required power modules should be designed to have multiple sets of min. 10kW or above per power module and they can be easily drawn out and inserted in. The charger can be operated in the lower charging output power in case of up to 3 power modules failure;
   d. Control and communication system;
   e. All above installed in the steel cabinet for safe and satisfactory charging of an electric vehicle complying with the relevant IEC charging standards.
3. The Mode 4 QC shall be converted three-phase AC to DC within the EV charging equipment. The resulting DC is supplied to the EV via a charging cable that is tethered to the EV charging equipment;
4. The Mode 4 QC casing shall provide protection against a minimum impact severity of AG2 as approved by the CM. It shall be a stainless steel or robust metal enclosure with epoxy powder coating finish with minimum 1.5mm thick, or other materials as approved by the CM;
5. The payment consoles and RFID card readers shall be provided for the Mode 4 QC to initiate the start / stop of the charging process;
6. The Mode 4 QC shall install standard quick charger and incorporates one DC charging standard in CCS Combo 2 and able to deliver not less than 100kW DC with max. current at 200Adc connector which shall be compatible with the CCS Combo 2 with the IEC 62196-3 compliant connector with a charging cable of about 5 metres in length;
7. The payment consoles shall connect with the Mode 4 QC to initiate the start / stop of the charging process. The charger shall be able to stop the charging process automatically when the EV is fully charged or the connector is disconnected from the EV;
8. The display screen shall be provided for each charger in order to show the following charger status or equivalent in both English and Chinese description:
   a. Out of Services 暫停服務
   b. Ready for Charging 準備充電
   c. Charging 充電中
   d. Charging Completed 充電完成
9. The Mode 4 QC shall be compliant with the Open Charge Point Protocol (OCPP) 1.6J or later version;

10. The DC quick charger shall normally be locked when charging unless the EV has been charging completed or stop charging from the EV;
11. The Mode 4 QC shall be protected from ingress of dust and water to an index of protection of IP55 in accordance with IEC 60529;
12. The Mode 4 QC shall have built-in power meter being capable of providing real time electrical data. The real time data captured includes but not limited to start / stop charging time and charging duration, voltage, ampere, power factor, kVA, real power (kWh) and data refers to ELE37.3.4.010 and other additional real time data as required by the CM. The Sub-contractor shall submit proposal regarding output format of the real time electrical data to the CM for approval;
13. The Mode 4 QC shall have appropriate input / output sockets at a convenience position, using Ethernet LAN or similar socket and plug as approved by the CM, for communication with central workstation for central energy monitoring purpose and fee collection system. The connection cable with the appropriate plug shall be provided. The data shall be in a common excel format or raw data with software for converting the raw data into excel format, as approved by the CM. In case a proprietary made software for data retrieval is being used, free license for the software shall be provided. The Sub-contractor shall demonstrate the function with a portable PC during testing and commissioning;
14. Oversea / Local job reference for installation of the Mode 4 QC with central management system, and with at least 12 months in-service record upon completion of the installation shall be provided;
15. The EV charger shall be designed to enable adoption of fee collection system;
16. For normal operation mode, the Mode 4 QC shall also be suitable for fee collection. One of the possible operation flow by paying the selected duration first before start charging with fee collection system is as follow for reference:
    a. The driver parks the EV at the designated parking area and switch off the power of EV;
    b. The driver connects the vehicle connector into EV charging inlet from Mode 4 QC. Once the vehicle connector is plugged into the EV from Mode 4 QC, ‘Ready for Charging’ display will be shown on the charger;
    c. The driver goes to the payment console and selects the respective parking space number in the touch screen. The driver selects the charging duration and presents the payment card or device to the reader to start the charging process. The display on charger will be changed to ‘Charging’ and the vehicle connector can be locked up by the EV automatically;
    d. After the charging process is completed, the charger will stop automatically. The display will change to ‘Charging Completed’ and the driver presents the same payment card or device which is used to start the charging process to the reader of payment console to pay the charging fee and unlocked the vehicle connector. If the driver would like to terminate the charging process during charging, the driver should go to the payment console and present the same payment card or device which is used to start the charging process to the reader to pay the charging fee and press the ‘stop’ selection on the payment console to stop charging and the vehicle connector will be unlocked from the EV, and plugged back to the QC by driver.
17. The Mode 4 QC shall be suitable for the following operation flow by RFID card at hourly parking space in by-pass mode upon failure of central workstation and / or fee collection system is as follow for reference:
    a. The driver parks the EV at the designated parking area and switch off the power of EV;

b. The driver connects the vehicle connector into EV charging inlet from Mode 4 QC. Once the vehicle connector is plugged into the EV from Mode 4 QC, 'Ready for Charging' display will be shown on the charger;

c. The carpark operator taps the RFID card over the card reader on Mode 4 QC. Once it is validated, the charging process will be activated. The display on charger will be changed to 'Charging' and the vehicle connector can be locked up by the EV automatically;

d. After the charging process is completed, the charger will stop automatically. The display will change to 'Charging Completed' and the vehicle connector can be unlocked by tapping the RFID card over the card reader on Mode 4 QC. If the driver would like to terminate the charging process during charging, the carpark operator stops the charging process by tapping the RFID card over the card reader on Mode 4 QC. Once it is validated, the charging process will be stopped, the vehicle connector will be unlocked from the EV, and plugged back to the QC by driver.

18. The Mode 4 QC shall also be suitable for the following operation flow by remote on / off of central workstation at hourly parking space in by-pass mode upon failure of fee collection system is as follow for reference:

    a. The driver parks the EV at the designated parking area and switch off the power of EV;

    b. The driver connects the vehicle connector into EV charging inlet from Mode 4 QC. Once the vehicle connector is plugged into the EV from Mode 4 QC, 'Ready for Charging' display will be shown on the charger;

    c. The driver goes to Shroff office to inform the carpark operator the respective parking space number. The carpark operator then activates the charging process via the central workstation. The display on charger will be changed to 'Charging' and the vehicle connector can be locked up by the EV automatically;

    d. After the charging process is completed, the charger will stop automatically. The display will change to 'Charging Completed' and the vehicle connector can be unlocked by carpark operator via the central workstation as requested by the driver. If the driver would like to terminate the charging process during charging, the driver should go to the Shroff office to inform the carpark operator. The carpark operator then stops the charging process via the central workstation, the vehicle connector will be unlocked from the EV, and plugged back to the QC by driver.

19. Mode 4 QC shall be either with front or side charging cable with chargers. The Sub-contractor shall select the suitable type of Mode 4 QC to suit site installation requirement, in which the Mode 4 QC with charging cable being plugged shall not occupy additional space inside the parking space;

20. The Contractor shall supply and install concrete plinth as foundation for installation of EV multi-standard quick chargers at EV quick charging station as advised by manufacturer. The concrete plinth with sufficient height shall be designed that the power supply cable can run underneath the DC charging station and be properly terminated onto the equipment.

ELE37.3.5.020.N INTERFACE WITH PAYMENT CONSOLES FOR FEE COLLECTION SYSTEM

1. The payment consoles shall exchange electronic data with the Mode 4 QC with the fee collection system and central workstation. The Mode 4 QC shall be designed in OCPP as specified in ELE37.3.5.010, and equipped with all necessary facilities including Ethernet LAN ports or other equivalent communication ports that supports electric charging, networking, payment gateway and remote monitoring such that it has the capability of serving as an online Mode 4 QC.

ELE37.3.5.030.N INTERFACING REQUIREMENTS WITH CENTRAL WORKSTATION

1. The fee collection system, Mode 4 QC shall be designed with communication protocol in compliance with the OCPP as specified in ELE37.3.5.010, and equipped with Ethernet LAN port or other suitable communication ports as approved by the CM and application programme interface to allow data logging, data transmission to central workstation for central monitoring and analysis of fee collection system data, he Mode 4 QC data. The payment console, Mode 4 QC shall be equipped with Ethernet LAN port or other provision to enable adoption of a smart system with features including fee collection system, dissemination of real-time information including availability status, capturing of usage data, reporting of utilization, smart phone interface and apps, load management, etc. The Mode 4 QC On / Off status and output signal for disconnection of charging plug from the charger shall be available and readable such that the EV medium and quick charger availability status can be relayed to the remote server for on-line display;
2. The fee collection system, Mode 4 QC shall be designed with time synchronization feature to synchronise with the clock time of the central workstation;
3. The Mode 4 QC should be designed with different operation modes including:
   a. By-pass mode for local start / stop operation;
   b. Control terminal mode for connection of the EV medium charger(s) to the central workstation for centralized management / fee collection, which will override the stand-alone mode automatically.

ELE37.3.6 LOAD MANAGEMENT SYSTEM

ELE37.3.6.010.N GENERAL

1. In case the electricity supply capacity in premises cannot support simultaneous medium charging at all monthly parking spaces to be covered, a load control by means of load management system (LMS) can be implemented to facilitate the EV charging in the carpark so as to fully utilise the available electricity supply for EV charging circuits and subject to the CM for approval prior to installation. When LMS is implemented, Mode 3 MC shall be provided instead of Mode 3 (Lite) MC for all monthly parking spaces which shall be connected to the central workstation;
2. The load management controller shall capable to control in different management control algorithms with numbers of connected chargers for Mode 3 MC;
3. The LMS shall adopt OCPP with 1.6J or later version to ensure compatibility with most EV chargers available in the market adopting the same protocol. Automatic sharing and distribution of power supply to all parking spaces shall be provided;
4. The control algorithms shall be devised in the LMS e.g. even distribution, queuing, priority, and etc. subject to the design. To enhance safety and reliability, fail-safe features shall also be provided in the LMS. The control algorithms can be modified by the LMS' supplier subject to management need from requested by Carpark operator;
5. A notification should be provided in the car park to alert users of the EV chargers that the anticipated charging rate (and hence charging time) may by varied with the prevalent demand on the total charging services in the carpark;
6. The Central Workstation described in ELE37.3.4 shall also be capable of handling the following activities for monthly parking only:
   a. Load management presented with graphical control;
   b. Even distribution mode in averaging current charging, the total current is shared with each individual car equally until the setting of minimum charging rating by queuing;

c. Priority mode that independent setting charging, the current is fixed to the designated Mode 3 MCs when charging and the remaining cars would be kept in averaging current charging;

d. Fail-safe in loss communication or failure with individual charger or whole cluster, the charging rating for all Mode 3 MCs would be set at minimal pre-set rating.

7. The Mode 3 MC completed with internal control device shall be compatible with the Load Management System that utilised for load control when charging.

ELE37.3.7 FEE COLLECTION SYSTEM

ELE37.3.7.010.N GENERAL

1. The fee collection system shall consist of central workstation and payment consoles to integrate the EV charging facilities on-site. The number of the payment consoles shall be confirmed by the CM. The fee collection system shall compatible with IEC 61851 and Open Charge Point Protocol (OCPP) v1.6J, subject to the EV charging facilities;
2. The payment console shall include the following:
   a. Octopus card reader;
   b. Communication interface (i.e. Octopus);
   c. Data point;
   d. Thermal printer;
   e. Hardware provision in the payment console for future installation of other payment devices such as online payment or mobile apps;
   f. Each payment console shall have sufficient capacity to serve all carpark spaces for future extension of EV charger.
3. The fee collection system shall be suitable for exchanging Octopus Data Exchange File(s) (in Octopus proprietary format) with Octopus Clearing System;
4. The fee collection system shall consist of 6 configurable EV charging tariff schemes, namely:
   a. Zero payment method (Before implementation fee collection for zero payment);
   b. Pre-paid time charge (Option after implementation fee collection);
   c. Pre-paid energy charge (Option after implementation fee collection);
   d. Post-paid time charge (Option after implementation fee collection);
   e. Post-paid energy charge (Option after implementation fee collection);
   f. Offline payment (Option after implementation fee collection).
5. The charging workflow and details of each scheme are detailed in the ELE37.3.2.010 and ELE37.3.5.010 of this Specification. The fee collection system shall be capable to enforce the captioned EV charging tariff schemes with the associated hardware and software provisions;
6. The fee collection system shall collect the EV charging tariffs by the Octopus card and shall be authorized by Octopus Holdings Limited for operations in Hong Kong through type approval test. Hardware provision shall be allowed in the payment console for future installation of other payment devices such as mobile payments;
7. The fee collection system shall operate through the internet router to perform Octopus card payment, paper receipt printing and vacancy reporting to the designated servers;
8. The fee collection system shall centralize the information collected from the live status of the EV charging facilities up to 2 years. The Central Workstation shall also perform the functions, including, but not limited to:

a. Management of the four (4) configurable EV charging tariff schemes;
b. Interface with the EV charging system for enabling / disabling of service, adopting tariff schemes and collecting usage data (i.e. power consumption, occupancy);
c. Data exchange with the payment consoles for usage of EV chargers and collection of tariffs;
d. Payment data transferred to Central Workstation for usage information;
e. Conduct Octopus Card payment service;
f. Store the required log and data, and generate statistic / summary reports;
g. Generate and transmit automatic notification messages via paper receipt;
h. Record fault log of all EV chargers and the System;
i. Any necessary functions to enable the payment service.

9. Each payment console shall act as the man-machine interface with the public users to operate the EV charging facilities and conduct payment, with the functions including but not limited to:
   a. Display the real-time status of each EV chargers on-site (e.g. available, in-use, out-of-service, error messages (e.g. Go to Shroff office for assistant), the remaining charging time of individual charger, etc.);
   b. Select, enable and disable the power transmission of each individual EV charger;
   c. Select, enable and disable EV charging cable locking mechanism of each individual EV charger;
   d. Select the desire charging duration / scheme;
   e. Conduct payment, check-in and check-out through Octopus card reader to select the desire charging duration / scheme;
   f. Any necessary functions to enable the payment service;
   g. The payment console shall also comply with the following parameters:

Processor:	Intel i5 and Four Core Chip minimum or equivalent
CPU Speed:	2.5 GHz or above
Memory:	At least 8GB DDR4 RAM
Storage harddisk:	One (1) unit of >=256GB SSD
Touch-screen:	21.5-inch LCD touch-screen which supports multi-touch function or better
Resolution:	1920 x 1080 pixels or better
Brightness:	300 cd/m^2 or better
Materials:	Metal casing or other material approved by the CM
Dimension	At most 500 (W) x 1800 (H) x 350 (D) or other size approved by the CM
Mounting	Floor mounted stand or wall mounted, subject to the site conditions
Operating voltage:	220 Vac
Operating system:	Agreeable to Octopus Holdings Limited

10. The payment consoles shall act as the platform for public to control and operate the new EV charging facilities on-site, perform EV charging payment for one to many;

11. The payment consoles shall be a computer with operating system (OS) agreeable to Octopus Holdings Limited installed and equipped with a LCD touch-screen and Octopus card reader to support the payment online service of the system;
12. The payment consoles shall be equipped with a tailor-made graphical user interface (GUI), e.g. showing the car park number and charging status, etc. The GUI shall allow user to select any connected EV chargers, activate and deactivate the power charging service, conduct payment via Octopus cards, and provide charging status and data for users' reference. The design and the workflow of the GUI shall be proposed by the Sub-contractor and submitted for CM's approval;
13. The payment consoles shall be equipped with touch-screen supporting multi-touch to collect users' input for the EV charging service;
14. The payment consoles shall be equipped with an Octopus card reader, support payment via Octopus card system and shall be authorized by Octopus Holdings Limited for Octopus card operation in Hong Kong. The Sub-contractor shall design the system and acquire the type approval from Octopus Holdings Limited;
15. Due to limited space available on-site, the Sub-contractor shall propose a suitable size of the payment consoles for CM's approval and tailor-made (if necessary) the payment consoles at his own expense;
16. The cable jacks shall be covered with locks or sealed off such that they can only be accessible by maintenance staff with specific tools (e.g. key locking, etc.);
17. The fee collection system shall be able to generate and transmit notification messages subject to the usage of each individual public user via receipt. The notification messages shall consist charging status and tariff summary information, including but not limited to:
    a. Current date and time of the System when generating the notifications;
    b. EV charger number selected;
    c. EV charging tariff scheme adopted;
    d. Duration of the EV charging service selected;
    e. Service start time and service end time;
    f. Total tariff to be collected;
    g. Tariff summary and breakdown;
    h. Error / fault notifications;
    i. Idling and penalty time notifications;
    j. Octopus card number and details;
    k. Other information and message as directed by the CM.
18. The fee collection system shall consist of interlocking mechanism to maintain the service of in-used EV chargers and prevent any intrusion from third party other than the original public user. The fee collection system shall verify the same Octopus card number before enabling, disabling, suspending and amending the service of in-used EV charger;
19. The interlocking mechanism shall extend to the operations of EV charger, where the connected charging cable shall only be released when the service is completed / suspended and checkout by the same Octopus card;
20. The Sub-contractor shall provide three (3) registered Octopus cards with the administrator rights to access to all payment consoles for fully operating all EV chargers. To access of these Octopus cards shall be recorded in the data logging for checking. The interlocking mechanism shall exclude these registered Octopus cards;

21. The fee collection system shall provide a bypass mode such that a failure of the System shall allow the continuous operation of the EV chargers. Under the activation of the bypass mode, all EV chargers shall allow users to operate directly as the same as the original operation without the fee collection system detailed in the ELE37.3.2.010 and ELE37.3.5.010 of this Specification. This bypass mode shall support both automatic and manual activation;
22. For failure of the fee collection system, the EV chargers shall be equipped with emergency button and shall allow users to stop the charging process and unlock the connected power cable. Or the Sub-contractor shall coordinate with the original supplier of the EV charging facilities and update all EV chargers to provide a default hidden "Stop Charging" button on the touch screen panel of the EV chargers during charging process. The button will be automatically shown upon failure of the fee collection system, and shall allow users to stop the charging process and unlock the connected power cable. Data such as EV charger identifier and timestamp, etc. of the use of this button shall be logged in database. The button in the screen shall be hidden automatically once the payment system resumes normal. The activation of this button shall also be allowed configurable by system administrator. Or a method to stop and resume as approved by the CM;
23. The Sub-contractor shall design and provide the user guide printed on each EV charger regarding the new charging procedure with payment consoles. The Sub-contractor shall also provide the payment console user guide, which shall be in the form of laminated, or other preservative, print-out next to each floor of payment consoles;
24. The fee collection system shall be able to exchange data with HD's back-end system through the OCPP Server of the EV charging system. One (1) set of software for the system with Application Programming Interface (API) shall be provided;
25. The OCPP Server shall also be able to exchange data with API provided by HD's back-end system and update the OCPP Server when necessary at the Sub-contractor own expense;
26. The fee collection system shall be connected with the EV charging system. One (1) set of software for the system with API shall be provided;
27. All APIs specifically developed under this Specification shall be provided and shall be perpetual in nature for permanent use;
28. The payment consoles shall be installed at various site location as confirmed by the CM and shall integrate with the EV charging facilities on-site to form a synchronized online payment with Octopus and control system for enabling EV charging payment services to the public users. The payment consoles shall act as a platform for public to operate the EV charging facilities on-site with user-selected durations and payment schemes. The fee collection system shall be capable of collecting EV charging fee from public via Octopus card and / or other payment devices (e.g. online payment or mobile apps, etc. where specified in future), which shall be subject to CM's approval, according to their individual usage of the EV charging facilities. Hardware provision shall be allowed in the payment consoles for future installation of other payment devices.

ELE37.4 INSTALLATION REQUIREMENTS

ELE37.4.1 EV CHARGING FACILITIES

ELE37.4.1.010.A GENERAL

1. Each EV charging facilities (Mode 3 (Lite) MC, Mode 3 MC and Mode 4 QC) shall be installed as a separate radial circuit of the fixed electrical installation;
2. Each EV charging facilities (Mode 3 (Lite) MC and Mode 3 MC) shall be individually protected by an earth leakage protective device of residual current operated circuit breaker (RCCB) or residual current operated circuit-breaker with integral overcurrent protection (RCBO) of 32A rating with residual operating current not exceeding 30mA. The earth leakage protective device shall be of type B characteristic to protect against DC fault current as per Code 26S of Electrical CoP;
3. Each DC charging station (Mode 4 QC) complied with the IEC 61851-23:2014 shall be individually protected by a residual current protective device of at least Type A, having the characteristic specified in Code 11J of the Electrical CoP, when installed on the AC supply circuit upstream to the charging station. The residual current protective device shall be able to use together with the charging station and function safely as intended as per Code 26S of Electrical CoP and Guidance Note on Fault Protection for Direct Current Electric Vehicle Charging Facilities.

ELE37.4.2 MODE 2 MEDIUM CHARGER

ELE37.4.2.010.X DELETED

ELE37.4.3 PAYMENT CONSOLES, MODE 3 (LITE), MODE 3 MEDIUM CHARGER AND MODE 4 QUICK CHARGER

ELE37.4.3.010.A GENERAL

1. The Mode 3 (Lite) MCs, Mode 3 MCs, and payment consoles shall be suitable for wall-mount or floor-mount. For wall-mounted application, wall-mounted brackets shall be provided while for floor-mounted application, a mounting pole shall be provided for Mode 3 (Lite) MC and Mode 3 MC by Contractor and a mounting pole made of 1.5mm stainless steel shall be provided for payment consoles by this Sub-contractor. Details of mounting method shall be submitted to the CM for approval prior to installation;
2. The Mode 4 QCs shall be suitable for floor-mounted application. Details of mounting method, maintenance space and concrete plinth shall be submitted to the CM for approval prior to installation.

ELE37.4.4 32A DOUBLE POLE ISOLATOR

ELE37.4.4.010.A GENERAL

1. The 32A double pole isolator at each parking space shall be housed inside a metal housing equipped with provision of padlocking. Details of metal housing shall be submitted to the CM for approval prior to installation;

2. For outdoor application, the 32A double pole isolator shall be housed inside a weatherproof enclosure of IP65 in accordance with IEC 60529 with provision of access door and padlocking. Details of weatherproof enclosure shall be submitted to the CM for approval prior to installation;
3. For the isolator is installed inside the EV pole for Mode 3 (Lite) MC and Mode 3 MC, the 32A double pole isolator shall be referred to the clause in ELE37.3.3.010. Details of EV pole shall be submitted to the CM for approval prior to installation.

ELE37.4.5 DOCUMENTATIONS AND SOFTWARE LICENSE

ELE37.4.5.010.N GENERAL

1. The Sub-contractor shall provide the documentation such as installation DVD/CD, and potable USB drive or other acceptable media of all the software supplied including but not limited to the operating system, system software, application programs, configuration files, together with the user licenses;
2. The Sub-contractor shall provide all necessary interfacing protocol and information of the equipment used to facilitate the development of integration;
3. The Sub-contractor shall provide, maintain, and update the following documentation:
   a. System manual;
   b. Data manual;
   c. Program manual;
   d. Application user manual;
   e. Maintenance manual;
   f. System interface specification;
   g. Disaster recovery plan.
4. The Sub-contractor shall provide all necessary software licences for the whole EV charging facilities.

ELE37.5 TESTING AND COMMISSIONING

ELE37.5.010.A TESTS

The Sub-contractor shall carry out the following tests for the installation in the presence of the CM or his representatives:

1. Test of all electrical installation in compliance with the Electrical COP;
2. Continuous operation of charging the electrical vehicle;
3. Testing and demonstration of all functions of the electric vehicle charging facilities including Mode 3 (Lite) MC, Mode 3 MC, Mode 4, LMS, fee collection system and central workstation, etc. as mentioned in the Specification.

ELE37.5.020.9 TEST RECORD

The Sub-contractor shall record all the tests and submit to the Contract Manager for Approval.

ELE37.5.030.9 TRAINING

1. The Sub-contractor shall provide not less than 40 hours training of the operation and maintenance for the EV charging facilities with a proposed training programme approved by the Contract Manager. The training shall be conducted during normal working hours for the estate management staff. The Sub-contractor shall record in 720p video or better throughout one training session and hand over 2 copies of DVD-videos of the record to the Contract Manager;
2. The Sub-contractor shall provide sufficient copies of detailed training manuals for operation and maintenance for the estate management staff;
3. The Sub-contractor shall provide 2 sets of the recovery disks for system restoration and e-copies of operation and maintenance manuals to the Contract Manager before handover.

ELE37.6 MAINTENANCE

ELE37.6.010.9 GENERAL

1. The Sub-contractor shall provide free maintenance including labour and materials to the system installation for the entire Maintenance Period after completion of the installation;
2. During the Maintenance Period, the Sub-contractor shall attend to all faults and complaints, remedy all defects, replace all malfunction items and maintain the complete installation in a clean, tidy and functional condition to the satisfaction of the Contract Manager.

ELE37.6.020.9 24-HOUR ON-CALL SERVICE DURING MAINTENANCE PERIOD

1. The Sub-contractor shall provide 24-hour on-call service at any time during the Maintenance Period. The Contract Manager may instruct the Sub-contractor, in the Maintenance Period via telephone, mobile phone, paging service or any other means as advised by the Sub-contractor and Approved by the Contract Manager, to attend the reported breakdowns, and the Sub-contractor shall dispatch competent technicians or such other suitable personnel, who shall arrive at site and shall carry out any necessary inspection testing and repair work as soon as practicable and under all weather conditions;
2. The Sub-contractor shall submit to the Contract Manager for this purpose at least two names of English speaking representatives, who can be reached at any time of the day, with contact telephone numbers of direct lines, mobile phones or paging service for Approval. Prior Approval shall also be obtained for any subsequent changes of representatives, contact telephone numbers etc. during the Maintenance Period at least two weeks before the change is effected;
3. The Sub-contractor shall attend to emergency calls within three (3) hours of receiving such calls out of normal working hours and a maximum time limit of two (2) hours during normal working hours. For other repair calls, they shall carry out repair work within twenty four (24) hours;
4. The maintenance and servicing works, as described above, form part of the Main Works described in Clause 8.3(2)(c) of the General Conditions of Main Contract.

ELE37.6.030.A PREVENTIVE MAINTENANCE

1. The Sub-contractor shall provide quarterly maintenance inspection and service to the electric vehicle charging facilities such as checking overall functioning of the system, review the status, logging, and alarm history for the EV charging facilities, system data backup, software configuration, diagnostic exercise for all components and perform physical inspection, checking and cleaning / replacing filter of DC charging station, supply and install printer paper in payment consoles, etc. The Sub-contractor shall submit a proposed maintenance programme, including the scope of maintenance activities, to the CM for Approval within 14 days after the commencement of the Maintenance Period. An inspection report should be submitted to the CM after each quarterly inspection;
2. For half yearly, the Sub-contractor shall provide the maintenance services including, but not limited to functional checking for program examination, and items in quarterly above;
3. For annually, the Sub-contractor shall provide the maintenance services including, but not limited to functional checking, gateway program examination, carry out the program modification and improvement work as required from the EV charger's supplier, and items in half yearly above;

4. Upon request by the CM within the Maintenance Period, the Sub-contractor shall also provide free service to modify the computer programme to facilitate alteration of the system, such as change of payment method;
5. Four weeks before expiry of the Maintenance Period, the Sub-contractor shall carry out a hand / take-over inspection with the party taking up the on-going maintenance of the system in the presence of the CM or his representatives. Defects found should be rectified by the Sub-contractor to the satisfaction of the CM;
6. At the end of the Maintenance Period, the Sub-contractor shall execute all work of inspection, examination, and overhaul as required, to the complete installation to the satisfaction of the CM.

ELE38 MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIMEP)

ELE38.1 SCOPE OF WORKS 2

ELE38.1.010.N EXTENT OF APPLICATION 2

ELE38.2 PARTICULAR REQUIREMENTS OF MIMEP MODULE 3

ELE38.2.010.N GENERAL 3

ELE38.2.020.N ELECTRICAL SERVICES IN MODULAR INTEGRATED CONSTRUCTION ELECTRICAL METER ROOMS (MIC EMR) ONLY AT TYPICAL FLOOR OF DOMESTIC BLOCK 3

ELE38.2.030.N CEILING MOUNTED HORIZONTAL MODULE 3

ELE38.1 SCOPE OF WORKS

ELE38.1.010.N EXTENT OF APPLICATION

1. The Sub-contractor shall design, assemble, install and test the off-site prefabricated MiMEP modules, including but not limited to the following items, for on-site assembly and installation:
   a. Electrical services in Modular Integrated Construction Electrical Meter Rooms (MiC EMR) only at typical floor of domestic block.
2. The complete off-site prefabricated MiMEP module shall mean, not only the major equipment, all associated electrical works and system components as shown on the Drawings, but all the incidental supporting frame / hanger, lifting lugs and sundry components necessary for the complete on-site assembly and installation, whether or not these supply components are mentioned in detail in the tender documents;

ELE38.2 PARTICULAR REQUIREMENTS OF MiMEP MODULE

ELE38.2.010.N GENERAL

1. Each individual MiMEP module shall be designed and constructed as a self-contained packaged unit with appropriate provisions to facilitate the transportation, delivery, assembly and services connection on Site.

ELE38.2.020.N ELECTRICAL SERVICES IN MODULAR INTEGRATED CONSTRUCTION ELECTRICAL METER ROOMS (MIC EMR) ONLY AT TYPICAL FLOOR OF DOMESTIC BLOCK

1. The module shall comprise switchgear assemblies for domestic unit as detailed in ELE2.1.5.010 and ELE2.1.6.010 including, but not limited to, TP & N fuse combination unit, MCB distribution board, prefabricated trunking, meter boards for the installation of Supply Company's meter, other accessories and the mounting framework as appropriate. Installation of double pole MCB and connecting cables may be conducted on-site;
2. Interconnection of cables between the MiMEP modules and other electrical installation shall be conducted on-site;
3. Pre-installed electrical wirings, if any, shall be neatly grouped and labelled for easy identification.

ELE38.2.030.N CEILING MOUNTED HORIZONTAL MODULE

1. Ceiling mounted Mechanical Ventilation (MV) installation in typical floor, corridor and plant room shall be constructed through MiMEP approach. The MV horizontal module shall be pre-fabricated in sections for assembly on Site to form a complete system;
2. Jointing details, material / equipment and assembly methodology shall be submitted to the CM for approval;
3. Individual module section shall not pass through fire compartmentation wall unless appropriate fire rated connection unit is facilitated between services modules passing through the compartmentation wall;
4. Integrated supporting frame and hanger shall be provided for composite fixing of the MV service for each module. The frame shall be of robust with flexible fixing and bracketry facilities for mounting of different duct works in position. The flexible fixing facilities shall be able to accommodate certain degree of services fixing adjustment in order to suit the alignment of module interfacing with on-site installation or among modules themselves;
5. 10% loading capacity for the integrated supporting frame / rack shall be allowed for the addition and alteration works for the system components;
6. The design of the supporting frame and hanger system shall allow the alteration, take down and re-fix of the MV components without affecting the structural integrity of the overall framing of the module. Clear marking / warning notice shall be shown for critical structural support components that shall not be dismantle during the alteration works;
7. The layout, appearance and arrangement of exposed ceiling mounted modules shall be submitted to the CM for approval.

AP1 APPENDIX 1

AP1 APPENDIX 1 - LIST OF TECHNICAL STANDARDS QUOTED IN THIS SPECIFICATION 2

AP1.A010.B LIST OF TECHNICAL STANDARDS QUOTED IN THIS SPECIFICATION 2

AP1 APPENDIX 1 - LIST OF TECHNICAL STANDARDS QUOTED IN THIS SPECIFICATION

AP1.A010.B LIST OF TECHNICAL STANDARDS QUOTED IN THIS SPECIFICATION

Standard	Year of Standards	Description	Sections
AS/NZS 1768	2007	Lightning protection	ELE14 ELE23
ASHRAE 52.1	1992	Dust Spot Efficiency	ELE31
ASHRAE 52.2	1999 or 2007	Dust Spot Efficiency	ELE31
ASTM D3467-04	2004	Standard Test Method for Carbon Tetrachloride Activity of Activated Carbon1	ELE31
BS 88-2	2007	Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to I	ELE3 ELE6
BS 88: Section2.2	1988(1992)	Cartridge fuses for voltages up to and including 1000 V a.c. and 1500 V d.c. Specification for fuses for use by authorized persons (mainly for industrial application). Additional requirements for fuses with fuse-links for bolted connections	ELE3 ELE6
BS 88: Part 6	1988(1992)	Cartridge fuses for voltages up to and including 1000 V a.c. and 1500 V d.c. Specification of supplementary requirements for fuses of compact dimensions for use in 240 / 415 V a.c. industrial and commercial electrical installations	ELE3
BS 91	1998	Electric cable soldering sockets. Specification	ELE3
BS 476	HS	Fire tests on building materials and structures.	ELE29
BS 546	1950 (1988)	Specification. Two-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors	ELE20
BS 1210	1963	Specification for wood screws	ELE28

Standard	Year of Standards	Description	Sections
BS 1362	1973	General purpose fuse links for domestic and similar purposes (primarily for use in plugs)	ELE19 ELE20 PSS20 ELE21
BS 1363: Part 1	1995	13 A plugs,socket-outlets, adaptors and connection units — Part 1: Specification for rewirable and non-rewirable 13 A fused plugs	ELE20
BS 1363: Part 2	1995	13 A plugs, socket-outlets, adaptors and connection units — Part 2: Specification for 13 A switched and unswitched socket-outlets	ELE20
BS 1363:Part 4	1995	13 A plugs, socket-outlets, adaptors and connection units — Part 4: Specification for 13 A fused connection units switched and unswitched	ELE20
BS 1449:Part 1	HS	Steel plate, sheet and strip. Carbon and carbon-manganese plate, sheet and strip.	ELE9
BS 1494:Part 1	1964	Fixing Accessories for building purposes - Part 1: Fixings for Sheet, Roof and Wall Coverings	ELE9
BS 1710	1984(1991)	Identification of pipelines and services	ELE1 ELE11
BS 1853 Part 2	1995	Fluorescent lamps for general lighting service — Part 2: Specification for lamps used in the United Kingdom not included in BS EN 60081, BS EN 60901, BS EN 61195 and BS EN 61199	ELE21
BS 2754	1976	Memorandum. Construction of electrical equipment for protection against electric shock	ELE19
BS 3416	1991	Specification for bitumen-based coatings for cold application, suitable for use in contact with potable water	ELE2
BS 3858	1992	Specification for Binding and identification sleeves for use on electric cables and wires	ELE8
BS 4066-1	1980	Tests on electric cables under fire conditions — Part 1: Method of test on a single vertical insulated wire or cable	ELE7
BS 4533	HS	Luminaires	ELE21
BS 4533 Section 102.1	1990	Luminaires — Part 102: Particular requirements — Section 102.1 Specification for fixed general purpose luminaires	ELE21

Standard	Year of Standards	Description	Sections
BS 4568:Part 1	1970	Steel conduit and fittings with metric threads of ISO form for electrical installations — Part 1: Steel conduit, bends and couplers	ELE11
BS 4579	HS	Specification for performance of mechanical and compression joints in electric cable and wire connectors. Compression joints in copper conductors	ELE8
BS 4607:Part 1	1984	Non-metallic conduit fittings for electrical installations - Part 1: Specification for Fittings and components of insulating material	ELE13
BS 4607: Part 5	1982	Non-metallic conduit fittings for electrical installations - Part 5: Specification for rigid conduits, fittings and boxes of insulating material	ELE13
BS 4652	1995	Specification for zinc-rich priming paint (organic media)	ELE28
BS 4662	2006+A1:2009	Boxes for flush mounting of electrical accessories – Requirements, test methods and dimensions	ELE2 ELE8 ELE11 ELE16 ELE17 ELE19 ELE20 ELE23 ELE25
BS 4678:Part 2	1973	Cable trunking — Part 2: Steel underfloor (duct) trunking	ELE12
BS 4800	1989	Schedule of paint colours for building purposes	ELE4 ELE28
BS 5266:Part 1	2005	Emergency lighting — Part 1: Code of practice for the emergency lighting of premises	ELE21
BS 5425-1	1986	Coaxial cable for wideband distribution systems — Part 1: Specification for single unit, semi-airspaced cables for wideband distribution systems	ELE23
BS 5467	1997+A3:2008	Electric cables — Thermosetting insulated, armoured cables for voltages of 600/1 000 V and1 900/3 300 V	ELE7 ELE8 ELE9
BS 5499:Part 3	1990	Fire safety signs, notices and graphic symbols — Part 3: Specification for internally-illuminated fire safety signs	ELE21

Standard	Year of Standards	Description	Sections
BS 5649:Part 5	1982	Lighting columns — Part 5: Specification for base compartments and cableways	ELE21
BS 5733	1995	Specification for general requirements for electrical accessories	ELE20
BS 5825	1980	Specification for low voltage switchgear and controlgear for industrial use. Mounting rails. G-profile for the fixing of terminal blocks	ELE4
BS 5839-1	2017	Fire detection and fire alarm systems for buildings - Part 1: Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises	ELE7
BS 5854	1980	Code of practice for flues and flue structures in buildings	ELE29
BS 5979	2007	Remote centres receiving signals from fire and security systems – Code of practice	ELE1
BS 6004	2012	Electric cables - PVC insulated and PVC sheathed cables for voltages up to and including 300/500 V, for electric power and lighting	ELE7 ELE8 ELE21
BS 6121:Part1	1989 or 2005	Mechanical cable glands — Part 1: Armour glands — Requirements and test methods	ELE7
BS 6231	2006	Electric cables - Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and controlgear wiring	ELE4 ELE7 ELE8 ELE21
BS 6290-4	2002	Lead-acid stationary cells and batteries – Part 4: Specification of Classifying Valve Regulated Types	ELE24
BS 6387	2013	Test method for resistance to fire of cables required to maintain circuit integrity under fire conditions	ELE7
BS 6423	1983(1993)	Code of practice for Maintenance of electrical switchgear and controlgear for voltages up to and including 1 kV	ELE30
BS 6724	1997+A3:2008	Electric cables — Thermosetting insulated, armoured cables for voltages of 600/1 000 V and 1 900/3 300 V, having low emission of smoke and corrosive gases when affected by fire	ELE7 ELE8

Standard	Year of Standards	Description	Sections
BS 7211	2012	Electric cables - Thermosetting insulated and thermoplastic sheathed cables for voltages up to and including 450/750 V for electric power and lighting and having low emission of smoke and corrosive gases when affected by fire	ELE7
BS 7371-12	2008	Coatings on metal fasteners – Part 12: Requirements for imperial fasteners	ELE12
BS 7430	1998	Code of practice for Earthing	ELE17 ELE29
BS 7629:Part 1	1997 or 2008	Electric cables – Specification for 300/500 V fire resistant screened cables having low emission of smoke and corrosive gases when affected by fire - Part 1: Multicore and multipair cables	ELE7 ELE8
BS 7671	2013	Requirements for electrical installations IET Wiring Regulations Seventeenth Edition	ELE1 ELE2 ELE7 ELE8 ELE12 ELE17 ELE21 ELE30
BS 7846	2009	Electric cables – Thermosetting insulated, armoured, fire-resistant cables of rated voltage 600/1 000 V, having low emission of smoke and corrosive gases when affected by fire – Specification	ELE7 ELE8
BS 7889	1997	Electric cables — Thermosetting insulated, unarmoured cables for a voltage of 600/1 000 V	ELE7 ELE8
BS 8434-2	2009	Methods of test for assessment of the fire integrity of electric cables — Part 2: Test for unprotected small cables for use in emergency circuits — BS EN 50200 with a 930 ˚C flame and with water spray	ELE7
BS 8491	2008	Method for assessment of fire integrity of large diameter power cables for use as components for smoke and heat control systems and certain other active fire safety systems	ELE7

Standard	Year of Standards	Description	Sections
BS ISO 3334	2006	Micrographics. ISO resolution test chart No 2. Description and use	ELE31
BS ISO 13347 _:Parts 1 to 4	2004	Industrial fans. Determination of fan sound power levels under standardized laboratory conditions. General overview	ELE31
BS EN 40-1	1992	Lighting columns — Part 1: Definitions and terms	ELE21
BS EN 40-2	2004	Lighting columns — Part 2: General requirements and dimensions	ELE21
BS EN 40-3-1	2000	Lighting columns — Part 3-1: Design and verification - Specification for characteristic loads	ELE21
BS EN 40-3-2	2000	Lighting columns — Part 3-2: Design and verification - Verification by testing	ELE21
BS EN 40-3-3	2003	Lighting columns — Part 3-3: Design and verification — Verification by calculation	ELE21
BS EN 1856-1	2009	Chimneys – Requirements for metal chimneys – System chimney products	ELE29
BS EN 10088-2	2005	Stainless steels. Technical delivery conditions for sheet / plate and strip of corrosion resisting steels for general purposes	ELE28
BS EN 10143	1993 or 2006	Continuously hot-dip coated steel sheet and strip. Tolerances on dimensions and shape	ELE12
BS EN 10216	HS	Seamless steel tubes for pressure purposes	ELE29
BS EN 10217	HS	Welded steel tubes for pressure purposes – Technical Delivery conditions	ELE29
BS EN 10255	2004	Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions	ELE29
BS EN 10327	2004	Continuously hot-dip coated strip and sheet of low carbon steels for cold forming. Technical delivery conditions	ELE31
BS EN 10346	2009	Continuously hot-dip coated steel flat products. Technical delivery conditions	ELE31
BS EN 12464-1	2011	Light and Lighting – Lighting of work places Part 1: Indoor work places	ELE21
BS EN 12476	2000	Phosphate conversion coatings of metals. Method of specifying requirements	ELE4

Standard	Year of Standards	Description	Sections
BS EN 13032-1	2004	Light and lighting — Measurement and presentation of photometric data of lamps and luminaires — Part 1: Measurement and file format	ELE21
BS EN 13601	2002	Copper and copper alloys. Copper rod, bar and wire for general electrical purposes	ELE3 ELE4 ELE6
BS EN 50085-1	2005	Cable trunking systems and cable ducting systems for electrical installations — Part 1: General requirements	ELE9
BS EN 50085-2-1	2006	Cable trunking systems and cable ducting systems for electrical installations — Part 2-1: Cable trunking systems and cable ducting systems intended for mounting on walls and ceilings	ELE9
BS EN 50117-1	2002	Coaxial cables — Part 1: Generic specification	ELE24
BS EN 50117-2-1	2005+A1:2008	Coaxial cables — Part 2-1: Sectional specification for cables used in cabled distribution networks — Indoor drop cables for systems operating at 5 MHz — 1 000 MHz	ELE24
BS EN 50117-2-2	2004+A1:2008	Coaxial cables — Part 2-2: Sectional specification for cables used in cabled distribution networks — Outdoor drop cables for systems operating at 5 MHz – 1 000 MHz	ELE24
BS EN 50117-2-3	2004+A1:2008	Coaxial cables — Part 2-3: Sectional specification for cables used in cabled distribution networks — Distribution and trunk cables for systems operating at 5 MHz – 1 000 MHz	ELE24
BS EN 50117-3	1996	Coaxial cables used in cabled distribution networks — Part 3: Sectional specification for outdoor drop cables	ELE24
BS EN 50117-4	1996	Coaxial cables used in cabled distribution networks —Part 4: Sectional specification for distribution and trunk cables	ELE24
BS EN 50200	2015	Method of test for resistance to fire of unprotected small cables for use in emergency circuits	ELE7
BS EN 50262	1999	Cable glands for electrical installations	ELE7

Standard	Year of Standards	Description	Sections
BS EN 50393	2006	Test methods and requirements for accessories for use on distribution cables of rated voltage 0,6/1,0 (1,2) kV	ELE7
BS EN 50525-2-11	2011	Electric cables - Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U) Part 2-11: Cables for general applications - Flexible cables with thermoplastic PVC insulation	ELE7
BS EN 50525-2-21	2011	Electric cables - Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U) Part 2-21: Cables for general applications - Flexible cables with crosslinked elastomeric insulation	ELE7
BS EN 50525-2-31	2011	Electric cables - Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U) Part 2-31: Cables for general applications - Single core non-sheathed cables with thermoplastic PVC insulation	ELE3 ELE7 ELE8 ELE17 ELE24
BS EN 50525-2-41	2011	Electric cables - Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U) Part 2-41: Cables for general applications - Single core cables with crosslinked silicone rubber insulation	ELE19
BS EN 50525-3-41	2011	Electric cables - Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U) Part 3-41: Cables with special fire performance - Single core non-sheathed cables with halogen-free crosslinked insulation, and low emission of smoke	ELE7
BS EN 50618	2015	Electric cables for photovoltaic systems	ELE33
BS EN 55011	2009+A1:2010	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement	ELE29
BS EN 55014-1	2006+A1:2009	Electromagnetic compatibility — Requirements for household appliances, electric tools and similar apparatus — Part 1: Emission	ELE24 ELE29
BS EN 55015	2006+A2: 2009	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment	ELE21
BS EN 60051	HS	Direct acting indicating analogue electrical measuring instruments and their accessories	ELE4

Standard	Year of Standards	Description	Sections
BS EN 60061-1	1993 +A42:2009	Lamp caps and holders together with gauges for the control of interchangeability and safety — Part 1: Lamp caps	ELE21
BS EN 60061-2	1993 +A39:2009	Lamp caps and holders together with gauges for the control of interchangeability and safety — Part 2: Lampholders	ELE21
BS EN 60079	HS	Explosive atmospheres	ELE29
BS EN 60079-0	2012	Explosive atmospheres — Part 0: Equipment – General requirements	ELE29
BS EN 60079-10-1	2009	Explosive atmospheres — Part 10-1: Classification of areas – Explosive gas atmospheres	ELE29
BS EN 60081	1998	Double-capped fluorescent lamps — Performance specifications	ELE21
BS EN 60155	1995	Glow-starters for fluorescent lamps	ELE21
BS EN 60188	2001	High-pressure mercury vapour lamps — Performance specifications	ELE21
BS EN 60192	2001	Low pressure sodium vapour lamps — Performance specification	ELE21
BS EN 60228	2005	Conductors of insulated cables	ELE8
BS EN 60238	2004	Edison Screw Lampholders	ELE21
BS EN 60255	HS	Measuring relays and protection equipment	ELE4
BS EN 60255-21-1	1996	Electrical relays. Vibration, shock, bump and seismic tests on measuring relays and protection equipment. Vibration tests (sinusoidal)	ELE4
BS EN 60255-21-2	1996	Electrical relays. Vibration, shock, bump and seismic tests on measuring relays and protection equipment. Shock and bump tests	ELE4
BS EN 60255-22-2	2008	Measuring relays and protection equipment. Electrical disturbance tests. Electrostatic discharge tests	ELE4
BS EN 60255-3	1998	Electrical relays. Single input energizing quantity measuring relays with dependent or independent time	ELE4
BS EN 60255-151	2009	Measuring relays and protection equipment. Functional requirements for over / under current protection	ELE4
BS EN 60309-2	1999	Plugs, socket-outlets and couplers for industrial purposes. Dimensional interchangeability requirements for pin and contact-tube accessories	ELE20
BS EN 60332-1-1	2004	Tests on electrical and optical cables under fire conditions. Test for a vertical flame propagation for a single insulated wire or cable	ELE7

Standard	Year of Standards	Description	Sections
BS EN 60332-1-2	2004	Tests on electric and optical fibre cables under fire conditions. Test for vertical flame propagation for a single insulated wire or cable. Procedure for 1 kW pre-mixed flame	ELE7
BS EN 60332-2-1	2004	Tests on electric and optical fibre cables under fire conditions. Test for vertical flame propagation for a single small insulated wire or cable.	ELE7
BS EN 60400	2008	Lampholders for tubular fluorescent lamps and starterholders	ELE21
BS EN 60439-3 (Consumer Unit)	1991 or 1991+A1:1994 or 1991+A2:2001	Low-voltage switchgear and controlgear assemblies. Particular requirements for low-voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access to their use. Distribution boards	ELE3
BS EN 60439-3 (MCB board)	1991+A2:2001	Low-voltage switchgear and controlgear assemblies. Particular requirements for low-voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access to their use. Distribution boards	ELE3
BS EN 60529	1992	Specification for degrees of protection provided by enclosures (IP code)	ELE20 ELE31
BS EN 60570	2003	Electrical supply track systems for luminaires	ELE21
BS EN 60598	HS	Luminaires	ELE21
BS EN 60598-1	2008	Luminaires — Part 1: General requirements and tests	ELE21
BS EN 60598-2-2	1997	Luminaires Part 2: Particular requirements Section 2: Recessed luminaires	ELE21
BS EN 60598-2-22	1998+A2:2008	Luminaires — Part 2-22: Particular requirements — Luminaires for emergency lighting	ELE21
BS EN 60598-2-3	2003	Luminaires — Part 2-3: Particular requirements — Luminaires for road and street lighting	ELE21
BS EN 60598-2-4	1998	Luminaires — Part 2: Particular requirements — Section 2.4 Portable general purpose luminaires	ELE21
BS EN 60598-2-5	1998	Luminaires — Part 2-5: Particular requirements — Floodlights	ELE21
BS EN 60662	1993	High-pressure mercury vapour lamps	ELE21

Standard	Year of Standards	Description	Sections
BS EN 60669-1	1999+A2:2008	Switches for household and similar fixed-electrical installations. General requirements	ELE20
BS EN 60670-22	2006	Boxes and enclosures for electrical accessories for household and similar fixed electrical installations. Particular requirements for connecting boxes and enclosures	ELE20
BS EN 60702-1	2002	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V — Part 1: Cables	ELE7
BS EN 60702-2	2002	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V — Part 2: Terminations	ELE7 ELE8
BS EN 60728-1	2008	Cable networks for television signals, sound signals and interactive services — Part 1: System performance of forward paths	ELE23
BS EN 60728-10	2006	Cable networks for television signals, sound signals and interactive services — Part 10: System performance for return paths	ELE23
BS EN 60896-21	2004+corr2009	Stationary lead-acid batteries – Part 21: Valve regulated types – Methods of test	ELE24
BS EN 60896-22	2004+corr2009	Stationary lead-acid batteries – Part 22: Valve regulated types – Requirements	ELE24
BS EN 60898-1	2003 or 2003+A1:2004	Circuit breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation	ELE2 ELE3 ELE21
BS EN 60901	1996+A4:2008	Single-capped fluorescent lamps— Performance specifications	ELE21
BS EN 60921	2004	Ballasts for tubular fluorescent lamps — Performance requirements	ELE21
BS EN 60923	2005	Auxiliaries for lamps — Ballasts for discharge lamps (excluding tubular fluorescent lamps) — Performance requirements	ELE21
BS EN 60925	1991	Performance requirements for D.C. supplied electronic ballasts for tubular fluorescent lamps	ELE21
BS EN 60929	2006	AC-supplied electronic ballasts for tubular fluorescent lamps — Performance requirements	ELE21

Standard	Year of Standards	Description	Sections
BS EN 61000-3-2	2006+A2:2009	Electromagnetic compatibility (EMC) — Part 3-2: Limits — Limits for harmonic current emissions (equipment input current <= 16 A per phase)	ELE21
BS EN 61000-6-1	2007	Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments	ELE21
BS EN 61000-6-2	2005	Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments	ELE4
BS EN 61000-6-3	2007	Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments	ELE21
BS EN 61000-6-4	2007	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments	ELE4 ELE29
BS EN 61009-1	2012+A12:2016	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules	ELE3
BS EN 61140	2016	Protection against electric shock. Common aspects for installation and equipment	ELE33
BS EN 61048	2006	Auxiliaries for lamps — Capacitors for use in tubular fluorescent and other discharge lamp circuits — General and safety requirements	ELE21
BS EN 61049	1993	Capacitors for use in tubular fluorescent and other discharge lamp circuits — Performance requirements	ELE21
BS EN 61167	1995	Metal halide lamps	ELE21
BS EN 61184	2008	Bayonet lampholders	ELE21
BS EN 61199	2000	Single-capped fluorescent lamps - Safety specifications	ELE21
BS EN 61238-1	2003	Compression and mechanical connectors for power cables for rated voltages up to 36 kV (Um = 42 kV). Test methods and requirements	ELE7
BS EN 61347-1	2008	Lamp controlgear — Part 1: General and safety requirements	ELE21
BS EN 61347-2-3	2001	Lamp controlgear — Part 2-3: Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps	ELE21

Standard	Year of Standards	Description	Sections
BS EN 61347-2-4	2001	Lamp controlgear — Part 2-4: Particular requirements for d.c. supplied electronic ballasts for general lighting	ELE21
BS EN 61347-2-5	2001	Lamp controlgear — Part 2-5: Particular requirements for d.c. supplied electronic ballasts for public transport lighting	ELE21
BS EN 61347-2-6	2001	Lamp controlgear — Part 2-6: Particular requirements for d.c. supplied electronic ballasts for aircraft lighting	ELE21
BS EN 61347-2-7	2006	Lamp controlgear — Part 2-7: Particular requirements for d.c. supplied electronic ballasts for emergency lighting	ELE21
BS EN 61347-2-8	2001 or 2001+A1:2006	Lamp controlgear — Part 2-8: Particular requirements for ballasts for fluorescent lamps	ELE21
BS EN 61347-2-9	2001	Lamp controlgear — Part 2-9: Particular requirements for ballasts for discharge lamps (excluding fluorescent lamps)	ELE21
BS EN 61347-2-13	2006	Lamp controlgear. Particular requirements for d.c. or a.c. supplied electronic controlgear for LED modules	ELE21
BS EN 61386-1	2008	Conduit systems for cable management – Part 1: General requirements	ELE11 ELE13 ELE24
BS EN 61386-21	2004	Conduit systems for cable management - Part 21: Particular requirements - Rigid conduit systems	ELE11 ELE13
BS EN 61547	2009	Equipment for general lighting purposes — EMC immunity requirements	ELE21
BS EN 61557-12	2008	Electrical safety in low voltage distribution systems up to 1000V a.c. and 1500V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 12: Performance measuring and monitoring devices (PMD)	ELE4
BS EN 61869-2	2012	Instrument transformers – Part 2: Additional requirements for current transformers	ELE3
BS EN 62031	2008	LED modules for general lighting. Safety specifications	ELE21

Standard	Year of Standards	Description	Sections
BS EN 62035	2000	Discharge lamps (excluding fluorescent lamps) — Safety specifications	ELE21
BS EN 62053-21	2003	Electricity metering equipment (a.c.) - Particular requirements - Part 21: Static meters for active energy (classes 1 and 2)	ELE3
BS EN 62305-1	2006	Protection against lightning – Part 1: General principles	ELE14 ELE23
BS EN 62305-2	2006	Protection against lightning – Part 2: Risk management	ELE14 ELE23
BS EN 62305-3	2006	Protection against lightning – Part 3: Physical damage to structures and life hazard	ELE14 ELE23
BS EN 62305-4	2006	Protection against lightning – Part 4: Electrical and electronic systems within structures	ELE14 ELE23
BS EN 62384	2009	DC or AC supplied electronic control gear for LED modules	ELE21
BS EN 62471	2008	Photobiological safety of lamps and lamp system	ELE21
BS EN 62560	2013	Self-ballasted LED lamps for general lighting services by voltage > 50V – safety specification	ELE21
BS EN 62612	2013	Self-ballasted LED lamps for general lighting services with supply voltages > 50V – performance requirements	ELE21
BS EN 62776	2015	Double-capped LED lamps designed to retrofit linear fluorescent lamps	ELE21
BS EN ISO 1461	2009	Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods (ISO 1461:2009)	ELE21
BS EN ISO 4016	2001	Hexagon head bolts. Product grade C	ELE28
BS EN ISO 4018	2001	Hexagon head screws. Product grade C	ELE28
BS EN ISO 4034	2001	Hexagon nuts. Product grade C	ELE28
BS EN ISO 4892-2	2013	Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps	ELE21 ELE33
BS EN ISO 5136	2003 or 2009	Acoustics. Determination of sound power radiated into a duct by fans and other air-moving devices. In-duct method	ELE31
BS EN ISO 5457	1999	Technical product documentation — Sizes and layout of drawing sheets	ELE1
BS EN ISO 9227	2017	Corrosion tests in artificial atmospheres – Salts spray tests	ELE21

Standard	Year of Standards	Description	Sections
BS EN ISO 10289	2001	Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates – Rating of test specimens and manufactured articles subjected to corrosion tests	ELE21
DW/144	1998	Specification for Sheet Metal Ductwork	ELE31
EN 40-1	1992	Lighting columns — Part 1: Definitions and terms	ELE21
EN 40-2	2004	Lighting columns - Part 2: General requirements and dimensions	ELE21
EN 40-3-1	2000	Lighting columns - Part 3-1: Design and verification -Specification for characteristic loads	ELE21
EN 40-3-2	2000	Lighting columns - Part 3-2: Design and verification - Verification by testing	ELE21
EN 40-3-3	2003	Lighting columns — Part 3-3: Design and verification — Verification by calculation	ELE21
EN 12373-1	2001	Aluminium and aluminium alloys. Anodizing. Method for specifying decorative and protective anodic oxidation coatings on aluminium	ELE6
EN 50083-1	1993	Electromagnetic compatibility - Generic immunity standard Part 1. Residential, commercial and light industry	ELE23
EN 50083-2	2006	Cable networks for television signals, sound signals and interactive services — Part 2: Electromagnetic compatibility for equipment	ELE23
EN 50083-8	2002	Cable networks for television signals, sound signals and interactive services — Part 8: Electromagnetic compatibility for networks	ELE23
EN 50117	HS	Coaxial cables	ELE23
EN 55015	2006+A2: 2009	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment	ELE21
EN 60598-2-1	1989	Luminaires - Part 2: Particular requirements	ELE21
EN 60728-1	2008	Cable networks for television signals, sound signals and interactive services — Part 1: System performance of forward paths	ELE23
EN 60728-10	2006	Cable networks for television signals, sound signals and interactive services — Part 10: System performance for return paths	ELE23

Standard	Year of Standards	Description	Sections
EN 60728-11	2005	Cable networks for television signals, sound signals and interactive services — Part 11: Safety	ELE23
EN 60728-3	2006	Cable networks for television signals, sound signals and interactive services — Part 3: Active wideband equipment for coaxial cable networks	ELE23
EN 60728-4	2008	Cable networks for television signals, sound signals and interactive services — Part 4: Passive wideband equipment for coaxial cable networks	ELE23
EN 60728-5	2008	Cable networks for television signals, sound signals and interactive services — Part 5: Headend equipment	ELE23
EN 60947-4-1	2001+A2:2005	Low-voltage switchgear and controlgear -- Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	ELE3
EN 62053-21	2003	Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)	ELE3
HD 623 S1	1996	Specification for joints, stop ends and outdoor terminations for distribution cables of rated voltage 0,6/1,0 kV	ELE7
IEC 11801-1	2017	Information technology — Generic cabling for customer premises — Part 1: General requirements	ELE24
IEC 60034-1	2004	Rotating electrical machines – Part 1: Rating and performance	ELE29
IEC 60034-2-1	2007	Rotating electrical machines - Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)	ELE29
IEC 60034-5	2006	Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification	ELE29
IEC 60044-1	2003	Instrument transformers - Part 1: Current transformers	ELE3 ELE4
IEC 60051	HS	Direct acting indicating analogue electrical measuring instruments and their accessories	ELE4
IEC 60051-1	1997	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 1: Definitions and general requirements common to all parts	ELE3

Standard	Year of Standards	Description	Sections
IEC 60051-2	1984	Direct acting indicating analogue electrical measuring instruments and their accessories. Part 2: Special requirements for ammeters and voltmeters	ELE3
IEC 60061-1	2002 or 2003 or 2005 or 1969+am42:2009	Lamp caps and holders together with gauges for the control of interchangeability and safety — Part 1: Lamp caps	ELE21
IEC 60061-2	2002 or 2003 or 2005 or 1969+am38:2009	Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 2: Lampholders	ELE21
IEC 60065	2005	Audio, video and similar electronic apparatus – Safety requirements	ELE23
IEC 60079	HS	Explosive atmospheres	ELE29 PSS29
IEC 60079-0	2007	Explosive atmospheres - Part 0: Equipment - General requirements	ELE29 PSS29
IEC 60079-10-1	2008	Explosive atmospheres –Part 10-1: Classification of areas – Explosive gas atmospheres	ELE29 PSS29
IEC 60081	2002 or 2002+am2:2003 or 2002+am3:2005	Double-capped fluorescent lamps – Performance specifications	ELE21
IEC 60085 (Alternator)	2007	Electrical insulation - Thermal evaluation and designation	ELE29
IEC 60085 (Contactors)	1984 or 2004 or 2007	Electrical insulation - Thermal evaluation and designation	ELE3
IEC 60096-3	1982	Radio-frequency cables. Part 3: General requirements and tests for single-unit coaxial cables for use in cabled distribution systems	ELE23
IEC 60896-22	2004	Stationary lead-acid batteries – Part 22: Valve regulated types - Requirements	ELE24
IEC 60155	1993+am2:2006	Glow-starters for fluorescent lamps	ELE21
IEC 60188	2001	High-pressure mercury vapour lamps - Performance specifications	ELE21
IEC 60192	2001	Low-pressure sodium vapour lamps – Performance specifications	ELE21
IEC 60227-3	1997	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 3: Non-sheathed cables for fixed wiring	ELE4 ELE21
IEC 60238	2004	Edison Screw Lampholders	ELE21
IEC 60255	HS	Measuring relays and protection equipment	ELE4

Standard	Year of Standards	Description	Sections
IEC 60255-22-2	2008	Measuring relays and protection equipment - Part 22-2: Electrical disturbance tests - Electrostatic discharge tests	ELE4
IEC 60255-151	2009	Measuring relays and protection equipment - Part 151: Functional requirements for over / under current protection	ELE4
IEC 60269-1	2005 2006 or 2006+am1:2009 or 2009	Low-Voltage Fuses - Part 1: General Requirements	ELE3 ELE6 ELE19 ELE20 PSS20 ELE21
IEC 60269-2	1986 or 1986+am1:1995 or 1986+am2:2001 or 2006	Low-voltage fuses –Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to I	ELE3 ELE6
IEC 60269-3	2013	Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) – Examples of standardized systems of fuses A to F	ELE21
IEC 60309-2	2005	Plugs, socket-outlets and couplers for industrial purposes. Dimensional interchangeability requirements for pin and contact-tube accessories	ELE20
IEC 60320	HS	Appliance couplers for household and similar general purposes	ELE4
IEC 60332-1-1	2004	Tests on electric and optical fibre cables under fire conditions - Part 1-1: Test for vertical flame propagation for a single insulated wire or cable - Apparatus	ELE7
IEC 60332-1-2	2004	Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame	ELE7
IEC 60332-3 Category C	1992 or 2000 or 2000+am1:2008 or 2009	Tests on electric and optical fibre cables under fire conditions – Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category C	ELE7
IEC 60335-1	2006	Household and similar electrical appliances – Safety – Part 1: General requirements	ELE16

Standard	Year of Standards	Description	Sections
IEC 60364	2005	Low-voltage electrical installations	ELE7 ELE8 ELE12 ELE17 ELE21
IEC 60364-7-704	2005	Low-voltage electrical installations – Part 7-704: Requirements for special installations or locations – Construction and demolition site installations	ELE1
IEC 60364-7-712	2017	Low Voltage Electrical Installations - Part 7-712: Requirements for Special Installations or Locations – Solar Photovoltaic (PV) Power Supply Systems	ELE33
IEC 60400	2008	Lampholders for tubular fluorescent lamps and starterholders	ELE21
IEC 60439-1	2004	Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies	ELE2 ELE4 PSS4
IEC 60439-1 (All insulated Busbar Trunking System)	1992 or 1992+am2:1996 or 1999 or 1999+am1:2004 or 2004	Low-voltage switchgear and controlgear assemblies-Part 1:Type-tested and partially type -tested assemblies	ELE6
IEC 60439-1 (Busbar Chamber)	2004	Low-voltage switchgear and controlgear assemblies-Part 1:Type-tested and partially type -tested assemblies	ELE6
IEC 60439-1 (MCCB Board)	1992+am2:1996 or 1999 or 1999+am1:2004 or 2004	Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially typetested assemblies	ELE3
IEC 60439-2 (All insulated Busbar Trunking System)	1991 or 2000 or 2000+am1:2005 or 2005	Low-voltage switchgear and controlgear assemblies-Part 2:Particular requirements for busbar trunking systems(busways)	ELE6
IEC 60439-2 (Busbar Chamber)	1991 or 2000 or 2000+am1:2005 or 2005	Low-voltage switchgear and controlgear assemblies-Part 2:Particular requirements for busbar trunking systems(busways)	ELE6
IEC 60439-3	2001	Low-voltage switchgear and controlgear assemblies. Part 3: Particular requirements for low-voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access for their use - Distribution boards	ELE3

Standard	Year of Standards	Description	Sections
IEC 60454-3-1	2002	Pressure-sensitive adhesive tapes for electrical purposes – Part 3 Specifications for individual materials – Sheet 1: PVC film tapes with pressure-sensitive adhesive	ELE8 ELE28
IEC 60502-1 (XLPE-insulated armoured / non-armoured cables)	2004 or 2004+am1:2009 or 2009	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) Part 1: Cables for rated voltages of 1 kV ((Um = 1,2 kV) and 3 kV (Um = 3,6 kV)	ELE7
IEC 60502-1 (XLPE-insulated prefabricated branch cables)	2004 or 2004+am1:2009 or 2009	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) Part 1: Cables for rated voltages of 1 kV ((Um = 1,2 kV) and 3 kV (Um = 3,6 kV)	ELE7
IEC 60529	1989 or 1989+am1:1999 or 2001	Degrees of protection provided by enclosures (IP Code)	ELE3 ELE4 ELE6 ELE16 ELE20 ELE31
IEC 60570	2003	Electrical supply track systems for luminaires	ELE21
IEC 60598	HS	Luminaires	ELE21
IEC 60598-1	2008	Luminaires – Part 1: General requirements and tests	ELE21
IEC 60598-2-1	1979 +am1:1987	Luminaires Part 2: Particular requirements Section One - Fixed general purpose luminaires	ELE21
IEC 60598-2-2	1997	Luminaires – Part 2: Particular requirements – Section 2: Recessed luminaires	ELE21
IEC 60598-2-22	2008	Luminaires – Part 2-22: Particular requirements – Luminaires for emergency lighting	ELE21
IEC 60598-2-3	2002	Luminaires – Part 2-3: Particular requirements – Luminaires for road and street lighting	ELE21
IEC 60598-2-5	1998	Luminaires - Part 2-5: Particular requirements - Floodlights	ELE21
IEC 60623	2001	Secondary cells and batteries containing alkaline or other non-acid electrolytes. Vented nickel-cadmium prismatic rechargeable single cells	ELE24 ELE29
IEC 60662	2002	High-pressure sodium vapour lamps	ELE21

Standard	Year of Standards	Description	Sections
IEC 60669-2-1	2002	Switches for household and similar fixed electrical installations – Part 2-1: Particular requirements – Electronic switches	ELE21
IEC 60670-1	2002	Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 1: General requirements	ELE2 ELE11 ELE13 ELE19
IEC 60702-1	2002	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V – Part 1:Cables	ELE7
IEC 60702-2	2002	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V Part 2: Terminations	ELE8
IEC 60708	2005	Low-frequency cables with polyolefin insulation and moisture barrier polyolefin sheath	ELE24
IEC 60754-1	2011+am1:2019	Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content	ELE7 ELE33
IEC 60831-1	2002	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V – Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation and operation	ELE5
IEC 60831-2	1995	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V Part 2: Ageing test, self-healing test and destruction test	ELE5
IEC 60891	2021	Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I-V characteristics	ELE33
IEC 60898-1	2002+am1:2002 or 2002+am2:2003 or 2003	Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation	ELE2 ELE3 ELE21
IEC 60901	2001+am4:2007	Single capped fluorescent lamps : performance specifications	ELE21
IEC 60904-1	2020	Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics	ELE33
IEC 60904-2	2023	Photovoltaic devices - Part 2: Requirements for photovoltaic reference devices	ELE33

Standard	Year of Standards	Description	Sections
IEC 60904-3	2019	Photovoltaic devices - Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data	ELE33
IEC 60904-4	2019 + cor1:2020	Photovoltaic devices - Part 4: Photovoltaic reference devices - Procedures for establishing calibration traceability	ELE33
IEC 60904-5	2011 + am1:2022	Photovoltaic devices - Part 5: Determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit voltage method	ELE33
IEC 60904-7	2019	Photovoltaic devices - Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices	ELE33
IEC 60904-8	2014	Photovoltaic devices - Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device	ELE33
IEC 60904-8-1	2017	Photovoltaic devices - Part 8-1: Measurement of spectral responsivity of multi-junction photovoltaic (PV) devices	ELE33
IEC 60904-9	2020	Photovoltaic devices - Part 9: Classification of solar simulator characteristics	ELE33
IEC 60904-10	2020	Photovoltaic devices - Part 10: Methods of linear dependence and linearity measurements	ELE33
IEC 60921	2006	Ballasts for tubular fluorescent lamps – Performance requirements	ELE21
IEC 60923	2006	Auxiliaries for lamps – Ballasts for discharge lamps (excluding tubular fluorescent lamps) – Performance requirements	ELE21
IEC 60925	2001	DC supplied electronic ballasts for tubular fluorescent lamps – Performance requirements	ELE21
IEC 60929	2006	AC-supplied electronic ballasts for tubular fluorescent lamps – Performance requirements	ELE21
IEC 60947-1	2007	Low-voltage switchgear and controlgear - Part 1: General rules	ELE3
IEC 60947-2	2006 or 2009	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers	ELE3 PSS3 ELE4 PSS4

Standard	Year of Standards	Description	Sections
IEC 60947-3	1999+am2:2005 or 2005 or 2008	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	ELE4 PSS4 ELE20
IEC 60947-3 (DP switch-disconnectors)	2001 or 1999+am2:2005 or 2005 or 2008	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	ELE3
IEC 60947-3 (TPN Switch-disconnectors)	1999+am1:2001 or 2001 or 1999+am2:2005 or 2008	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	ELE3 PSS3
IEC 60947-3(Fuse-disconnectors, 40-160A)	1999+am1:2001 or 2001 or 1999+am2:2005 or 2005 or 2008	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	ELE3 PSS3
IEC 60947-3 (Fuse-disconnectors, 200-800A)	2001 or 1999+am2:2005 or 2005 or 2008	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	ELE3 PSS3
IEC 60947-4-1 (Contactor)	2000 or 2000+am1:2002 or 2000+am2:2005 or 2009	Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	ELE3
IEC 60947-4-1 (Starter)	2000 or 2000+am1:2002 or 2000+am2:2005 or 2009	Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	ELE3
IEC 60947-7-1	1999 or 2002 or 2009	Low-voltage switchgear and controlgear - Part 7-1: Ancillary equipment - Terminal blocks for copper conductors	ELE4
IEC 60998-1	2002	Connecting devices for low-voltage circuits for household and similar purposes – Part 1: General requirements	ELE21
IEC 61000-3-2	2009	Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase)	ELE21
IEC 61000-3-3	2013	Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection - Edition 3.0	ELE21

Standard	Year of Standards	Description	Sections
IEC 61000-4-2	2001	Electromagnetic Compatibility (EMC) - Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test	ELE3
IEC 61000-4-3	2001	Electromagnetic Compatibility (EMC) - Part 4-3: Testing and Measurement Techniques - Radiated, Radio-Frequency, Electromagnetic Field Immunity Test	ELE3
IEC 61000-4-4	2004	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient / burst immunity test	ELE3
IEC 61000-4-5	2005	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test	ELE3
IEC 61000-6-2	2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments	ELE4
IEC 61000-6-4	2006	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments	ELE4
IEC 61008-1	1996+am2:2006	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) - Part 1: General rules	ELE3
IEC 61009-1	2010+am2:2013 +corr2014	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules	ELE3
IEC 61010-1	2001	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements	ELE4
IEC 61034-2	2005+ am2:2019	Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and requirements	ELE7 ELE33
IEC 61048	2006	Auxiliaries for lamps – Capacitors for use in tubular fluorescent and other discharge lamp circuits – General and safety requirements	ELE21
IEC 61049	1991+corr1992	Capacitors for use in tubular fluorescent and other discharge lamp circuits — Performance requirements	ELE21
IEC 61084-1	1991	Cable trunking and ducting systems for electrical installations - Part 1: General requirements	ELE12

Standard	Year of Standards	Description	Sections
IEC 61084-2-1	1996	Cable trunking and ducting systems for electrical installations - Part 2: Particular requirements - Section 1: cable trunking and ducting systems intended for mounting on walls or ceilings	ELE12
IEC 61146-1	1994	Video cameras (PAL/SECAM/NTSC) - Methods of measurement - Part 1:Non-broadcast single-sensor cameras	ELE24
IEC 61167	1992+am3:1998	Metal halide lamps	ELE21
IEC 61184	2008	Bayonet lampholders	ELE21
IEC 61196-1	2005	Coaxial communication cables - Part 1: Generic specification - General, definitions and requirements	ELE23
IEC 61196-5	2007	Coaxial communication cables - Part 5: Sectional specification for CATV trunk and distribution cables	ELE23
IEC 61196-6	2009	Coaxial communication cables - Part 6: Sectional specification for CATV drop cables	ELE23
IEC 61199	1999	Single-capped fluorescent lamps – Safety specifications	ELE21
IEC 61215-1	2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements	ELE33
IEC 61215-1-2	2021 + am1:2022	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-2: Special requirements for testing of thin-film Cadmium Telluride (CdTe) based photovoltaic (PV) modules	ELE33
IEC 61215-1-3	2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-3: Special requirements for testing of thin-film amorphous silicon based photovoltaic (PV) modules	ELE33
IEC 61215-1-4	2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-4: Special requirements for testing of thin-film Cu(In,GA)(S,Se)2 based photovoltaic (PV) modules	ELE33
IEC 61215-2	2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures	ELE33
IEC 61238-1	2003	Compression and mechanical connectors for power cables for rated voltages up to 30 kV (Um = 36 kV) - Part 1: Test methods and requirements	ELE8

Standard	Year of Standards	Description	Sections
IEC 61347-1	2007	Lamp controlgear – Part 1: General and safety requirements	ELE21
IEC 61347-2-11	2001	Lamp controlgear — Part 2-1 1 : Particular requirements for miscellaneous electronic circuits used with luminaires	ELE21
IEC 61347-2-13	2006	Lamp controlgear – Part 2-13: Particular requirements for d.c. or a.c. supplied electronic controlgear for LED modules	ELE21
IEC 61347-2-3	2000+am2:2006	Lamp controlgear – Part 2-3: Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps	ELE21
IEC 61347-2-4	2000	Lamp controlgear – Part 2-4: Particular requirements for d.c. supplied electronic ballasts for general lighting	ELE21
IEC 61347-2-5	2000	Lamp controlgear – Part 2-5: Particular requirements for d.c. supplied electronic ballasts for public transport lighting	ELE21
IEC 61347-2-6	2000	Lamp controlgear – Part 2-6: Particular requirements for d.c. supplied electronic ballasts for aircraft lighting	ELE21
IEC 61347-2-7	2006	Lamp controlgear – Part 2-7: Particular requirements for d.c. supplied electronic ballasts for emergency lighting	ELE21
IEC 61347-2-8	2006	Lamp controlgear - Part 2-8: Particular requirements for ballasts for fluorescent lamps	ELE21
IEC 61347-2-9	2009	Lamp controlgear – Part 2-9: Particular requirements for ballasts for discharge lamps (excluding fluorescent lamps)	ELE21
IEC 61386-1	2008	Conduit systems for cable management – Part 1: General requirements	ELE11 ELE13 ELE24
IEC 61386-21	2002	Conduit systems for cable management – Part 21: Particular requirements – Rigid conduit systems	ELE11 ELE13
IEC 61386-23	2002	Conduit systems for cable management – Part 23: Particular requirements – Flexible conduit systems	ELE11
IEC 61439-1	2009	Low-voltage switchgear and controlgear assemblies - Part 1: General rules	ELE4 PSS4

Standard	Year of Standards	Description	Sections
IEC 61439-2	2009	Low-voltage switchgear and controlgear assemblies - Part 2: Power switchgear and controlgear assemblies	ELE4 PSS4
IEC 61537	2001 or 2006	Cable management - Cable tray systems and cable ladder systems	ELE9
IEC 61547	2009	Equipment for general lighting purposes – EMC immunity requirements	ELE21
IEC 61557-12	2018	Electrical safety in low voltage distribution systems up to 1000V AC and 1500V DC. – Equipment for testing, measuring or monitoring of protective measures – Part 12: Power metering and monitoring devices (PMD)	ELE4
IEC 61558-1	2017	Safety of transformers, reactors, power supply units and combinations thereof - Part 1: General requirements and tests	ELE20 ELE33
IEC 61558-2-23	2010	Safety of transformers, reactors, power supply units and combinations thereof - Part 2-23: Particular requirements and tests for transformers and power supply units for construction sites	ELE20 ELE33
IEC 61558-2-8	1998	Safety of small power transformers, power supply units and similar – Part 2-8: Particular requirements for bell and chime transformers	ELE16
IEC 61683	1999	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency	ELE33
IEC 61701	2020	Photovoltaic (PV) modules - Salt mist corrosion testing	ELE33
IEC 61724-1	2021	Photovoltaic system performance - Part 1: Monitoring	ELE33
IEC 61727	2004	Photovoltaic (PV) systems - Characteristics of the utility interface	ELE33
IEC 61730-1	2016	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction	ELE33
IEC 61730-2	2016	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing	ELE33
IEC 61829	2015	Photovoltaic (PV) array - On-site measurement of current-voltage characteristics	ELE33
IEC TS 61836	2016	Solar photovoltaic energy systems - Terms, definitions and symbols	ELE33

Standard	Year of Standards	Description	Sections
IEC 62116	2014	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures	ELE33
IEC 61869-2	2012	Instrument transformers – Part 2: Additional requirements for current transformers	ELE3
IEC 61951-1	2003 or 2003+am1:2005 or 2006	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Portable sealed rechargeable single cells - Part 1: Nickel-cadmium	ELE4
IEC 61951-2	2003	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Portable sealed rechargeable single cells - Part 2: Nickel-metal hydride	ELE4 ELE21
IEC 62031	2012	LED modules for general lighting – Safety specifications - Edition 1.1	ELE21
IEC 62035	2003	Discharge lamps(excluding fluorescent lamps) –Safety specifications	ELE21
IEC 62040-1	2017	Uninterruptible power systems (UPS) – Part 1: Safety requirements	ELE24
IEC 62040-2	2016	Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements	ELE24
IEC 62040-3	2011	Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements	ELE24
IEC 62040-4	2013	Uninterruptible power systems (UPS) – Part 4: Environmental aspects – Requirements and reporting	ELE24
IEC 62040-5-3	2016	Uninterruptible power systems (UPS) – Part 5-3: DC output UPS – Performance and test requirements	ELE24
IEC 62053-21	2003	Electricity metering equipment (a.c.) - Particular requirements - Part 21: Static meters for active energy (classes 1 and 2)	ELE3
IEC 62109-1	2010	Safety of power converters for use in photovoltaic power systems – Part 1: General requirements	ELE33
IEC 62109-2	2011	Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters	ELE33
IEC 62109-3	2020	Safety of power converters for use in photovoltaic power systems - Part 3: Particular requirements for electronic devices in combination with photovoltaic elements	ELE33

Standard	Year of Standards	Description	Sections
IEC 62259	2003	Secondary cells and batteries containing alkaline or other non-acid electrolytes Nickel-cadmium prismatic secondary single cells with partial gas recombination	ELE24
IEC 62262	2002+A1:2021	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)	ELE24
IEC 62305-1	2006	Protection against lightning – Part 1: General principles	ELE14 ELE23
IEC 62305-2	2006	Protection against lightning – Part 2: Risk management	ELE14 ELE23
IEC 62305-3	2006	Protection against lightning – Part 3: Physical damage to structures and life hazard	ELE14 ELE23
IEC 62305-4	2006	Protection against lightning – Part 4: Electrical and electronic systems within structures	ELE14 ELE23
IEC 62384	2011	DC or AC supplied electronic control gear for LED modules – Performance requirements - Edition 1.1	ELE21
IEC 62471	2006	Photobiological safety of lamps and lamp systems - Edition 1	ELE21
IEC 62560	2012	Self-ballasted LED lamps for general lighting services by voltage > 50V – safety specification	ELE21
IEC 62612	2013	Self-ballasted LED lamps for general lighting services with supply voltages > 50V – performance requirements	ELE21
IEC 62776	2014	Double-capped LED Lamps Designed to retrofit linear fluorescent lamps – Safety Specifications	ELE21
IEEE 519	2022	Standard for Harmonic Control in Electric Power Systems	ELE33
IEEE 1547 & P1547	2018	Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces	ELE33
ISO 1460	1992	Metallic coatings -- Hot dip galvanized coatings on ferrous materials – Gravimetric determination of the mass per unit area	ELE9
ISO 1461	1999 or 2009	Hot dip galvanized coatings on fabricated iron and steel articles -- Specifications and test methods	ELE9
ISO 15550	2002	Internal combustion engines. Determination and method for the measurement of engine power. General requirements	ELE29

Standard	Year of Standards	Description	Sections
ISO 3046-1	2002	Reciprocating internal combustion engines. Performance. Declarations of power, fuel and lubricating oil consumptions, and test methods. Additional requirements for engines for general use	ELE29
ISO 3046-3	2006	Reciprocating internal combustion engines. Performance. Test measurements	ELE29
ISO 8528	HS	Reciprocating internal combustion engine driven alternating current generating sets.	ELE29
ISO 8528-1	2005	Reciprocating internal combustion engine driven alternating current generating sets. Application, ratings and performance	ELE29
ISO 8528-2	2005	Reciprocating internal combustion engine driven alternating current generating sets. Engines	ELE29
ISO 8528-3	2005	Reciprocating internal combustion engine driven alternating current generating sets. Alternating current generators for generating sets	ELE29
ISO 8528-5	2005	Reciprocating internal combustion engine driven alternating current generating sets. Generating sets	ELE29
ISO 8528-6	2005	Reciprocating internal combustion engine driven alternating current generating sets. Test methods	ELE29
ISO 9001	2008	Quality management systems -- Requirements	ELE4 ELE7
ISO 9050	2003	Glass in building — Determination of light transmittance, solar direct transmittance, total solar energy transmittance, ultraviolet transmittance and related glazing factors	ELE33
ISO 9227	2017	Corrosion tests in artificial atmospheres – Salts spray tests	ELE21
ISO 10289	1999	Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates – Rating of test specimens and manufactured articles subjected to corrosion tests	ELE21
ISO/885	2000	General purpose bolts and screws. Metric series. Radii under the head	ELE28
ISO/IEC 7810	2013	Identification Cards – Physical Characteristics	ELE26
ITU-T H.264	2021	Advanced video coding for generic audiovisual services	ELE24

Standard	Year of Standards	Description	Sections
ITU-T H.265	2021	High efficiency video coding	ELE24
JIS C 2810	1995	General rules on non-separable type wire connectors for interior wiring	ELE7
JIS C 3005	2000	Test methods for rubber or plastic insulated wires and cables	ELE7
UL 1703	2002	Standard for Flat-Plate Photovoltaic Modules and Panels	ELE33
UL 1741	2022	Standard for Safety Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources	ELE33

IEC 60034-2-1	2014	Rotating electrical machines - Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)	FWP11	11.2.060
IEC 60034-5	2000+A1:2006 2020	Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification	FWP11	11.2.010
IEC 60034-6	1991	Rotating electrical machines - Part 6: Methods of cooling (IC Code)	FWP11	11.2.010
IEC 60034-7	1992+A1:2000 2020	Rotating electrical machines – Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM Code)	FWP11	11.2.010
IEC 60034-9	2003+A1:2007 2021	Rotating electrical machines – Part 9: Noise limits	FWP11	11.2.040
IEC 60034-14	2018	Rotating electrical machines – Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity	FWP11	11.2.040
IEC 60034-30-1	2014	Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE-code)	FWP11	11.2.010
IEC 60051-1	2016	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 1: Definitions and general requirements common to all parts	FWP11	11.5.020
IEC 60051-2	2018	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 2: Special requirements for ammeters and voltmeters	FWP11	11.5.020
IEC 60076	-	Power transformers	FWP11	11.3.010
IEC 60085	2007	Electrical insulation - Thermal evaluation and designation	FWP11	11.2.010
IEC 60269-1	2006+A1:2009+A2:2016	Low-voltage fuses - Part 1: General requirements	FWP11	11.3.020
IEC 60269-4	2009+A1:2012+A2:2016	Low-voltage fuses - Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices	FWP11	11.3.020
IEC 60623	2017	Secondary cells and batteries containing alkaline or other non-acid electrolytes. Vented nickel-cadmium prismatic rechargeable single cells	FWP10 FWP PSS	10.6.020, 10.10.050, 10.10.135 10.10.050

IEC 60831-1	2002	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V – Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation and operation	FWP11	11.1.130
IEC 60831-2	2014	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V – Part 2: Ageing test, self-healing test and destruction test	FWP11	11.1.130
IEC 60947-3	2008+A1:2012+A2:2015 2020	Low-voltage switchgear and control gear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	FWP11	11.5.010
IEC 60947-4-1	2018	Low-voltage switchgear and control gear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	FWP11	11.3.010
IEC 60947-4-2	2011 2020	Low-voltage switchgear and control gear - Part 4-2: Contactors and motor-starters - Semiconductor motor controllers, starters and soft-starters	FWP11	11.3.020
IEC 60947-7-1	2009	Low-voltage switchgear and control gear - Part 7-1: Ancillary equipment - Terminal blocks for copper conductors	FWP11	11.5.080
IEC 61000-4-2	2008	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	FWP11	11.1.130 11.3.020
IEC 61000-4-3	2010 2020	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	FWP11	11.1.130 11.3.020
IEC 61000-4-4	2012	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient / burst immunity test	FWP11	11.1.130 11.3.020
IEC 61000-4-5	2014+A1:2017	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	FWP11	11.1.130 11.3.020
IEC 61131-2	2017	Industrial-process measurement and control. Programmable controllers. Equipment requirements and tests	FWP11	11.5.090
IEC 61810-1	2015+A1:2019	Electromechanical elementary relays - Part 1: General and safety requirements	FWP11	11.5.070
IEC 61869-2	2012	Instrument transformers - Part 2: Additional requirements for current transformers	FWP11	11.5.020
IEC 62053-11	2003+A1:2016	Electricity metering equipment (a.c.) - particular requirements - part 11: electromechanical meters for active energy (classes 0,5, 1 and 2)	FWP15	15.1.040

IEC 62259	2003	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Nickel-cadmium prismatic secondary single cells with parial gas recombination	FWP10	10.6.020 10.10.050, 10.10.135
			FWP PSS	10.10.050
ISO 9001	2015	Quality management systems. Requirements	FWP PSS	2.1.3.010
ISO 11731	2017	Water quality - Enumeration of Legionella	FWP14	14.1.120
JIS G5501	2020	Grey iron castings	FWP6	6.2.020 6.2.040 6.2.050
JIS H5120	2020	Copper and copper alloy castings	FWP6	6.2.020 6.2.050
NFPA 72	2019 2022	National Fire Alarm and Signaling Code	FWP10	10.9.010
NFPA 2001	2018 2022	Standard on clean agent fire extinguishing systems	FWP9	9.1.020 9.3.010 9.4.020 9.5.010
			FWP12	12.4.010
UL 94	2013	UL Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances	FWP11	11.5.080
UL 154	2005	UL Standard for Safety Carbon-Dioxide Fire Extinguishers	FWP12	12.3.020
UL 299	2012	UL Standard for Safety Dry Chemical Fire Extinguishers	FWP12	12.3.020
UL 626	2005	UL Standard for Safety Water Fire Extinguishers	FWP12	12.3.020
UL 2129	2017	UL Standard for Safety Halocarbon Clean Agent Fire Extinguishers	FWP12	12.3.020
UL 2166	2017	UL Standard for Safety Halocarbon Clean Agent Extinguishing System Units	FWP9	9.1.020

FWP FIRE SERVICES & WATER PUMP INSTALLATION

FWP1 GENERAL REQUIREMENTS

FWP1.1 THE WORKS 2

FWP1.1.010.9 SITE OF THE WORKS 2
FWP1.1.020.A SCOPE OF THE WORKS 2
FWP1.1.030.9 SAMPLE FLATS AND SAMPLE WING 3

FWP1.2 DOCUMENTATION 4

FWP1.2.010.9 DRAWINGS AND DOCUMENTS 4
FWP1.2.020.9 TECHNICAL INFORMATION SUPPLIED WITH TENDER 4
FWP1.2.030.A DEFINITIONS AND ABBREVIATIONS 4
FWP1.2.040.9 REQUIREMENTS FOR SUB-CONTRACTOR'S DRAWINGS 6

FWP1.3 COMPLIANCE WITH REGULATIONS AND STANDARDS 8

FWP1.3.010.A STATUTORY REGULATIONS 8
FWP1.3.020.B STANDARDS AND PRACTICE 8
FWP1.3.030.9 PRECEDENCE 9
FWP1.3.040.9 APPLICATION OF BRITISH STANDARDS / INTERNATIONAL OR NATIONAL STANDARDS / CODES OF PRACTICE 9

FWP1.4 MATERIALS 10

FWP1.4.010.9 METRIC UNITS 10
FWP1.4.020.A SUBMISSIONS FOR APPROVAL 10
FWP1.4.030.9 SAMPLES - SPECIAL REQUIREMENTS 10
FWP1.4.040.9 EQUIPMENT SCHEDULE 10
FWP1.4.050.9 ALTERNATIVE SOURCES OF SUPPLY 11
FWP1.4.070.9 CONSISTENCY 11
FWP1.4.080.9 ZINC FREE BRONZE 11
FWP1.4.090.9 USE OF ASBESTOS 11
FWP1.4.100.9 FIRE EXTINGUISHING MEDIA 11
FWP1.4.110.9 SITE STORAGE 11

FWP1.5 SUPERVISION 12

FWP1.5.010.9 APPOINTMENT OF SUPERVISING ENGINEERS AND SITE SUPERVISORS 12
FWP1.5.020.9 SUPERVISING ENGINEERS 12
FWP1.5.030.9 SITE SUPERVISORS 13

FWP1.6 SUB-CONTRACTORS OBLIGATIONS 14

FWP1.6.010.9 RADIATION ORDINANCE - IONISATION TYPE SMOKE DETECTORS 14
FWP1.6.020.9 OBTAINING FIRE CERTIFICATE 14
FWP1.6.030.9 BUILDING SERVICES PERFORMANCE ASSESSMENT SCORING SYSTEM 14
FWP1.6.040.9 MODIFICATION WORKS IN NON-DOMESTIC PREMISES DURING MAINTENANCE PERIOD 14
FWP1.6.050.A LICENSED PLUMBER AND ATTENDANCE FOR INSPECTION BY THE WATER AUTHORITY 15
FWP1.6.060.9 WSD INSPECTION OF UNDERGROUND AND CONCEALED PIPEWORK BEFORE COVERING UP 16

FWP1.1 THE WORKS

FWP1.1.010.9 SITE OF THE WORKS

The site of the Works is specified in Project Specific Specification.

FWP1.1.020.A SCOPE OF THE WORKS

1. The works to be carried out under this Sub-contract shall include the whole of the materials and labour necessary for the complete fire services installation, water pump installation and rainwater treatment installation, and the maintenance of the same for twenty four (24) months following the certified completion date of the Main Works or any Section(s) of the Main Works, for the buildings / premises specified in Project Specific Specification all as shown on the Drawings and detailed in this Specification;
2. The fire services installation comprises:
    a. Fire hydrant / hose reel system and associated fixed and intermediate booster fire pumps;
    b. Sprinkler system and associated sprinkler pumps;
    c. Drencher system and associated drencher pumps;
    d. Fire alarm system;
    e. Automatic fire detection system;
    f. Audio / visual advisory system;
    g. Automatic fixed installation other than water;
    h. Portable hand-operated approved appliance;
    i. Street fire hydrant booster pump system.
3. The water pump installation comprises:
    a. Fresh water feed pumps;
    b. Flush water feed pumps;
    c. Fire services feed pumps;
    d. Fresh water / flush water / irrigation water booster pumps;
    e. Sewage / waste water / storm water pumps;
    f. Lift pit dewatering system;
    g. PRV fault indication system.
4. The rainwater treatment installation comprises all associated pumps, chlorinators, cartridge filters and pipework;
5. The rainwater treatment installation by the Sub-contractor is part of the rainwater harvesting system which also include the rainwater catchments areas, rainwater collection pipeworks and treated rainwater distribution system. The Sub-contractor shall coordinate with the Contractor for the completion of the whole rainwater harvesting system;

6. The complete installation shall mean, not only the major items of equipment, associated pipework, fittings, control and electrical works and apparatus conveyed in this Specification, but all the incidental sundry components necessary for the complete execution of the works and for the proper operation of the installation with their labour charges, whether or not these supply components are mentioned in detail in the tender documents.

FWP1.1.030.9 SAMPLE FLATS AND SAMPLE WING

During the construction for domestic building blocks, a specified sample flats and wing located on a typical floor will be required to be completed by the Main Contractor including the flats, the corridor and the lift lobby etc.. The Sub-contractor shall complete the fire service installations such as fire hydrant, hose reel etc. in the specified sample flats and wing in coordination with the Main Contractor to cope with the sample flats and wing construction programme. The proposed samples and details of fire service installations in the sample flats and wing shall be submitted to the CM for Approval prior to commencement of works. The Sub-contractor shall be responsible for replacement of any fire services installations which are found damaged or deformed and to carrying out the necessary adjustments to restore to as-new condition before building completion.

FWP1.2 DOCUMENTATION

FWP1.2.010.9 DRAWINGS AND DOCUMENTS

1. Schedule of the Sub-contract Drawings is listed in the Appendix as specified in Project Specific Specification;
2. The tenderer's attention is also drawn to the latest revision of the following Standard Drawing and Document issued by the Housing Department which shall also be complied with where relevant:
   a. Standard Symbol Schedule.
3. The aforesaid Standard Drawings and Documents will be available for inspection at the office of Housing Department during normal office hours upon application to the Contract Manager;
4. The Sub-contract Drawings and the above Standard Drawings and Documents shall hereinafter be referred to as the Drawings.

FWP1.2.020.9 TECHNICAL INFORMATION SUPPLIED WITH TENDER

1. All technical information supplied with the tender, including the materials offered, is for tender assessment only;
2. Acceptance of the tender will not relieve the Sub-contractor of his responsibility for the proper working of the installation to meet the specified requirements in compliance with the Sub-contract documents to the entire satisfaction of the Contract Manager;
3. In the event of the installation being, in the opinion of the Contract Manager, not in compliance with the specified requirements, the Sub-contractor shall modify his design, replace any unsatisfactory materials and do everything necessary for compliance with the specified requirements at his own cost.

FWP1.2.030.A DEFINITIONS AND ABBREVIATIONS

In this Specification the word "shall" is mandatory, the word "will" is informative, the word "should" is advisory, and the word "provide" means supply and fix, or supply and install. In addition, the following words shall have meanings herein assigned:

1. "Authority"

   Hong Kong Housing Authority.

2. "Indicated"

   Indicated elsewhere in the Specification or on the Drawings.

3. "Or Equal" or "Or Similar"

   Having similar characteristics and specification as regards type of construction, performance, general appearance and standard of quality of manufacture.

4. "FSD"

   Fire Services Department of the Government of Hong Kong Special Administrative Region.

5. "BS"

   British Standards, including British Standard Specifications and British Standard Codes of Practice published by the British Standards Institution.

6. "EN"

European Standard.

7. "BS EN"

   European Standard adopted as British Standard.

8. "LPC"

   Loss Prevention Council, United Kingdom.

9. “LPCB”

   Loss Prevention Certification Board, United Kingdom.

10. "NFPA"

    National Fire Protection Association, USA.

11. "UL"

    Underwriters' Laboratory, USA.

12. "IEE Regulations"

    The "Regulations for Electrical Installations" 17th Edition or later published by the BSI and the IET.

13. “IET”

    The Institution of Engineering and Technology, United Kingdom.

14. “APHA”

American Public Health Association

15. “AISI”

American Iron and Steel Association

16. “ASME”

The American Society of Mechanical Engineers

17. "ASTM"

    American Society for Testing and Materials.

18. "ANSI"

    American National Standards Institute.

19. "PASS"

    Performance Assessment Scoring System.

20. "BEC"

    Code of Practice for Energy Efficiency of Building Services Installation.

21. “WSD”

Water Supplies Department of the Government of Hong Kong Special Administrative Region.

22. “ISO”

    International Organization for Standardization.

23. “IEC”

    International Electrotechnical Commission.

24. “JIS”

Japanese Industrial Standards.

FWP1.2.040.9 REQUIREMENTS FOR SUB-CONTRACTOR'S DRAWINGS

1. Size of Drawings:

   Drawings submitted by the Sub-contractor shall be of a standard size from A0 to A4 in accordance with BS EN ISO 5457. "As-fitted" drawings shall be of A0 or A1 size only.

2. Installation Drawings

   a. The Installation Drawings (See PRE.BS1.210) shall detail and dimension the following, where relevant:

      i. General layout drawings giving accurate and dimensioned locations of all plant and equipment included in the Sub-contract;

      ii. Details showing arrangement of assemblies, piping and valve arrangements, connections and junctions between components, etc., which cannot be accurately defined on layout drawings;

      iii. Schematic diagrams for each system to confirm the principle of operation and operating conditions, provisions for testing and commissioning to be included;

      iv. Electrical details, including schematic diagrams for motor control panels, component layout, cable and conductor sizes, cabling arrangement, termination details, control & interlocking logic diagram;

      v. Fire detector and alarm positions and wiring routes with details and function;

      vi. Conduit and trunking routes with conduit / trunking sizes, showing all accessories, details of cables and circuit references;

      vii. Earthing and equipotential bonding system with details of conductor sizes and routing, bonding arrangement;

      viii. Label schedules, showing wording and formats for the labelling of equipment and distribution board circuits.

   b. Operating and maintenance clearances for the equipment and their static and dynamic structural loading shall be shown on the installation drawings wherever necessary.

3. "As-fitted" Drawings

   a. The "as-fitted" drawings shall be based on the full set of Approved Installation Drawings updated to show the actual positions and arrangement of all items installed. Any additional drawings which are considered necessary by the CM for showing the complete installation shall be included. The Drawings shall be drawn in black-ink lines on quality paper suitable for reproduction of prints;

   b. "As-fitted" drawings shall include, but not be limited to, the following:

      i. Site plan (showing street hydrant and underground pipe routes, water mains and pump room locations, rainwater treatment plant room locations etc.);

      ii. Schematic piping diagram;

      iii. Schematic wiring diagram;

      iv. Block control diagram for fire services and water pump systems;

      v. Block control diagram for rainwater treatment system;

      vi. Operation sequence for fire services and water pump systems;

vii. Fire services layout plan;

viii. Pump / booster pump room layout plan;

ix. Rainwater treatment plant room layout plan;

x. Control cubicle layout;

xi. Details for other installations (such as water feature, etc.);

xii. Conduit drawings;

xiii. Other items as required by the CM.

FWP1.3 COMPLIANCE WITH REGULATIONS AND STANDARDS

FWP1.3.010.A STATUTORY REGULATIONS

The Sub-contractor shall comply with all Regulations and requirements including those of the Government of Hong Kong Special Administrative Region, the Hong Kong Fire Services Department (FSD), the Water Authority, the Building Authority, the Electrical and Mechanical Services Department (EMSD) and Electricity Supply Company, together with any revisions or amendments made thereto, and shall be responsible for giving notifications to the appropriate Authorities and for paying all fees all in accordance with the Sub-contract. The following are particularly relevant:

1. The Fire Services Ordinance and its Regulations;
2. The Waterworks Ordinance and its Regulations;
3. The Electricity Ordinance and its Regulations;
4. The Noise Control Ordinance and its Regulations;
5. The Radiation Ordinance and its Regulations;
6. Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment issued by the Fire Services Department (hereinafter referred to as Fire Services CoP);
7. Circular Letters issued by the Fire Services Department;
8. Technical Requirements for Plumbing Works in Buildings and Circular Letters issued by the Water Supplies Department;
9. Code of Practice for the Electricity (Wiring) Regulations (hereinafter referred to as the Electrical CoP);
10. Building Energy Efficiency Ordinance;
11. Code of Practice for Energy Efficiency of Building Services Installation (hereinafter referred to as the Building Energy Code (BEC).

FWP1.3.020.B STANDARDS AND PRACTICE

All materials and workmanship shall comply, where applicable, with all relevant sections, together with any revisions or amendments made thereto, of the following:

1. Relevant Worksections for Electrical Installation of Building Services Installation Specification of the HKHA Specification Library (hereinafter referred to as the HKHA Electrical Installation Specification) as specified in Project Specific Specification;
2. The BEC, 2024 Edition, issued by the Electrical and Mechanical Services Department. The Sub-contractor shall provide necessary information and documents to the CM for preparation of submissions under the Building Energy Efficiency Ordinance;
3. The Supply Rules issued by the respective Supply Company currently in operation in Hong Kong;
4. Relevant Worksections of Building Works Specification of the HKHA Specification Library (hereinafter referred to as the HKHA Building Works Specification);

5. Appropriate British Standard Specification(s) (subject to FWP1.3.040). When a British Standard quoted in this Specification has been wholly or partially superseded by another equivalent or similar national / international standard, the Sub-contractor is allowed to offer material in compliance with the latter in lieu of the former for the CM's approval, on condition that prior approval by the appropriate Authorities (where required) has already been given;
6. National Fire Protection Association codes / standards (hereinafter referred to as NFPA codes / standards);
7. Code of Practice for Prevention of Legionnaires' Disease;
8. Loss Prevention Council Rules for Automatic Sprinkler Installations incorporating BS EN 12845: 2015 and relevant FSD circular letters (hereinafter collectively referred to as LPC Sprinkler Rules);
9. The Standard for Fire Detection and Fire Alarm Systems for Buildings BS 5839-1: 2017 (Incorporating Corrigendum No.1) and relevant FSD circular letters (hereinafter collectively referred to as AFA Rules).

FWP1.3.030.9 PRECEDENCE

In case of conflict between the requirements among the publications referred to in FWP1.3.010 and FWP1.3.020, interpretation shall be in accordance with the following order of precedence unless otherwise directed by the Contract Manager:

1. Ordinances and Regulations, Laws of Hong Kong;
2. Fire Services CoP and Circular Letters issued by the Fire Services Department;
3. Electrical CoP;
4. LPC Sprinkler Rules and AFA Rules;
5. The Specification and/or the Drawings;
6. HKHA Electrical Installation Specification;
7. Building Energy Code;
8. Supply Rules;
9. HKHA Building Works Specification;
10. British Standard Specifications and British Standard Codes of Practice;
11. NFPA codes/standards.

FWP1.3.040.9 APPLICATION OF BRITISH STANDARDS / INTERNATIONAL OR NATIONAL STANDARDS / CODES OF PRACTICE

1. Where the date / year of British Standards (BS) / International or National Standards / Codes of Practice (CoP) is not specified in the Specification, it shall be deemed to refer to any valid or latest version, and any applicable amendments to that version;
2. Where the date / year is specified, due to intended purposes, the specified version and any amendments to that version shall be complied with unless otherwise approved by the Contract Manager;
3. "Head standards" (HS) are not dated because they do not contain any technical content. However reference to a head standard invokes all relevant extant "parts" of that standard which are themselves dated. Reference to head standards is a practicable method of using a general BS reference in situations where detailed reference to each part would be cumbersome.

FWP1.4 MATERIALS

FWP1.4.010.9 METRIC UNITS

Unless otherwise specified, only materials of metric unit shall be used.

FWP1.4.020.A SUBMISSIONS FOR APPROVAL

1. The Sub-contractor shall submit catalogues, technical information and samples of the materials proposed for approval as required by the CM. (See PRE.BS1.350 and PRE.BS1.360);
2. The Sub-contractor shall include in the submissions copies of valid approval documents / certificates issued by FSD and / or product certification bodies recognised by FSD for those items on the List of Fire Service Installations and Equipment and other products requiring FSD's approval / Acceptance published by FSD;
3. The Sub-contractor shall include in the submissions copies of valid documents substantiating compliance with the requirements of the Water Authority:
    a. For those piping and fittings to be reported in Form WWO 1149, submit General Acceptance Letter issued by the Water Authority;
    b. For materials not required to be reported in Form WWO 1149, submit documents as follows:
        i. Certified true copy of the test reports issued by the accredited laboratory accepted by the Water Authority showing full compliance with the requirements of the Water Authority; or
        ii. Copy of Certificate issued by Water Regulations Advisory Scheme of UK (WRAS) for testing in compliance with the relevant British Standard as listed on WSD webpage.

FWP1.4.030.9 SAMPLES - SPECIAL REQUIREMENTS

In addition to the requirements of PRE.BS1.360 a sample of each type of sprinkler head, fire alarm call point, heat detector and smoke detector as included in the tender shall be submitted to the Contract Manager upon request. Tests to demonstrate the function of the equipment shall be conducted where required. Samples may be required immediately after submission of Tender and before tender recommendation or acceptance. The Tenderer shall be prepared to deliver the materials to the Contract Manager's office and collect after examination and demonstration.

FWP1.4.040.9 EQUIPMENT SCHEDULE

The Tenderer shall complete the Equipment Schedule attached to the Tender Document and also furnish the following information, as required by the Contract Manager:

1. Name of manufacturer, country of manufacture, type and catalogue number, and full technical performance details, of all major items of equipment offered;
2. Voltage of operation and current consumption of automatic smoke and heat detectors under:
    a. Normal conditions; and
    b. Alarm conditions.
3. Type and size of wiring for alarm circuits;

4. Evidence, or a signed statement, to the effect that all items of equipment are approved by FSD;
5. Copies of test certificates showing compliance with the specified standards of the offered equipment and materials issued by the British Standards Institution or any other recognized international testing authorities;
6. Illustrated technical brochures in English showing all major items of equipment and their installation requirements.

FWP1.4.050.9 ALTERNATIVE SOURCES OF SUPPLY

1. Items of equipment and materials for the Works included in the Equipment Schedule shall fully comply with the Specification and Drawings and the Tenderer is allowed to include up to three offers for any one item;
2. Following acceptance of the Tender the Contract Manager may accept alternative equipment and materials proposed by the Sub-contractor in writing provided always that they are fully in compliance with the Specification and Drawings without imposing any additional contractual and financial liabilities on the Authority. Save as aforesaid, alternatives to the agreed Equipment Schedule will not be accepted.

FWP1.4.070.9 CONSISTENCY

All equipment of the same category shall preferably be of the same colour scheme throughout and shall be the product of the same manufacturer.

FWP1.4.080.9 ZINC FREE BRONZE

Where zinc free bronze is specified in the Specification, the zinc content shall not exceed 0.5%.

FWP1.4.090.9 USE OF ASBESTOS

Asbestos or products containing asbestos shall not be used without prior Approval.

FWP1.4.100.9 FIRE EXTINGUISHING MEDIA

Fire extinguishing media for any fire services equipment installation shall be of zero ozone depleting potential product. Upon request, the Sub-contractor shall produce evidence and document to prove that the fire extinguishing media is of zero ozone depleting potential product.

FWP1.4.110.9 SITE STORAGE

1. Tubes and all items of plant and equipment shall be delivered, stored, and maintained in perfect condition;
2. Tubes shall have their ends effectively sealed;
3. All plant and equipment shall be stored under weatherproof cover until they are required to be incorporated into the installation.

FWP1.5 SUPERVISION

FWP1.5.010.9 APPOINTMENT OF SUPERVISING ENGINEERS AND SITE SUPERVISORS

1. Immediately upon the award of the Sub-contract, the Sub-contractor shall appoint Supervising Engineer(s) and Site Supervisor(s) specified in this Specification, who shall be both English and Cantonese speaking and in the Sub-contractor's full-time employment for the supervision of the Sub-contract Works to the satisfaction of the Contract Manager;
2. Immediately after the award of the Sub-contract, the name, qualifications and curriculum vitae of the Supervising Engineer(s) and Site Supervisor(s) shall be submitted for Approval to the satisfaction of the Contract Manager;
3. None of the Supervising Engineer(s) and Site Supervisor(s) shall be removed from their respective duties without prior Approval;
4. In the event of any of them being unsatisfactory, in the opinion of the Contract Manager, or misconducting themselves, they shall be removed forthwith and be replaced by suitable substitutes to the Contract Manager's satisfaction within seven days from the Contract Manager's instruction in writing.

FWP1.5.020.9 SUPERVISING ENGINEERS

1. Unless otherwise specified, the Sub-contractor is to employ for the supervision of all works on Site, at least one qualified Supervising Engineer. The Supervising Engineer shall generally represent the Sub-contractor in all respects of the Sub-contract and assume the following duties:
    a. Coordinate and supervise the work in the Sub-contractor's office and the Site;
    b. Develop, in conjunction with the Main Contractor, schedules of installation drawings, builder's work drawings, material submission and delivery, statutory submissions, the programme of works and testing and commissioning programme, for approval by the CM;
    c. Liaison with the CM and other parties;
    d. Attend at the office of the CM for the finalisation of drawings and equipment selection;
    e. Attend progress meetings and coordination meetings;
    f. Monitor and supervise installation drawings submission, builder's work drawings submission, material submission and delivery, statutory submissions in accordance with the respective submission schedules approved by the CM. Submit progress reports to the CM monthly or at shorter intervals when such requested by the CM;
    g. Check and confirm the installation drawings, builder's work drawings and material submissions are suitable for the installation works and in compliance with the requirements of the Sub-contract;
    h. Examine, verify and confirm in writing to the CM on a monthly basis that the material delivered to the Site under the Sub-contract has been approved by the CM;
    i. Certify all material delivery vouchers in accordance with PRE.B12.280 of the Main Contract;
    j. Prepare, in conjunction with the Main contractor, the delivery method statements for delivery of plant and equipment;

k. Undertake all site test and commissioning of the Sub-contract Works and endorse the test and commissioning reports to confirm that he is satisfied with the completeness, workmanship and performance of the installations which comply fully with the Sub-contract requirements, prior to submission to the CM.

2. Qualification requirements:

   At least one year of proven post qualification experience at supervisory level on fire services and water pump installations in buildings with the following qualification:

   a. Registered Professional Engineer (Mechanical, Fire or BS Discipline) under the Engineers Registration Ordinance; or

   b. Member of the Institution of Mechanical Engineers, UK; or

   c. Member of the Chartered Institution of Building Services Engineers, UK; or

   d. Member of the Hong Kong Institution of Engineers (Mechanical, Fire or BS Discipline) elected after 5 December 1975.

3. The Supervising Engineer shall be highly competent and experienced, and shall be given a high level of delegated authority such that he / she can take decisions, including those involving expenditure.

FWP1.5.030.9 SITE SUPERVISORS

1. Unless otherwise specified, the Sub-contractor is to employ at least one qualified Site Supervisor. The Site Supervisor shall be stationed on site;

2. Qualifications requirements:

   Mechanic with at least 3 years of practical experience in fire services and water pump installation.

FWP1.6 SUB-CONTRACTORS OBLIGATIONS

FWP1.6.010.9 RADIATION ORDINANCE - IONISATION TYPE SMOKE DETECTORS

The Sub-contractor shall hold a valid Radioactive Substances Licence granted by the Hong Kong Radiation Board and observe all conditions of licence, rules and regulations of the Radiation Ordinance and Radiation (Control of Radioactive Substances) Regulations in the storage, handling, installation, disposal etc. of ionization type smoke detectors throughout the whole contract period and the subsequent Maintenance Period.

FWP1.6.020.9 OBTAINING FIRE CERTIFICATE

1. The Sub-contractor shall be responsible for giving notifications to the appropriate Authorities, attending necessary inspection and paying all fees levied, including them in the Tender Price, and also for collecting all necessary certificates and licences for the installation as soon as available, and delivering them to the Contract Manager;
2. The Sub-contractor shall also be responsible for amending FS installation drawings for submission of FSI/314 in accordance with the latest approved building plans certifying that the details and specifications of all installations shown on drawings are prescribed by the Fire Services Department and in accordance with all relevant rules and codes;
3. The Sub-contractor shall also be responsible for submission of FSI/501a to the Fire Services Department for all FS installations and the associated requirements including fireman's lifts.

FWP1.6.030.9 BUILDING SERVICES PERFORMANCE ASSESSMENT SCORING SYSTEM

1. The Housing Authority has adopted a Building Services Performance Assessment Scoring System (BSPASS) to assess the performance of building services Nominated Sub-contractors undertaking works for the Authority;
2. BSPASS will be operated in this Sub-contract and assessments by Building Services PASS Assessment Team (BSPAT) or other staff of the Housing Authority will be conducted at quarterly intervals or other intervals as required by the Contract Manager;
3. Upon the Contract Manager's notification, the Sub-contractor's authorised representative shall attend all such assessments;
4. The Sub-contractor shall provide all necessary attendance, and all necessary measuring instruments, in addition to those specified in PRE.BS1.630, etc. to facilitate the BSPASS assessment as stipulated in the relevant BSPASS manuals;
5. In addition, the Sub-contractor shall also provide labours for the opening up and re-fixing of the works, the operation of the equipment and the testing, etc. as required by the assessment.

FWP1.6.040.9 MODIFICATION WORKS IN NON-DOMESTIC PREMISES DURING MAINTENANCE PERIOD

1. During the Maintenance Period, the Employer may employ other workmen or contractors to carry out modification works pertaining to the installation to suit the fitting out works of the tenants;
2. The Sub-contractor shall provide the necessary attendance, including operation of the installation, as instructed by the Contract Manager to facilitate such modification works;

3. The costs of the attendance will be determined by a fair valuation made by the Contract Manager in conjunction with the Sub-contractor and paid for separately;

4. The employment of other workmen or contractors by the Employer for the modification of the installation shall not in any way relieve the Sub-contractor of his responsibilities for the maintenance and defects of the Works, other than those parts which have been modified by others, in accordance with the Contract.

FWP1.6.050.A LICENSED PLUMBER AND ATTENDANCE FOR INSPECTION BY THE WATER AUTHORITY

1. The Sub-contractor and their employed Licensed Plumber (LP) shall carry out the water services works for fire services and water pump installation mentioned in this Specification and shown on the Drawings, as approved by the Water Authority;

2. The LP should have obtained Level 2 or above in English Language in the Hong Kong Diploma of Secondary Education Examination (HKDSEE), or Grade E or above in English Language (Syllabus B) in the Hong Kong Certificate of Education Examination (HKCEE), or equivalent. In case the LP cannot meet such requirement, the Sub-contractor shall provide a competent personnel (e.g. registered engineer, relevant site personnel) with equivalent qualification in English to support the water services works for fire services and water pump installation handled by the LP;

3. The Sub-contractor shall submit and update all necessary applications and forms to the Water Authority and attend upon their representative for the purpose of tests and inspections for the water services works for fire services and water pump installation. All applications and forms for WSD submission shall be submitted to the CM for comment before submitting to WSD and record after approval;

4. The LP referred to in sub-clause (1) shall:

    a. Submit material list to WSD under Form WWO 1149 and subsequent update as soon as the proposed materials, and / or proposed change of approved materials, which are approved by the CM, and before placement of order for such materials;

    b. Ensure that all pipes and fittings have been acknowledged by the Water Authority with permission given for proceeding with the approved water services works for fire services and water pump installation before installation;

    c. Supervise all water services works for fire services and water pump installation under his charge with attendance record submitted to the CM on monthly basis after commencement of water services works for fire services and water pump installation on Site;

    d. Attend the Main Contractor’s regular site meetings with Nominated Sub-contractors, Direct Contractors and Utility Undertakings as appropriate;

    e. Submit monthly report on quality control and progress for review at the site meetings. The report shall include progress of water services works for fire services and water pump installation, LP’s site inspection and site attendance records, record of material quarantine and verification tests, updated WSD submission record etc.;

    f. Attend regular site meetings if required by the CM;

    g. Upon completion of the water services works for fire services and water pump installation:

        i. Submit LP’s inspection report of the completed water services works for fire services and water pump installation;

ii. Declare that all pipes and fittings installed on Site have been approved by the Water Authority and registered with WSD under Form WWO 1149;

iii. Declare that only cadmium-free category brazing alloy and lead-free category soldering alloy are used, if applicable;

iv. Declare that all pipes and fittings installed and any materials used for the construction and installation of the water services works for fire services and water pump installation are as prescribed by the Waterworks Regulations and approved by the Water Authority.

h. Attend all WSD inspections for the water services works for fire services and water pump installation.

5. The Sub-contractor shall monitor the LP's carrying out of duties as specified in sub-clause (4) above and ensure water services works for fire services and water pump installation under the LP are in full compliance with the Specification and as prescribed by the Waterworks Regulations;

6. The Sub-contractor shall monitor the LP's submission to WSD related to the water services works for fire services and water pump installation. The Sub-contractor shall check the validity of the WSD Form and attachments before onward submission to the CM for comment / signing. The Sub-contractor's checking of the WSD submission forms, with declaration that the materials used and the construction of the fire services and water pump installation described therein are as prescribed by the Waterworks Regulations, shall be recorded in a standard form in AP2.FWP.APPEND1 which shall be jointly signed by the Sub-contractor's supervising engineer and their employed LP, and countersigned by the building services engineer of the Main Contractor and submitted to the CM for record;

7. The Sub-contractor shall verify that the LP's declaration under sub-clause (4)(g) are valid. The verification and the declaration shall be recorded in a standard form in AP2.FWP.APPEND2 which shall be jointly signed by the Sub-contractor's supervising engineer and their employed LP, and countersigned by the building services engineer of the Main Contractor and submitted to the CM for record.

FWP1.6.060.9 WSD INSPECTION OF UNDERGROUND AND CONCEALED PIPEWORK BEFORE COVERING UP

Before covering up of the underground and concealed pipework, the Sub-contractor and their employed Licensed Plumber shall invite WSD to conduct interim inspection of the pipework in accordance with the Waterworks Regulations.

FWP2 SYSTEM REQUIREMENTS

FWP2.1 FIRE SERVICES INSTALLATION 3

FWP2.1.1 FIRE HYDRANT/HOSE REEL (FH/HR) INSTALLATION 3
FWP2.1.1.010.A FH/HR SYSTEM DESCRIPTION 3
FWP2.1.1.020.B FH/HR SYSTEM OPERATION 3
FWP2.1.1.030.A SPRINKLER HEAD OVER REFUSE CHUTE AND AT REFUSE STORAGE AND MATERIAL RECOVERY CHAMBER 4
FWP2.1.1.040.9 PIPEWORK 4
FWP2.1.1.050.9 DUTY OF INTERMEDIATE BOOSTER PUMP / FIXED FIRE PUMP 4
FWP2.1.1.060.9 TYPE OF INTERMEDIATE BOOSTER PUMP AND FIXED FIRE PUMP 5
FWP2.1.1.070.9 MOTOR RATING OF INTERMEDIATE BOOSTER PUMP AND FIXED FIRE PUMP 5

FWP2.1.2 FIRE SERVICES PUMP CONTROL CUBICLE 5
FWP2.1.2.010.9 APPROVAL OF LAYOUT 5
FWP2.1.2.020.9 MOTOR STARTER PROTECTION 5
FWP2.1.2.030.9 TANK EMPTY SIGNAL AT FIRE SERVICES SUPPLY TANK 5

FWP2.1.3 FIRE ALARM AND CONTROL SYSTEM 6
FWP2.1.3.010.A ALARM AND CONTROL SYSTEM 6
FWP2.1.3.020.9 MANUAL FIRE ALARM POINT 6
FWP2.1.3.030.A CIRCUITRY OF MANUAL FIRE ALARM POINTS 6
FWP2.1.3.040.A FIRE ALARM CONTROL PANEL 7

FWP2.1.4 PORTABLE EQUIPMENT 7
FWP2.1.4.010.9 GENERAL 7
FWP2.1.4.020.9 FIRE EXTINGUISHERS INSIDE TRANSFORMER ROOM 7

FWP2.1.5 SPRINKLER SYSTEM INSTALLATION 7
FWP2.1.5.010.A SPRINKLER SYSTEM DESCRIPTION 7
FWP2.1.5.020.B SPRINKLER SYSTEM OPERATION 7
FWP2.1.5.030.A DUTY OF SPRINKLER PUMP 8
FWP2.1.5.035.N INTERMEDIATE BOOSTER PUMP 8
FWP2.1.5.040.9 TYPE OF SPRINKLER PUMP 9
FWP2.1.5.050.9 PIPEWORK 9
FWP2.1.5.060.9 SPRINKLER HEADS 9
FWP2.1.5.070.A SPRINKLER CONTROL VALVE SET 9
FWP2.1.5.080.B WATER MOTOR ALARM AND GONG 10
FWP2.1.5.090.A FLOW SWITCHES 10
FWP2.1.5.100.9 DRAIN PIPE WORKS 10
FWP2.1.5.110.9 ORIFICE PLATE/LOCK-SHIELD VALVES 10
FWP2.1.5.120.A SPRINKLER AND CONTROL SYSTEM 10

FWP2.1.6 AUTOMATIC FIRE DETECTION SYSTEM 11
FWP2.1.6.010.A SYSTEM DESCRIPTION 11
FWP2.1.6.020.A FIRE ALARM CONTROL FOR AUTOMATIC FIRE DETECTION SYSTEM 11
FWP2.1.6.030.N ACTUATION OF FIRE SHUTTERS 12

FWP2.1.7 AUDIO / VISUAL ADVISORY SYSTEM 12
FWP2.1.7.010.A WORKS DESCRIPTION 12
FWP2.1.7.020.A SYSTEM OPERATION 13

FWP2.1.8 DRENCHER SYSTEM INSTALLATION 13
FWP2.1.8.010.N DRENCHER SYSTEM DESCRIPTION 13
FWP2.1.8.020.N DRENCHER SYSTEM OPERATION 14
FWP2.1.8.030.A DUTY OF DRENCHER PUMP / DRENCHER INTERMEDIATE BOOSTER PUMP 14

FWP2.1.8.040.N PROVISION OF ORIFICE PLATES AND LOCKSHIELD VALVES 15

FWP2.2 WATER PUMP INSTALLATION 16

FWP2.2.1 SYSTEM DESCRIPTION 16
FWP2.2.1.010.9 GENERAL 16
FWP2.2.1.020.9 SUB-CONTRACTOR'S RESPONSIBILITIES 16
FWP2.2.1.030.A FRESH WATER BOOSTER PUMP SYSTEM 16
FWP2.2.1.040.9 PRV FAULT INDICATION SYSTEM DESCRIPTION 17

FWP2.2.2 SYSTEM OPERATION 17
FWP2.2.2.010.9 FRESH AND FLUSH WATER PUMP INSTALLATION 17
FWP2.2.2.020.A FRESH WATER BOOSTER PUMP SYSTEM INSTALLATION 18
FWP2.2.2.026.9 RAINWATER IRRIGATION PUMP SYSTEM INSTALLATION 19
FWP2.2.2.030.A FIRE SERVICES FEED PUMP INSTALLATION 20
FWP2.2.2.035.B STATUS OF FIRE SERVICES SUPPLY TANK 20
FWP2.2.2.040.A CONTROL CUBICLE LAYOUT FOR FRESH / FLUSH WATER PUMPS, RAINWATER IRRIGATION PUMPS AND FOR FS FEED PUMP 21
FWP2.2.2.050.9 PRV FAULT INDICATION SYSTEM OPERATION 21

FWP2.2.3 PUMPS 22
FWP2.2.3.010.9 PUMP DUTY 22
FWP2.2.3.020.9 TYPE OF PUMPS 22

FWP2.3 RAINWATER HARVESTING SYSTEM INSTALLATION FOR DOMESTIC BLOCK 23

FWP2.3.1 SYSTEM DESCRIPTION 23
FWP2.3.1.010.9 GENERAL 23

FWP2.3.2 SYSTEM OPERATION 23
FWP2.3.2.010.9 SYSTEM CONTROL 23

FWP2.4 SEWAGE / WASTE WATER / STORM WATER PUMPING SYSTEM INSTALLATION 24

FWP2.4.1 SYSTEM DESCRIPTION 24
FWP2.4.1.010.N GENERAL 24
FWP2.4.1.020.N LEVEL CONTROL SYSTEM 24
FWP2.4.1.030.N LOCAL CONTROL PANEL 25
FWP2.4.1.040.N REMOTE ALARM PANEL 25

FWP2.4.2 SYSTEM OPERATION 26
FWP2.4.2.010.N SYSTEM CONTROL 26

FWP2.4.3 PUMPS 26
FWP2.4.3.010.N PUMP DUTY 26
FWP2.4.3.020.N TYPE OF PUMPS 27

FWP2.1 FIRE SERVICES INSTALLATION

FWP2.1.1 FIRE HYDRANT/HOSE REEL (FH/HR) INSTALLATION

FWP2.1.1.010.A FH/HR SYSTEM DESCRIPTION

1. The FH/HR system comprises main risers, with Fire Service Inlets, supplying the fire hydrants on each floor and secondary risers supplying hose reels on each floor as shown on the Drawings;
2. The FH/HR system shall be fed from the fire services tank which will be erected by the Main Contractor;
3. Identical duty and standby intermediate booster pumps / fixed fire pumps as shown on the Drawings shall be used in the system to ensure sufficient pressure at each hose reel to provide a minimum jet stream of 6 m and an aggregate flow of not less than 900 1/min at any two hydrant outlets each with a flow of 450 1/min at a running pressure of not less than 350 kPa when the system is fed from the supply tank or with the fire engines boosting water into the Fire Service Inlet at a constant pressure of 800kPa upstream of the Inlet. Pressure reducing valves or self-contained pressure reducing hydrants shall be used wherever the pressure at any hydrant outlet is over 850 kPa;
4. The pressure at any fire hydrant shall in no case exceed 850 kPa. The running pressure at any hydrant outlet, when delivering 450 1/min, shall be not less than 350 kPa.

FWP2.1.1.020.B FH/HR SYSTEM OPERATION

1. The system shall be inter-connected with the Fire Alarm and Control System in accordance with the Drawings and Specification;
2. The standby intermediate booster pump / fixed fire pump shall start when the pressure switch in the duty intermediate booster pump / fixed fire pump discharge does not sense a correct pressure within 15 seconds after the duty intermediate booster pump / fixed fire pump receives the "start" signal. The timer shall be adjustable from 0-2 minutes;
3. Whenever intermediate booster pumps are required, suitable start / stop push buttons together with pump status indicator lights (comprising “power supply on”, “pump running” and “pump failed” indicators for each pump) and alarm buzzer shall be provided adjacent to the corresponding fire service inlet(s);
4. The fire alarm control panel shall start the fixed fire pump automatically upon receiving the call from any manual call point and once started, the fixed fire pump shall run continuously until it is stopped only manually at the pump control panel;
5. When the intermediate booster pump is independent of the fixed fire pump, it shall be controlled by the 'start / stop' push buttons adjacent to fire service inlets. Once started, the pump shall run continuously until stopped manually either at the 'start / stop' button adjacent to the same fire service inlet or at the pump control panel;

6. When the intermediate booster pump also serves as fixed fire pump, it shall be either started automatically upon receiving the call from any manual call point as stated in above paragraph 4, or by the 'start / stop' push buttons as stated in above paragraph 5. Once started, the pump shall run continuously until stopped manually either at the 'start / stop' push buttons adjacent to the same fire service inlet or at the pump control panel.

FWP2.1.1.030.A SPRINKLER HEAD OVER REFUSE CHUTE AND AT REFUSE STORAGE AND MATERIAL RECOVERY CHAMBER

1. Quartzoid bulb type sprinkler head shall be provided at the top of the refuse chute and at the Refuse Storage and Material Recovery Chamber (RS&MRC) of domestic blocks;
2. The operating temperature of the sprinkler head at refuse chute and at RS&MRC shall be 57°C and 68°C respectively;
3. The isolating stop valves with micro switches shall be provided for the top of refuse chute and RS&MRC to identify the valves at open / close status at the fire alarm control panel. Security devices shall be provided to prevent tempering / unauthorized operation of the valves;
4. The flow switch provided to detect the operation of the sprinkler shall be of high sensitivity as in FWP11.6.040. The location and method of connection shall be submitted for Approval.

FWP2.1.1.040.9 PIPEWORK

1. Unless otherwise shown on Drawings, galvanised steel pipework and fittings complying with FWP3 and FWP4 shall be used;
2. The installation shall include all pipework and fittings fully installed as indicated on the Drawings.

FWP2.1.1.050.9 DUTY OF INTERMEDIATE BOOSTER PUMP / FIXED FIRE PUMP

1. The pressure of the intermediate booster pump / fixed fire pump shall fall progressively with the increase of flow, with the shut-off pressure being at the highest. The pump shall deliver not more than 150% of rated capacity at 65% of rated head and the shut-off head shall not exceed 130% of the rated head;
2. Overheating due to continuous operation at no system draw-off condition is not acceptable. By-pass device for excessive water flow to the suction tank shall be provided by the Sub-contractor. The leak off rate of the pump(s) to prevent overheating shall be determined by Sub-contractor;
3. The pump shall be able to deliver water at flow rate and pressure head as indicated on the Drawings;
4. The duty and standby intermediate booster pump / fixed fire pumps shall each be capable of providing an aggregate flow of not less than 900 1/min at any two hydrant outlets each with a flow of 450 1/min at a running pressure of not less than 350 kPa. The pressure at any hydrant shall in no case exceed 850 kPa;
5. The intermediate booster pump shall also be able to maintain the required aggregate flow and pressure at any two hydrants when water is pumped through the FS Inlet at a constant pressure of 800 kPa;
6. The sub-contractor shall be responsible for checking the pump duty operating head and capacity of flow based upon the characteristics of the pipework system and equipment actually installed. Any non-compliance with the design requirements found shall be notified to the Contract Manager;

7. Predicted total head, efficiency, required NPSH and power absorbed versus flow quantity curves shall be submitted. The curves shall commence at zero and be extended to show the performance at 150% of the rated capacity to demonstrate that the pump will be capable of meeting the full range of operating condition on site.

FWP2.1.1.060.9 TYPE OF INTERMEDIATE BOOSTER PUMP AND FIXED FIRE PUMP

1. The intermediate booster pump/ fixed fire pump shall be either horizontal split casing, end suction or horizontal/vertical multi-stage type as shown on the Drawings. Construction of the horizontal split casing or end suction pump shall permit removal of back cover, stuffing box and impeller without disturbance of suction/delivery pipework;
2. For installation with motor rating not exceeding 2.2 kW, close-coupled pumps may be accepted as alternative subject to Approval.

FWP2.1.1.070.9 MOTOR RATING OF INTERMEDIATE BOOSTER PUMP AND FIXED FIRE PUMP

The motor driving the intermediate booster pump / fixed fire pump shall be rated to give 20% more power in addition to the hydraulic power required for the rated flow of the system.

FWP2.1.2 FIRE SERVICES PUMP CONTROL CUBICLE

FWP2.1.2.010.9 APPROVAL OF LAYOUT

Unless otherwise Approved, prior to manufacture, control circuit and panel layout arrangement of the control cubicle shall be in accordance with the Drawings and FWP11.3, FWP11.4 and FWP11.5.

FWP2.1.2.020.9 MOTOR STARTER PROTECTION

The Sub-contractor shall advise the CM of the appropriate type and rating of the short circuit protective device to be used in conjunction with the motor starter in accordance with the motor starter manufacture's recommendation in order to achieve the specified type of coordination.

FWP2.1.2.030.9 TANK EMPTY SIGNAL AT FIRE SERVICES SUPPLY TANK

1. A level control switch for tank empty signal shall be provided at fire services supply tank such as FH/HR tank, sprinkler tank, street fire hydrant tank and drencher tank, when applicable;
2. When water level at fire services supply tank falls to 150 mm above the top level of the suction pipe of the fire services pump, the level control switch at the fire service supply tank shall:
    a. Switch off the pump when it is operating under manual mode; and
    b. Activate a tank empty indication light on the pump control cubicle.

FWP2.1.3 FIRE ALARM AND CONTROL SYSTEM

FWP2.1.3.010.A ALARM AND CONTROL SYSTEM

1. The Sub-contractor shall design, supply, install and connect up, by concealed PVC conduit system, fire alarm and control system from all wired fire services equipment to their respective control panels, fire alarm control panels and repeater panels wherever applicable, at the locations as shown on the Drawings. The fire alarm control panel and associated repeater panel of domestic block shall be of conventional electronic type acceptable to FSD. For non-domestic premises with large nos. of control and monitor points and multi-interfacing arrangement, addressable electronic type fire alarm control panel is acceptable to substitute conventional type fire alarm control panel as shown on drawings subject to approval by the CM;
2. The Sub-contractor shall provide the concealed PVC conduit system complete with wiring for and in connection with the fire alarm control panel, repeater panels, automatic fire alarm panel, sprinkler control panel, drencher system control panel and other fire services equipment;
3. The arrangement on the fire alarm control panels, sub-panel and repeater panels shall be submitted for Approval. The system shall be operated from the 24V battery supply as mentioned in FWP2.1.3.040 if required;
4. Whenever necessary and subject to Approval, parts of the conduit system may be installed in galvanised steel surface conduit / trunking;
5. The Sub-contractor shall apply direct telephone line connections to Fire Services Communication Centre (FSCC) where necessary. The installation cost including connection fee, rental and maintenance charges within the Maintenance Period for the direct telephone lines shall be borne by the Sub-contractor.

FWP2.1.3.020.9 MANUAL FIRE ALARM POINT

1. The manual fire alarm point shall comprise a manual fire alarm call point and an audible alarm point as shown on the Drawings;
2. The manual fire alarm call point shall be semi-flush mounted or surface mounted with the thickness of mounting box not more than 25 mm unless otherwise approved by Contract Manager. Its drip holes beneath the mounting box shall not be blocked.

FWP2.1.3.030.A CIRCUITRY OF MANUAL FIRE ALARM POINTS

1. Wiring of the manual fire alarm points shall be divided into zones;
2. The manual fire alarm points in each floor of a domestic block shall form an individual zone;
3. The sprinkler head over refuse chute and at the refuse chamber of a domestic block shall each form a separate zone at the fire alarm control panel;
4. Zoning arrangement of the manual fire alarm points at non-domestic premises shall be submitted and subject to the CM’s approval;
5. For conventional type fire alarm control panel, the circuit of each zone shall be individually wired to the fire alarm control panel;
6. Cables shall be clearly labelled by cable markers so as to be easily identified at the fire alarm control panel to facilitate testing of each individual circuit.

FWP2.1.3.040.A FIRE ALARM CONTROL PANEL

1. Control and monitoring details shall be referred to the Drawings and FWP10 and submitted for Approval prior to installation;
2. A key box with glass front shall be installed next to each fire alarm control panel, repeater panel or other locations as directed by the CM. One set of properly labelled key for operation of the panel shall be provided in the key box. Another two sets of keys for each panel shall be provided to the CM;
3. The fire alarm and control system and the fire alarm control panel shall operate at 24V DC supply from battery and charger unit connected to essential power supply as detailed in FWP10.6.

FWP2.1.4 PORTABLE EQUIPMENT

FWP2.1.4.010.9 GENERAL

Fire extinguishers, sand buckets and fire blankets shall be provided if applicable and mounted in the positions as shown on the Drawings.

FWP2.1.4.020.9 FIRE EXTINGUISHERS INSIDE TRANSFORMER ROOM

The fire extinguishers inside the Transformer Rooms shall be supplied and installed by the Sub-contractor unless otherwise specified.

FWP2.1.5 SPRINKLER SYSTEM INSTALLATION

FWP2.1.5.010.A SPRINKLER SYSTEM DESCRIPTION

1. The sprinkler system shall be designed as specified in Project Specific Specification;
2. The system is designed to discharge water under pressure from sprinkler heads (detecting devices) at / or near the point of origin of the fire within the areas as shown on the Drawings and to sound an alarm;
3. The system shall be fed from a sprinkler water tank located as specified in Project Specific Specification;
4. The Main Contractor will erect the sprinkler water tank;
5. The Sub-contractor shall carry out the installation work from this water tank onward including the connection of this system thereto;
6. The system shall comprise sprinkler pumps (if applicable), control valves, sprinkler inlet valves, non-return valves, risers, distribution pipes, range pipes, sprinkler heads, flow switches, pressure switches, drains, test facility devices etc. together with all associated equipment, whether or not they are shown on the Drawings, necessary for a complete installation.

FWP2.1.5.020.B SPRINKLER SYSTEM OPERATION

1. The sprinkler system will operate automatically and shall be inter-connected with the Fire Alarm and Control System. Should a sprinkler head located at any part of the area served by the sprinkler system on any level operates, the pressure switch, on sensing the pressure drop, shall start the sprinkler pump. The flow switch, on sensing the flow of water, shall actuate the fire alarm control panels;
2. The sprinkler pumps and jockey pump shall start automatically by means of pressure switches as described below:

a. The jockey pump shall be set to operate at 95% of the system pressure and shall stop when the system pressure is restored to 100% level. The jockey pump shall cease to operate when the sprinkler pump is started in response to a reduction in system pressure;

b. The duty sprinkler pump shall start when the pressure in the trunk main falls to a value of above 80% of the churning pressure of sprinkler pump(s) under closed valve conditions, and that the standby pump shall start at a lower pressure setting of not less than 80% of the trunk mains pressure;

c. Once a sprinkler pump has started, it shall continue to run until stopped manually.

3. The status of each sprinkler pump comprising "Power supply on", "Pump running" and "Pump failed" shall be monitored and displayed at the sprinkler pump control cubicle, and repeated at fire alarm control and indicating panel;

4. Electrical devices, either water flow switches or pressure switches, as required by the LPC Sprinkler Rules shall be provided to detect and monitor the operation of sprinkler systems.

FWP2.1.5.030.A DUTY OF SPRINKLER PUMP

1. For duty / standby pumps for sprinkler system, the pumps (including any orifice plates) must comply with the pressure / flow characteristics, suction lift requirement, close off maximum pressure and other relevant paragraphs in the LPC Sprinkler Rules. The pumps shall conform to the nominal rating within limits of + 5% on the flow at the nominal pressure rating;

2. The discharge rate of the jockey pump shall be less than that of the most hydraulically remote sprinkler head or discharge outlet, but in no case less than 25 1/min, and the pressure generated by the jockey pump shall not exceed the maximum allowable pressure permitted on the sprinkler system;

3. The Sub-contractor shall be responsible for checking the pump duty operating head and capacity of flow based upon the characteristics of the pipework system and equipment actually installed. Any non-compliance with the design requirements found shall be notified to the CM;

4. A listed flow measuring device accepted by FSD shall be permanently installed and shall be capable of checking each water supply from pump according to the LPC Sprinkler Rules. The test lines shall be discharged to the sprinkler water tank wherever practical.

FWP2.1.5.035.N INTERMEDIATE BOOSTER PUMP

1. In buildings for installation(s) where the height between the topmost sprinkler heads and the lowest Sprinkler Inlet is in excess of 60m, the flow and pressure characteristics according to the LPC Sprinkler Rules shall be maintained by intermediate booster pumps;

2. Unless otherwise specified or shown on the Drawings, the sprinkler pumps shall utilise as intermediate booster pumps whenever required. The dual purpose pump shall be able to perform the duties as required by the LPC Sprinkler Rules and FSD;

3. For dual purpose pump, pressure reducing valve set (PRV) shall be installed in duplicated and normally open position between pump suction pipe and sprinkler inlet. Positive running pressure at the downstream side of the PRV shall be maintained.

FWP2.1.5.040.9 TYPE OF SPRINKLER PUMP

1. The sprinkler pump shall be either horizontal split casing, end suction type or horizontal/ vertical multi-stage type having construction permitting removal of back cover, stuffing box and impeller without disturbance of suction/delivery pipework;
2. For jockey pumps, multi-stage pumps shall be used. The maximum number of stages acceptable is seven unless otherwise Approved;
3. For installation with motor rating not exceeding 2.2kW, close-coupled pumps may be accepted as an alternative subject to Approval.

FWP2.1.5.050.9 PIPEWORK

1. The installation shall include all pipework and fittings complying with FWP3 and FWP4, installed to LPC Sprinkler Rules and as indicated on the Drawings;
2. The distribution pipes as well as the range pipes shall run through beams as far as possible unless otherwise specified.

FWP2.1.5.060.9 SPRINKLER HEADS

1. The sprinkler heads shall be located as shown on the Drawings and they shall be of quartzoid bulb type, unless otherwise Approved;
2. Samples of each type of sprinkler heads shall be submitted for Approval before installation.

FWP2.1.5.070.A SPRINKLER CONTROL VALVE SET

1. Each control valve set shall comprise:
    a. Main stop valve of gate type;
    b. Alarm valve of wet pipe;
    c. By-pass stop valve or duplicated alarm valve set for sprinkler system in compliance with LPC Sprinkler Rules, if applicable;
    d. Alarm devices, including water motor alarm and gong, local visual indicator, pressure switch, etc.;
    e. Facilities for testing to suit Fire Services Department's requirements;
    f. Pressure gauges to indicate "upstream" and "downstream" system pressure;
    g. Retarding chamber or other device as necessary to prevent false alarm due to incoming pressure variations;
    h. Other equipment as necessary.
2. Where the sprinkler system comprises more than one installation, and subject to the CM’s approval, a single water motor alarm and gong common to a group of wet alarm valves situated in the same valve room may be accepted. In such circumstance, all local visual indicators shall be fitted at the alarm gong to indicate which alarm valve(s) is / are operating;
3. For buildings with a single control valve set, the local visual indicator shall not be required;
4. The control valve set shall be installed at the location as shown on the Drawings. All installation, materials and fixing bolts, etc. for mounting the equipment inside the cabinets or on walls as applicable shall be provided by the Sub-contractor;

5. The main stop valve location plate shall be as detailed in LPC Sprinkler Rules, but lettering shall be in both English and Chinese to suit Fire Services Department's requirements.

FWP2.1.5.080.B WATER MOTOR ALARM AND GONG

Water motor alarm and gong shall be constructed of non-corrosive materials and shall have gong of not less than 200 mm in diameter, suitable for external installation. The water motor alarm gong shall be painted and labelled as required by the Fire Services Department.

FWP2.1.5.090.A FLOW SWITCHES

1. Flow switches complying with FWP11.6.040 shall be installed to such positions as indicated on the Drawings;
2. Water flow alarm switches as detailed in LPC Sprinkler Rules shall be utilised for sending signal back to the fire alarm control and indicating panel to indicate which the location is under operation with both visual indication and audible alarm;
3. A test connection shall be fitted downstream of each switch to simulate the operation of a single sprinkler. The test pipe outlet shall be positioned relative to the drainage system in such a way that the flow of water can be seen during tests.

FWP2.1.5.100.9 DRAIN PIPE WORKS

Drain pipe works complete with supports and accessories, duly painted, shall be supplied and installed by the Sub-contractor, connecting various drain points of the sprinkler system to the nearest drains. The drain valve and drain pipe shall be not less than 25 mm in diameter, to allow the system to be efficiently drained if required.

FWP2.1.5.110.9 ORIFICE PLATE/LOCK-SHIELD VALVES

Notwithstanding that the orifice plate/lock-shield valve is not shown on the Drawings, the Sub-contractor shall provide the suitably sized orifice plate/lock-shield valve in the sprinkler system wherever necessary, to suit the pressure/flow characteristics of the sprinkler pump and to meet the requirements of LPC Sprinkler Rules.

FWP2.1.5.120.A SPRINKLER AND CONTROL SYSTEM

1. The Sub-contractor shall design, supply, install and connect up, by concealed PVC conduit system complete with wiring, the fire alarm and control system, fire alarm control panel and sprinkler pump control cubicle (if applicable) as shown on the Drawings;
2. The sprinkler control and alarm indication shall comply with Technical Guidance on Application of Loss Prevention Council Rules for Automatic Sprinkler Installation 2015 incorporating BS EN 12845 in Hong Kong. The Control and Indicating Equipment for sprinkler system shall be of conventional electronic type acceptable to FSD and inter-connected with the fire alarm control panel to form a complete fire and alarm system The arrangement on the panels shall be submitted for Approval. For non-domestic premises with large nos. of control and monitor points and multi-interfacing arrangement, the sprinkler control and alarm indication can be integrated into the addressable electronic type fire control panel subject to approval by the CM. The system shall be operated from the 24V battery supply as mentioned in FWP2.1.3.040 sub-clause (3);
3. Whenever necessary, and subject to Approval, parts of the conduit system may be installed in galvanised steel surface conduit / trunking.

FWP2.1.6 AUTOMATIC FIRE DETECTION SYSTEM

FWP2.1.6.010.A SYSTEM DESCRIPTION

1. Automatic fire detection (AFA) system comprising smoke detectors, heat detector, visual alarm points, etc. shall be supplied and installed by the Sub-contractor as shown on the Drawings;
2. Smoke detector shall be of photoelectric type unless otherwise specified. The design and construction shall be of LPC approved type or other standards acceptable to FSD;
3. Heat detector shall be of combined fixed temperature and rate of rise type except in kitchen area which shall be of fixed temperature type. The design and construction shall be of LPC approved type or other standards acceptable to FSD;
4. Flame detector or other specific types of fire detectors shall be provided at areas with ceiling height where smoke or heat detectors do not cover. Flame detector shall comply with BS EN54-10. Nonetheless, flame detector shall not be adopted at areas vulnerable to false fire alarm due to direct sunlight;
5. The automatic fire detection system shall comply with the statutory requirements as stipulated in FWP1.3.010 and shall be acceptable to FSD.

FWP2.1.6.020.A FIRE ALARM CONTROL FOR AUTOMATIC FIRE DETECTION SYSTEM

1. The Sub-contractor shall design, supply, install and connect up fire detectors by concealed PVC conduit system, to the control and indicating equipment for AFA system, fire alarm control panel(s), sub-panel(s) and repeater panel(s) at the locations shown on the Drawings;
2. The control and indicating equipment for AFA system shall be of conventional electronic type acceptable to FSD and compatible with the smoke / heat detector installed, unless otherwise approved by the CM. For non-domestic premises with large nos. of control and monitor points and multi-interfacing arrangement, the AFA control and indicating signals can be integrated into the addressable electronic type fire alarm control panel subject to approval by the CM;
3. The AFA system shall be either connected to the main fire alarm control panel or formed a sub-panel to feed fire detection signals to the main fire alarm control panel. The arrangement shall be submitted for Approval;
4. Arrangement of sub-panels for Ancillary Facilities Premises
    a. The fire detection system in a domestic block shall be connected to the main fire alarm control panel while the fire detection system for each of the ancillary facilities premises under a domestic block, if required, shall be connected to a sub-panel;
    b. For each of the ancillary facilities premises, a sub-panel, if required, shall be installed at the main entrance of the premise with pairs of fire signals connecting to the main fire alarm control panel of the domestic block as shown in Standard Details Drawing no. STD/B/FS-17. An additional fire alarm bell for the automatic fire detection system of each ancillary facilities premise shall be provided on the external wall of the premise;
    c. Battery & charger for the sub-panel and direct telephone line connection to the Fire Services Communication Centre (FSCC) for each of the ancillary facilities premises shall be separately provided.

5. The Sub-contractor shall provide the concealed PVC conduit system complete with wiring for the automatic fire detection system; whenever necessary and subject to Approval, parts of the conduit system may be installed in galvanised steel surface conduit / trunking;

6. The Sub-contractor shall apply direct telephone line connections to FSCC for each automatic fire detection system. The installation cost including connection fee, rental and maintenance charges within the Maintenance Period for each of the direct telephone lines shall be borne by the Sub-contractor.

FWP2.1.6.030.N ACTUATION OF FIRE SHUTTERS

1. Where automatic fire shutters for compartmentation are provided by the Contractor, the Sub-contractor shall provide actuating devices and an interfacing point adjacent to each fire shutter control panel;

2. The actuating devices shall comprise smoke detectors, audio and visual alarm indicators, installed at both sides of a fire shutter;

3. The actuating signal of an automatic fire shutter shall be connected to the interfacing point and led to the fire alarm control panel of respective premise for control and indication;

4. Each actuating signal shall form an indication zone on the fire alarm control panel;

5. Whenever approved by the FSD, smoke detectors installed solely for fire shutter, fire door, and fire / smoke curtain provided for the purpose of fire compartmentation shall be connected in cross-zoned operation and shall only be operated with fire alarm when any two detectors in coincidence connection are activated. Activation of one detector shall give visual and audible alarm indication on the control panel only. Whenever approved by the FSD, activation of detectors provided solely for the above fire compartmentation provisions shall not activate the building fire alarm and shall not send the fire signal to the FSD via the alarm transmitter and fire alarm direct telephone line.

FWP2.1.7 AUDIO / VISUAL ADVISORY SYSTEM

FWP2.1.7.010.A WORKS DESCRIPTION

1. The Sub-contractor shall provide audio / visual advisory (AVA) system(s) at the areas as shown on the Drawings with equipment and components as specified in FWP10.10. The relevant Standard Detail drawings and schematics in the Sub-contract are for indication of the design intent only. The Sub-contractor shall be responsible for the detailed design of the system to meet with the statutory and performance requirements in the Specification;

2. The Sub-contractor shall provide all necessary equipment and materials to complete the AVA system in order to meet all prescribed requirements in the Fire Services CoP to the satisfaction of the FSD. The Sub-contractor shall propose and submit the system layouts, equipment, materials and detailed wiring schematics for Approval;

3. The AVA system shall provide audio advisory signals throughout the specified areas using an audio advisory system located adjacent to the fire alarm control panel in the fire services control room and loudspeakers at the areas as shown on the Drawings;

4. The Sub-contractor shall be responsible for designing the audio advisory system including the exact quantity and positioning of loudspeakers. The layout of loudspeakers as shown on the Drawings is the design intent for indication of the areas where the audio announcement is required to be provided and the types of loudspeakers required at specified locations;
5. When any of the loudspeakers for the audio advisory system are required to be connected to the public address system(s) provided by other(s), an automatic audio input change-over unit shall be provided for automatic switching of audio inputs;
6. The AVA system shall include visual advisory signs of flashing exit sign boxes in the AVA system protected areas, high level flashing directional sign boxes and low level photo-luminous directional signs in the specified areas for indication of evacuation route to the nearest exit.

FWP2.1.7.020.A SYSTEM OPERATION

1. Upon receipt of the fire alarm signal from the fire alarm control panel, the flashing mode of the exit sign boxes inside AVA system protected areas and directional sign boxes shall be activated throughout the AVA system protected areas;
2. The fire alarm bells shall operate for 10 seconds and then be followed by a pre-recorded emergency announcement in English, Cantonese and Putonghua to alert occupants and direct them to evacuate immediately following the flashing exit signs and flashing directional signs. An attention drawing signal such as a chime sound shall be given out each time before broadcasting of the emergency announcement;
3. The fire alarm bells and the emergency announcement for the AVA system protected areas shall repeat alternately until the fire alarm signal has been reset;
4. The message of the emergency announcement shall be recorded in a voice message module and shall be announced using amplifiers and loudspeakers;
5. In case of failure of the voice message module, the microphone of the audio advisory system in the fire services control room shall be used by an operator to give emergency announcement with a preceding attention drawing signal such as a chime sound to draw the attention of the public;
6. Fire alarm bells shall be operated continuously to give the fire alarm warning if no audio signal is received from the voice message module or microphone.

FWP2.1.8 DRENCHER SYSTEM INSTALLATION

FWP2.1.8.010.N DRENCHER SYSTEM DESCRIPTION

1. The Sub-contractor shall provide drencher system(s) for protection against internal and/or external openings and/or for fire compartmentation as shown on the Drawings with equipment and components as specified in Worksubsection FWP8.2;
2. The Main Contractor will erect the drencher water tank. The Sub-contractor shall check and furnish all necessary dimensional information to enable its capacity shall be adequate for not less than 30 minutes of operation;
3. The Sub-contractor shall carry out the installation work from drencher water tank onward including the connection of this system thereto;

4. Each drencher system shall comprise drencher pumps/ drencher intermediate booster pumps, pressure switches, deluge valve set, manual operating devices, drencher inlets, drencher heads, control panel, heat detectors or pilot sprinklers where appropriate, and all associated equipment, whether or not they are shown on the Drawings, necessary to complete the system complying with the FSD requirements.

FWP2.1.8.020.N DRENCHER SYSTEM OPERATION

1. The drencher system(s) shall be operated both manually and automatically and be inter-connected with the fire alarm and control system;
2. Manual operating devices with operating instruction shall be provided at the deluge valve and near each exit door of the area served by the system(s) and at location(s) required by FSD;
3. For refuge floor, heat detectors shall be used to activate the drencher system;
4. For other locations, the drencher system shall be activated either by heat detectors or pilot sprinklers as shown on the Drawings;
5. In case pilot sprinklers are used, a separate local sprinkler flow switch with test facilities shall be installed to the pilot sprinkler system for actuating the drencher system, such that actuation of sprinklers in other area shall not cause the drencher system to operate;
6. Upon actuation, the system will be capable of delivering the required pressure and flow rate of water to the drencher heads by the drencher pumps through the drencher deluge valve set.

FWP2.1.8.030.A DUTY OF DRENCHER PUMP / DRENCHER INTERMEDIATE BOOSTER PUMP

1. Identical duty and standby drencher pumps as shown on the Drawing shall be used in the system to provide adequate flow of not less than 10 l/min/m^2 of the protected opening and sufficient pressure that capable to maintain the discharge density and pressure at all drencher heads of not less than 0.35 bars when the system is fed from the drencher water storage tank, once started manually or automatically as stated in FWP2.1.8.020;
2. Whenever drencher intermediate booster pumps are required, suitable start / stop push buttons together with pump status indicator lights (comprising “power supply on”, “pump running” and “pump failed” indicators for each pump) and alarm buzzer shall be provided adjacent to the corresponding drencher inlet(s);
3. The drencher intermediate booster pumps shall be capable to provide adequate flow and pressure to the installation with the fire engines boosting water into drencher inlet at a constant pressure of 800 kPa upstream of the inlet upon actuated by the ‘start / stop’ push buttons adjacent to corresponding drencher inlet(s);
4. When the drencher pumps are also utilised as the drencher intermediate booster pumps as shown on the Drawing, they shall be able to perform both functions as stated in above paragraphs 1 and 3;
5. The standby drencher pump/ drencher intermediate booster pump shall be energised to become the duty pump within 15 seconds should the duty drencher pump / drencher intermediate booster pump fail to operate;
6. The pump flow and pressure characteristics, operation sequence, controls, status indications, labelling and by-pass arrangement for drencher pumps / drencher immediate booster pumps, shall comply with Fire Services CoP;

7. The Sub-contractor shall check the pump duty operating head and capacity of flow based on the characteristics of the pipework system and equipment actually installed by hydraulic calculation and on site verification.

FWP2.1.8.040.N PROVISION OF ORIFICE PLATES AND LOCKSHIELD VALVES

Notwithstanding that the orifice plate/lock-shield valve is not shown on the Drawings, the Sub-contractor shall provide the suitably sized orifice plate / lock-shield valve in the drencher system wherever necessary, to suit the pressure/flow characteristics of the drencher pump and to meet the FSD's requirements.

FWP2.2 WATER PUMP INSTALLATION

FWP2.2.1 SYSTEM DESCRIPTION

FWP2.2.1.010.9 GENERAL

1. The water pump installation for each domestic block shall comprise the following as shown on the Drawings:
    a. Two sets of fresh water pump;
    b. Two sets of flush water pump;
    c. A fresh water booster pump system on Roof;
    d. Two sets of fire services feed pump;
    e. One set of night duty pump for fresh water.
2. The water pump installation shall include all associated electrical works, pipework and system components such as pressure switches, pressure gauges, flexible connectors, gate valves, check valves and strainers as shown on the Drawings.

FWP2.2.1.020.9 SUB-CONTRACTOR'S RESPONSIBILITIES

1. The Sub-contractor shall be responsible for connecting the suction and discharge pipework to the puddle flanges at the sump tanks and the riser pipes connection point inside the pump room as shown on Drawings;
2. The Sub-contractor shall provide and install pressure reducing valves and modulating float valves at the fresh and flush water sump tanks as shown on the Drawings. Ball float valve shall also be provided and installed by the Sub-contractor at the fire services sump tank as shown on the Drawings;
3. The Sub-contractor shall provide, install and connect concealed PVC conduit system for water pump control.

FWP2.2.1.030.A FRESH WATER BOOSTER PUMP SYSTEM

1. A fresh water booster pump system shall consist of the following:
    a. Three sets of fresh water booster pumps as specified in FWP6.2.025, two duties and one standby, coupled with induction motors as specified in FWP11.2, assembled in the manufacturer's factory, suitable for variable speed drive control;
    b. A pump control cubicle complying with FWP11.4, consisting of power supply, control and indication wiring circuits, along with necessary components of the variable speed drive (VSD) unit, including multi-pump control microprocessor, variable frequency drives matching pump motor rating and a VSD control monitor as specified in FWP11.3.030;
    c. A set of at least two nos. of stainless steel pneumatic pressure vessels as specified in FWP5.2.056 and of capacities as shown on Drawings;
    d. Pressure transducers as specified in FWP11.6.080 to hunt water discharge pressure and transmit feedback signal to the multi-pump control microprocessor;
    e. Other necessary components for completing the system.

FWP2.2.1.040.9 PRV FAULT INDICATION SYSTEM DESCRIPTION

1. The Sub-contractor shall provide and install a PRV fault indication system for monitoring all pressure reducing valves installed in fresh, floor washing, irrigation and flush water systems as shown on the Drawings;

2 The PRV fault indication system for each domestic or non-domestic block shall comprise the following:

   a. A PRV fault indication panel consisting of power supply, control and indication wiring circuits at G/F guard counter or at a location shown on the Drawings;

   b. System components including but not limited to pressure switches, valves and associated water pipes and fittings connecting to all pressure reducing valves in the block. Pipe materials in various applications shall refer to FWP3.1.2.050;

   c. G.I. adaptable box with LED indication lamp in the vicinity of respective pressure reducing valve for connecting signal cable to the pressure switch via surface conduit; and

   d. Signal wiring of PVC cables in concealed conduits, connecting between the adaptable box and the PRV fault indication panel.

3. The PRV fault indication panel shall be made of epoxy coated galvanised steel sheet and equipped with the following controls / indicators:

   a. Fault indication lights with designation for each PRV;

   b. A power supply status indicator;

   c. An alarm reset switch;

   d. A buzzer mute switch;

   e. A lamp test button;

   f. A buzzer alarm.

4. For ratio type pressure reducing valves at the down-feeding pipework, the sub-contractor shall inform the main contractor to allow and provide plug-offs of compatible size at the upstream and downstream pipeworks of the pressure reducing valves for installation of pressure switches;

5. Pressure switch for flush water shall be constructed of corrosion resistant material.

FWP2.2.2 SYSTEM OPERATION

FWP2.2.2.010.9 FRESH AND FLUSH WATER PUMP INSTALLATION

1. The pumps shall be operated by level control switches installed at the roof tanks of each block. The control schematic wiring diagram of the fresh and flush water pump installation is shown on the Drawings;

2. When the water level at the roof tank is 100 mm above the top of the outlet pipe, the low level control switch shall start the duty pump until the water level corresponding to the specified tank capacity is reached;

3. When the water level at sump tank falls to 150 mm above the top level of the suction pipe of the pump, a level control switch at the sump tank shall switch off the pump;

4. An audio and visual alarm panel shall be provided at conspicuous high level outside the fresh and flush water pump room to indicate the common fault alarm at each pump control cubicle. The audio alarm shall be a buzzer rated for continuous operation with its sound audible at a distance of not less than 10 m and the visual alarm shall be a red indicating light. The audio and visual alarm shall be reset manually at the pump control cubicle;
5. For domestic blocks, daily automatic operation of full capacity duty pump at an adjustable preset time on or before 11 p.m. shall be incorporated in the fresh and flush water pump controls to fill up the roof water tanks for use over the night.

FWP2.2.2.020.A FRESH WATER BOOSTER PUMP SYSTEM INSTALLATION

1. The fresh water booster pump system shall perform automatic multi-pump control functions as follows:
    a. To maintain preset constant water output pressure as specified on the Drawings by varying the motor running speed according to the feedback signals of corresponding pressure transducers at pump discharge side to meet system water flow demand;
    b. To switch on lagging pump when demand exceeding the maximum capacity of leading pump;
    c. To switch pump start-and-stop automatically according to the programme built in the multi-pump control microprocessor, which is either an integrated part of the VSD unit or a separate programmable logic controller, for pump sequence operation and alternatively in order to maintain equal tear and wear of all pumps;
    d. To count the running hours of each pump and to perform automatic switching of pumps to avoid non-stop operation of any pump exceeding the preset maximum running hours in every on / off cycle;
    e. To utilize the associated pneumatic pressure vessels to keep pump running at zero demand for certain moment before pump stopping and to supply the least flow prior to pump starting to avoid quick start-and-stop of pump;
    f. To enable automatic switching of duty pump and trigger visual and audio alarm in case of any VSD fault and /or pump failure in running;
    g. To stop all pumps and trigger alarm for low water level at supply water tank.
2. The fresh water booster pump system shall comply with the following operating and installation requirements:
    a. All pumps in a booster pump system shall be capable of operating simultaneously regardless of their design function of duty and standby purposes;
    b. Each VSD unit is normally equipped with its own pressure transducer. For any system which feedback signal is grouped from one common pressure transducer for all pumps, a duplicate transducer capable of automatic changeover shall be provided as a standby;
    c. The VSD unit shall perform multi-pump control functions through its integrated microprocessor or via a separate programmable logic controller that is compatible with the variable frequency drives. If a programmable logic controller is utilised to fulfil the multi-pump control functions, an identical duplicate shall be provided in parallel with a selector knob for easy changeover in case the master unit in use is found faulty. Both units shall be installed in the pump control cubicle;

d. Functions of the multi-pump control on every VSD unit in operation shall be maintained when one or more VSD units in the water booster system is/are isolated no matter being switched off manually or tripped automatically at fault. Failure of any individual system component including pump, VSD unit, master display and control unit and pressure transducer shall not cause total stoppage of the booster pump system;

e. Each pump shall be capable of switching on / off manually at its associated VSD unit.

3. The following power supply, control and indication features shall be provided in the booster pump control cubicle:

   a. Switch isolator for each pump motor;

   b. Contactor for emergency stop for each pump motor;

   c. Automatic / OFF selector for VSD of each pump motor;

   d. Multi-function electronic meter as specified in ELE4.4.5.040 for each pump motor;

   e. Phase indication for each pump motor;

   f. Pump running indication for each pump motor;

   g. Visual and audio indication for pump fault coming from VSD of each pump motor;

   h. Visual and audio indication for low water level at supply water tank;

   i. Visual and audio indication for low pressure at discharge side;

   j. VSD control monitor as specified in FWP11.3.030;

   k. Changeover selector for duty / standby programmable logic controller, where applicable.

4. Upon failure of one pump, the faulty pump shall be automatically switched off while at the same time an audio and visual alarm shall be given at the alarm panel outside the pump room on roof and repeated at the alarm panel outside the water pump room on G/F installed with Fresh Water Pump with clear label "Alarm for Roof Fresh Water Booster Pump System". The audio and visual alarm shall be same as that described in FWP2.2.2.010. Upon failure of the control system and when the system pressure has dropped to or below a pressure setting as shown on the Drawings, the audio and visual alarm shall also be actuated.

FWP2.2.2.026.9 RAINWATER IRRIGATION PUMP SYSTEM INSTALLATION

1. The pumps shall be under automatic control according to the cut-in/cut-out sequence as shown on the Drawings;

2. Upon failure of one pump, the faulty pump shall be automatically switched off while at the same time an audio and visual alarm shall be given at the alarm panel outside the pump room and repeated at the alarm panel outside the water pump room as shown on Drawings with clear label "Alarm for Rainwater Irrigation Pump System". The audio and visual alarm shall be same as that described in FWP2.2.2.010. Upon failure of the control system and when the system pressure has dropped to or below a pressure setting as shown on the Drawings, the audio and visual alarm shall also be actuated.

FWP2.2.2.030.A FIRE SERVICES FEED PUMP INSTALLATION

1. The fire services feed pump shall be operated by level control switch(es) installed at the roof fire services supply tanks such as FH/HR tank, sprinkler tank, street fire hydrant tank and drencher tank, if applicable. The control schematic wiring diagram of the fire services feed pump installation and supply tank low level alarm system is shown on the Drawings;
2. When the water level at a roof fire services supply tank has fallen to a level close to but above the full effective water volume, the level control switch shall start the feed pump until the water level corresponding to at least 10% above the specified effective water volume is reached. Once the normal water fill level is reached, it shall actuate the corresponding normal level indicator light(s) as described in FWP2.2.2.035;
3. The level control switch for tank empty at the sump tank shall be adjusted to switch off the fire services feed pump when the sump water level falls to 150 mm above the top level of the suction pipe of the pump;
4. An audio and visual alarm panel shall be provided at conspicuous high level outside the feed pump room to indicate the common fault alarm at the feed pump control cubicle. The audio alarm shall be a buzzer rated for continuous operation with its sound audible at a distance of not less than 10 m and the visual alarm shall be a red indicating light. The audio and visual alarm shall be reset manually at the pump control cubicle;
5. For water level monitoring of sprinkler system, it shall also comply with BS EN 12845.

FWP2.2.2.035.B STATUS OF FIRE SERVICES SUPPLY TANK

1. The status of each of the fire services supply tank comprising “normal level” and “low level” shall be monitored;
2. A level control switch for low level alarm shall be provided at each of the fire services supply tanks. It shall actuate alarms when the water level in any of the fire services supply tanks falls more than 10% below the level of full effective water volume;
3. In case that the fire services supply tank(s) is / are located at roof or on building higher level where the water is fed by fire services feed pump:
    a. A fire services tank low level indication lamp at the front panel of the feed pump control cubicle and respective FS pump control cubicle shall be lit on upon activation of the low level alarm;
    b. The alarm signal wiring for water low level of fire services supply tank shall also be connected to the audio and visual alarm panel as described in FWP2.2.2.030 outside fire services feed pump room. The signal for low level alarm shall be reset manually at the pump control cubicle;
    c. A fire services tank normal level indication lamp at the front panel of the feed pump control cubicle and respective FS pump control cubicle shall be lit on once the normal water fill level is reached.
4. In case that a fire services supply tank is located at basement or on building lower level where the water is directly fed from town mains:
    a. A fire services tank low level indication lamp shall be lit on at the front panel of respective FS pump control cubicle once the low level alarm activated;

b. The alarm signal wiring for water low level of fire services supply tank shall also be connected to an audio and visual alarm panel outside the fire services supply tank room. The signal for low level alarm shall be reset manually at the pump control cubicle;

c. A level control switch for normal level monitoring shall be provided at each fire services supply tank. It shall activate the fire services tank normal level indication lamp at the front panel of respective FS pump control cubicle once the normal water fill level is reached.

5. In any case, the status of each of the fire services supply tanks comprising "normal level" and "low level" shall be further connected to the Fire Alarm Control Panel (FAP) near security counter at entrance lobby of a domestic block or FAP / repeater panel at the FS Control Room where provided in any building. Alarm signal shall also be provided at the FAP / repeater panel when there is fault at the water level monitoring and control circuits.

FWP2.2.2.040.A CONTROL CUBICLE LAYOUT FOR FRESH / FLUSH WATER PUMPS, RAINWATER IRRIGATION PUMPS AND FOR FS FEED PUMP

1. Unless otherwise Approved, control circuit and panel layout arrangement of the control cubicle shall be as shown on the Drawings;

2. The Sub-contractor shall advise the CM of the appropriate type and rating of the short circuit protective device to be used in conjunction with the motor starter in accordance with the motor starter manufacturer's recommendation in order to achieve the specified type of coordination.

FWP2.2.2.050.9 PRV FAULT INDICATION SYSTEM OPERATION

1. The PRV fault indication system shall comply with the following operating requirements:

   a. All system components provided for pressure monitoring and the associated pipes and fittings shall be able to withstand the maximum pressure that may arise upon the failure of respective pressure reducing valve;

   b. Upon system pressure has risen to or above the pre-set high level due to failure of pressure reducing valve, the system shall actuate the local LED indication lamp in the vicinity of respective PRV and send the signal back to the PRV fault indication panel to actuate corresponding indication light with audible alarm;

   c. The buzzer shall sound continuously until manually muted by activation of the mute switch while the red fault indication light shall remain on until the fault is cleared. The audio and visual alarm shall be reset manually at the PRV fault alarm indication panel;

   d. The Sub-contractor shall perform testing and commissioning of the system so as to ensure its compliance with statutory and performance requirements in the Specification;

   e. A permanent marking shall be made on the pressure switch after set up to avoid unintentional shifting of the setting.

2. For ratio type pressure reducing valves at the down-feeding pipework, the actuating pressure of pressure switch shall be close to but higher than the downstream pressure of the respective pressure reducing valve;

3. For pilot type pressure reducing valves at the incoming water supply pipework, the actuating setting of pressure switches for monitoring the first stage and second stage pressure reducing valves for fresh water supply, the pressure reducing valve for flush water supply and the pressure reducing valve for direct feed fresh water supply shall be close to but higher than respective downstream pressure according to the Drawings;
4. The Sub-contractor shall be responsible for the detailed design of the system to suit site specific factors such as incoming mains pressures, pressure reduction setting of pressure reducing valve and modulating float valve characteristics etc., and submit shop drawings and proposed actuating setting of pressure switches for Approval.

FWP2.2.3 PUMPS

FWP2.2.3.010.9 PUMP DUTY

The fresh, flush, booster fresh and fire services water pumps shall be able to deliver water at flow rates and pressure heads as indicated on the Drawings.

FWP2.2.3.020.9 TYPE OF PUMPS

1. Fresh water pumps: horizontal/vertical multi-stage;
2. Flush water pumps: horizontal/vertical multi-stage;
3. Fire services feed pumps: horizontal/vertical end-suction/multi-stage;
4. Fresh water booster pumps: stamped stainless steel multi-stage vertical in-line pump for variable speed drive;
5. Rainwater irrigation pumps: stamped stainless steel multi-stage vertical in-line pump.

FWP2.3 RAINWATER HARVESTING SYSTEM INSTALLATION FOR DOMESTIC BLOCK

FWP2.3.1 SYSTEM DESCRIPTION

FWP2.3.1.010.9 GENERAL

1. The rainwater harvesting system (RWHS) installation shall comprise the following as shown on the Drawings:
    a. Chlorine Dosing;
    b. Cartridge Filter;
    c. Two number of 2-way Valves;
    d. Rainwater Irrigation Pumps;
    e. Control and Metering System.
2. The collected rainwater in the rainwater collection tank shall be treated by both chlorinated solution and cartridge filter before being fed to the 2-way valve, and finally to the irrigation points. Fresh water from break tank shall be fed to the irrigation points through another 2-way valve if the rainwater collected inside the collection tank is at low level.. Control and metering system shall monitor the performance of the RWHS with monitoring measurements on the water and electricity consumptions.
3. The RWHS installation shall include all associated electrical works, pipework and system components as shown on the Drawings.

FWP2.3.2 SYSTEM OPERATION

FWP2.3.2.010.9 SYSTEM CONTROL

1. Water to the irrigation points being fed either from the rainwater collection tank or fresh water break tank shall be controlled by 2 number of inter-connected 2-way valves.
2. One inlet port of a 2-way valve shall be connected to the rainwater outlet pipe of the collection tank through a cartridge filter while the inlet port of another 2-way valve shall be connected to the fresh water supply through a break tank.
3. When the water level in the rainwater collection tank is above the preset low level, the level sensor shall issue a signal to allow rainwater instead of fresh water entering the 2-way valve connected to the rainwater outlet pipe of the collection tank through a cartridge filter.
4. When the water level in the rainwater collection tank is below the preset low level, the level sensor shall issue a signal to allow fresh water instead of rainwater entering the 2-way valve connected to the fresh water supply through a break tank.
5. The function of the two 2-way valves shall be electrically interlocked such that water is either fed from rainwater collection tank or fresh water break tank.

FWP2.4 SEWAGE / WASTE WATER / STORM WATER PUMPING SYSTEM INSTALLATION

FWP2.4.1 SYSTEM DESCRIPTION

FWP2.4.1.010.N GENERAL

1. Sewage / waste water / storm water pumping system, if required and as shown on the drawings, shall be provided for collecting effluents from the building and discharging to the nearby suitable drainage;
2. The Sub-contractor shall supply and install all associated electrical works, pipework and system components for each sewage / waste water / storm water pumping station including, but not limited to the following:
    a. Two sets of sump pumps;
    b. Pipes, joints, fittings and valves;
    c. Level electrodes and controllers;
    d. Local control panel and instrumentation;
    e. Remote alarm panel;
    f. Power, signal and control cabling.
3. For sewage / waste water / storm water pumping station of dry pit design, a flooding sensor shall be installed at the recess pit of dry pit and connected to respective sewage / waste water / storm water pump control panel.

FWP2.4.1.020.N LEVEL CONTROL SYSTEM

1. The level control system of each sewage / waste water / storm water pumping station shall comprise a controller, a reference electrode and four numbers of active level electrodes as follows:
    a. All pumps stop;
    b. Duty pump starts;
    c. Standby pump starts;
    d. Extra high level alarm.
2. A minimum distance of 200mm between each level electrode is normally required. The Sub-contractor shall adjust and determinate the exact actuation levels on site, and submit the proposed settings to the CM for approval;
3. The level electrodes shall be of conductive type made of stainless steel and have PVC protective coatings on the outside;
4. When connection of the level electrodes is necessary, screw joints shall be used to enable the electrodes to have uniform external diameters. No more than one joint shall be allowed for each level electrode;
5. The controller shall detect and process the electrical conductivity signal between each active level electrode and the reference electrode. It shall trigger the operation of pumps and the extra-high level alarm when sewage / waste water / storm water level reaches respective pre-set levels;

6. The controller sensitivity shall be adjustable to suit the conductivity characteristics of various liquids. Mains supply indicator and indicating lamp which illuminates when the relay is energised shall be provided.

FWP2.4.1.030.N LOCAL CONTROL PANEL

1. The Sub-contractor is responsible for all the electrical wiring work for each sewage / waste water / storm water pumping system from the main isolator;
2. The Sub-contractor shall advise the CM of the appropriate type and rating of the short circuit protective device to be used in conjunction with the motor starter in accordance with the motor starter manufacture's recommendation in order to achieve the specified type of coordination;
3. All indicators, control switches, push-buttons, voltmeters, ammeters and other auxiliary apparatus shall be provided with labels clearly stating their function in English and Chinese and conform to the requirements as stipulated in Worksection FWP11;
4. The sewage / waste water / storm water pump control panel shall include, but not be limited to, the following operational features:
   a. Switch isolators;
   b. Start and stop push buttons for each pump;
   c. Automatic / Off / Manual selectors for each pump;
   d. Phase indications for each pump;
   e. Pump running and fault indications for each pump;
   f. Lamp test and buzzer mute buttons;
   g. Ammeters and phase selector switches for each pump;
   h. Voltmeter and selector switch;
   i. Hour-run meters for each pump;
   j. Separate visual indication lamps for motor overload, motor under-current and power supply phase failure for each pump, sump pit extra high level alarm, pump running with no-flow condition and dry pit flooding alarm if applicable;
   k. Audio alarm for above fault(s).
5. The buzzer shall sound continuously until manually muted by activation of the mute switch while the respective red fault indication shall remain on until such error is rectified;
6. The Sub-contractor shall submit the schematic control circuit and the layout and labelling of the control panel to the CM for approval.

FWP2.4.1.040.N REMOTE ALARM PANEL

1. The Sub-contractor shall supply and install a remote common fault alarm panel for each sewage / waste water / storm water pumping station, which shall include signal wiring in concealed conduits connecting from the local control panel and all associated electrical works;
2. The remote alarm panel shall be lockable and made of epoxy coated galvanised steel sheet;
3. The audio and visual alarm of the remote alarm panel at the guard counter of nearby domestic block or other location specified on Drawings shall be given off upon detection of any fault as mentioned in FWP2.4.1.030 sub-clause (4)(j);

4. The audio alarm can be muted by mute switch while the visual indication lamp shall remain on until the fault is rectified and the system is reset manually at the pump control panel;
5. A common remote alarm panel with clear labelling and separate indication lamps for supervision of multiple sewage / waste water / storm water pumping stations may be accepted subject to the CM's approval;
6. The location of the remote alarm panel and its layout, arrangement and labelling in English and Chinese shall be approved prior to installation.

FWP2.4.2 SYSTEM OPERATION

FWP2.4.2.010.N SYSTEM CONTROL

1. The two sewage / waste water / storm water sump pumps installed in each pumping station shall be operated in one duty one standby arrangement and controlled by the level control system as described in FWP2.4.1.020;
2. When the sewage / waste water / storm water level in the wet pit rises to the predetermined level, the duty pump shall be operated automatically under the control of the level electrode at that level. The duty pump stops when the sewage / waste water / storm water level falls to the lowest level electrode;
3. If there is an upsurge of sewage/waste water/storm water, the standby pump shall be started if the level reaches the next higher level electrode. Under this circumstance, both pumps shall then be operating simultaneously until the sewage / waste water / storm water level falls to the lowest level electrode;
4. There shall be another extra high level electrode to cater for the situation when both pumps are incapable of discharging the incoming sewage / waste water / storm water flow;
5. Manual operation for these pumps shall be provided for individual control of the pump operation for maintenance purpose. However, the pump shall be stopped automatically by the lowest level electrode;
6. The standby / duty operation of the two sump pumps shall be interchanged after each pumping operation;
7. An emergency stop button shall be provided adjacent to each pump at a location approved by the CM;
8. Check valves at sump pump discharge shall be completed with limit switches to detect the no-flow condition. An adjustable timer shall also be provided to inhibit the no-flow detection system during starting of pumps;
9. The signal of no-flow condition as mentioned above shall be transmitted to respective sewage / waste water / storm water pump control panel to prevent overloading of the running pumps.

FWP2.4.3 PUMPS

FWP2.4.3.010.N PUMP DUTY

1. The sewage / waste water / storm water sump pumps shall meet the required capacity as indicated on the Drawings;
2. Hydraulic calculation verifying the selection of pumps with respect to the characteristics of pipework, fittings and accessories as actually installed shall be submitted to the CM for approval.

FWP2.4.3.020.N TYPE OF PUMPS

1. The sump pumps shall be of vertical centrifugal type suitable for dry sump or wet sump installation as shown on the drawings, and with construction and components as specified in Worksection FWP6;
2. All sump pumps shall have a stable, non-overloading and non-clogging characteristic. Pumps installed in the same pumping station shall be identical.

FWP3 PIPEWORK AND FITTINGS

FWP3.1 MATERIALS 4

FWP3.1.1 GENERAL 4
FWP3.1.1.010.9 SUITABILITY FOR PURPOSE 4
FWP3.1.1.020.9 CONFORMITY WITH SPECIFICATION 4
FWP3.1.1.030.9 PIPE SIZES 4

FWP3.1.2 PIPEWORK 4
FWP3.1.2.010.A DUCTILE IRON PIPES, FITTINGS AND ACCESSORIES 4
FWP3.1.2.020.A GALVANIZED STEEL PIPES AND FITTINGS 5
FWP3.1.2.040.A CARBON STEEL PIPES AND FITTINGS 5
FWP3.1.2.045.9 UNPLASTICIZED PVC (UPVC) PIPES AND FITTINGS 5
FWP3.1.2.050.A PIPEWORK APPLICATION 6

FWP3.1.3 PIPE FITTINGS 6
FWP3.1.3.010.9 STANDARD PIPE FITTINGS 6
FWP3.1.3.020.9 LOCALLY MANUFACTURED PIPE FITTINGS 6
FWP3.1.3.030.9 BENDS 6
FWP3.1.3.040.9 TEES 7
FWP3.1.3.050.9 FLANGES 7
FWP3.1.3.060.9 REDUCERS 7
FWP3.1.3.070.9 PIPE BRACKETS 7
FWP3.1.3.080.9 PROVISION OF SLEEVES 7
FWP3.1.3.090.9 POLYTETRAFLUOROETHYLENE (PTFE) TAPES 7

FWP3.1.4 EXPANSION JOINTS AND FLEXIBLE CONNECTORS 7
FWP3.1.4.010.9 STAINLESS STEEL TYPE EXPANSION JOINTS 7
FWP3.1.4.020.A RUBBER FLEXIBLE CONNECTORS / EXPANSION JOINTS 8
FWP3.1.4.030.A STAINLESS STEEL FLEXIBLE CONNECTORS 9

FWP3.1.5 STRAINERS 10
FWP3.1.5.010.9 TYPE AND APERTURE 10
FWP3.1.5.020.9 SIZE AND PERFORMANCE 10
FWP3.1.5.030.B CONSTRUCTION 10
FWP3.1.5.040.9 END CONNECTIONS 11
FWP3.1.5.050.9 CERTIFICATION 11
FWP3.1.5.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 12

FWP3.2 INSTALLATION 13

FWP3.2.1 SITE HANDLING 13
FWP3.2.1.010.9 STORAGE 13
FWP3.2.1.020.9 CLEANLINESS 13

FWP3.2.2 PIPEWORK LAYOUT 13
FWP3.2.2.010.9 COORDINATION OF PIPEWORK 13
FWP3.2.2.020.9 ROUTING AND GRADING OF PIPEWORK 13
FWP3.2.2.030.9 ARRANGEMENT OF PIPEWORK 13
FWP3.2.2.040.9 VENTING 13
FWP3.2.2.050.9 DRAINING 13
FWP3.2.2.060.9 PROVISION FOR DISMANTLING 14
FWP3.2.2.070.9 LOCATION OF STRAINERS 14

FWP3.2.3 PIPEWORK JOINTING 14
FWP3.2.3.010.9 MANUFACTURERS INSTRUCTIONS 14
FWP3.2.3.020.9 LOCATION OF PIPE JOINTS 14
FWP3.2.3.030.9 JOINTING GALVANIZED STEEL PIPES 14
FWP3.2.3.040.9 JOINTING DUCTILE IRON PIPES 14

FWP3.2.3.045.9 JOINTING UNPLASTICIZED PVC (UPVC) PIPES 14
FWP3.2.3.050.A MECHANICAL COUPLINGS AND FITTINGS FOR FIRE SERVICES SYSTEM 15

FWP3.2.4 PIPEWORK SUPPORTS 16
FWP3.2.4.010.9 FIRE SERVICES PIPEWORK 16
FWP3.2.4.020.9 FRESH WATER AND FLUSHING WATER PIPEWORK 16
FWP3.2.4.030.9 PERFORMANCE 16
FWP3.2.4.040.9 PROVISION FOR MOVEMENT 17
FWP3.2.4.050.9 FIXED TYPE PIPE BRACKET 17
FWP3.2.4.060.9 PIPE BRACKET WITH VIBRATION ISOLATOR 18
FWP3.2.4.070.A SUPPORT INTERVALS 18
FWP3.2.4.080.9 HANGERS FOR HORIZONTAL PIPEWORK 19

FWP3.2.5 INTEGRATION WITH STRUCTURE 19
FWP3.2.5.010.9 MARKING OUT 19
FWP3.2.5.020.9 CLEARANCE OF HOLES 19
FWP3.2.5.030.9 FIXING PIPE SLEEVES 19
FWP3.2.5.040.9 CAULKING PIPE SLEEVES 19
FWP3.2.5.050.9 PIPE ENTRY TO BUILDINGS 20
FWP3.2.5.060.9 PROTECTION OF UNDERGROUND PIPES 20
FWP3.2.5.070.9 PIPES PASSING THROUGH ASPHALT COVERED FLAT ROOFS 20

FWP3.1 MATERIALS

FWP3.1.1 GENERAL

FWP3.1.1.010.9 SUITABILITY FOR PURPOSE

All pipes and fittings shall be constructed of materials suitable for the required working and test pressures and temperatures of the fluid carried.

FWP3.1.1.020.9 CONFORMITY WITH SPECIFICATION

1. All pipes and fittings shall conform to the Specification. Alternative materials may be used only with prior Approval;
2. Comply with BS 6920 for non-metallic components in contact with water intended for human consumption. Submit test reports or test certificates to demonstrate full compliance with BS 6920.

FWP3.1.1.030.9 PIPE SIZES

Pipe sizes indicated on the Drawings or in this Specification are nominal bores, with the exception of copper tube, for which the sizes indicated are nominal outside diameters.

FWP3.1.2 PIPEWORK

FWP3.1.2.010.A DUCTILE IRON PIPES, FITTINGS AND ACCESSORIES

1. Ductile iron pipes, pipe fittings and accessories to BS EN 545;
2. Be capable of withstanding the concerned working pressure and maximum static pressure that may arise upon failure of the associated pressure reducing devices;
3. Be accepted by the Water Authority for the intended application. Produce type test certificate / report issued by the certification bodies or accredited laboratories acceptable to the Water Authority for the verification of compliance with this Specification;
4. Slip on flange adaptors:
    a. Be provided at check meters positions;
    b. Be designed and manufactured to suit the pipework installation. The flanges shall comply with BS EN 1092-2 PN 16 or PN 25 as appropriate;
    c. Be made of ductile iron to BS EN 545 and shall be coated with epoxy externally and internally comply with BS EN 14901-1;
    d. Stud bolts and nuts of the flange adaptors shall be made of stainless steel to BS EN 10088-3-1.4401;
    e. Gaskets shall be made of Ethylene Propylene Diene Monomer (EPDM). If used for fresh water, it shall comply with relevant requirements in BS 6920 as required by the Water Authority;
    f. Be equipped with guide rod assembly to prevent damage from excessive movement. The assembly shall consist of guide rod plates, guide rods and steel washers on both sides, and shall be fitted with resilient neoprene sleeves, resilient neoprene washers on at least one side of the assembly for isolating vibration transmission.

5. Be coated with metallic zinc and bitumen finishing externally to BS EN 545 and lined with cement mortar internally, or be coated with metallic zinc and epoxy externally and lined with cement mortar and epoxy internally for use in corrosive condition. Epoxy coating shall comply with BS EN 14901-1. Adoption of epoxy coating shall be submitted to the CM for Approval;
6. The minimum wall thickness of pipes and fittings, which has already taken into account the negative tolerance, shall comply with the following table:

Nominal size DN	Minimum wall thickness of pipes and fittings mm
80	5.62
100	5.80
150	6.35
200	6.90
250	7.45
300	8.00

7. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the ductile iron pipes and fittings delivered to the Site or installed.

FWP3.1.2.020.A GALVANIZED STEEL PIPES AND FITTINGS

1. Galvanised steel pipes to BS EN 10255 with screwing to BS EN 10226-1 and of medium grade for above ground installation and of heavy grade for below ground installation unless otherwise Specified or shown on the Drawings;
2. Galvanised malleable cast iron pipe fittings to BS 143 and 1256 or BS EN 10242;
3. Galvanised wrought steel pipe fittings to BS EN 10241;
4. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the galvanized steel pipes and fittings delivered to the Site or installed.

FWP3.1.2.040.A CARBON STEEL PIPES AND FITTINGS

1. Carbon steel pipes of P265TR1 to BS EN 10216-1 or BS EN 10217-1 with wall thickness suitable for particular application and system working pressure, and with dimensions to BS EN 10220;
2. Correlated fittings shall be butt welding type carbon steel for pressure purposes to BS EN 10253-1.

FWP3.1.2.045.9 UNPLASTICIZED PVC (UPVC) PIPES AND FITTINGS

1. Pipes: comply with BS 3505, Class E or BS EN ISO1452-2 series S6.3 or higher to suit system working pressure and as shown on the Drawings;
2. Fittings: comply with BS 4346-1 in conjunction with BS EN ISO 1452-3 for fittings jointed by solvent cementing, comply with BS EN ISO 1452-3 for other fittings;
3. Colour: white unless approved by the Contract Manager;
4. Jointing compound: be of a type recommended by the manufacturer of the pipes and fittings.

FWP3.1.2.050.A PIPEWORK APPLICATION

Installations shall be carried out using the specifications indicated below unless otherwise specified elsewhere or shown on the Drawings:

	Application	Pipe Diameters	Material
1.	Fresh water pipe / Rainwater pipe	≤ 54 mm	Stainless steel pipe of BS EN 10088-1 grade 1.4401 and to BS EN10312 Series 2
		54 mm < Ø ≤ 65 mm	Stainless steel pipe of BS EN 10088-1 grade 1.4401 and to BS EN 10217-7 or BS EN10312 Series 2
		> 65 mm	Ductile iron pipe as FWP3.1.2.010
2.	Fire services pipe	≤ 150 mm	Galvanized Steel pipe as FWP3.1.2.020
		> 150 mm	Ductile iron pipe as FWP3.1.2.010
3.	Flush water pipe	> 65 mm	Ductile iron pipe as FWP3.1.2.010
		≤ 65 mm	uPVC pipe to BS3505 Class E or BS EN ISO 1452 : Part 2 pipe series S6.3 or higher to suit system pressure and as shown on the Drawings
4.	Bore well water pipe	All	Medium grade galvanized steel pipe as FWP3.1.2.020
5.	High pressure pipes when specified	All	Carbon steel pipe as FWP3.1.2.040

FWP3.1.3 PIPE FITTINGS

FWP3.1.3.010.9 STANDARD PIPE FITTINGS

1. Unless otherwise specified or Approved, only standard fittings and pipe fittings as appropriate shall be used;
2. Pipe fittings shall be of the same size as the pipework connected to them;
3. Pipe fittings fabricated on site, reducing bush and locally manufactured pipe fittings will not be accepted.

FWP3.1.3.020.9 LOCALLY MANUFACTURED PIPE FITTINGS

1. Where restricted site condition does not permit the use of standard pipe fittings, purpose made local fittings may be used only with prior Approval;
2. Local fittings shall be internally and externally painted with two coats of anti-corrosion materials and pressure tested as directed by the Contract Manager, prior to installation.

FWP3.1.3.030.9 BENDS

All bends shall be of long radius type unless otherwise Approved;

Short radius bends can be used for pipe size up to 50 mm diameter and for pipes installed in limited spaces.

FWP3.1.3.040.9 TEES

All tees shall be of the pitcher or twin elbow type, unless otherwise indicated or Approved.

FWP3.1.3.050.9 FLANGES

1. All flanges shall conform to BS EN 1092 and shall be of suitable pressure rating;

2.Gaskets to BS EN 681-1 and shall be suitable for the operation condition in which they are installed.

FWP3.1.3.060.9 REDUCERS

1. Pipe size changes shall be effected by reducers of appropriate length to minimize pressure loss or otherwise by reducing bends or tees;
2. In the case of suction lift, eccentric reducers shall be used at pump suction for air elimination.

FWP3.1.3.070.9 PIPE BRACKETS

1. Pipe brackets shall be of sufficient strength to take the load with no noticeable deflection with clips detachable without disturbing the fixing;
2. Samples or details of the pipe brackets shall be submitted for Approval prior to installation.

FWP3.1.3.080.9 PROVISION OF SLEEVES

All sleeves for openings in walls within a fire compartment shall be PVC. All sleeves for openings in walls and slab connecting the fire compartment with other fire compartments/public area shall be galvanized mild steel.

FWP3.1.3.090.9 POLYTETRAFLUOROETHYLENE (PTFE) TAPES

1. Use PTFE tapes complying with BS 7786 to form a leak-free seal to screw joint;
2. When used under the conditions for which they are designated, PTFE tapes in contact with, or likely to come into contact with potable water shall comply with BS 6920.

FWP3.1.4 EXPANSION JOINTS AND FLEXIBLE CONNECTORS

FWP3.1.4.010.9 STAINLESS STEEL TYPE EXPANSION JOINTS

1. Stainless steel expansion joints shall be used in fresh, rainwater and fire services water pipeworks passing through building expansion joints or other locations as shown on the Drawings, and they shall comply with the following requirements:
    a. Be of axial pattern bellows type and be able to withstand horizontal and vertical movement;
    b. Be screwed ends to BS EN 10226-1, 2, 3 or flanged ends to BS EN 1092-1 as appropriate to facilitate replacement;

c. Be manufactured from stainless steel of Grade 1.4301 to BS EN 10088-1 or equivalent standard or other Approved material appropriate to the system;

d. Be designed to withstand the test pressure of the system and maximum static pressure that may arise upon failure of the associated pressure reducing devices;

e. Be equipped with guide rod assembly to prevent damage from excessive movement. The assembly shall consist of guide rods, rod plates and steel washers on both sides, and be fitted with resilient neoprene sleeves and resilient neoprene washers on at least one side of the assembly for isolating vibration transmission;

f. Testing pressure of the expansion joints shall be not less than twice of the system pressure involved;

g. All expansion joints shall be designed with a long cycle life to suit a pipe system with at least 20 years life expectancy and be installed properly without misalignment;

h. The expansion joints shall be the type accepted by the Water Authority and FSD. For sprinkler system, the expansion joints shall be provided according to the requirement of LPC Sprinkler Rules;

i. Anchors and guides shall be installed according to the recommendations of the expansion joint manufacturer and the details shall be submitted for Approval.

2. Submit the following for Approval of the CM:

a. Type hydraulic test certificates / reports from accredited laboratories; and

b. The installation lengths, materials, rated movements (axial extension, axial compression, lateral deflection, angular rotation, or any combination thereof) and pressure ratings of the expansion joints.

3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the stainless steel type expansion joints delivered to the site or installed.

FWP3.1.4.020.A RUBBER FLEXIBLE CONNECTORS / EXPANSION JOINTS

1. Rubber flexible connectors shall be used for pipeline vibration elimination in flush water and fire services water pipeworks at pump rooms and rubber expansion joints shall be used in only flush water pipework passing through building expansion joints. Rubber flexible connectors / expansion joints shall comply with the following requirements:

a. Be of double or multiple arch / sphere type;

b. Be able to sustain a working pressure compatible with the piping system with which they are connected. Unless otherwise specified, the working pressure shall be no less than 16 bars with a minimum test pressure of 150% of the working pressure and a minimum burst pressure of 55 bars;

c. Be non-toxic, corrosion and abrasion resistant and of sufficient length for effective isolation of vibration;

d. Be fitted with corrosion resistant steel or ductile iron floating flanges to BS EN 1092-1 or BS EN 1092-2;

e. Be provided with a flexible tube made of multiple layers of high tensile fabric reinforcement with EPDM, neoprene or synthetic rubber cover and liner. Tube end shall be of locked bead construction with steel wire bead ring and raised face;

f. Be equipped with control rod assembly to prevent damage from excessive movement. The assembly shall consist of guide rods, rod plates and steel washers on both sides, and be fitted with resilient neoprene sleeves and resilient neoprene washers on at least one side of the assembly for isolating vibration transmission.

2. Submit the following for Approval upon the CM's request:

   a. Type hydraulic test certificates / reports from accredited laboratories;

   b. The installation lengths, materials, rated movements (axial extension, axial compression, lateral deflection, angular rotation, or any combination thereof) and pressure ratings of the rubber flexible connectors.

3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the rubber flexible connectors / expansion joints delivered to the Site or installed.

FWP3.1.4.030.A STAINLESS STEEL FLEXIBLE CONNECTORS

1. Stainless steel flexible connectors shall be used for pipeline vibration elimination in fresh water and rainwater pipework at pump room, and they shall comply with the following requirements:

   a. Be of omega-shape, close pitch annular corrugation, and fabricated from stainless steel plates / sheets / strips;

   b. Be able to sustain a working pressure compatible with the piping system with which they are connected. Unless otherwise specified, the working pressure shall be no less than 16 bars with a minimum test pressure of 150% of the working pressure and a minimum burst pressure of 40 bars;

   c. Be provided with a bellow which shall be non-toxic, corrosion and abrasion resistant and complete with braiding. Appropriate heat treatment shall be conducted to release the internal stress imposed on the bellow during the forming process when the convolution of the bellow is not gradually formed by continuous rolling in shape;

   d. Be of sufficient length for absorption of offset motion and effective isolation of vibration. The total stress on bellow due to internal pressure, offset motion and vibration shall not exceed the design endurance limit. Unless otherwise specified, the minimum rated lateral movement shall be as tabulated below:

Nominal bore of braided bellow	Minimum rated lateral movement
Up to 100 mm diameter	4 mm offset motion plus ±1 mm vibration
Above 100 mm diameter	6 mm offset motion plus ±1 mm vibration

   e. Be comprised of the following component material unless otherwise specified and inert gas arc welding shall be used for the termination of bellow and braiding at the tube ends:

      i. Bellow: austenitic chromium nickel or austenitic chromium nickel molybdenum stainless steel sheet to BS EN 10029, BS EN ISO 9445-1, BS EN ISO 9445-2, BS EN 10048, BS EN 10051 or BS EN 10095;

      ii. Braiding: stainless steel wires or plates;

      iii. Flange: corrosion resistant carbon steel.

   f. Have any part which is in contact with the water of the same material as the bellow;

g. Unless otherwise specified, be of flanged end connection. Flanges shall comply with BS EN 1092-1;

h. Have identification markings for the brand name, model number, bellow material, braiding material, working pressure and bellow nominal diameter;

i. Be equipped with guide rod assembly to prevent damage from excessive movement. The assembly shall consist of guide rods, rod plates and steel washers on both sides, and be fitted with resilient neoprene sleeves and resilient neoprene washers on at least one side of the assembly for isolating vibration transmission.

2. Submit the following for Approval upon the CM's request:

a. Type hydraulic test certificates / reports from laboratories accepted by the Water Authority;

b. The installation lengths, materials, rated movements (axial extension, axial compression, lateral deflection, angular rotation, or any combination thereof) and pressure ratings of the stainless steel flexible connectors.

3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the stainless steel flexible connectors delivered to the Site or installed.

FWP3.1.5 STRAINERS

FWP3.1.5.010.9 TYPE AND APERTURE

Strainer shall be of Y-type or U-type (Bucket/Basket type) as specified below, unless otherwise specified on Drawings. The minimum free flow area ratio shall be 2 and the maximum aperture size shall be of ∅1.5 mm for strainers of nominal size 100 mm or below and of ∅3.0 mm for strainers of nominal size 150 mm or above, unless otherwise specified. For U-type strainer of any nominal size to be used as secondary stage strainer at discharge side of water pump in flush water system, the minimum free flow area ratio shall be 1 and the maximum aperture size shall be of ∅1.0 mm, unless otherwise specified.

FWP3.1.5.020.9 SIZE AND PERFORMANCE

Strainers shall have the same nominal sizes as the pipes in which they are connected and shall be suitable for both working and test pressures of the piping system in which they are installed. Unless otherwise specified all strainers shall have a working pressure of not less than 16 bar.

FWP3.1.5.030.B CONSTRUCTION

1. Strainers shall be constructed of materials as specified below suitable for the required working and test pressures and temperature of the fluid carried. Better or equivalent materials may be offered for Approval;

2. At nominal sizes up to and including 50 mm:

a. For fresh water and fire services, use the following:

i. Adoption: Y-type screwed joint;

ii. Body and cover: bronze to BS EN 1982 CuSn5Zn5Pb5 or CB491K or CC491K;

iii. Screen: stainless steel to BS EN 10088-1 Grade 1.4401.

b. For flush water, use the following:

i. Adoption: Y-type screwed joint;

ii. Body and cover: spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15 or bronze to BS EN 1982 CuSn5Zn5Pb5 or CB491K or CC491K;

iii. Screen: stainless steel to BS EN 10088-1 Grade 1.4401.

3. At nominal sizes above 50 mm:

a. For fire services, use the following:

i. Adoption: Y-type flanged joint;

ii. Body and cover: grey cast iron to BS EN 1561 EN-GJL-250 or spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15;

iii. Screen: stainless steel to BS EN 10088-1 Grade 1.4401;

iv. Drain Plug: malleable iron;

v. Stud and Nut: stainless steel to BS EN 10088-1 Grade 1.4401.

b. For fresh water and flush water, use the following:

i. Adoption: U-type flanged joint with quick release cover;

ii. Body: grey cast iron to BS EN 1561 EN-GJL-250 or spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15;

iii. Cover: stainless steel to BS EN 10088-1 Grade 1.4401 or BS EN 10283 Grade 1.4408;

iv. Screen: stainless steel to BS EN 10088-1 Grade 1.4401;

v. Drain Plug: malleable iron;

vi. Clamper, Stud and Nut: stainless steel to BS EN 10088-1 Grade 1.4401 or BS EN 10283 Grade 1.4408.

4. All cast iron and ductile iron components shall be coated with epoxy based material both on internal and external surfaces. The coating for use in fresh water shall be in compliance with relevant requirements in BS 6920 for potable use and to the satisfaction of the Water Authority. Test certificate / report from accredited certification bodies or laboratories shall be submitted to the CM for Approval;

5. U-type strainer shall be equipped with quick release cover composed of clamper or stud and hand nuts which shall be so designed that the basket can be taken out for cleaning without using tools. Appropriate safety mechanism shall be incorporated in the quick release cover.

FWP3.1.5.040.9 END CONNECTIONS

Strainers of 50 mm or below shall be of screwed female end connection to BS EN 10226-1, 2, 3 and strainers of above 50 mm shall be of flanged end connection to BS EN 1092-2.

FWP3.1.5.050.9 CERTIFICATION

Type test certificates / report from laboratories accepted by the Water Authority confirming that the strainers have been tested conforming to this Specification shall be produced upon request.

FWP3.1.5.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the strainers for fresh water and fire services systems delivered to the site or installed.

FWP3.2 INSTALLATION

FWP3.2.1 SITE HANDLING

FWP3.2.1.010.9 STORAGE

Prior to installation, all materials shall be stored properly in accordance with the manufacturer's instructions to afford maximum protection against weather, corrosion, mechanical damage and other causes. All pipes shall be stored with closed ends. All damaged materials shall be removed from site immediately.

FWP3.2.1.020.9 CLEANLINESS

All pipes and fittings shall be cleaned before erection with all scale, burrs, furs, sand, slag etc. removed. Cleanliness shall be maintained throughout erection by covering the exposed ends of pipework with a metal or plastic cap.

FWP3.2.2 PIPEWORK LAYOUT

FWP3.2.2.010.9 COORDINATION OF PIPEWORK

The Drawings are diagrammatic and indicate only the approximate location and manner in which the pipework is to be installed. The Sub-contractor shall allow for any diversion to avoid structural beams and other services etc., ascertain the actual work involved and coordinate his pipework installation with the work of other trades and services.

FWP3.2.2.020.9 ROUTING AND GRADING OF PIPEWORK

Pipework shall, where applicable, follow the lines of walls and be graded to ensure venting and draining. A minimum clearance of 25 mm shall be maintained between the pipework and the finished mounting surface.

FWP3.2.2.030.9 ARRANGEMENT OF PIPEWORK

All pipework shall, be neatly arranged and mounted. For a number of pipes running close to one another, they shall be grouped and mounted on steel framed racks arranged so that the number of cross-over is minimum. All vertical pipes shall be plumbed.

FWP3.2.2.040.9 VENTING

Air vents of automatic type must be provided at all high points wherever required.

FWP3.2.2.050.9 DRAINING

1. All water pipework, except those for fire services, shall be fitted with 13 mm diameter key operated cocks, with hose unions, at low points in the system to facilitate drain down;
2. A 25 mm diameter drain cock with hose bib shall be provided between the check valve and the gate valve at the pump discharge to facilitate draining of the riser pipe.

FWP3.2.2.060.9 PROVISION FOR DISMANTLING

1. Sufficient joints and fittings shall be provided to facilitate easy removal of pipes, valves, pumps, etc., for inspection and repair. Disconnecting flanges, or screwed unions as applicable, shall be provided at suitable locations and at valves, pumps, etc;
2. Pipes shall not be embedded in the concrete structure, or grouted in or otherwise installed in such a way as to make alterations difficult at a later date.

FWP3.2.2.070.9 LOCATION OF STRAINERS

Install strainers in positions shown on the Drawings.

FWP3.2.3 PIPEWORK JOINTING

FWP3.2.3.010.9 MANUFACTURERS INSTRUCTIONS

Installation, jointing, storage and handling of the pipes and fittings shall be in accordance with the manufacturer's recommendations.

FWP3.2.3.020.9 LOCATION OF PIPE JOINTS

Pipe joints shall not be made in the thickness of any wall, floor, ceiling or beam.

FWP3.2.3.030.9 JOINTING GALVANIZED STEEL PIPES

1. Unless otherwise Approved, galvanized steel pipes with diameter less than and equal to 150 mm shall be jointed with screwed fittings. Screwed flanges shall be employed only for connection to flanged end valves or equipment;
2. Unless otherwise Approved, galvanized steel pipes with diameter greater than 150 mm shall be jointed with screwed flanges or flanged fittings;
3. Jointing of steel pipes by welding shall only be used when Approved;
4. Screwed fittings shall have pipe threads complying with BS EN 10226-1, 2, 3. Screwed joints shall have tapered threads and shall be made with Approved jointing material. Where the cutting of threads removes the galvanising, an anti-corrosive sealing compound shall be applied to restore the integrity of the protective finish;
5. Galvanized steel pipes for fire services pipework can be jointed by mechanical couplings and fittings with the Approval of the Contract Manager.

FWP3.2.3.040.9 JOINTING DUCTILE IRON PIPES

Unless otherwise specified, all ductile iron pipes shall be jointed:

1. For above ground installation: with screwed flanges or flanged fittings, stainless steel bolts and nuts of BS EN 10088-3 Grade 1.4401 for fresh and flush water pipes and fittings inside water pump room;
2. For below ground installation: with flexible push-on type connection joints.

FWP3.2.3.045.9 JOINTING UNPLASTICIZED PVC (UPVC) PIPES

1. All pipes shall be cut to square ends, free from harmful burrs and be prepared in accordance with the manufacturer's recommendations. Purpose made equipment recommended by the manufacturer shall be used for cutting the pipes and shall be submitted for the Contract Manager's approval;

2. All uPVC pipes shall be jointed with sockets and fittings and as recommended by the uPVC pipes manufacturer;

3. Solvent cementing shall be used for all pipeworks. All the surfaces shall be cleaned with abrasive paper and spirit cleaner. In the application of solvent cementing, heat shall be avoided as the cement may dry before chemical bonding between the two surfaces is completed. Mating surfaces shall be turned for even spread of the solvent. Excessive cement shall be wiped off quickly;

4. Flanged joints shall be used where solvent cementing is not practicable and at locations to facilitate dismantling. Neoprene ring gaskets provided or approved by the flange manufacturer shall be used between flanges. The jointing compound for the pipe and flange must be applied in accordance with the jointing compound manufacturer's recommendation.

FWP3.2.3.050.A MECHANICAL COUPLINGS AND FITTINGS FOR FIRE SERVICES SYSTEM

1. As an alternative to flanged and screwed joints, grooved end mechanical couplings may be employed subject to the Approval of the CM;

2. Mechanical couplings shall be hot dip galvanized, self-centering, engaged and locked in place onto the grooved or shouldered pipe and pipe fitting ends. The result shall be in a positive watertight couple providing some allowance for angular pipe deflection, contraction and expansion. Coupling housing clamps shall consist of two or more malleable iron castings or rolled steel or ductile iron segment holdings with a composition water sealing gasket so designed that the internal water pressure increases in the water tightness of the seal. Sealing gasket shall be selected for the service and working temperature according to the manufacturer's recommendations. The coupling assembly shall be securely held together by two or more zinc plated track head square or oval-neck heat-treated carbon steel bolts and nuts. All pipe fittings connected to mechanical pipe couplings shall have groove and shouldered ends. Flanged or threaded end valves may be used with grooved adapters;

3. Regarding material specification, specifications on components of mechanical couplings shall be as follows:

    a. For coupling housing material, ductile iron shall be to ASTM A536 or to BS EN 1563 or other standards subject to the CM's Approval;

    b. Rubber gaskets shall be tested to the following specifications:

        i. Hardness: ASTM D2240;

        ii. Tensile testing: ASTM D412;

        iii. Compression: ASTM D395;

        iv. Heat aging: ASTM D573.

4. Before couplings are assembled, pipe ends and outsides of gaskets shall be lightly coated with suitable lubricant or graphite paste to facilitate installation;

5. Pipe grooving shall be carried out by using proprietary grooving machine or manufacturer’s recommended grooving machine as approved by the CM and in accordance with the pipe coupling manufacturer's latest specifications. The grooving shall be roll-grooved without the removal of any metal. Zinc coating damaged during the grooving operation of galvanized steel pipe shall be rectified by scrubbing clean the affected area and coated with a zinc rich galvanizing paint approved by the CM;

6. Unless otherwise specified, all mechanical couplings and fittings shall have a minimum working pressure of not less than 16 bars and the testing pressure shall not be less than 1.5 times the working pressure;
7. The electrical continuity of the mechanical couplings shall be effective and shall be verified by site measurement;
8. The mechanical couplings and fittings shall comply with standards acceptable to FSD;
9. The entire coupling installation shall be in accordance with the latest published selected manufacturer's recommendations;
10. The sub-contractor shall obtain WSD's consent on project basis for adopting mechanical couplings and fittings for pipework installation;
11. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the mechanical couplings and fittings delivered to the Site or installed.

FWP3.2.4 PIPEWORK SUPPORTS

FWP3.2.4.010.9 FIRE SERVICES PIPEWORK

1. Pipe bracket for fire services pipework shall be of fixed type;
2. Neoprene or rubber vibration isolation pad of 6 mm thick shall be added between pipe and bracket for installation inside fire services pump room.

FWP3.2.4.020.9 FRESH WATER AND FLUSHING WATER PIPEWORK

1. Pipe bracket for fresh water and flushing water pipework inside water pump room and pressure reducing valve chamber shall be completed with vibration isolator in accordance with FWP3.2.4.060. Where it is impractical to provide vibration isolator in accordance with FWP3.2.4.060, 6 mm thick neoprene or rubber isolation pad between pipework and bracket or other means of vibration isolation shall be provided subject to Approval by the Contract Manager;
2. Fixed type pipe bracket shall be installed at anchor points of the pipework system to avoid pipe movement in critical areas such as at pump suction connecting to puddle flange of water tank, non-return valve at pump discharge side, etc. Means of vibration isolation such as neoprene/rubber pad between pipework and bracket has still to be provided;
3. The sub-contractor shall be responsible for selecting fixed type pipe brackets or brackets with vibration isolator, as appropriate, for the whole pipework system and installing in accordance with the manufacturer's recommendations of brackets with vibration isolator to ensure that the vibration and noise generated from the pipework system would be isolated, in particular, to avoid causing nuisance to the tenants of the domestic flats.

FWP3.2.4.030.9 PERFORMANCE

All pipework shall be well supported so that it is free from excessive stress due to weight of its contents, its own dead weight, and dynamic forces due to liquid movement. Particular care should be taken with branches from vertical risers to ensure that the branch is not supporting the riser.

FWP3.2.4.040.9 PROVISION FOR MOVEMENT

Pipework shall be supported in such a manner as to allow adequate movement for expansion and contraction.

FWP3.2.4.050.9 FIXED TYPE PIPE BRACKET

1. Fixed type pipe bracket shall comprise pipe clip and hanger as follows:
   a. Pipe clip refers to the two halves components which are in direct contact with the pipework;
   b. Hanger refers to the component connecting the pipe clip for fixing onto the mounting structure/supports.
2. Components of the pipe brackets shall be not less than 3 mm thick. Materials of the pipe brackets shall be not less than those as specified below:
   a. Except for sprinkler pipework, pipe brackets for all pipeworks shall comply with the following requirements:
      i. All components including pipe clip, bolt, nut, washer, hanger and anchor bolt shall be made of stainless steel.
   b. Pipe brackets for sprinkler pipework shall comply with the following requirements:
      i. Pipe clip, bolt, nut and washer shall be made of stainless steel; and
      ii. Hanger and anchor bolt shall be made of galvanised mild steel.
   c. I-beam and U-channel for further supporting pipe brackets shall be made of mild steel with anti-corrosion painting;
   d. Stainless steel for components including pipe clip, bolt, nut, washer, hanger and anchor bolt shall be at least to BS EN 10088-3 grade 1.4301 unless otherwise specified.
3. Pipe brackets shall be arranged as close as possible to joints and changes of direction, with each bracket taking its share of the load and of sufficient strength to take the load with no noticeable deflection with clips detachable without disturbing the fixing. Brackets fixing to structure shall be fixed by at least two anchor bolts of adequate size. Samples or details of the pipe brackets shall be submitted for Approval prior to installation;
4. Supports shall be spaced at intervals as specified in FWP3.2.4.070;
5. For all pipeworks except sprinkler pipework where LPC Sprinkler Rules shall apply, the minimum bolt diameter for the clips and the minimum anchor bolt diameter for fixing the pipe hanger to the mounting structure/support at two or more points shall be as follows:

Nominal Pipe Size (mm)	Minimum Bolt Diameter for Pipe Clips (mm)	Minimum Anchor Bolt Diameter for Hanger, Double Fixing (mm)
25 – 50	6	6
65 – 100	10	10
125 – 150	12	12

6. For pipe bracket and support interval designs other than those specified above, substantiation/calculation to demonstrate that the proposed bolt/anchor has sufficient strength to take up the load shall be submitted by the Sub-contractor for Approval by the Contract Manager.

FWP3.2.4.060.9 PIPE BRACKET WITH VIBRATION ISOLATOR

1. Vibration isolator:

   a. Vibration isolator shall contain a steel spring with minimum 8 mm pad of neoprene in series and enclosed in hanger box. The neoprene element shall be moulded with a rod isolation bushing that passes through the isolator hanger box. Spring diameter and isolator hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the edge of the hole and short circuiting the spring. The minimum static deflection of the spring shall be 20 mm;

   b. Unless otherwise Approved, vibration isolator shall be selected fully in accordance with manufacturer's guidelines and taken into account weight distribution of the pipework system, pipe anchor points, guide etc. to produce uniform deflections and to ensure that the vibration and noise generated from associated pipework system would be isolated and would not be transmitted to other parts of the building, in particular, to avoid causing nuisance to the tenants of the domestic flats;

   c. The Sub-contractor shall be responsible for and submit calculation to verify the correctness of selection and overall suitability of every vibration isolator for the pipework system.

2. Pipe bracket:

   Details of the pipe clip, bolt, nut, washer, hanger and anchor bolt shall be in accordance with those specified in FWP3.2.4.050 wherever applicable.

3. Connection between vibration isolator and pipe bracket:

   Unless approved by the Contract Manager, pipe bracket shall be secured firmly to the vibration isolator in accordance with the manufacturer's guidelines of the vibration isolator.

FWP3.2.4.070.A SUPPORT INTERVALS

1. Supports shall be spaced at intervals not exceeding those shown in the following tables for straight runs, as defined in Table 2 of BS 8000-15, with additional supports for bends and tees:

   a. Ductile iron pipes:

Nominal pipe size (mm)	Spacing for horizontal runs	Spacing for vertical runs
80	2.7 m	2.7 m
100	2.7 m	2.7 m
150 & above	3.6 m	3.6 m

   b. Galvanized steel pipes:

Nominal pipe size (mm)	Spacing for horizontal runs	Spacing for vertical runs
15	1.8 m	2.4 m
20 & 25	2.4 m	3.0 m
32	2.7 m	3.0 m
40 & 50	3.0 m	3.6 m
65 & 80	3.6 m	4.5 m
100	3.9 m	4.5 m
125	4.5 m	5.0 m
150	4.5 m	5.0 m

2. Supports on ground for pipework inside water pump room for fresh and flush water service shall be of stainless steel of BS EN 10088-3 grade 1.4401.

FWP3.2.4.080.9 HANGERS FOR HORIZONTAL PIPEWORK

Unless otherwise specified, hangers for horizontal pipework at high level shall be supported from angle or channel irons, provided by the Sub-contractor, suitable for building-in or otherwise secured to the structure.

FWP3.2.5 INTEGRATION WITH STRUCTURE

FWP3.2.5.010.9 MARKING OUT

The Sub-contractor shall be responsible for marking the exact location of all holes/slots which will be cut by the Main Contractor where required and permitted.

FWP3.2.5.020.9 CLEARANCE OF HOLES

The holes, sleeves and slots reserved through walls/slabs/beams will be cleared and cleaned by the Main Contractor before handover to the Sub-contractor for use. The nails appertaining to concealed electrical boxes shall be cleared by the Sub-contractor subsequent to work completion and prior to execution of final painting work by the Main Contractor.

FWP3.2.5.030.9 FIXING PIPE SLEEVES

Where pipes pass through walls, beams, floors and ceiling, sleeves shall be provided. The Sub-contractor shall ascertain whether slots/holes are to be grouted later and shall fix galvanized steel/PVC sleeves with 2 to 12 mm clearance to allow for expansion and movement of pipe, as FWP3.1.3.080, immediately after pipe erection as follows:

1. Through walls and beams: fix sleeves flush with the finished surfaces;
2. Through floor slabs: fix sleeves in position with 100 mm projection above finished floor level and flush with the underside of the floor.

FWP3.2.5.040.9 CAULKING PIPE SLEEVES

Galvanised steel sleeves used in walls and slabs between fire compartments shall have the full length of annular space between the sleeve and the pipe filled with non-flammable mineral wool or Approved equivalent materials, pointed with Approved fire-rated sealant to maintain the required FRP of the walls / floor slabs, and are durable and effective in sound insulation.

FWP3.2.5.050.9 PIPE ENTRY TO BUILDINGS

Pipe entries into buildings shall be sealed and plugged with mastic compound after installation of pipework to prevent the ingress or egress of water or vermin.

FWP3.2.5.060.9 PROTECTION OF UNDERGROUND PIPES

1. Underground pipes shall be protected against corrosion;
2. Pipework shall be cleaned after jointing and treated with two coats of good quality bituminous paint and wrapped with petrolatum tape for protection against corrosion due to water, salts, soil organics, etc. before laying, and rested on sand or sieved soil before the trench is backfilled;
3. All underground pipework shall be pressure tested before the application of bituminous paint and the application of the petrolatum tape.

FWP3.2.5.070.9 PIPES PASSING THROUGH ASPHALT COVERED FLAT ROOFS

Where pipes pass through flat roofs covered with asphalt, the Sub-contractor shall, unless otherwise specified:

1. Cast or build in cast iron or galvanized mild steel sleeve, of internal diameter 20 mm (minimum) larger than the external diameter of the pipe concerned, projecting minimum 150 mm above roof finish;
2. Caulk space and fill both ends with fire-rated mastic sealant;
3. Cover tops of sleeves with lead collars or pre-fabricated 304 stainless steel collars of 1.5 mm thick to fit the pipe size and sleeve.

FWP4 SYSTEM CONTROL FITTINGS

FWP4.1 VALVES - GENERAL ... 3

FWP4.1.010.9 GENERAL ... 3
FWP4.1.020.A STANDARD ... 3
FWP4.1.030.9 TESTING ... 3
FWP4.1.040.A CERTIFICATION ... 3
FWP4.1.050.9 SIZE ... 4
FWP4.1.060.9 ROTATION ... 4
FWP4.1.070.9 LOCATION ... 4
FWP4.1.080.B CONSTRUCTION ... 4
FWP4.1.090.9 APPLICATION ... 6
FWP4.1.100.A COATING FOR CAST IRON PARTS OF VALVES ... 6

FWP4.2 GATE AND GLOBE VALVES ... 7

FWP4.2.010.9 TYPE ... 7
FWP4.2.020.9 DESIGN AND CONSTRUCTION ... 7
FWP4.2.030.9 END CONNECTIONS ... 7
FWP4.2.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY ... 7
FWP4.2.050.9 CERTIFICATION ... 7
FWP4.2.060.A VERIFICATION TESTS FOR GATE VALVES WITH NOMINAL SIZES UP TO AND INCLUDING 50MM FOR FRESH WATER APPLICATION DELIVERED TO SITE ... 7

FWP4.3 BUTTERFLY VALVES ... 9

FWP4.3.010.9 TYPE ... 9
FWP4.3.020.9 DESIGN AND CONSTRUCTION ... 9
FWP4.3.030.A END CONNECTIONS ... 9
FWP4.3.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY ... 9

FWP4.4 NON-RETURN VALVES ... 10

FWP4.4.010.A TYPE ... 10
FWP4.4.020.A DESIGN AND CONSTRUCTION ... 10
FWP4.4.030.A END CONNECTIONS ... 10
FWP4.4.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY ... 10

FWP4.5 BALL FLOAT VALVES ... 11

FWP4.5.010.A GENERAL ... 11
FWP4.5.020.9 TYPE ... 11
FWP4.5.030.A DESIGN AND CONSTRUCTION ... 11
FWP4.5.040.A BALL FLOATS ... 11
FWP4.5.050.A LEVER ARMS ... 11
FWP4.5.060.X DELETED ... 11
FWP4.5.070.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY ... 11

FWP4.6 PRESSURE REDUCING VALVES (PILOT TYPE) ... 12

FWP4.6.010.9 TYPE ... 12
FWP4.6.020.9 OPERATION AND PERFORMANCE ... 12
FWP4.6.030.A MATERIAL ... 12
FWP4.6.040.9 PRESSURE ... 12

FWP4.6.050.9 CERTIFICATION 13
FWP4.6.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 13

FWP4.8 MODULATING FLOAT VALVE AT FRESH AND FLUSH WATER SUMP TANK 14

FWP4.8.010.B GENERAL 14
FWP4.8.020.A MATERIAL 14
FWP4.8.030.9 PRESSURE 14
FWP4.8.040.9 TEST CERTIFICATE 15
FWP4.8.050.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 15

FWP4.9 BALL VALVES 16

FWP4.9.010.9 TYPE 16
FWP4.9.020.A DESIGN AND CONSTRUCTION 16
FWP4.9.030.9 END CONNECTIONS 16
FWP4.9.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 16

FWP4.11 OTHER FITTINGS 17

FWP4.11.010.A VORTEX INHIBITORS 17
FWP4.11.020.A ORIFICE PLATES 17

FWP4.12 SUBMERSIBLE BALL FLOAT VALVES 18

FWP4.12.010.9 DESIGN AND CONSTRUCTION 18
FWP4.12.020.9 MAIN VALVE 18
FWP4.12.030.9 MAIN VALVE BODY 18
FWP4.12.040.9 PILOT CONTROL SYSTEM 18

FWP4.1 VALVES - GENERAL

FWP4.1.010.9 GENERAL

1. All valves shall be designed and constructed of materials suitable for both the working and test pressures of the piping system in which they are installed and the temperature of the fluid carried. Unless otherwise specified, all valves shall have a working pressure of not less than 16 bar;
2. Valves of the same type shall be from the same manufacturer.

FWP4.1.020.A STANDARD

Valves shall comply with the following standards unless otherwise specified:

Type of Valve	Standard		
	For nominal size up to and including 50 mm	For nominal size above 50 mm	Cast iron grading
Gate Valves	Copper alloy to BS EN 12288	Cast iron to BS 5163-1 in conjunction with BS EN 1074-1 and 2	Grey cast iron to BS EN 1561 EN-GJL-250 Spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15
Globe Valves	Copper alloy to BS 5154	Cast iron to BS EN 13789	Grey cast iron to BS EN 1561 EN-GJL-250 Spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15
Non-return valves	Copper alloy to BS 5154	Cast iron to BS EN 12334 or BS EN 16767	Grey cast iron to BS EN 1561 EN-GJL-250 Spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15

FWP4.1.030.9 TESTING

All valves shall be pressure tested in accordance with the relevant British Standards / European Standards or equivalent international / national standards by the valve manufacturer before leaving the factory.

FWP4.1.040.A CERTIFICATION

1. Be of the type accepted by the Water Authority as required by the statute;
2. Type test Certificate / Report from certification bodies or accredited laboratories acceptable to Water Authority confirming that the valves have been tested conforming to this Specification shall be produced;
3. The following type test Certificates / Reports shall be submitted, wherever applicable:
   a. Test certificates for valves in compliance with the Standards quoted in FWP4.1.020;

b. Test certificates on composition analysis, chemical, physical and mechanical properties of the metallic materials for valves;

c. Test certificates for resilient seating material and epoxy coating showing compliance with the physical property and thickness requirements of this Specification;

d. In case of valves in potable water application, test certificates for non-metallic materials including resilient seating material and epoxy coating, showing compliance with relevant requirements in BS 6920 and suitable for potable water usage issued by Water Regulations Advisory Scheme of the United Kingdom (WRAS) or other accredited laboratories acceptable to Water Authority.

FWP4.1.050.9 SIZE

All valves (except those for flow or pressure control such as modulating float valve and pressure reducing valve) shall have the same nominal size as the pipe in which they are installed unless otherwise specified.

FWP4.1.060.9 ROTATION

Manually operated valves shall be closed by turning the handwheel in a clockwise direction when facing the handwheel. All valves of cast iron body construction shall be provided with an indicator to show the open and shut position.

FWP4.1.070.9 LOCATION

All valves shall be located at convenient positions of operation from the floor.

FWP4.1.080.B CONSTRUCTION

Valves shall be constructed to the following minimum specification; better or equivalent materials may be offered for Approval:

1. Specification A in FWP4.1.090:
   a. For nominal sizes up to and including 50 mm:
      i. Body, bonnet and disc

         Bronze to BS EN 1982 CuSn5Zn5Pb5 or CB491K or CC491K;

      ii. Stem

         Brass to high tensile brass to BS EN 12163 or BS EN 12164.

   b. For nominal sizes above 50 mm:
      i. Body and bonnet

         Grey cast iron to BS EN 1561 EN-GJL-250, or spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15;

      ii. Disc or Seat

         - Solid or trimmed with bronze to BS EN 1982 CuSn5Zn5Pb5 or CB491K or CC491K; or
         - Resilient material to BS EN 681-1, Type WA, Hardness Category "70" with nominal thickness of minimum 1.5mm on the non-seating areas and 4.0mm on the seating areas, and in case for fresh water application, showing compliance with relevant requirements in BS 6920.

      iii. Stem

         Brass to high tensile brass or leaded brass to BS EN 12163, or stainless steel to BS EN 10088-3 Number 1.4462, 1.4301, 1.4401, 1.4006, 1.4005, 1.4021 or 1.4057.

2. Specification B in FWP4.1.090:

a. For nominal sizes up to and including 50mm (working pressure below 10 bar):
   i. Valve components:
      - UPVC;
      - Ball center-pivoted, smooth and spherical with a circular orifice, and seated on resilient seating suitable for tight shut off;
      - Stem one piece with O-ring made of Ethylene Propylene Diene Monomer (EPDM) for positive sealing of the body.
   ii. Valve operation:
      - By wrench turned in a clockwise direction to close when facing the wrench;
      - At fully open position of valve, wrench to be mounted parallel to the flow of passage through the ball;
      - Wrench to fully close valve at a quarter turn;
      - Provide suitable stops for both fully open and fully closed positions of valve.
   iii. Valve end connections and pressure standards:
      - Socket or union suitable for directly connecting the pipe to which it is installed;
      - Testing method to BS EN ISO 1452-4.

b. For nominal sizes up to and including 50 mm (working pressure at or above 10 bar):
   i. Body, bonnet and disc

      Bronze to BS EN 1982 CuSn5Zn5Pb5 or CB491K or CC491K;
   ii. Stem

      Dezincification Resistant Brass or Bronze to BS EN 1982 CuSn5Zn5Pb5 or CB491K or CC491K.

c. For nominal sizes above 50 mm:
   i. Body and bonnet

      Grey cast iron to BS EN 1561 EN-GJL-250, or spheroidal graphite cast iron (ductile iron) to BS EN 1563 EN-GJS-400-15;
   ii. Disc or Seat
      - Solid or trimmed with zinc free bronze to BS EN 1982 CuSn10 or trimmed with austenitic chromium nickel stainless steel or austenitic chromium nickel molybdenum stainless steel to BS EN 10283 Number 1.4308 or 1.4408; or
      - Resilient material to BS EN 681-1, Type WA, Hardness Category "70" with nominal thickness of minimum 1.5mm on the non-seating areas and 4.0mm on the seating areas.
   iii. Stem

      Stainless steel to BS EN 10088-3 Number 1.4462, 1.4301, 1.4401 or 1.4057.

FWP4.1.090.9 APPLICATION

	Purpose	Clause reference
1.	a. Fresh water (including potable water) b. Fire services c. Waste water d. Storm water e. Bore well water - non-corrosive f. Rainwater	FWP4.1.080 Specification A
2.	a. Flush water b. Sewage c. Bore well water - corrosive	FWP4.1.080 Specification B

FWP4.1.100.A COATING FOR CAST IRON PARTS OF VALVES

1. Cast iron parts of all valves shall be coated with an epoxy based material both on internal and external surfaces. The following minimum thickness of epoxy coating shall apply:

	Electrostatically Fusion Powder Coated (µm)	Airless Sprayed Application (µm)
Flat and Pressurised Parts	250	400
Convex Outer Edges	150	300

2. The coating for use in fresh potable water shall comply with relevant requirements laid down in BS 6920 and be to the satisfaction of the Water Authority.

FWP4.2 GATE AND GLOBE VALVES

FWP4.2.010.9 TYPE

1. Gate valves shall be of the full way solid or split wedge disc type and globe valves shall be of the straight globe type;
2. Gate valves shall be handwheel operated with rising or non-rising stem;
3. Globe valves shall be handwheel operated with rising stem.

FWP4.2.020.9 DESIGN AND CONSTRUCTION

1. The valve body shall be robust and capable of withstanding hard wear;
2. For valves of bronze body construction, the bonnet shall be of the screwed type with ample threads to ensure positive sealing to the body;
3. For valves of grey cast iron body and spheroidal graphite cast iron (ductile iron) construction, the body and bonnet shall be bolted together and the disc shall be guided;
4. The gland shall be fitted with non-asbestos packing and shall be bolted for grey cast iron and spheroidal graphite cast iron (ductile iron) valves.

FWP4.2.030.9 END CONNECTIONS

1. All copper alloy valves shall be of the screwed female end connection and all cast iron valves shall be of the flanged end connections;
2. Threads in screwed end connection shall comply with BS EN 10226-1, 2, 3 and flanges of flanged end connection shall comply with BS EN 1092-2 and their bolts and nuts shall be complied to BS EN 1515-1.

FWP4.2.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the gate and globe valves for fresh water and fire services systems delivered to the site or installed.

FWP4.2.050.9 CERTIFICATION

When gate valve with nominal sizes up to and including 50mm for fresh water application is used, submit at sample submission and approval stage either:

1. A copy of the Kitemark Certificate or Kitemark Licence, together with the associated test report demonstrating compliance with BS EN 12288, all issued by the British Standards Institution if available for the CM's information; or
2. Test report issued or certified by the laboratory accepted by the Water Authority demonstrating full compliance with BS EN 12288 for the CM's information.

FWP4.2.060.A VERIFICATION TESTS FOR GATE VALVES WITH NOMINAL SIZES UP TO AND INCLUDING 50MM FOR FRESH WATER APPLICATION DELIVERED TO SITE

1. Test Arrangements:
    a. Verification tests shall be carried out by the CM or his representatives or a Direct Contractor upon delivery of material to Site under a delivery note, or during the course of construction as directed by the CM. A representative batch means the material delivered to Site under the same delivery note;
    b. Comply with the followings pertaining to verification tests:
        i. Provide attendance on the Site;

ii. Provide, deliver and collect samples etc. as directed by the CM or as specified.

2. Testing Samples:
   a. Samples shall be selected by the CM or his representatives and witnessed by representative of the Sub-contractor;
   b. For gate valve with the Kitemark Certificate or Kitemark Licence:
      i. provide one test sample of any sizes of gate valves from a batch of material delivered to Site under the delivery note as selected by the CM;
      ii. when instructed by the CM, provide another test sample of any sizes of gate valves from any other batch of material delivered to Site under the delivery note.
   c. For gate valve without the Kitemark Certificate or Kitemark Licence, when instructed by the CM, provide two test samples of any sizes of gate valves from each batch of material delivered to Site under the delivery note.
3. Testing Methods:
   a. Laboratory testing of chemical composition of the body, bonnet, disc and stem of gate valve as arranged by the CM or his representatives;
   b. Acceptance standard:

      The result shall indicate that the chemical composition of the body, bonnet, disc and stem of gate valve complies with the specified standards in FWP4.1.080 or the test report showing the material composition which has been accepted by Water Authority.
4. Non-compliance:
   a. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(b), follow either one of the following actions:
      i. Remove the representative batch of material off-site; or
      ii. Carry out re-test for the representative batch of material in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that accepted by the Water Authority on three separate sets of samples selected by the CM from the representative batch. In the event that the testing sample fails to meet the acceptance standard as specified in sub-clause (3)(b), remove the representative batch of material off-site.
   b. When the representative batch of material is removed off-site, replace with another new batch and carry out test in accordance with the testing methods as specified in sub-clauses (3)(a) and (3)(b) in a laboratory that accepted by the Water Authority for one sample of gate valve with the Kitemark Certificate or Kitemark Licence or two samples of gate valve without the Kitemark Certificate or Kitemark Licence, all selected by the CM from the replacing batch. In the event that the testing sample(s) fail to meet the acceptance standard as specified in sub-clause (3)(b), carry out re-testing as specified in sub-clauses (4)(a);
   c. Bear all associated costs and extra time required for the test and re-test required in sub-clauses (4)(a) and (4)(b).

FWP4.3 BUTTERFLY VALVES

FWP4.3.010.9 TYPE

1. Butterfly valves shall be applied in fire services installation only;
2. Butterfly valves shall be of wafer type to BS EN 593 or grooved end type with FSD approval or equivalent with resilient seat suitable for tight shut-off purpose;
3. Butterfly valve used as sprinkler subsidiary stop valve shall be connected to an actuator for remote indication of its open/close status in the fire services alarm control panel.

FWP4.3.020.9 DESIGN AND CONSTRUCTION

1. The valve body and disc shall be of ductile iron of grades as specified in FWP4.1.080, or equivalent;
2. Shaft shall be of stainless steel of grades as specified in FWP4.1.080, or equivalent;
3. Unless otherwise specified, valves shall be operated by handwheel or wrench.

FWP4.3.030.A END CONNECTIONS

1. For wafer type, the valve body ends shall be capable of matching connecting flanges complying with the requirements of BS EN 1092-2;
2. For grooved end type, the valve body ends shall match with the mechanical couplings and fittings as stated in FWP3.2.3.050.

FWP4.3.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the butterfly valves for fire services systems delivered to the site or installed.

FWP4.4 NON-RETURN VALVES

FWP4.4.010.A TYPE

1. Unless otherwise specified, non-return valves shall be of the hinged swing or recoil type for horizontal installation and spring type shall be of globe or wafer type suitable for both vertical and horizontal installations;
2. When the valve is installed vertically, the flow shall be in an upward direction;
3. When installed at the pump discharge with a water head exceeding 15 m, non-return valves shall be of the recoil or spring type to ensure silent shut-off operation;
4. When installed at the pump discharge of sewage / waste water / storm water pumping station, non-return valves shall be of the hinged swing type with lever and spring suitable for horizontal or vertical installations as shown on the drawings;
5. Notwithstanding the requirements of clause FWP4.1.080, recoil or spring type check valve of cast iron or spheroidal graphite cast iron (ductile iron) body construction shall be acceptable for nominal size of 65mm or below.

FWP4.4.020.A DESIGN AND CONSTRUCTION

1. Hinged swing type:
   a. The valve body shall be robust and capable of withstanding hard wear;
   b. Bronze swing non-return valves shall have screwed type cap and cast iron swing non-return valves shall have the cap and body bolted together to ensure a strong, tight closure;
   c. Hinge pins shall be of brass / bronze for nominal size of 50mm or below and stainless steel for nominal size above 50mm;
   d. The valves shall be designed to close when reversal of flow starts.
2. Recoil type non-return valves shall have a flow area not less than the cross-sectional area of the connected pipework and shall be non-slam in operation;
3. Spring type:
   a. The valve body shall be robust and capable of withstanding hard wear;
   b. Springs shall be of stainless steel;
   c. The valves shall have a flow area not less than the cross-sectional area of the connected pipework and shall be non-slam in operation;
   d. The valves shall be designed to close when reversal of flow starts.

FWP4.4.030.A END CONNECTIONS

1. End connections of non-return valves shall be as FWP4.2.030;
2. Wafer type spring non-return valves will be acceptable, provided the body ends are capable of matching connecting flanges complying with the requirements of BS EN 1092- 2.

FWP4.4.040.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the non-return valves for fresh water and fire services systems delivered to the site or installed.

FWP4.5 BALL FLOAT VALVES

FWP4.5.010.A GENERAL

1. Unless otherwise specified, ball float valves shall have a working pressure of not less than 10 bar and be tested to 16 bar on the body;
2. Ball float valves of all sizes shall be accepted for fire services systems only;
3. For installations other than fire services system, only ball float valves of size up to and including 50 mm shall be accepted.

FWP4.5.020.9 TYPE

Ball float valves shall be of the slow closing type, unless otherwise specified.

FWP4.5.030.A DESIGN AND CONSTRUCTION

1. General:
   a. The valve body shall be robust and shaped to give a good flow pattern;
   b. The valve piston shall close in the direction of flow such that the pressure in the main will tend to keep the valve closed and that the piston seal is afforded protection from the flow by the piston;
   c. All internal parts shall be easily removable for maintenance with the face and piston seals easily replaced.
2. For nominal sizes above 50mm: epoxy coated cast iron or epoxy coated ductile iron body with gunmetal piston, seat and guide;
3. For nominal sizes up to and including 50 mm: bronze construction valves shall be accepted.

FWP4.5.040.A BALL FLOATS

Ball floats shall be spherical or cylindrical, and be constructed of copper alloy or stainless steel for fresh water application and of stainless steel for flush water application.

FWP4.5.050.A LEVER ARMS

Lever arms for flush water application shall be of stainless steel to BS EN 10088-1 Number 1.4401 and of direct mechanical linkage type.

FWP4.5.060.X DELETED

FWP4.5.070.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the ball float valves for fire services systems delivered to the site or installed.

FWP4.6 PRESSURE REDUCING VALVES (PILOT TYPE)

FWP4.6.010.9 TYPE

The pressure reducing valve shall be hydraulically operated, pilot-controlled type. The whole valve shall be assembled and tested by the manufacturer.

FWP4.6.020.9 OPERATION AND PERFORMANCE

1. The operating range shall be suitable for the particular application;
2. The valve shall maintain a constant reduced downstream pressure regardless of changes in upstream pressure or flow rates;
3. The pilot control system shall be provided with a strainer. The valve shall be flanged-end connection with flange to PN16. The main valve and its pilot control system shall contain no packing glands or stuffing boxes;
4. The valve shall reduce a higher inlet pressure to a steady downstream pressure regardless of fluctuations in flow rate and/or varying inlet pressure. The downstream pressure shall be adjustable and could be reduced down to a pressure suitable for the application. The valve shall be selected in such way that no cavitation shall occur within the anticipated flow and pressure ranges;
5. The amount of pressure reduction against various flow rates and inlet pressures shall comply with the requirements as indicated on the Drawings;
6. Performance curves showing the above characteristics shall be submitted to the Contract Manager upon request.

FWP4.6.030.A MATERIAL

Material composition of every component of the valve shall be suitable for fresh or flush water use as in accordance with its application, and shall have the minimum standard as specified below for its intended purposes. Equivalent materials may be offered for Approval.

1. Body & bonnet

   Cast iron to BS EN 1561 EN-GJL-250 or ductile iron to BS EN 1563 EN-GJS-400-15. The body of the valve shall be coated with an epoxy based material both on internal and external surfaces;
2. Disc & Seat
   a. Solid or trimmed with bronze to BS EN 1982 CuSn5Zn5Pb5 or trimmed with stainless steel to BS EN 10283 Number 1.4308 or 1.4408 for fresh water use;
   b. Solid or trimmed with zinc free bronze to BS EN 1982 CuSn10 or trimmed with stainless steel to BS EN 10283 Number 1.4408 for flush water use.
3. Stem
   a. High tensile brass or leaded brass to BS EN 12163 or stainless steel to BS EN 10088-3 Number 1.4301 or 1.4401 for fresh water use;
   b. Stainless steel to BS EN 10088-3 Number 1.4401 for flush water use.

FWP4.6.040.9 PRESSURE

1. Each valve shall be hydraulic tested at 1.5 times the nominal pressure of the valve for a period of not less than 1 minute at the factory;
2. The valve shall be suitable for both the working and test pressure of the piping system in which they are installed. Unless otherwise specified or Approved, it shall have a working pressure of not less than 16 bar.

FWP4.6.050.9 CERTIFICATION

The valve shall be of the type acceptable to the Water Authority for fresh or flush water use as in accordance with its application. Type test certificate / report from certification bodies or accredited laboratories acceptable to Water Authority for the verification of the hydraulic pressure requirements and material used shall be produced.

FWP4.6.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the pressure reducing valves for fresh water system delivered to the site or installed.

FWP4.8 MODULATING FLOAT VALVE AT FRESH AND FLUSH WATER SUMP TANK

FWP4.8.010.B GENERAL

1. The modulating float valve shall be hydraulically operated, pilot-control and of diaphragm. The whole valve shall be assembled and tested by the manufacturer;
2. The pilot control system shall be provided with a strainer. The valve shall be flanged-end connection with flange to BS EN 1092-2 PN16. The main valve and its pilot control system shall contain no packing glands or stuffing boxes. The ball float shall be spherical. Lever arm / float connecting rod shall be of direct mechanical linkage type;
3. The valve shall be operated to modulate water flow into the tank in such way as to maintain predetermined water tank level within narrow limits. The valve shall be installed such that there is an air gap between the float and the pilot valve.

FWP4.8.020.A MATERIAL

Material composition of every component of the valve shall be suitable for fresh or flush water use as in accordance with its application, and shall have the minimum standard as specified below for its intended purposes. Equivalent materials may be offered for Approval;

1. Body & bonnet:

   Cast iron to BS EN 1561 EN-GJL-250 or ductile iron to BS EN 1563 EN-GJS-400-15. The body of the valve shall be coated with an epoxy based material both on internal and external surfaces;
2. Disc & Seat:
   a. Solid or trimmed with bronze to BS EN 1982 CuSn5Zn5Pb5 or trimmed with stainless steel to BS EN 10283 Number 1.4308 or 1.4408 for fresh water use;
   b. Solid or trimmed with zinc free bronze to BS EN 1982 CuSn10 or trimmed with stainless steel to BS EN 10283 Number 1.4408 for flush water use.
3. Stem:
   a. High tensile brass or leaded brass to BS EN 12163 or stainless steel to BS EN 10088-3 Number 1.4301 or 1.4401 for fresh water use;
   b. Stainless steel to BS EN 10088-3 Number 1.4401 for flush water use.
4. Ball float:
   a. Spherical or cylindrical;
   b. Constructed of copper alloy or stainless steel for fresh water application and of stainless steel for flush water application.
5. Lever arm/float connecting rod for flush water application:

   Stainless steel to BS EN 10088-1 Number 1.4401.

FWP4.8.030.9 PRESSURE

The valve shall be suitable for both the working and test pressure of the piping system in which they are installed. Unless otherwise specified or Approved, it shall have a working pressure of not less than 16 bar.

FWP4.8.040.9 TEST CERTIFICATE

The valve shall be of the type acceptable to the Water Authority for fresh or flush water use as in accordance with its application. Type test certificate / report from certification bodies or accredited laboratories acceptable to Water Authority confirming that the valve has been tested conforming to this specification shall be produced.

FWP4.8.050.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the modulating float valves for fresh water system delivered to the site or installed.

FWP4.9 BALL VALVES

FWP4.9.010.9 TYPE

Unless otherwise specified, the application of ball valves shall only be used for hose reel control valve in fire services installation and pipeline drain cock for pumpset, pressure switch and pressure vessel in water pump installation. Ball valves shall be of spherical bore with PTFE seats and directly operated by a lever. Lever shall be so mounted that it is parallel to the valve axis when the valve is in the fully open position. When the valve is in the fully closed position, the lever shall be at 90° to the valve axis.

FWP4.9.020.A DESIGN AND CONSTRUCTION

1. Valves shall be robust and capable of withstanding hard wear;
2. Valves shall be constructed to the following minimum specification:
   a. Body and stem
      Brass to BS EN 12165 CuZn40Pb2 with or without nickel/chromium plated;
   b. Seat bore
      Brass to BS EN 12165 CuZn40Pb2;
   c. Lever handle
      Carbon steel or zinc plated steel with red plastic sleeve and open/close operating direction marking.
3. The lever retaining nut or screw of ball valves shall be permanently sealed with industrial type heavy duty threadlocking adhesive/sealant;
4. Valves shall have a working pressure of not less than 20 bar. The test pressures of valve body and seat shall be 1.5 and 1.1 times the maximum permissible working pressure respectively.

FWP4.9.030.9 END CONNECTIONS

1. Ball valves shall be of the screwed female end connection;
2. Threads in screwed end connection shall comply with BS EN 10226-1, 2, 3.

FWP4.9.060.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the modulating float valves for fresh water system delivered to the site or installed.

FWP4.11 OTHER FITTINGS

FWP4.11.010.A VORTEX INHIBITORS

1. Vortex inhibitors shall be LPCB approved type or approved by similar widely recognised independent regulatory body acceptable to FSD with PN16 flanges and in compliance with requirements of BS EN 12845. They shall be used for operation under positive head conditions;
2. The Sub-contractor shall provide copies of valid certificates issued by LPCB or other recognised product certification bodies acceptable to the CM;
3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the vortex inhibitors delivered to the site or installed.

FWP4.11.020.A ORIFICE PLATES

1. Orifice plates for system balancing, pump churning water circuits, where applicable, shall be provided as required for proper commissioning of the systems. Wherever necessary to suit the pump performance in respect of system balance, orifice plates shall be provided even if they are not indicated on drawings;
2. An orifice plate used to hydraulically balance an installation, or to accommodate pump characteristics, shall:
   a. has an orifice diameter not less than one-half of the internal diameter of the pipe into which it is fitted;
   b. be fitted only in pipes of 50 mm nominal bore or greater;
   c. be of brass with a plain central hole without burrs, and of a thickness complying with the following table:

Pipe nominal bore (mm)		Orifice plate thickness (mm)
over	not greater than	
-	80	3
80	150	6
150	200	9

   d. has an identification tag, projecting beyond any flanges between which it is clamped, on which is clearly stamped the nominal pipe diameter and the orifice k factor.
3. An orifice plate shall be fitted not less than two pipe internal diameters downstream of the outlet from any elbow or bend;
4. The flow characteristic data of the orifice plate shall be included in the operation and maintenance manual;
5. Orifice plates shall be generally designed, constructed and installed according to LPC Sprinkler Rules or other standards acceptable to FSD.

FWP4.12 SUBMERSIBLE BALL FLOAT VALVES

FWP4.12.010.9 DESIGN AND CONSTRUCTION

This valve is a non-modulating valve which controls the liquid level in tanks. This valve shall open fully when the liquid level reaches a preset low point and closes drip tight when the level reaches a preset high point.

FWP4.12.020.9 MAIN VALVE

The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body with seat installed the cover with bearing installed, and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

FWP4.12.030.9 MAIN VALVE BODY

1. No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be bronze to BS EN 1982 CuSn5Zn5Pb5 of cast material. No fabrication or welding shall be used in the manufacturing process;
2. The valve shall contain a resilient, synthetic rubber disc and forming a tight seal against a single removable seat insert. The bronze disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place;
3. The diaphragm shall be nylon reinforced rubber assembly contains a non-magnetic 316 stainless steel stem, nut and spring of sufficient diameter to withstand high hydraulic pressures and shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure;
4. The flexible, non-wicking diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The centre hole for the main valve stem must be sealed. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position;
5. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat valves shall be threaded into the cover and body. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline.

FWP4.12.040.9 PILOT CONTROL SYSTEM

1. The valve pilot system shall contain a flow clean brass Y-strainer to BS EN 1982 with stainless steel screen to BS EN 10088-3. The strainer shall project into the flow stream. The eddies and current caused by this projection shall self clean the screen;

2. The float and float rod shall be stainless steel and float control shall be a rotary disc, plate-type pilot. The pilot shall direct supply pressure into the cover of the main valve to close it. Then vent the cover of the main valve to atmosphere to open the main valve;
3. The valve shall open wide when the float is at a low liquid level and close drip tight when the float is at a high liquid level. Once the pilot signals the main valve to open or to close, the valve shall travel through its entire stroke without additional movement of the pilot control.

FWP5 WATER TANKS

FWP5.1 GENERAL 2

FWP5.1.010.9 COMPLIANCE WITH RULES/REGULATIONS 2
FWP5.1.020.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 2

FWP5.2 PNEUMATIC PRESSURE VESSELS 4

FWP5.2.055.A MILD STEEL PNEUMATIC PRESSURE VESSEL 4
FWP5.2.056.A STAINLESS STEEL PNEUMATIC PRESSURE VESSEL 4

FWP5.3 CONCRETE WATER TANKS 6

FWP5.3.010.9 RESPONSIBILITY OF MAIN CONTRACTOR 6
FWP5.3.020.9 RESPONSIBILITY OF SUB-CONTRACTOR 6
FWP5.3.030.A VERIFICATION BY SUB-CONTRACTOR 6

FWP5.1 GENERAL

FWP5.1.010.9 COMPLIANCE WITH RULES/REGULATIONS

1. All fire services water tank installations including gravity tank/pump suction tank provided by the Sub-contractor shall comply with the LPC Sprinkler Rules;
2. All water tank installations provided by the Sub-contractor shall comply with the requirements of the Water Authority.

FWP5.1.020.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the pneumatic pressure vessels delivered to the site or installed.

FWP5.2 PNEUMATIC PRESSURE VESSELS

FWP5.2.055.A MILD STEEL PNEUMATIC PRESSURE VESSEL

1. The vessels shall be constructed of welded mild steel to BS EN 13831 or European Directive 2014/68/EU or other approved standards. The internal mild steel surfaces of the vessels shall be coated at manufacturer's factory with a resin (such as epoxy resin) of anti-corrosion material suitable for use with potable water. The vessels shall be provided with appropriate certificate issued by an approved authority or laboratory to substantiate their suitability in potable water application;
2. The vessels shall be pre-charged with air or nitrogen at factory at a pressure suitable for the application. The pre-charged pressure shall be adjustable and charging port with non-return device shall be provided in each vessel;
3. Gas and water space shall be separated by a bladder made of rubber membrane, which must be acceptable to and acceptable to the Water Authority. There shall be no contact between the water and metal surface of the vessel;
4. The bladder shall be replaceable and made of rugged rubber membrane. Material of the membrane shall be flexible, non-porous, of resistance to acids and alkalis, non-toxic and free of impairing taste and odour;
5. Whereas for potable water use, rubber bladder shall be provided with type-tested certificate(s) issued by approved authority or laboratory acceptable to the Water Authority to substantiate its suitability in contact with potable water;
6. The vessel shall withstand a minimum working pressure according to system configuration and under no circumstances less than 10 bar. A manufacturer's test certificate for the test pressure of the vessel shall be submitted for Approval;
7. The vessels shall be provided with air bleed cock, pressure gauges and drain cock with drain pipe extension to the nearest drain point;
8. A test certificate for the test pressure of the pneumatic pressure vessel issued by the manufacturer shall be submitted to the CM for Approval;
9. An open-up inspection randomly chosen from one of the delivered vessels shall be carried out. If the opened-up vessel is found lack of internal coating of anti-corrosion material or any non-conformance, the Sub-contractor shall open up all delivered vessels for inspection with no additional charge. The conformed vessels shall be re-charged to a pressure suitable for the application. All non-conformed products shall be removed off site for replacement;
10. In addition to the Regular Monthly Visits as stipulated in FWP14.3.040, the Sub-contractor shall inspect every pneumatic pressure vessel bi-weekly to identify any sign of rupture of the internal bladder inside the vessel. The Sub-contractor is required to identify the tones of knocking at the upper and lower portions of the vessel and to check the pressure at the gas inlet point in order to ensure the health of the bladder.

FWP5.2.056.A STAINLESS STEEL PNEUMATIC PRESSURE VESSEL

1. The construction of a welded stainless steel pneumatic pressure vessel shall be to BS EN 13831 or European Directive 2014/68/EU or equivalent international standards. Body, flange, bolts and nuts shall be of AISI grade 304 stainless steel or better in corrosion resistivity. Whereas for salt water use, flange shall be of AISI grade 316 stainless steel;

2. The vessel shall be pre-charged with air or nitrogen at a pressure suitable for the application. The pre-charged pressure shall be adjustable. Gas charging port with non-return device shall be provided in each vessel;
3. Gas and water space shall be separated by a replaceable bag-type bladder. There shall be no contact between water and metal surface of the vessel;
4. The bladder shall be replaceable and made of rugged rubber membrane. Material of the membrane shall be flexible, non-porous, of resistant to acids and alkalis, non-toxic and free of impairing taste and odour;
5. Whereas for potable water use, rubber bladder shall be provided with type-tested certificate(s) issued by approved authority or laboratory acceptable to the Water Authority to substantiate its suitability in contact with potable water;
6. The vessel shall withstand a minimum working pressure according to system configuration and under no circumstances less than 8 bar. A manufacturer's test certificate for the test pressure of the vessel shall be submitted for Approval;
7. The vessel shall be provided with drain cock and drain pipe connected to the nearest drain point;
8. The Sub-contractor shall inspect every stainless steel pneumatic pressure vessel at the Regular Monthly Visits as stipulated in FWP14.3.040. The Sub-contractor is required to identify the tones of knocking at the upper and lower portions of the vessel and to check the pressure at the gas inlet point in order to ensure the health of the bladder.

FWP5.3 CONCRETE WATER TANKS

FWP5.3.010.9 RESPONSIBILITY OF MAIN CONTRACTOR

1. Water tanks forming part of the building construction, or of concrete, including overflow, drains and inlet piping shall be supplied and installed by the Main Contractor;
2. Puddle flanges at the water tank for inlet and outlet pipes shall be supplied and installed by the Main Contractor.

FWP5.3.020.9 RESPONSIBILITY OF SUB-CONTRACTOR

All other piping connections and valves shall be supplied and installed by the Sub-contractor as indicated on Drawings.

FWP5.3.030.A VERIFICATION BY SUB-CONTRACTOR

1. The Sub-contractor shall check the construction drawings for concrete water tanks for fire service installations and water pump installations and verify their correctness for his installation purposes;
2. The effective water quantity of each supply tank serving fire service installations shall be checked based on the method of measurement as stated in Fire Services CoP;
3. The Sub-contractor shall coordinate with the Main Contractor and submit proposals for modification to the design, as necessary, prior to commencement of site works.

FWP6 PUMPSETS

FWP6.1 DESIGN AND SPECIFICATION 3

FWP6.1.010.A COMPLIANCE WITH RULES / REGULATIONS 3
FWP6.1.020.9 TYPE 3
FWP6.1.030.9 DUTY 3
FWP6.1.040.9 PUMP CURVES 3
FWP6.1.050.9 MAXIMUM PUMP SPEED 3

FWP6.2 CONSTRUCTION 4

FWP6.2.010.9 GENERAL 4
FWP6.2.020.A FRESH WATER / FIRE SERVICES PUMPS 4
FWP6.2.025.9 FRESH WATER BOOSTER/RAINWATER IRRIGATION PUMPS 5
FWP6.2.030.A FLUSH WATER PUMPS 5
FWP6.2.035.9 JOCKEY PUMPS FOR FIRE SERVICE INSTALLATION 6
FWP6.2.040.A SEWAGE / WASTE WATER / STORM WATER PUMPS 6
FWP6.2.050.9 BORE WELL PUMPS 6

FWP6.3 PUMP TYPES 8

FWP6.3.010.A HORIZONTAL SPLIT CASING PUMPS 8
FWP6.3.020.A END SUCTION PUMPS 8
FWP6.3.030.B MULTI-STAGE PUMPS 9
FWP6.3.040.A SUBMERSIBLE SUMP PUMPS 10
FWP6.3.050.9 MULTI-STAGE SUBMERSIBLE PUMPS 11
FWP6.3.060.N DRY PIT SUMP PUMPS 12

FWP6.4 BEARINGS AND SEALS 15

FWP6.4.010.A PUMP BEARINGS 15
FWP6.4.020.X DELETED 15
FWP6.4.030.9 PUMP SEALS 15

FWP6.5 FITTINGS AND ACCESSORIES 16

FWP6.5.010.9 FITTINGS 16
FWP6.5.020.9 COUPLINGS 16
FWP6.5.030.9 LUBRICATION FITTINGS 16
FWP6.5.040.9 AIR BLEED COCKS 16
FWP6.5.050.9 LIFTING EYES 16
FWP6.5.060.9 IDENTIFICATION 16
FWP6.5.070.9 MOTORS AND WIRING 16

FWP6.6 INSTALLATION 17

FWP6.6.010.9 GENERAL 17
FWP6.6.020.9 BASEPLATE 17
FWP6.6.030.9 VIBRATION ISOLATION 17

FWP6.7 TESTING AND CERTIFICATION 19

FWP6.7.010.9 TEST 19
FWP6.7.015.9 PROVISION OF TEST PIECE FOR STAINLESS STEEL FLUSH WATER PUMP AND ATTENDANCE FOR INSPECTION AND TESTING 19
FWP6.7.020.9 PUMP CERTIFICATES 19

FWP6.8 DOCUMENTATION 20

FWP6.8.010.9 IN-SERVICE RECORDS FOR STAINLESS STEEL FLUSH WATER PUMPS 20
FWP6.8.020.A WARRANTY FOR STAINLESS STEEL FLUSH WATER PUMPS 20

FWP6.1 DESIGN AND SPECIFICATION

FWP6.1.010.A COMPLIANCE WITH RULES / REGULATIONS

1. Pumps and pump installations for sprinkler systems shall comply with the detailed requirements of the LPC Sprinkler Rules;
2. Pumps and pump installations for hydrant / hosereel systems shall comply with Code of Practice for Minimum Fire Service Installations and Equipment published by Hong Kong Government and BS 5306-1wherever applicable.

FWP6.1.020.9 TYPE

1. The type of pump(s) required for any particular application is detailed in FWP2;
2. Only the type specified should be listed in the tender documents; alternative proposals may be submitted separately, together with a list of advantages for Approval;
3. All pumps shall be electric motor driven centrifugal pumps, unless otherwise specified.

FWP6.1.030.9 DUTY

1. The pump(s) shall be selected to suit the design requirements for capacity as indicated in FWP2 or Drawings;
2. The pump heads stated in FWP2 or Drawings are only for the reference of tendering purposes;
3. The Sub-contractor shall calculate the actual pump heads based upon the characteristics of the pipework systems including fittings, equipment and accessories and carry out such alterations as may be necessary to achieve the specified duty.

FWP6.1.040.9 PUMP CURVES

1. Predicted total Head/Quantity, required NPSH/Quantity, Efficiency/ Quantity, and Power Absorbed/Quantity Curves shall be supplied;
2. The curves shall commence at zero flow and be extended to show the performance at heads lower than the minimum head;
3. In general, the pump shall be selected to operate near its best efficiency point shown on the performance curves;
4. Unless otherwise specified, fresh and flush feed pumps selected to operate below the best efficiency point by a figure of 10% or more (in efficiency) will normally be unacceptable.

FWP6.1.050.9 MAXIMUM PUMP SPEED

1. Maximum speed of fresh and flush water pumps shall not exceed 25r/s;
2. Maximum speed of booster fresh water pumps shall not exceed 25r/s;
3. Maximum speed of fire services feed pumps shall not exceed 50r/s;
4. Unless otherwise specified, maximum pump speed shall not exceed 50r/s.

FWP6.2 CONSTRUCTION

FWP6.2.010.9 GENERAL

1. All pump parts shall be constructed of materials suitable for the required working pressure, temperature and mechanical strength and also the liquid handled by the pump. The materials specified in this Section shall be of the minimum standard required. Better or equivalent materials may be offered for Approval (including alternative international / national standards);
2. Pump seals shall be mechanical seals for fresh water up-feed pumps, fire services water up-feed pumps, fresh water booster pumps, various fire services pumps as well as flush salt water up-feed pumps unless otherwise specified;
3. All dangerous accessible rotating and moving parts which would cause injury upon bodily contact, including but not limited to rotating shafts, couplings etc., shall be effectively guarded against contact of bodily parts with stainless steel see-through guards. All apertures shall be such that finger access to dangerous part is not possible. Removable stainless steel see-through guards shall be used for rotating and moving parts which require inspection during pump running.

FWP6.2.020.A FRESH WATER / FIRE SERVICES PUMPS

1. Casing:

   Grey cast iron to BS EN 1561 EN-GJL-250, or JIS G5501FC250.
2. Impeller:
   a. Bronze casting to BS EN 1982 CuSn5Zn5Pb5, or CuSn10; or
   b. Bronze casting to JIS H5120-CAC406, JIS H5120-CAC502A; or
   c. Austenitic chromium nickel molybdenum stainless steel casting to BS EN 10283 grade 1.4408.
3. Diffuser (detachable):

   Grey cast iron to BS EN 1561 EN-GJL-250, or JIS G5501FC250.
4. Wearing ring:
   a. Grey cast iron to BS EN 1561 EN-GJL-250, or JIS G5501FC250; or
   b. Copper-tin alloy to BS EN 1982, or phosphor bronze to JIS H5120.
5. Shaft:

   Stainless steel to BS EN 10088-3 - 1.4301, or JIS SUS 304.
6. Sleeve:

   Stainless steel same as shaft or cast bronze.
7. Bearing bush (for vertical pump only):

   Tungsten carbide or silicon carbide.
8. Bearing for horizontal pump:

   Stainless steel.
9. Pump seals:

   Mechanical seal.
10. Other parts which may be in contact with water:

Stainless steel or bronze.

11. Prior to the time of material submission for Approval, the equipment shall have proven record of reliability in local application for a minimum continuous period of 12 months to the satisfaction of the CM.

FWP6.2.025.9 FRESH WATER BOOSTER/RAINWATER IRRIGATION PUMPS

Unless otherwise specified, fresh water booster pumps / rainwater irrigation pumps shall be of stamped stainless steel vertical multi-stage in-line type which shall comply with the following requirements:

1. Casing
   a. Casing shall be made of stainless steel of AISI grade 304 or better in corrosion resistivity, accurately machined and assembled with metal-to-metal joints;
   b. Suction and discharge ports shall be in line with one another.
2. Impellers and Diffusers
   a. Impellers and diffusers shall be made of stainless steel of AISI grade 304 or better in corrosion resistivity. They shall be welded to sufficient strength, mechanically balanced, and all water ways to be finished smooth;
   b. Each stage of the pump casing, diffusers and impellers shall be identical and interchangeable;
   c. Individual impeller lock nut with guides shall be of stainless steel.
3. Shaft, Bearing and Seal
   a. Shaft shall be made of stainless steel with water lubricant bearing bush at the suction casing;
   b. Bearings shall be made of ceramic, silicon carbide, and/or tungsten carbide where appropriate;
   c. Shaft seal shall be mechanical seal.
4. Motor Bracket, Mounting Foot, Tie Bolts and Nuts
   a. Motor bracket and mounting foot shall be made of cast iron coated with epoxy paint or of stainless steel;
   b. Tie bolts shall be made of high tensile steel with epoxy paint or of stainless steel;
   c. Nuts shall be made of stainless steel.
5. Pump Strength

   The pump shall be capable of withstanding a pressure of 1.5 times of the operating pressure or minimum 16 bar;
6. Reliability
   a. The pump shall be the product of a pump manufacturer who continuously manufactured similar type of products in the past 5 years;
   b. Prior to the time of material submission for Approval, the pump model shall have proven record of reliability in local application for a minimum continuous period of one year to the satisfaction of the Contract Manager.

FWP6.2.030.A FLUSH WATER PUMPS

1. Casing:

   Stainless steel to BS EN 10283 grade 1.4408, or JIS SCS14 or SCS14A.

2. Impeller:

   Stainless steel to BS EN 10283 grade 1.4408, or JIS SCS14 or SCS14A.

3. Wearing ring:

   Stainless steel of grade 316.

4. Shaft:

   Stainless steel to BS EN10088-3 – 1.4401, or JIS SUS316.

5. Sleeve:

   Stainless steel of grade 316.

6. Diffuser (detachable):

   Stainless steel to BS EN 10283 grade 1.4408, or JIS SCS14 or SCS14A.

7. Bearing for horizontal pump:

   Stainless Steel.

8. Bearing bush for vertical pump:

   Tungsten carbide or silicon carbide.

9. Pump seals:

   Mechanical Seal.

10. Parts which may be in contact with water:

    Stainless steel of grade 316.

11. No external painting is allowed for the pump body.

12. In-service records of stainless steel pumps shall be as specified in FWP6.8.010.

FWP6.2.035.9 JOCKEY PUMPS FOR FIRE SERVICE INSTALLATION

Unless otherwise specified, jockey pumps for fire service installation shall be constructed as per fresh water/fire service pumps as specified in FWP6.2.020, or as per fresh water booster pumps as specified in FWP6.2.025.

FWP6.2.040.A SEWAGE / WASTE WATER / STORM WATER PUMPS

Sewage, waste water or storm water pumps shall be constructed of:

1. Casing

   Grey cast iron to BS EN 1561 EN-GJL-250 or JIS G5501FC250.

2. Impeller

   a. Grey cast iron to BS EN 1561 EN-GJL-250 or JIS G5501FC250; or

   b. Stainless steel to BS EN10088-3 - 1.4401, or JIS SUS316.

3. Shaft

   a. Stainless steel to BS EN 10088-3 - 1.4301, or JIS SUS 304 for waste / storm water;

   b. Stainless steel to BS EN10088-3 - 1.4401, or JIS SUS316 for sewage.

FWP6.2.050.9 BORE WELL PUMPS

1. Bore well pumps for use with corrosive water shall be constructed of the same material specification as FWP6.2.030;

2. Bore well pumps for use with non-corrosive water shall be constructed of:
   a. Casing

      Grey cast iron to BS EN 1561EN-GJL-250, or JIS G5501FC250.
   b. Impeller

      Bronze to BS EN 1982 CuSn5Zn5Pb5, or JIS H5120-CAC406.
   c. Shaft

      Stainless steel to BS EN 10088-3 - 1.4301, or JIS SUS 304.

FWP6.3 PUMP TYPES

FWP6.3.010.A HORIZONTAL SPLIT CASING PUMPS

1. Casing:
    a. The casing shall be of the volute type, of robust construction, split axially, accurately machined, with the suction and delivery connections mounting feet, bearing pedestals cast integrally in the lower half of the casing;
    b. The water passage ways shall be smooth, free from blow holes, sand pockets and other detrimental defects, to permit maximum efficiency;
    c. Means shall be provided to drain the casing;
    d. An air bleed cock at the upper most point of the casing shall also be provided;
    e. Flanges shall conform to BS EN 1092-1 or BS EN 1092-2, class PN16 or higher pressure rating as required;
    f. The casing bolts shall be of corrosion resistant high strength steel.
2. Impeller:
    a. The impeller shall have sufficient strength at the boss to withstand all possible stresses that may be imposed by the drive;
    b. The impeller shall be machined to close limits, hand finished and balanced dynamically;
    c. The impeller is to be keyed to the shaft, and fixed in an axial position by corrosion resistant fixing nuts of the same material as the shaft, threaded opposite to rotation and secured by set screws or other means;
    d. Renewable guide rings are to be provided in the casing, keyed to prevent rotation by stainless steel pin;
    e. Wearing ring shall be straight type with close tolerance to permit minimum re-circulation.
3. Shaft:
    a. The shaft shall be of sufficient size and strength to withstand the impeller weight, the torque to be transmitted as well as the axial and radial load developed in operation;
    b. Shaft sleeves, if used, shall be keyed to prevent rotation and secured against axial movement.
4. Shaft Seal:
    a. Mechanical seal for pumps shall be provided as specified in FWP6.4.030.

FWP6.3.020.A END SUCTION PUMPS

1. Casing:
    a. The casing shall be of the volute type and of robust construction;
    b. Suction and delivery flanges shall conform to BS EN 1092-1 or BS EN 1092-2, class PN16 or higher pressure rating as required;
    c. Means shall be provided to bleed the air and drain the casing;
    d. The water passage ways shall be smooth, free from blow holes, sand pockets, and other detrimental defects to permit maximum efficiency;

e. The casing bolts shall be of corrosion resistant high strength steel.

2. Impeller:

   a. The impeller shall have sufficient strength to withstand all possible stress that may be imposed by the drive;

   b. The impeller shall be of the shrouded type, dynamically balanced to ensure vibration free operation;

   c. The impeller is to be keyed to the shaft, and fixed in an axial position by corrosion resistant fixing nuts of same material as the shaft, threaded opposite to rotation and secured by set screws or other means;

   d. Renewable guide rings are to be provided in the casing, keyed to prevent rotation by stainless steel pin;

   e. Wearing ring shall be straight type with close tolerance to permit minimum re-circulation.

3. Shaft:

   a. The shaft shall be of sufficient size and strength to withstand the impeller weight, the torque to be transmitted as well as the axial and radial load developed in operation;

   b. Shaft sleeves, if used, shall be keyed to prevent rotation and secured against axial movement.

4. Shaft Seal:

   a. Mechanical seal for pumps shall be provided as specified in FWP6.4.030.

5. Close-coupled Pump:

   For installation with motor rating not exceeding 2.2 kW, close-coupled pumps may be acceptable, subject to the Approval of the CM.

FWP6.3.030.B MULTI-STAGE PUMPS

1. Casing:

   a. Unless otherwise specified, multi-stage pumps shall be of the radially split casing type, with all casing parts kept together by external tie bolts and sealed against each other by gaskets or O-rings, suction and discharge flanges shall conform to BS EN 1092-1 or BS EN 1092-2, class PN16 or higher pressure rating as required;

   b. Wearing / split ring shall be provided between impeller, detachable diffuser and pump casing;

   c. Means shall be provided to bleed the air and drain the casing;

   d. Pumps shall be vertically or horizontally mounted as specified in FWP2. For vertically mounted pump, the bearing bush shall be made of tungsten carbide or silicon carbide to minimise wear. Besides, stainless steel motor stool should be provided for vertically mounted stainless steel flush water pump.

2. Impeller:

   a. The impellers shall have sufficient strength to withstand all possible stress that may be imposed by the drive;

   b. The impellers shall be of the shrouded type, dynamically balanced using grinding machine to ensure vibration free operation;

c. The impellers shall be keyed to the shaft and fixed in an axial position by corrosion resistant fixing nuts of same material as the shaft, threaded opposite to rotation and secured by setscrews or other means.

3. Diffuser (detachable):

   a. The diffuser should be the same material as casing with sufficient strength. It should be so designed to have even water passage to avoid turbulence;

   b. Diffuser shall be detachable and prevented from rotation by an acceptable means;

   c. A pin if so designed to withstand the diffuser from rotation shall be an integral part of the casing. Detachable pin fixed on the casing shall not be allowed.

4. Shaft:

   a. The shaft shall be of sufficient size and strength to withstand the impeller weight, the torque to be transmitted as well as the axial and radial load developed in operation;

   b. Shaft sleeves, if used, shall be keyed to prevent rotation and secured against axial movement.

5. Shaft seal:

   a. Mechanical seal for pumps shall be provided as specified in FWP6.4.030.

6. Stage:

   a. Unless otherwise specified, the maximum number of stages shall not exceed twelve (12).

7. Efficiency:

   a. Multi-stage pumps shall be selected with efficiency as specified in FWP6.1.040. When appropriate pumps are not available, pumps with lower efficiency may be acceptable, subject to the Approval of the CM.

FWP6.3.040.A SUBMERSIBLE SUMP PUMPS

1. Stage:

   Pump shall be of single stage centrifugal type suitable for wet sump installation.

2. Casing:

   a. The casing shall be of the volute type and robust construction;

   b. The water passage ways shall be smooth and free from blow holes and sand pockets;

   c. Casing bolts shall be of stainless steel.

3. Impeller:

   a. For sewage pumps, the impeller shall be of the non-clog type designed for handling sewage containing solid particles up to 60 mm diameter, unless otherwise specified;

   b. For waste or storm water pumps, smaller solid passage impeller with suction strainer will be acceptable;

   c. The impeller shall be dynamically balanced for all hydraulic loads within the pumps operating range and shall be keyed to the shaft and secured in an axial position by corrosion resistant fixing nuts;

   d. Renewable wear rings shall be provided and shall be keyed to prevent rotation by stainless steel pin.

4. Shaft:
    a. The pump shall be of mono-block type with the impeller keyed to the motor shaft;
    b. The shaft shall be of sufficient size and strength to withstand the impeller weight, the torque to be transmitted as well as the axial and radial load developed in operation.
5. Shaft seal:
    a. Double mechanical seal lubricated by an oil chamber shall be provided;
    b. Lower seal faces shall be of tungsten carbide or other Approved hard metal;
    c. All components shall be of corrosion resistant materials with high quality stainless steel spring;
    d. Lower seal shall be protected from ingress of grits.
6. Bearing:
    a. The bearings shall be of the ball or roller type, oil or grease lubricated;
    b. Bearings shall have a minimum re-grease interval of 5000 hours.
7. Motor:
    a. Each pump shall be closely coupled to the totally enclosed built-in submersible electric motor and conform to FWP11 of this Specification. Enclosure type of IP68 shall be used;
    b. Built-in thermal protection to BS EN 60034-11 shall be provided for motor of rating exceeding 7.5 kW.
8. Cable:
    a. The cable used inside sump shall be multi-core submersible cable and shall be of sufficient length without connections inside the sump;
    b. Cable entry to the junction chamber of the motor shall be provided with strain relief clamp and seal gland.
9. Installation and accessories:
    a. The pump shall be capable of being raised from or fixed back to the sump without the need to enter or drain the sump;
    b. For installation with motor rating exceeding 2.0 kW, discharge connection and stainless steel slide rails and lifting chain shall be provided for automatic connection of the pump to the discharge piping;
    c. For smaller installations, lifting chain and flexible hose-coupling connection will be acceptable;
    d. All bolts, nuts and fasteners shall be of stainless steel and electric cable entry shall be of watertight construction.
10. Surface treatment:

    All surfaces of pump and motor in contact with the fluid handled shall be treated with anti-corrosion primer or paint for additional protection.

FWP6.3.050.9 MULTI-STAGE SUBMERSIBLE PUMPS

1. Construction:

a. The pump and motor shall be of small diameter profile to suit the bore well size specified; arranged vertically with the discharge connection on top, followed by the pump, the suction port with strainer and the motor at the bottom;

b. The assembly is to be submerged below the lowest pumping level and suspended in the well by the discharge pipe;

c. Pump shall also be suitable for horizontal installation if specified in FWP2.

2. Casing:

a. Pump shall be made up of independent stage casing bowls, complete with diffuser vanes or inter-stage piece and sleeve bearing for the pump shaft and easily removable for servicing;

b. The water passage way shall be smooth to provide best efficiency.

3. Impeller:

a. Impeller shall be of axial, enclosed radial or mixed flow type, machined to close limit with smooth water passage and dynamically balanced;

b. The impellers shall be secured to the shaft by taper lock bushes or keys and fixed in the correct axial position by distance sleeve, shaft sleeves or the extended boss of the impeller, all keyed to prevent rotation;

c. Renewable guide rings shall be provided in the pump casing;

d. Guide rings shall be of straight type providing close radial running clearance.

4. Shaft and sleeve bearings:

a. Pump shaft shall be carried by sleeve bearings at both ends and intermediate stage positions, all lubricated by the fluid handled;

b. Downthrust shall be transmitted to and carried by the motor shaft, however, the pump shall be designed to carry momentary upthrust encountered under normal operation.

5. Motor:

a. The submersible motor shall be a water-fitted squirrel cage induction motor and conform to FWP11;

b. The motor shaft shall be connected to the pump shaft by a keyed sleeve coupling;

c. A thrust bearing shall be located at the bottom end of the motor to absorb the axial thrust generated by the pump.

6. Cable:

a. The cable inside the bore well shall be multi-core submersible cable and shall be of sufficient length without connections inside the well;

b. The cable shall be secured to the discharge riser by corrosion resistant clips.

7. Accessories:

a. Each pump shall be provided with a non-return valve immediately connected to the discharge of the pump;

b. A pipe support clamp shall be provided at the top of the bore well for holding the discharge pipe and the pump.

FWP6.3.060.N DRY PIT SUMP PUMPS

1. Stage:

Pump shall be of single stage centrifugal type suitable for dry sump installation.

2. Casing:
    a. The casing shall be of the volute type and robust construction;
    b. The water passage ways shall be smooth and free from blow holes and sand pockets;
    c. Casing bolts shall be of stainless steel.
3. Impeller:
    a. For sewage pumps, the impeller shall be of the non-clog type designed for handling sewage containing solid particles up to 60 mm diameter, unless otherwise specified;
    b. For waste or storm water pumps, smaller solid passage impeller with suction strainer will be acceptable;
    c. The impeller shall be dynamically balanced for all hydraulic loads within the pumps operating range and shall be keyed to the shaft and secured in an axial position by corrosion resistant fixing nuts;
    d. Renewable wear rings shall be provided and shall be keyed to prevent rotation by stainless steel pin.
4. Shaft:
    a. The pump shall be of mono-block type with the impeller keyed to the motor shaft;
    b. The shaft shall be of sufficient size and strength to withstand the impeller weight, the torque to be transmitted as well as the axial and radial load developed in operation.
5. Shaft seal:
    a. Double mechanical seal lubricated by an oil chamber shall be provided;
    b. Lower seal faces shall be of tungsten carbide or other Approved hard metal;
    c. All components shall be of corrosion resistant materials with high quality stainless steel spring;
    d. Lower seal shall be protected from ingress of grits.
6. Bearing:
    a. The bearings shall be of the ball or roller type, oil or grease lubricated;
    b. Bearings shall have a minimum re-grease interval of 5000 hours.
7. Motor:
    a. Each pump shall be closely coupled to the totally enclosed built-in air-cooled submersible electric motor and conform to FWP11 of this Specification. Enclosure type of IP68 shall be used;
    b. Motor shall be capable of tolerating a maximum continuous starting frequency of 10 times per hour without overheating;
    c. Motor shall be equipped with built-in cooling system which enable it to operate continuously at its rated current in dry conditions.
8. Cable:
    a. The cable used inside sump shall be multi-core submersible cable and shall be of sufficient length without connections inside the sump;

b. Cable entry to the junction chamber of the motor shall be provided with strain relief clamp and seal gland.

9. Installation and accessories:

   a. The pump shall be arranged with flanged connection to the discharge pipe;

   b. Each pump shall be provided with guide bars, cable supports and lifting chains;

   c. The guide bars shall be properly installed and the alignment shall not exceed the tolerance as required by the manufacturer or obstruct lifting up of the pump;

   d. Proprietary supporting base shall be provided for dry sump installations;

   e. All bolts, nuts and fasteners shall be of stainless steel and electric cable entry shall be of watertight construction.

10. Surface treatment:

    All surfaces of pump and motor in contact with the fluid handled shall be treated with anti-corrosion primer or paint for additional protection.

FWP6.4 BEARINGS AND SEALS

FWP6.4.010.A PUMP BEARINGS

1. All bearings shall be of types readily obtainable;
2. For horizontal mounted pumps, the bearings shall be of the sealed ball or roller type, oil or grease lubricated;
3. Means shall be provided to protect the bearing from ingress of dust and water;
4. Appropriate lubrication nipple / connections or oiler sump with drain plug shall be provided for maintenance purpose;
5. For fresh water pumps, the bearing housings shall be cast iron. For flush water and rainwater pumps, the bearing housing and cover shall be stainless steel to BS EN 10283 grade 1.4408, or JIS SCS14 or SCS14A. The bearing housing and covers shall be easily removable for service;
6. The bearing cover shall provide a suitable seal to contain grease / oil in the housing;
7. For vertical pumps, the bearing bush (thrust bearing) shall be made of tungsten carbide or silicon carbide.

FWP6.4.020.X DELETED

FWP6.4.030.9 PUMP SEALS

1. For various fire services pumps and fresh water pumps, the materials of mechanical seal heads and seal seats, and the materials of seal faces, shall be suitable for conveying fresh water at a speed of 2900 rev/min for non-stop running up to 6 hours unless otherwise specified;
2. For flush water up-feed pumps, the materials of mechanical seal heads and seal seats, and the materials of seal faces, shall be suitable for conveying flush salt water at a speed of 2900 rev/min for non-stop running up to 6 hours unless otherwise specified;
3. For sewage and rainwater pumps, the materials of mechanical seal heads and seal seats, and the materials of seal faces, shall be suitable for conveying waster water at a speed of 2900 rev/min for non-stop running up to 6 hours unless otherwise specified.

FWP6.5 FITTINGS AND ACCESSORIES

FWP6.5.010.9 FITTINGS

Each pump shall be fitted with:

1. Valves: suction and discharge valves, strainer, and non-return valves as shown on the Drawings;
2. Cocks: suction and discharge gauge cocks of 10 mm BSP female thread;
3. Pressure gauges: pressure gauge as FWP11.6.060 complete with cock and coiled connector as sub-clause (2) above at the suction and discharge side of each surface mounted pump;
4. Gland drain where applicable: 25 mm or larger uPVC gland drain pipe which shall discharge to the nearest drain or waste pipe.

FWP6.5.020.9 COUPLINGS

1. Each pump, except "close-coupled" type, shall be fitted with a secure coupling and shaft guard. Mild steel coupling can be provided for stainless steel flush water pumps;
2. The coupling shall be of semi-flexible steel pin and rubber bush type, accurately aligned on site;
3. The Sub-contractor shall be required to demonstrate correct alignment prior to handover of the installation;
4. The couplings shall be totally enclosed by stainless steel see-through guard to prevent any direct contact of bodily parts.

FWP6.5.030.9 LUBRICATION FITTINGS

Each pump shall be fitted with appropriate lubrication fittings, where necessary.

FWP6.5.040.9 AIR BLEED COCKS

Each surface mounted pump shall be equipped with test and/or air bleed cocks of the high pressure type.

FWP6.5.050.9 LIFTING EYES

Vertical pumps of more than 200 kg in weight shall be provided with lifting eyes to facilitate maintenance and future replacement.

FWP6.5.060.9 IDENTIFICATION

A serial number for identification purpose should be indelibly marked or label fixed on the pump casing. An arrow indicating the normal direction of rotation shall be cast clearly on the pump casing or a brass arrow and plate engraved with the words "Direction of Rotation" shall be screwed to the pump casing near the coupling.

FWP6.5.070.9 MOTORS AND WIRING

Electrical motors and wiring shall comply with FWP11 and the relevant sections of the HKHA Electrical Installation Specification.

FWP6.6 INSTALLATION

FWP6.6.010.9 GENERAL

All pumps shall be installed as per manufacturers' recommendations and instructions and shall be carefully levelled and aligned by competent specialist before start-up.

FWP6.6.020.9 BASEPLATE

1. The pump and motor for all horizontal pumpset shall be mounted on a single baseplate constructed of stainless steel of grade 316; vertical pumpset shall be provided with integral base suitable for direct mounting onto the pump plinth;
2. The pump and motor of horizontal pumpset with motor rating exceeding 22 kW shall be secured with jack bolts or dowel pins as recommended by the motor manufacturer;
3. The baseplate shall be a stainless steel plate welded on a stainless steel channel base frame. The stainless steel plate shall not be deformed after welding;
4. The baseplate shall be sufficiently rigid and properly supported such that it will not deflect under the weight of the pump and motor. The pump set and baseplate shall be fixed in place by sufficient number of suitably sized anchor bolts cast or grouted in the concrete inertia block or pump base.

FWP6.6.030.9 VIBRATION ISOLATION

1. Pumpsets shall be provided with Approved vibration isolators to prevent the transmission of vibration to the building structure;
2. Vibration isolators shall be carefully selected and installed in accordance with manufacturers' recommendations and instructions;
3. For horizontal pumpsets, spring isolators shall be provided for all installations;
4. For vertical pumpsets, isolation cork shall be acceptable for all installations;
5. Isolation cork shall be in the form of cork panels installed under and around the whole concrete pump base. Cork panels shall be at least 50 mm thick and shall have a density suitable for the load they carry. Cork panels shall be entirely covered by waterproof paper prior to pouring of concrete for the pump base and after the pump base is formed, all exposed cork shall be sealed by mastic or bitumen;
6. Anti-vibration spring isolators shall have a rated deflection of not less than 38 mm unless otherwise specified. Each spring isolator shall consist of one or multiple steel helical coil springs, seated inside a robust cast iron or steel housing with an external-accessible adjustment bolt and lockout for levelling;
7. Spring isolators shall be laterally stable. Spring diameter shall be no less than 0.8 of the compressed height of the spring at rated load. Spring isolators shall have a minimum additional travel to solid equal to 25% of rated deflection. They shall have identification markings / colour codes for identification of rated load;
8. Spring isolators shall be integral with non-adjustable neoprene sponge inserts between the projections of the upper and lower housing. Non-skid neoprene acoustical isolation pad of no less than 6 mm thick shall be properly bonded to the underside of the lower housing of the isolator;
9. Information as required in Clause 11 of BS ISO 2017-1 shall be submitted for Approval;

10. The Sub-contractor shall advise the Main Contractor of the detailed requirements of the fabricated steel framed reinforced concrete inertia block for pumpset, which shall be provided by the Main Contractor to decrease the vibrational motion. Inertia block shall have a minimum thickness of 150 mm and weight 1½ times that of the pumpset. If there is additional piping rigidly connected to the pump suction inlet and / or discharge outlet before the flexible connectors, the inertia block shall be large enough to accommodate the support to be provided for this piping to prevent its load being imposed onto the pump where applicable;

11. Each pumpset shall be connected to its pipework with flexible connectors to prevent the transmission of vibration to the pipework, and the flexible connectors should be close to the pump as far as practicable;

12. Supports for piping between each pumpset and its flexible connectors shall be properly mounted on the inertia block as required whilst supports for piping after the flexible connectors shall be attached to structural members such as beams, columns or floating / ground floor slabs in preference to walls and shall be provided with rubber or neoprene pads for vibration isolation;

13. For horizontal split-casing pumpset mounted on inertia block with spring isolators for vibration isolation, bends should be used after the flexible connectors, and the piping after the flexible connectors shall be properly supported as specified above and shall not impose additional load onto the pumpset and inertia block;

14. The completed pump installation, when in operation, shall cause no noticeable or objectionable vibration transmission to any part of the building structure. In the event that undue vibration occurs, the Sub-contractor shall rectify the installation or replace the equipment as necessary at his own expenses to the satisfaction of the Contract Manager.

FWP6.7 TESTING AND CERTIFICATION

FWP6.7.010.9 TEST

Pumps shall be type-tested in accordance with the requirement of BS EN ISO 9906 or equivalent. Performance curves under tests shall be submitted for Approval.

FWP6.7.015.9 PROVISION OF TEST PIECE FOR STAINLESS STEEL FLUSH WATER PUMP AND ATTENDANCE FOR INSPECTION AND TESTING

1. A test piece, forming an integral part of the pump casing shall be provided for each stainless steel flush water pump. The size and shape of the test piece shall not be smaller than 25 mm diameter x 150 mm length. The test piece shall be suitable for conducting the following tests:
   a. Tensile test;
   b. Chemical composition analysis.
2. The Sub-contractor shall provide assistance, instruments, machines, labour and other facilities necessary for cutting the test piece, open-up inspection and examining the quality of pump. The pump shall be randomly selected by the the Contract Manager. The Sub-contractor shall arrange such inspection in his workshop or elsewhere if Approved;
3. The expense involved for complying with the above requirements, including any transportation costs, tests etc. shall be borne by the Sub-contractor;
4. The Sub-contractor shall cut the test piece in the presence of the Contract Manager or his representatives and send it to an accredited laboratory for carrying out the chemical composition analysis and tensile test. The laboratory shall be accredited for testing such type of alloy under the “Metallic Materials” or “Steel” sub-category of the “Construction Materials” category in the HOKLAS list;
5. The pumps shall be free from blow holes, sand pockets, cracks, welding, pitting, hammering marks, excessive machining / wearing and other detrimental defects;
6. If the selected pump fails either the tensile test or chemical composition analysis as mentioned in sub-clause (1) above or the open-up inspection, the entire batch of stainless steel flush water pumps shall be rejected. The Contract Manager may at his discretion to call for further open-up inspection and material test on another pump as appropriate. The cost so arisen will be borne by the Sub-contractor;
7. For the rejected pumps, the Sub-contractor shall arrange free replacement of them in accordance with the Conditions of Contract, and no extension of time to the Contract period will be allowed.

FWP6.7.020.9 PUMP CERTIFICATES

1. Each pump shall be provided with a certificate issued and signed by the manufacturer. The certificate shall clearly record the pump model, serial number and the materials of the casing, shaft and impeller;
2. Each pump or each batch of pumps shall also be provided with a certificate on their place of manufacture. The certificate shall be issued by a recognized Chamber of Commerce of the place of manufacture concerned.

FWP6.8 DOCUMENTATION

FWP6.8.010.9 IN-SERVICE RECORDS FOR STAINLESS STEEL FLUSH WATER PUMPS

1. When instructed by the Contract Manager, the Sub-contractor shall submit full details and particular of in-service records established in local application for the pump offered to substantiate conformance with the Specification. Failure to submit full and complete details and particulars of in-service records or failure to allow sufficient time for site inspection may result in rejection of the pump offered;
2. The in-service records shall contain the following information:
    a. Place of manufacture of the materials and parts of the pump;
    b. Rated capacity of the pump, which shall not be less than 6 l/s and 70 m at 1450 rpm unless otherwise accepted by the Contract Manager;
    c. Period of continuous and satisfactory operation and maintenance which shall be at least six months prior to the time of tender submission; and
    d. Provision of a test piece for materials composition and tensile test and open-up inspection.

FWP6.8.020.A WARRANTY FOR STAINLESS STEEL FLUSH WATER PUMPS

1. Each stainless steel pump shall be supplied with a certificate of warranty issued by its manufacturer guaranteeing to provide free replacement for defective parts, components or the pump as a whole against inferior materials, faulty design and/or workmanship for a period of five years commencing from the certified date of completion of the Section of the Works within the scope of which the pump is installed. Consumables items such as bearing, wearing ring and sleeve are excluded from the warranty. The Sub-contractor shall submit the content and format of the letter of warranty for Approval before shipment;
2. Each pump shall also be supplied with a certificate issued by the manufacturer stating the chemical composition for the materials used for the pump casing, impeller, shaft and diffuser etc.;
3. Each pump shall be fixed with a metal nameplate showing the manufacturer's name, serial number, pump head, flow rate, speed, rated power absorbed, material used and warranty expiry date. The Sub-contractor shall be responsible for collecting and punching the information on the nameplate;
4. The Sub-contractor shall also submit an undertaking issued by the local supplier of the pump guaranteeing to provide the following:
    a. Free labour and materials for replacing any parts, components or the pump as a whole found to be defective except consumables items;
    b. Free on-site technical support during testing and commissioning and the 5-year warranty period..

FWP7 HYDRANT/HOSEREEL SYSTEM EQUIPMENT AND FOAM INLET

FWP7.1 SYSTEM EQUIPMENT 2

FWP7.1.010.9 GENERAL REQUIREMENT 2
FWP7.1.020.A FIRE SERVICE INLETS AND HYDRANT OUTLETS 2
FWP7.1.030.A FIRE SERVICE INLETS 3
FWP7.1.040.9 HYDRANT OUTLETS 3
FWP7.1.050.9 VENTING AND DRAINING 4
FWP7.1.060.9 EARTHING OF RISING MAINS 4
FWP7.1.070.A PRESSURE REDUCING HYDRANT OUTLETS 4
FWP7.1.080.9 HOSEREELS 5
FWP7.1.100.A PLASTIC HOSEREEL SHUT-OFF NOZZLE 6
FWP7.1.110.9 OPERATION INSTRUCTION AND WARNING NOTICE FOR HOSEREEL 6
FWP7.1.120.9 CABINETS 7
FWP7.1.130.9 INSTALLATION MATERIALS 7
FWP7.1.140.9 PIPEWORK INSTALLATION 7
FWP7.1.150.A SUPPLY TANK, FIXED FIRE / INTERMEDIATE BOOSTER PUMPS, ETC 7
FWP7.1.160.A CONTROLS 8
FWP7.1.170.9 STOP VALVES MANAGEMENT SYSTEM 8

FWP7.1 SYSTEM EQUIPMENT

FWP7.1.010.9 GENERAL REQUIREMENT

1. The hydrant / hosereel system and the individual equipment installations shall comply with the Fire Services CoP, FSD Requirements and Circular Letter;
2. The Fire Service inlets, hydrant outlet valves, hose reels, related equipment fittings shall be approved by FSD;
3. Copies of valid Approval documents issued by FSD and / or product certification bodies recognized by FSD for the Fire Services inlets, hydrant outlets and hose reels shall be produced for the CM's inspection;
4. Copies of valid Approval documents issued by the Water Authority and test certificates / reports issued by the certification bodies or accredited laboratories acceptable to the Water Authority for the Fire Service inlets, hydrant outlets and hose reels shall be produced for the CM's inspection;
5. Higher standards wherever required are described elsewhere in this Specification or on the Drawings;
6. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the fire services inlet, fire hydrants and hose reels delivered to the site or installed.

FWP7.1.020.A FIRE SERVICE INLETS AND HYDRANT OUTLETS

1. The Fire Service inlets and hydrant outlets shall conform to BS 5041-1 and be of copper alloy construction except for the handwheel which shall be of cast iron or hard aluminium alloy;
2. The inlet and outlet fittings shall be supplied and manufactured to the quality of material, construction, and dimensions as detailed in the British Standard Specification listed:
   a. Globe & check valve of service rating 1000 kPa to BS 5154 or BS EN 12288;
   b. Male and female instantaneous terminals to BS 336;
   c. All fittings shall be tested to at least 2000 kPa.
3. Each hydrant outlet shall be tested at factory in accordance with manufacturer's quality assurance / control system. In particular, testing on the proper connection of hydrant outlet (female coupling) with male delivery hose coupling shall be carried out for each hydrant outlet to verify that the outlet connection is manufactured to BS 336. The dimensions of the male delivery hose coupling for the testing shall comply with BS 336. A water resistant and indelible label bearing the name or logo of the manufacturer and the signature of their quality controller shall be stuck at a conspicuous position on the body of hydrant outlet to denote the outlet has passed the manufacturer's quality assurance / control system;
4. After installation, each hydrant outlet shall be checked at Site by the Sub-contractor and witnessed by the CM or his representatives for verifying whether it can be properly connected to a pair of calibrated male delivery hose couplings provided by the Employer and of dimensions to the lower and upper limits specified respectively in BS 336. Any installed hydrant outlet which cannot pass the site check shall be removed and replaced;
5. The record of site check for individual hydrant outlets shall be included in the testing and commissioning report of the O&M Manual.

FWP7.1.030.A FIRE SERVICE INLETS

Fire service inlets shall:

1. Be connected to the main riser and located as shown on the Drawings;
2. Be of twin type, comprising screw-down globe type stop valve with male screwed outlet of suitable bore and two horizontal male instantaneous inlet connections, complete with integral spring loaded non-return valves;
3. Have a separate non-return valve behind the inlets;
4. Have a pressure gauge connected between the downstream side of the inlet and the upstream side of the non-return valve;
5. Have a metal plate with minimum 70 mm high marked "FIRE SERVICE INLET 消防入水掣" or "SPRINKLER INLET 花灑入水掣" in RED letters in both English and Chinese characters using raised letterings, hung on each of inlet;
6. Have a durable label in English letters and Chinese characters of not less than 10 mm and 15 mm respectively for indicating the floor level of the fixed fire pumps and intermediate booster pumps, where applicable. The wordings in the label shall be red on white background or vice versa;
7. For intermediate booster pump systems only, a waterproof box comprising pump start and stop push buttons; pump status indication lights (comprising “power supply on”, “pump running” and “pump failed” indicators for each pump) and alarm buzzer shall be provided in the FSI cabinet for fire hydrant / hosereel system; (Details shall be submitted for the CM’s approval prior to installation.);
8. Have an enclosure constructed by the Main Contractor. The Sub-contractor shall furnish the Main Contractor with all necessary dimensional information to enable there shall be an all-round clearance of not less than 100 mm between any part of the inlet and the enclosure.

FWP7.1.040.9 HYDRANT OUTLETS

Hydrant outlets shall:

1. Be of single type;
2. Comprise screw-down globe type stop valve with male screwed inlet of suitable bore and female instantaneous outlet;
3. Have the stop valve controlled by a handwheel to close in clockwise rotation with the direction of open and close engraved on the wheel of the valve in both English and Chinese characters;
4. Have outlet branches inclined 70 degrees from the centre line of the handwheel;
5. Have release plunger located at the side of each outlet branch for locking any connecting male delivery hose coupling;
6. Have the letters “HKHA” and the name of the estate and the phase number together with the batch number (e.g. SMP5-1 for Sau Mau Ping Phase 5 batch 1), or a suitable description of the Contract approved by the Contract Manager, indelibly marked on a conspicuous surface of the copper lock nut of the release plunger and on the body of the valve but not on the handwheel for identification;
7. Be selected to carry out and report on dimensional checking and chemical composition analysis against inferior materials and faulty workmanship, as follows:
    a. One hydrant outlet from each batch delivered to site or two hydrant outlets if the batch quantity exceeds 200, shall be randomly selected by the Contract Manager or his representative and then sent to an accredited laboratory to carry out the following tests:

i. Dimensional checking of the connector section of the hydrant outlet against the matching delivery hose connector specified in BS336. The laboratory shall be accredited to carry out dimensions measurement under the "Specific Test or Property Measured" for a material or product of the "Construction Materials" or "Calibration Services" category in the HOKLAS list;

ii. Chemical composition analysis for the body of the hydrant outlet against the copper alloy specified in BS5041-1. The laboratory shall be accredited for testing such type of alloy under the "Metallic Materials" sub-category of the "Construction Materials" category in the HOKLAS list.

b. The expense involved, including any transportation cost, checking and testing, etc. shall be borne by the Sub-contractor;

c. If the selected hydrant outlet fails in the dimensional checking and / or the chemical composition analysis, the Contract Manager or his representative may at his / her discretion call for the same checking and testing on another hydrant outlet. The cost so arisen shall be borne by the Sub-contractor;

d. If the second hydrant outlet still fails in the checking and testing mentioned in c. above, the entire batch of the hydrant outlets shall be rejected. The Sub-contractor shall arrange replacement free of charge to the Employer and no extension of time to the contract period will be allowed. The batch of rejected hydrant outlets shall not be re-used in any HKHA's projects.

FWP7.1.050.9 VENTING AND DRAINING

All hydrant risers, shall be provided with automatic air relief valves of 25 mm size at the highest points and drain valves at the lowest points of the systems.

FWP7.1.060.9 EARTHING OF RISING MAINS

Rising mains shall be effectively electrically earthed and joints, which are not provided with electrical continuity, shall be bonded. Earthing and bonding shall be in accordance with the Electrical CoP.

FWP7.1.070.A PRESSURE REDUCING HYDRANT OUTLETS

1. Pressure reducing hydrant outlets shall be adopted at locations where the running pressure at the hydrant outlets exceeds 700 kPa. The pressure at any hydrant outlet even at no flow situation shall in no case exceed 850 kPa;

2. In accordance with the Drawings, pressure reducing hydrant outlet shall be either:

   a. Self-contained type without the use of parity valve, which shall be capable of reducing the running pressure and satisfying the flow test requirements. The pressure reducing mechanism of the valve shall be located downstream of the valve seat. Pressure reduction shall be achieved by means of hydraulic pressure balancing with metal diaphragm. The 100% effectiveness pressure reducing performance shall be maintained at all time of operation; or

   b. Achieved by installation of parity valve in conjunction with the hydrant outlet. The parity valve shall have a relief connection to drain of not less than 40 mm in diameter. Material of parity valve body shall be same as that of hydrant outlet. The cover of the parity valve shall be indelibly marked with the letters "HKHA" and the name of the estate and the phase number (e.g. SMP5 for Sau Mau Ping Phase 5) or a suitable description of the Contract approved by the CM.

3. Specification for hydrant outlets in Clauses FWP7.1.020 and FWP7.1.040 shall also be applicable to the pressure reducing hydrant outlets;

4. In addition to the dimensional checking and chemical composition analysis as described in FWP7.1.040, the specimen(s) selected from each delivery batch shall also undergo water flow rate and outlet pressure tests in accordance with BS 5041-1. The test results shall be documented and reported.

FWP7.1.080.9 HOSEREELS

1. Hosereels shall be type-tested to BS EN671-1 or other recognized standard(s) and with FSD acceptance letter.
2. A hosereel shall be :
   a. of fixed or swinging type to suit site installation conditions or as indicated on the Drawings;
   b. drip free for the entire assembly;
   c. with drum to be constructed of diecast light alloy, or spindle of rigid construction with equivalent robust material(s), hydraulically balanced, free from denting and twisting, and finished red colour in enamel or epoxy powder coated;
   d. with a device to prevent overrun of the hose and a glandless centre seal at the hub and shaft;
   e. with permanently and firmly connected reinforced rubber or PVC hose tubing of 30 m in length and 19 mm in internal bore to be capable of withstanding a bursting pressure of not less than 2700 kPa and connected to hose reel shut-off nozzle as specified in FWP7.1.100;
   f. unless otherwise specified, with two-way ball valve as hose reel control valve, supported with WSD acceptance letter;
   g. with hose guide complete with nylon or similar runners adjacent to fixed type hose reel to enable the hose to be run out in any direction as required;
   h. with wall-mounting bracket to be capable of supporting the whole weight of the hose reel and tubing for the fixed type hose reel;
   i. with support brackets and swinging arm to enable the whole hose reel assembly to be swung to 180° in a horizontal plan for the swinging type hose reel;
   j. with two nos. of 30 mm wide white ring marking of completed circumference with durable paint indelibly marked on hose tubing, making the first marking at the connection point of the hose tightened to the hose reel drum/spindle and the second marking at the required minimum length of the hose, i.e. if the farthest point of the hose reel protected area is 24 m, the second marking shall be at 24 m measured from that of the first marking;
   k. with an operation instruction notice affixed to the wall in a prominent position adjacent to the hose reel or affixed on the outer surface of the hose reel door. If the hose reel is located in a recess to which a door is fitted, such notice shall be affixed immediately below the words 'FIRE HOSE REEL 消防喉轆' on the outer surface of the door. The operation instruction notice shall be submitted for Approval prior to installation.
3. The Sub-contractor shall coordinate with the Main Contractor to position a metal/plastic striker and a glass fronted box for housing the hose reel shut-off nozzle so that no undue obstruction will be imposed to the free use of the hose reel. The glass fronted box and the striker shall be supplied and installed by the Main Contractor.

FWP7.1.100.A PLASTIC HOSEREEL SHUT-OFF NOZZLE

1. Hosereel nozzle shall have a not less than 4.5 mm orifice and be fitted with a lever-operated two-way valve to open or shut off the jet. The valve shall not be spring-loaded;
2. The nozzle shall be constructed of PVC or high quality ABS plastics in red colour or other materials as approved by the CM. The surface of the nozzle shall be smooth;
3. The nozzle shall be coupled to the F.S. hose by at least four holding threads and further secured by means of a worm-drive clip or other devices as approved by the CM;
4. The nozzle shall be indelibly marked with the manufacturer's name or trademark for identification purpose;
5. Under the operating condition as specified in the Fire Services CoP issued by FSD, the nozzle shall be capable of delivering water in the form of a water jet with flow rate not less than 24 litre/min. and the range of the jet not less than 6 metres as in accordance with BS EN 671-1;
6. The nozzle shall be tested according to the following procedures:
   a. The nozzle is connected to a 19 mm diameter (internal bore) F.S. hose and secured by means of a worm-drive clip;
   b. Water is supplied to the nozzle with 8.5 bar pressure at inlet of the nozzle;
   c. Fully open the nozzle cock by hand for 5 second and then fully close the nozzle cock by hand for 5 second;
   d. Repeat the cycle of open / close the nozzle cock in item (6)(c) above for 500 times.
7. During the test specified in sub-clause (6) above, there shall not be any sign of water leakage, crack or damage in any part of the nozzle assembly, including connection to the F.S. hose;
8. The nozzle shall be approved by FSD. Type test reports / certificates from an independent and reputable laboratory for verification of compliance with the test requirement in sub-clauses (6) and (7) above shall be produced upon request.

FWP7.1.110.9 OPERATION INSTRUCTION AND WARNING NOTICE FOR HOSEREEL

1. The notice shall be clearly marked with the following standard wording in English and Chinese characters of at least 5 mm high in red lettering on white background. The wording of the Chinese characters shall follow Fire Services CoP and the Water Authority Circular Letter as below.

   TO OPERATE FIRE HOSE REEL

   使用消防喉轆

   (1) BREAK GLASS OF THE FIRE ALARM CALL POINT

   打爛火警鐘玻璃 (or)

   ACTUATE FIRE ALARM CALL POINT

   按動火警鐘掣

   (2) OPEN CONTROL VALVE BEFORE RUNNING OUT HOSE

   先開啟來水掣，再拉出膠喉

   (3) TURN ON WATER AT NOZZLE AND DIRECT JET AT BASE OF FIRE

將喉咀掣開啟，然後射向火之底部

(NOT SUITABLE FOR ELECTRICAL FIRES)

(不適用於電火)

消 防 用 水

嚴禁作其他用途

USE OF WATER FROM FIRE SERVICES

FOR PURPOSES OTHER THAN FIRE

FIGHTING IS STRICTLY PROHIBITED

水務監督辦事處 Office of the Water Authority

2. The notice shall be made of 3 mm thick plastic material with engraved characters.

FWP7.1.120.9 CABINETS

1. Cabinets for the housing of fire service inlets, hydrant outlets, and hosereels, if specified, shall be provided by the Main Contractor;
2. The Sub-contractor shall furnish all necessary information to enable these cabinets to be designed and constructed including proposed dimensions for the cabinets and the dimensions, weights, etc. of the apparatus supplied by him;
3. Requirements for any special housings for electrical controls shall be included;
4. It should be noted that space may be required in hosereel cabinets for portable equipment, as indicated elsewhere;
5. Where hosereels are located in recesses to which doors are fitted, the doors (whether glazed or otherwise) shall be painted in red with the words "FIRE HOSEREEL 消防喉轆" prominent and easily identifiable from all lines of sight in the surrounding. The lettering of wording shall be of at least 50 mm high;
6. In the case of doors which can only be opened by pushing in first, they shall also be annotated "PUSH TO OPEN 推開";
7. Hosereel cabinets fitted with doors shall not be locked but shall be easily identified and opened in time of emergency.

FWP7.1.130.9 INSTALLATION MATERIALS

All installation materials, fixing bolts etc. for mounting the equipment except for the nozzle box and striker inside the cabinets or on walls as applicable shall be provided by the Sub-contractor.

FWP7.1.140.9 PIPEWORK INSTALLATION

The installation shall include all pipework and fittings fully installed as indicated on the drawings and as specified in Worksections FWP2 and FWP3 of this Specification.

FWP7.1.150.A SUPPLY TANK, FIXED FIRE / INTERMEDIATE BOOSTER PUMPS, ETC

Supply tank, fixed fire / intermediate booster pumps, etc., where indicated, shall comply with the general requirements of Worksections FWP5 and FWP6 of this Specification.

FWP7.1.160.A CONTROLS

Fire hydrant / hose reel system controls, including control of fixed fire / intermediate booster pumps, shall be as detailed in Worksection FWP2 of this Specification.

FWP7.1.170.9 STOP VALVES MANAGEMENT SYSTEM

1. The Subcontractor shall provide stop valves management systems as per FSD's requirements for all fire services systems including FH/HR system and other fixed installations such as foam system and street fire hydrant system;
2. Stop valves in fire services systems shall refer to all essential valves which have to be kept open for proper functioning of the fire services systems;
3. A stop valves management system (SVMS) shall comprise the following:
    a. The maintenance services and operation of the stop valves for each fire services system shall be maintained and recorded as required in the "Log Book" provided and kept by the Estate Management of the employer after handover;
    b. Each stop valve shall be provided with a pull-up tamper-proof seal security tag using steel wire-rope with pad lock and labelling with unique tag number and a durable warning label placed inside a durable and readable plastic bag;
    c. Each stop valve shall have an identification label with estate code, block code, floor number and valve number assigned by the Estate Management for easy identification and traceability of records. For SVMS hidden inside false ceiling or covered up area, a label shall be posted at a prominent location to show the position of the hidden SVMS;
    d. Each SVMS shall have a "Normally Open" weatherproof label attached to the valve body confirming the valve status;
    e. A proper registry on the serial numbers of the security tag shall be kept and produced for inspection upon request.
4. The Sub-contractor shall carry out regular maintenance visits to ensure the systems are in sound operating condition as described in FWP14.

FWP8 AUTOMATIC SPRINKLER SYSTEM INSTALLATIONS

FWP8.1 SPRINKLER SYSTEM INSTALLATION 2

FWP8.1.010.A STANDARDS AND CERTIFICATION 2
FWP8.1.020.9 DEFINITION OF TERMS 2
FWP8.1.030.9 TYPES OF SYSTEMS 2
FWP8.1.040.9 CLASSIFICATION OF FIRE HAZARD 2
FWP8.1.050.9 CLASSIFICATION OF WATER SUPPLIES 2
FWP8.1.060.9 TYPE OF WATER 2
FWP8.1.080.9 BRANCH CONNECTION TO WATER SUPPLY SYSTEM 2
FWP8.1.090.A ANTI-POLLUTION VALVE FOR DIRECT CONNECTION TO TOWN MAINS 3
FWP8.1.100.A SPRINKLERS 3
FWP8.1.110.A SPRINKLER GUARDS 4
FWP8.1.120.A SPACING AND LOCATION OF SPRINKLERS 4
FWP8.1.130.A SPARE SPRINKLERS 4
FWP8.1.140.9 PIPEWORK INSTALLATION 4
FWP8.1.150.9 PRESSURE GAUGES, VALVES, ALARM DEVICES 4
FWP8.1.160.A CABINETS FOR CONTROL VALVE SETS AND SPRINKLER INLETS 5
FWP8.1.165.N SPRINKLER INLETS 5
FWP8.1.170.A PUMPS AND TANKS 5
FWP8.1.180.A CONTROLS 5
FWP8.1.190.9 NOTICES FOR SPRINKLER SYSTEM 5
FWP8.1.195.N SPRINKLER SUBSIDIARY STOP VALVES 5
FWP8.1.200.9 SPRINKLER SUBSIDIARY STOP VALVES MANAGEMENT SYSTEM 6

FWP8.2 DRENCHER SYSTEM INSTALLATION 7

FWP8.2.010.N STANDARDS AND CERTIFICATION 7
FWP8.2.020.N DELUGE VALVE SET 7
FWP8.2.030.N MANUAL OPERATING DEVICES 7
FWP8.2.040.N DRENCHER INLETS 8
FWP8.2.050.N TYPE OF PUMP 8
FWP8.2.060.N DRENCHER HEADS 8
FWP8.2.070.N DRENCHER PIPEWORK 9
FWP8.2.080.N WATER MOTOR ALARM AND GONG 9
FWP8.2.090.N DRENCHER AND CONTROL SYSTEM 9
FWP8.2.100.N HEAT DETECTORS FOR DRENCHER ACTUTATION 9
FWP8.2.110.N PILOT SPRINKLERS FOR DRENCHER ACTUATION 9

FWP8.1 SPRINKLER SYSTEM INSTALLATION

FWP8.1.010.A STANDARDS AND CERTIFICATION

1. Sprinkler systems shall be installed in accordance with the following standards and requirements:
   a. LPC Sprinkler Rules as described in FWP1.3.020;
   b. Fire Services CoP;
   c. FSD Circular Letters.
2. Copies of valid certificates issued by LPCB or other recognized product certification bodies acceptable to the FSD, including but not limited to sprinkler heads, sprinkler control valves, and subsidiary valves and otherwise as required by the CM shall be produced for the CM's inspection;
3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the sprinkler equipment delivered to the site or installed.

FWP8.1.020.9 DEFINITION OF TERMS

For the definitions of terms used for sprinkler systems, reference should be made to the LPC Sprinkler Rules and Fire Services CoP.

FWP8.1.030.9 TYPES OF SYSTEMS

Types of Sprinkler systems are as defined in the LPC Sprinkler Rules and as Worksection FWP2 of this Specification.

FWP8.1.040.9 CLASSIFICATION OF FIRE HAZARD

LPC Sprinkler Rules define various classes of fire hazard according to the occupancy of the building to be protected. Reference should be made to this standard.

FWP8.1.050.9 CLASSIFICATION OF WATER SUPPLIES

Sprinkler systems are graded according to the number and type of water supplies available. Reference should be made to the LPC Sprinkler Rules.

FWP8.1.060.9 TYPE OF WATER

Unless otherwise indicated the sprinkler system shall be suitable for use with fresh water from the Water Authority.

FWP8.1.080.9 BRANCH CONNECTION TO WATER SUPPLY SYSTEM

Whenever a direct feed town mains, gravity tank or other supply systems are used to supply any sprinkler system, no branch connection for any other purpose, hosereels included, will be permitted.

FWP8.1.090.A ANTI-POLLUTION VALVE FOR DIRECT CONNECTION TO TOWN MAINS

1. For sprinkler systems without water storage tanks and supplied from a direct connection to town mains, an additional butterfly valve (anti-pollution valve), without stop screw and lock nut on handle and strapped in open position shall be installed at a point on supply pipe before the sprinkler inlet;
2. The anti-pollution valve shall be installed in accordance with relevant requirements of FSD and the Water Authority.

FWP8.1.100.A SPRINKLERS

1. Sprinklers shall be with the approval of the FSD. Sprinkler for general application shall be of LPCB approved conventional type or type approved by similar widely recognised independent regulatory body accepted by FSD;
2. Fast response type sprinklers shall be used whenever required by FSD or as shown on the drawings, which shall be approved by LPCB or approved by similar widely recognised independent regulatory body accepted by FSD;
3. Sprinklers shall not be altered in any respect, nor have any type of ornamentation or coating applied after leaving the production factory;
4. Sprinklers shall be constructed with the appropriate characteristics, to suit each particular application. The sprinkler shall be of a type that suit the installation requirements in accordance with the LPC Sprinkler Rules and FSD requirements. Each one may be defined by any of the following characteristics:
    a. Nominal size of orifice;
    b. Type of heat-operated element;
    c. Operation temperature;
    d. Type of deflector.
5. Glass bulb sprinkler shall be constructed with heat sensitive quartzoid bulb with temperature rating as required by the FSD, typically as follows:
    a. General purposes (including Refuse Storage and Material Recovery Chamber): 68°C;
    b. Heated rooms such as kitchen cooking area: 93°C;
    c. At top of refuse chute: 57°C;
    d. In unventilated concealed spaces, under skylights or glass roofs etc.: 93°C.
6. Sprinklers installed at false ceiling shall be of the flush pattern, pendant type, and be provided with an adjustable screw type metal escutcheon and rosette to be installed flush with the false ceiling with the heat sensitive element exposed below the false ceiling line. The escutcheon and rosette shall be chromium plated or finished to a coating of white colour subject to the CM's approval;
7. For sprinklers installed at false ceiling at locations susceptible to outdoor conditions, the escutcheon and rosette shall be made of gloss stainless steel or formed by metal sheet finished to a rustproof coating of white colour subject to the CM's approval;
8. Where indicated on Drawings, concealed pendant type sprinklers shall be provided at false ceiling. Each concealed pendant type sprinkler head assembly shall include a metal flat cover plate that conceals the sprinkler operating components above the ceiling. Being an integral component of the sprinkler head assembly, the cover plate shall be chromium plated or finished to a coating of white colour subject to the CM's approval;

9. Recessed and concealed sprinklers shall not be used on the false ceiling with positive air pressure in the space above the false ceiling and in the areas required to provide fast response type sprinkler.

FWP8.1.110.A SPRINKLER GUARDS

When sprinklers, other than concealed, recessed, or flush sprinklers, are installed in a position at risk accidental mechanical damage such as at a height less than 2m from finished floor level or wherever required by FSD, they shall be fitted with an approved metal guard even if they are not indicated on drawings.

FWP8.1.120.A SPACING AND LOCATION OF SPRINKLERS

1. The Sub-contractor shall check the actual site conditions before and during installation works to ensure that the spacing and location of sprinklers comply with the LPC Sprinkler Rules;
2. The CM shall be informed in advance of any necessary change of pipe sizes or sprinkler layout in order to suit the finished architectural layout. Taking down and re-fixing works shall be carried out without charges if the site condition is not checked and the CM is not informed in good time about such alterations;
3. Sprinklers around ceiling openings formed by escalators, stairs etc. shall be neither more than 2 m nor less than 1.5 m away from each other. The horizontal distance between the sprinklers and the opening in the ceiling shall not exceed 0.5 m;
4. Metal baffles of not less than 200mm wide and 150mm high in size shall be provided and located midway between the sprinklers wherever required by the LPC Sprinkler Rules even if they are not indicated on drawings. When the baffle is fitted on the range pipe, its top edge shall extend above the sprinkler deflector by 50mm to 75mm.

FWP8.1.130.A SPARE SPRINKLERS

1. The Sub-contractor shall provide a cabinet containing an adequate quantities of spare sprinklers as recommended by the LPC Sprinkler Rules or as required by Worksection FWP2 of this Specification;
2. Where installations contain high-temperature sprinklers and / or other variations of sprinkler pattern, an adequate number of spares for each type of sprinklers shall be maintained as per the recommendation in the LPC Sprinkler Rules for any hazard class;
3. Sprinkler spanners furnished by the manufacturers of the Sprinklers shall be provided and kept in the cabinet.

FWP8.1.140.9 PIPEWORK INSTALLATION

1. Pipework installation for sprinkler systems shall be installed in accordance with the LPC Sprinkler Rules and, wherever applicable, with Worksections FWP3 and FWP4 of this Specification;
2. The Sub-contractor shall inform the Contract Manager immediately of any on-site situation which he knows will contravene the LPC Sprinkler Rules.

FWP8.1.150.9 PRESSURE GAUGES, VALVES, ALARM DEVICES

Pressure gauges, various types of valves and alarm devices shall be installed in accordance with the LPC Sprinkler Rules.

FWP8.1.160.A CABINETS FOR CONTROL VALVE SETS AND SPRINKLER INLETS

Cabinets for housing the sprinkler control valve sets and sprinkler inlets shall be provided by the Main Contractor. The Sub-contractor shall furnish all necessary dimensional information to enable these cabinets to be designed and constructed.

FWP8.1.165.N SPRINKLER INLETS

1. The general requirement and construction of the Sprinkler Inlet shall be the same as "Fire Service Inlet" described in Worksection FWP7 of this Specification. Labelling and lettering shall be in accordance with Fire Services CoP and relevant requirements of FSD;
2. Sufficient number of sprinkler inlet shall be provided to feed in the water flow rates as required by LPC Sprinkler Rules with the maximum water flow rate of each sprinkler inlet should be not more than 2000 l/min. At least two sprinkler inlets shall be provided for high rise installation;
3. All sprinkler inlets of the same 45m Installation Zone shall be interconnected;
4. Whenever sprinkler intermediate booster pumps are required, start / stop push buttons together with pump status indicators and alarm buzzer shall be provided adjacent to the corresponding sprinkler inlet(s) in accordance with the requirements for intermediate booster pump of FH/HR system stipulated in the Fire Services CoP.

FWP8.1.170.A PUMPS AND TANKS

Tanks and pumps where applicable, shall comply with Worksections FWP5 and FWP6 of this Specification.

FWP8.1.180.A CONTROLS

1. The control system, where applicable, shall comply with Worksection FWP10 of this Specification and the LPC Sprinkler Rules. All associated electrical wiring and installation shall comply with Worksection FWP11 of this Specification;
2. Tamper-proof electric monitoring switch to indicate the correct operational mode of each stop valve in the sprinkler system shall be supplied and installed complying with the LPC Sprinkler Rules.

FWP8.1.190.9 NOTICES FOR SPRINKLER SYSTEM

All notices required by LPC Sprinkler Rules and/or Fire Services CoP shall be in both the English and Chinese languages.

FWP8.1.195.N SPRINKLER SUBSIDIARY STOP VALVES

1. Each sprinkler protected zone shall be independently controlled by a zone subsidiary stop valve, installed in a readily accessible position in common area at the floor level of the zone it controls. Subject to the CM’s approval, the subsidiary stop valve may be installed at nearest alternative level where it is impractical to install at the level served;
2. Tamper-proof devices required by LPC Sprinkler Rules shall be provided to monitor the status of each subsidiary stop valves and water flow into each zone by a water flow alarm switch capable of detecting a flow equal to or greater than that from any single sprinkler;
3. Permanent test and drainage facilities required by LPC Sprinkler Rules shall be provided immediately downstream of the water flow alarm switch on each zone.

FWP8.1.200.9 SPRINKLER SUBSIDIARY STOP VALVES MANAGEMENT SYSTEM

The Sub-contractor shall provide a sprinkler subsidiary stop valves (SSSV) management system including the following:

1. Provide all necessary information of SSSV for each sprinkler system as required in the 'Log Book' provided and kept by the Estate Management of the employer after handover;
2. Each SSSV shall be provided with a pull-up seal security tag using steel wire-rope with pad lock and labelling with unique tag number and a warning label placed inside a durable and readable plastic bag;
3. Each SSSV shall have an identification label with estate code, block code, floor number and valve number assigned by the Estate Management for easy identification and traceability of records. For SSSV hidden inside false ceiling or covered up area, a label shall be posted at a prominent location to show the position of the hidden SSSV;
4. Each SSSV shall have a "Normal Open" weatherproof label attached to the valve body confirming the valve status;
5. A proper registry on the serial numbers of the security tag shall be kept and produced for inspection upon request;
6. The Sub-contractor shall carry out regular maintenance visits to ensure the system is in sound operating condition as described in FWP14; and
7. SSSV Management System shall include valves governing the sprinklers over the top of refuse chute and at ground floor refuse storage and material recovery chamber of the domestic blocks, not forming part of a sprinkler system.

FWP8.2 DRENCHER SYSTEM INSTALLATION

FWP8.2.010.N STANDARDS AND CERTIFICATION

1. The drencher system shall be designed, installed and commissioned in accordance with the Fire Services CoP and international standards acceptable to FSD;
2. Copies of valid certificates issued by recognised product certification bodies acceptable to the FSD, including but not limited to drencher head, deluge valve and otherwise as required, shall be produced for inspection by the CM;
3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the drencher equipment delivered to the site or installed.

FWP8.2.020.N DELUGE VALVE SET

1. Deluge valve sets shall be installed at the locations as shown on the Drawings. Each deluge valve set shall comprise the following:
   a. A diaphragm type main control valve complete with associated trim;
   b. Water discharge / alarm pressure switch;
   c. Water supply and diaphragm chamber pressure gauges;
   d. Solenoid releasing valve;
   e. Hydraulic manual operating device;
   f. Water motor alarm and gong;
   g. Drain valves, check valves, test valves and strainers;
   h. Other components as necessary to suit FSD's requirements.
2. The deluge valve shall be designed to allow external resetting with no need to open the diaphragm cover;
3. Solenoid releasing valve shall be 24V D.C. operated and normally closed. Upon system activation, it shall release water pressure from the differential chamber and open the deluge valve for supplying water into the system piping;
4. All installation, materials and fixing bolts, etc. for mounting the equipment inside a cabinet or on wall as applicable shall be provided by the Sub-contractor;
5. The cabinet for housing the deluge valve set, if applicable, will be provided by the Main Contractor. The Sub-contractor shall furnish all necessary dimensional information to enable the cabinet to be designed and constructed;
6. Deluge valve shall be listed by a product certification body acceptable to FSD.

FWP8.2.030.N MANUAL OPERATING DEVICES

1. Hydraulic type manual operating device with a pull handle mounted in a robust box shall be provided at the drencher deluge valve;

2. Manual operating device(s) at location(s) other than the deluge valve shall be an electric type manual switch, semi-flushed mounted, positioned within 900mm to 1200mm above finished floor level. It shall be with a resettable frangible element and a transparent hinged cover forming integral parts of the device, complying with BS EN 54-11, acceptable to FSD. Where located at outdoor or at location(s) susceptible to weather conditions or where specified on the Drawings, the device(s) shall be weatherproof type to IP66 or better;
3. The Sub-contractor shall provide an operation instruction notice adjacent to each manual operating device. The notice shall be clearly marked with wordings in English and Chinese characters of at least 6mm and 14mm high respectively, in red lettering on white background.

FWP8.2.040.N DRENCHER INLETS

1. The general requirement and construction of drencher inlets shall be the same as "Fire Service Inlets" described in Worksection FWP7 of this Specification;
2. A metal plate with minimum 70 mm high marked " DRENCHER INLET 水簾入水掣" in RED letters in both English and Chinese characters using raised letterings, hung on each of inlet;
3. Cabinet for housing the drencher inlet will be provided by the Main Contractor. The Sub-contractor shall furnish all necessary dimensional information of the cabinet to the Main Contractor.

FWP8.2.050.N TYPE OF PUMP

1. The construction of pumps for drencher installation shall comply with respective parts of FWP6 as appropriate;
2. The drencher pumps / drencher intermediate booster pumps shall be either horizontal split casing, end suction type or horizontal/ vertical multi-stage type having construction permitting removal of back cover, stuffing box and impeller without disturbance of suction/delivery pipework;
3. For jockey pump where applicable, multi-stage pumps shall be used. The maximum number of stages acceptable is seven unless otherwise Approved;
4. For installation with motor rating not exceeding 2.2kW, close-coupled pumps may be accepted as an alternative subject to Approval.

FWP8.2.060.N DRENCHER HEADS

1. Drencher head shall be of brass construction and listed by a product certification body acceptable to FSD;
2. The Sub-contractor shall calculate the number of drencher heads, their separation and their arrangement to provide an even flow of water over the opening to be protected;
3. The spacing of drencher heads shall be not more than 2.4m;
4. The Sub-contractor shall submit hydraulic calculation to justify the selected orifice size and k factor of drencher head to the CM for approval;
5. The Sub-contractor shall take due consideration on the effect of wind and air movement in surrounding environment of the protected area in the design and selection of equipment for drencher system.

FWP8.2.070.N DRENCHER PIPEWORK

1. The installation shall include all pipework and fittings as indicated on the Drawings complying with Worksections FWP3 and FWP4 of this Specification;
2. The Sub-contractor shall check and verify the sizing of pipework by hydraulic calculation and submit fully calculated results to the CM for approval.

FWP8.2.080.N WATER MOTOR ALARM AND GONG

Water motor alarm and gong shall comply with FWP2.1.5.080 of this Specification.

FWP8.2.090.N DRENCHER AND CONTROL SYSTEM

1. The Sub-contractor shall provide concealed PVC conduit system complete with wiring for and in connection with the fire alarm and control system, fire services alarm control panel and drencher pump control cubicle wherever necessary;
2. The drencher system control panel shall comply with FWP10.5 of this Specification as appropriate;
3. The drencher system control panel shall be a standard product of the same manufacturer of the deluge valve and worked in conjunction with solenoid releasing valve to allow a flow of water into the system upon actuation;
4. Whenever necessary, and subject to Approval, parts of the conduit system may be installed in galvanised steel surface conduit/trunking.

FWP8.2.100.N HEAT DETECTORS FOR DRENCHER ACTUTATION

1. Heat detector shall comply with FWP10.3 of this Specification as appropriate;
2. Heat detection system in coincidence connection (cross-zone operation) shall be used to activate the drencher system whenever necessary and as shown on the Drawing, such as for fire compartmentation. The detectors for cross-zone operation shall be arranged each on either side of the drencher heads. The activation of one detector shall energise an alarm with visual and audible warnings on the control panel. The activation of any two detectors arranged in coincidence connection shall operate the drencher installation;
3. Where required by the FSD and approved by the CM, activation of the detectors provided solely for the drencher system shall not activate the general fire alarm and shall not send the fire signal via the fire alarm direct link and alarm transmitter.

FWP8.2.110.N PILOT SPRINKLERS FOR DRENCHER ACTUATION

1. Sprinkler shall comply with FWP8.1.100 of this Specification as appropriate;
2. Pilot sprinklers shall be of quick response type with a short Response Time Index (RTI) value suitable for the hazard to be protected;
3. The Sub-contractor shall submit the RTI value to the CM for approval..

FWP9 GAS EXTINGUISHING SYSTEM INSTALLATION

FWP9.1 SYSTEM REQUIREMENTS 3
FWP9.1.010.9 GENERAL 3
FWP9.1.020.A FM–200 EXTINGUISHING SYSTEM 3
FWP9.1.030.9 MATERIAL STANDARDS 3

FWP9.3 SYSTEM PERFORMANCE 4
FWP9.3.010.9 FM-200 TOTAL FLOODING SYSTEM 4
FWP9.3.020.9 RESPONSIBILITY 4
FWP9.3.030.9 DESIGN CALCULATIONS 4
FWP9.3.040.9 COMPLETE WORKING SYSTEM 4

FWP9.4 GAS STORAGE PRESSURE 5
FWP9.4.010.9 STORAGE 5
FWP9.4.020.9 FM-200 5
FWP9.4.030.9 DESIGN 5

FWP9.5 GAS CYLINDERS 6
FWP9.5.010.9 FM-200 CYLINDERS 6
FWP9.5.020.9 CYLINDER MOUNTING 6
FWP9.5.030.9 CYLINDER OVER PRESSURE PROTECTION 6
FWP9.5.040.9 CYLINDER ACCESSORIES 6
FWP9.5.050.9 CYLINDER CONTENTS MEASURING DEVICES 6
FWP9.5.060.9 DISCHARGING FROM CYLINDERS 6
FWP9.5.070.9 PAINTING CYLINDERS 6

FWP9.6 SYSTEM RELEASE OPERATION 7
FWP9.6.010.9 AUTOMATIC RELEASE MECHANISM 7
FWP9.6.020.9 MANUAL RELEASE MECHANISM 7
FWP9.6.030.9 EMERGENCY RELEASE MECHANISM 7
FWP9.6.040.9 GAS RELEASE MECHANISM 7

FWP9.7 PIPEWORK AND FITTINGS 8
FWP9.7.010.9 GENERAL 8
FWP9.7.020.A FM-200 SYSTEMS 8
FWP9.7.030.9 PIPE FITTINGS AND FLANGES 8
FWP9.7.040.9 PIPE JOINTING 8
FWP9.7.050.9 PIPEWORK SUPPORTS 9
FWP9.7.060.9 DISCHARGE NOZZLES 9
FWP9.7.070.9 FLEXIBLE HOSE CONNECTIONS 9
FWP9.7.080.9 PRESSURE RELIEF VALVES 9
FWP9.7.090.9 MANIFOLDS 9
FWP9.7.100.9 EARTHING 9
FWP9.7.110.9 PAINTING 10

FWP9.8 SYSTEM PROTECTION 11
FWP9.8.010.9 SECURITY OF FIXING 11
FWP9.8.020.9 GUARDING 11

FWP9.9 INDICATOR LIGHTS, WARNING NOTICES AND LABELS 12
FWP9.9.010.9 GAS STORAGE COMPARTMENTS AND PROTECTED COMPARTMENTS 12

FWP9.9.020.9 TOTAL FLOODING SYSTEM 12
FWP9.9.030.9 SYSTEM ODORISERS 12

FWP9.1 SYSTEM REQUIREMENTS

FWP9.1.010.9 GENERAL

1. Unless otherwise specified, gas extinguishing systems shall be of the total flooding type with a high pressure open-ended piping installation on the distribution side;
2. The automatic gas release mechanism shall be operated by means of fire detection units at the protected compartment or manually by a pull handle or push button as described below;
3. FM-200 shall be used for total flooding systems in normal occupied areas;
4. Where local application systems are specified they will normally use carbon dioxide gas as the extinguishing agent;
5. Copies of valid Approval documents / certificates issued by FSD and / or product certification bodies recognized by FSD for the components in gas extinguishing system shall be produced for CM's inspection;
6. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the gas extinguishing equipment delivered to the site or installed.

FWP9.1.020.A FM–200 EXTINGUISHING SYSTEM

FM-200 system shall be designed and installed in accordance with UL Standard 2166, NFPA 2001 or BS EN 15004-1 and BS EN 15004-5 or other recognized established standards on Clean Agent Fire Extinguishing Systems acceptable to FSD, FSD requirements and Circular Letters.

FWP9.1.030.9 MATERIAL STANDARDS

Materials shall be to the appropriate British Standard and sized in standard metric dimensions. Where the installation is designed in accordance with NFPA codes/standards, the Sub-contractor shall show that the materials selected are in accordance with a British Standard not inferior to the standard recommended in the NFPA standard and that the metric sized materials are sized to give a performance of the system not inferior to the performance called for this Specification and the NFPA standard. The Sub-contractor shall also show that all components are compatible and that any variations in dimensions due to the use of metric sized components do not adversely affect the balance of the system.

FWP9.3 SYSTEM PERFORMANCE

FWP9.3.010.9 FM-200 TOTAL FLOODING SYSTEM

FM-200 total flooding system shall be designed to achieve an acceptable concentration in the protected compartment as stipulated in NFPA 2001 or any recognized system design manual from the manufacturer at room temperature. Discharge of gas shall be substantially completed within 10 seconds. Following discharge, the concentration of FM-200 shall develop throughout the protected compartment to achieve final extinguishment of fire within 60 seconds.

FWP9.3.020.9 RESPONSIBILITY

1. The enclosure to be protected and the position of the gas cylinders shall be as indicated on the Drawings. The layout of pipework and nozzles indicated on the Drawings is optional but if the Sub-contractor proposes any other layout he remains responsible for ensuring that the proposed layout is acceptable to the Contract Manager, that it will not obstruct any other services, and that necessary openings in the structure are permissible and are provided, by giving sufficient notice for them to be provided by the Main Contractor;
2. Notwithstanding that the Sub-contractor has demonstrated, by calculation, to the satisfaction of the Contract Manager, that the system will perform to the standard required, the Sub-contractor shall remain responsible for ensuring that under test the system does, in fact, perform in accordance with this Specifications.

FWP9.3.030.9 DESIGN CALCULATIONS

1. To justify the selection of components and pipe sizes for the system, the Sub-contractor shall provide with his tender either full mathematical calculations or computer model flow calculations. Where the computer programme does not show all calculation steps it will be necessary for the Sub-contractor to produce evidence that the computer programme produces a design that will perform in accordance with the Specification as indicated by Underwriters' Laboratory listing or approved by any similar widely recognised independent regulatory body acceptable to the Contract Manager;
2.
    a. The calculations shall be based on the equipment offered;
    b. Valves, syphon tubes, distribution valves as well as bends and junctions shall be represented in the calculations as equivalent lengths of pipe;
    c. The actual size and location of pipes and nozzles and the number of nozzles shall be designed on the basis of the calculated flow rates and terminal pressures required to ensure successful operation;
    d. The calculations or computer programme shall provide all the information necessary to complete the installation including the quantity of gas used to flood to the required concentration, the allowance for losses and the total quantity, the flow rate and start and end pressure of each section of pipe and the orifice size for each nozzle.

FWP9.3.040.9 COMPLETE WORKING SYSTEM

The Sub-contractor shall provide all the components necessary for full operation of the system in the automatic or manual mode regardless of whether or not such components are detailed on the Drawings or in this Specification.

FWP9.4 GAS STORAGE PRESSURE

FWP9.4.010.9 STORAGE

All the gas extinguishing agents shall be stored in rechargeable cylinders to hold the pressurized agents in liquid form at ambient temperature.

FWP9.4.020.9 FM-200

FM-200 cylinders shall be charged in accordance with NFPA 2001 or any recognized system design manual from the manufacturer acceptable to FSD.

FWP9.4.030.9 DESIGN

Gas cylinders, distribution pipework, valves, nozzles and fittings shall be manufactured to standards designed to withstand the maximum pressure of stored agent allowing for variations in ambient temperature.

FWP9.5 GAS CYLINDERS

FWP9.5.010.9 FM-200 CYLINDERS

1. FM-200 cylinders shall be of high-strength alloy steel construction that complies with the Department of Transportation regulation for refillable pressure vessels and conform to NFPA 2001;
2. The maximum storage gaseous agent at each gas cylinder shall be not more than 120kg. Each cylinder shall have a permanent nameplate indicates the agent, tare and gross weights, and super-pressurization level of the cylinder.

FWP9.5.020.9 CYLINDER MOUNTING

Cylinders shall be securely mounted in a frame bolted to the wall and arranged so that external parts may be readily inspected and corrosion cannot occur.

FWP9.5.030.9 CYLINDER OVER PRESSURE PROTECTION

Where pressure–operated cylinder valves are used, means shall be provided to vent any cylinder gas leakage. The means of pressure venting shall be arranged so as not to prevent reliable operation of the cylinder valve.

FWP9.5.040.9 CYLINDER ACCESSORIES

Each cylinder shall be complete with gas valve/actuator, pressure gauge, flexible hose, check valve and all other necessary accessories.

FWP9.5.050.9 CYLINDER CONTENTS MEASURING DEVICES

1. A device shall be provided for measuring the amount of liquid in the cylinder at any time;
2. This shall be done by a method which does not require the cylinder to be detached from the remainder of the plant;
3. If a weighing device of the type that requires suspension is proposed, means shall be provided above each cylinder for the attachment of the weighing device;
4. The contents of the cylinders may alternatively be checked by the use of a liquid level indicator of an Approved type.

FWP9.5.060.9 DISCHARGING FROM CYLINDERS

1. The liquid shall be discharged from the cylinder through a syphon tube;
2. The pressure of the liquid stored in the cylinder shall be such that freezing cannot take place at the lowest possible ambient temperature;
3. Means shall be provided to prevent gas discharging into empty containers and to prevent loss if the gas is released when any of the cylinders is disconnected.

FWP9.5.070.9 PAINTING CYLINDERS

Gas cylinders shall be painted signal red as specified in BS 381C in accordance with the requirements of BS 5252. The type of extinguishing agent, the tare weight, gross weight and liquid level at 25°C shall be clearly painted on each cylinder with white paint.

FWP9.6 SYSTEM RELEASE OPERATION

FWP9.6.010.9 AUTOMATIC RELEASE MECHANISM

1. Fire detection in the protected area shall be by means of ionization chamber smoke detectors and heat detectors as detailed in FWP2. The detectors, of sufficient number and suitably positioned to give duplicate coverage of the whole of the protected area, shall be connected in zones so that smoke or heat generated in any part of the area will activate two zones. The fire detection control panel and the detectors shall be compatible and the fire detection system shall comply with FWP10;
2. Activation of a detector on one zone shall cause alarm bells to sound. Activation of detectors on two zones shall cause a siren or Klaxon horn to sound to warn that, if the system is in the automatic mode, the extinguishing agent is about to be released. These warnings will also be activated by operation of the manual release;
3. The gas extinguishing control panel shall control and monitor the release system. It will include an automatic / manual lock-off unit controlled by keyswitches at each entrance to the protected area. Any one keyswitch shall be capable of switching the automatic system on or off. The manual release mechanism will remain operative whether the automatic system is on or off. A time delay unit shall be provided which shall be adjustable and lockable in the range 15 to 30 seconds. Relays shall be provided, to shut down ventilation and air conditioning, to close openings and to switch off equipment as necessary. These relays will operate immediately when two zones of the fire detection system are activated or when the manual release is operated. Release of the gas will follow after the pre-set time delay.

FWP9.6.020.9 MANUAL RELEASE MECHANISM

A manual release unit shall be provided in a suitable position outside each entrance to the protected compartment. The manual release unit shall consist of a pull handle or push button mounted in a box with "break glass" cover. The box shall be so designed that its glass front may be readily replaced and that its front cover can be opened with a key for the purpose of operating the switch without breaking the glass.

FWP9.6.030.9 EMERGENCY RELEASE MECHANISM

An emergency release handle with direct mechanism shall be provided in an accessible position at or near the gas cylinders. The emergency release shall require no power supply to operate and it shall be provided with a removable pin to prevent accidental release of gas. Provision shall be made for operation of the emergency release to activate the relays to cause simultaneous shutdown of ventilation, air-conditioning, equipment etc. and to sound the alarm.

FWP9.6.040.9 GAS RELEASE MECHANISM

1. The operation of the gas release mechanism shall require minimum power from an external electrical, pneumatic or mechanical source and shall preferably be operated by a falling weight device. No springs shall be used in any position where their failure or fracture would prevent the correct operation of the gas release mechanism or cause the inadvertent release of the gas;
2. All release devices and mechanisms shall be designed for the working conditions they will encounter and shall not readily be rendered inoperative or susceptible to accidental operation. They shall have proper protection from mechanical, chemical or other damage that would render them inoperative.

FWP9.7 PIPEWORK AND FITTINGS

FWP9.7.010.9 GENERAL

All pipework shall be non-combustible and able to withstand the expected pressures and temperatures without damage. Specification of materials and installation shall conform to the relevant British Standards for the respective gas extinguishing agent used.

FWP9.7.020.A FM-200 SYSTEMS

Pipes for FM-200 system shall be as follows:

1. For system pressure not more than 25 bars:

a. Up to and including 65 mm :	Galvanized steel pipes conforming to BS EN 10255, heavy grade, butt welded;
b. All other sizes	Carbon steel pipes conforming to BS EN 10216-1 or BS EN 10217-1 with wall thickness not lower than ASME B36.10M Schedule No. 40 pipe and with steel grade P265TR1 or ASTM A53/A53M, seamless, grade A.

2. For system pressure more than 25 bars:

a. Up to and including 100 mm:	Carbon steel pipes conforming to BS EN 10216-1or BS EN 10217-1 with wall thickness not lower than ASME B36.10M Schedule No. 80 pipe and with steel grade P265TR1or ASTM A53/A53M, seamless, grade B.

FWP9.7.030.9 PIPE FITTINGS AND FLANGES

Pipe fittings and flanges shall be as specified in the following relevant Standards for the particular gas extinguishing installations in accordance with the pipe size and pressure of the system. The following British Standards are relevant:

BS 3799	Forged steel pipe fittings, screwed and socket-welding for the petroleum industry.
BS EN 10253-2	Butt-welding pipe fittings. Non alloy and ferritic alloy steels with specific inspection requirements.

FWP9.7.040.9 PIPE JOINTING

1. All pipework and fittings shall be free of burrs, spelter and rust and shall be galvanized inside and out;
2. Screwed threads shall conform to the dimensions specified inBS EN 10226-1, 2, 3;
3. Screwed joints shall be made with PTFE tape or Approved equivalent but chemically inert to the extinguishing agent used;
4. Compressed fibre gaskets free of asbestos shall be used for flange joints.

FWP9.7.050.9 PIPEWORK SUPPORTS

1. Pipework supports shall be arranged as near as possible to joints and changes of direction and each support shall take its share of the load. The maximum space between supports to take into the total mass of pipe and extinguishing agent shall be as tabulated in sub-clause (2) but additional supports shall be provided where there are extra loads such as valves;

2. Maximum space between supports:

Pipe size (mm)	15	20	25	32	40	50	80	100
Span (m)	1.5	1.8	2.1	2.4	2.7	3.0	3.6	4.2

FWP9.7.060.9 DISCHARGE NOZZLES

1. Discharge nozzles shall be of robust construction and designed for use with the expected working pressure and temperature without deformation. The discharge orifices shall be made of corrosion resistant metal and have a permanent marking for identification and to show the equivalent single orifice diameter;

2. Gas discharge nozzles shall be provided to distribute the gaseous agents uniformly throughout the protected spaces, the nozzles shall be discharged in either 180º or 360º patterns, depending on location. The nozzles shall be permanently marked to identify the manufacturer as well as the type and size of the orifice. The flow characteristics, area coverage, height limits, and minimum pressure of discharge nozzles shall be in accordance with the manufacture's listed limitations;

3. Gas discharge nozzles shall be certified by UL / FM and approved by FSD for use in clean agent gas flooding fire extinguishing system.

FWP9.7.070.9 FLEXIBLE HOSE CONNECTIONS

Flexible hose connections shall be selected, inspected and tested only by a suitably trained engineer or technician and shall be designed for service at the pressures and temperatures involved.

FWP9.7.080.9 PRESSURE RELIEF VALVES

1. To prevent entrapment in pipework, a suitable excess pressure relief valve shall be provided at any section of high pressure piping blocked by valves at both ends and shall operate at the following pressures:

   2 times the maximum system pressure

2. Valves shall be capable of being opened when subjected to the maximum operating pressure and shall be so equipped that they can be opened manually. Valves for FM200 system constantly under pressure shall be designed for maximum working pressure plus a 50% safety factor.

FWP9.7.090.9 MANIFOLDS

Manifolds shall be tested for a duration of minimum 5 minutes at the manufacturer's works to the following minimum pressures:

2 times the maximum system pressure.

FWP9.7.100.9 EARTHING

Pipework shall be earthed to prevent build up of electrostatic charge.

FWP9.7.110.9 PAINTING

Pipework shall be painted signal red as specified and illustrated in BS 381C in accordance with the requirements of BS 5252. Brass fittings shall be left unpainted.

FWP9.8 SYSTEM PROTECTION

FWP9.8.010.9 SECURITY OF FIXING

The whole gas discharge system including cylinders, pipework and nozzles shall be securely fixed to the structure with saddles or brackets correctly spaced so that all components will remain in place when subjected to the pressures and forces produced during discharge. Fixings shall allow for movement due to thermal expansion.

FWP9.8.020.9 GUARDING

The system shall be guarded so that it shall be impossible to obstruct the operation of any moving parts.

FWP9.9 INDICATOR LIGHTS, WARNING NOTICES AND LABELS

FWP9.9.010.9 GAS STORAGE COMPARTMENTS AND PROTECTED COMPARTMENTS

1. All gas storage compartments and compartments protected by a gas extinguishing system shall have a warning notice fixed on each entrance door to the compartment;
2. Configuration, lettering, colour and size of the notice shall be in accordance with the requirement of FSD for the respective gas extinguishing system;
3. The notice shall be made of sheet metal plate not less than 1.6 mm thick.

FWP9.9.020.9 TOTAL FLOODING SYSTEM

For a total flooding system, protecting a normally occupied area, which is designed to operate automatically when unoccupied but to be in the manual mode when occupied, the following warning lights shall be installed together with explanatory/warning notices in English and Chinese. Such notices shall be clearly legible and painted or engraved on substantial durable material. Warning lights and notices for systems other than as described above (e.g. local application systems or systems designed to be in the automatic mode when the area is occupied), shall be equally informative and suitably substantial and shall be arranged and worded either as specified in FWP2 or as agreed with the Contract Manager:

1. Inside the protected area: a flashing red light to indicate gas release imminent with a notice which shall read:

   "WARNING - FM-200 gas release imminent. Leave the room at once."

2. Outside each entrance to the protected area:

   a. A green light to show that the system is on manual control with automatic control locked off, with a notice which shall read:

      "Safe to enter. FM-200 fire extinguishing system on manual control. When room vacated switch to automatic control."

   b. An amber light to show that the system is on automatic control, with a notice which shall read:

      "Not safe to enter. FM-200 fire extinguishing system on automatic control. Switch to manual control before entering."

   c. A red light to show that the system has operated, with a notice which shall read:

      "DANGER - Do not enter. FM-200 gas discharged."

3. The manual/automatic lock off key switches, the manual release units and the emergency release handle shall all be labelled in English and Chinese so that it is clear what their purpose is and how to operate them.

FWP9.9.030.9 SYSTEM ODORISERS

Odorisers, where specified in FWP2, shall be capable of automatically treating the gas after release from the cylinder and shall be of citrus odour type, so that a hazardous atmosphere can be recognised at once. Where odorisers are provided, a suitable notice to the effect that anyone detecting the citrus odour should leave the area immediately and report the occurrence to a responsible person shall be provided worded in English and Chinese.

FWP10 FIRE ALARM AND CONTROL SYSTEM EQUIPMENT

FWP10.1 GENERAL 3
FWP10.1.010.9 COMPONENTS AND EQUIPMENT COMPATIBILITY 3

FWP10.2 MANUAL FIRE ALARM POINTS 4
FWP10.2.010.9 CONSTRUCTION 4
FWP10.2.020.9 OPERATION 4
FWP10.2.030.9 CERTIFICATION 5
FWP10.2.040.9 MOUNTING 5

FWP10.3 HEAT DETECTORS 6
FWP10.3.010.9 STANDARD 6
FWP10.3.020.9 TYPE 6
FWP10.3.030.A INSTALLATION 6
FWP10.3.040.A CERTIFICATION 6

FWP10.4 SMOKE DETECTORS 7
FWP10.4.010.9 STANDARD 7
FWP10.4.020.A TYPE 7
FWP10.4.030.9 CONSTRUCTION 7
FWP10.4.040.9 ELECTRONIC CIRCUITRY 8
FWP10.4.050.9 ELECTRICAL CONTINUITY 8
FWP10.4.060.A INSTALLATION 8
FWP10.4.070.9 REVERSIBLE RESPONSE TIME DELAY 8
FWP10.4.080.9 RADIATION LEVEL 8
FWP10.4.090.9 PROBE UNITS 8
FWP10.4.100.A CERTIFICATION 9

FWP10.5 CONTROL AND INDICATING EQUIPMENT (CONTROL PANELS) 10
FWP10.5.010.A DESCRIPTION 10
FWP10.5.020.9 OPERATION 10
FWP10.5.030.A EQUIPMENT 10
FWP10.5.040.A ALARM OPERATION 11
FWP10.5.050.A FAULT INDICATION 11
FWP10.5.060.A INDICATOR LAMPS 11
FWP10.5.070.9 RELAYS 11
FWP10.5.080.9 CONTACTS 11
FWP10.5.090.A POWER SUPPLIES 11
FWP10.5.100.A CERTIFICATION 12

FWP10.6 BATTERIES AND CHARGERS 13
FWP10.6.010.9 PERFORMANCE 13
FWP10.6.020.A BATTERY TYPE 13
FWP10.6.030.9 BATTERY VOLTAGE 13
FWP10.6.040.A BATTERY CHARGERS 14
FWP10.6.050.9 FAULT WARNING 14
FWP10.6.060.9 BATTERY / CHARGER MOUNTING 14

FWP10.7 FIRE ALARM BELLS AND CIRCUITS 15
FWP10.7.010.9 BELL LOCATION 15
FWP10.7.020.A BELL PERFORMANCE 15

FWP10.7.030.9 BELL CONSTRUCTION 15
FWP10.7.040.9 BELL FINISH 15
FWP10.7.050.9 BELL CIRCUITS 15
FWP10.7.060.A ALARM TRANSMITTERS 15
FWP10.7.070.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 16

FWP10.8 AUXILIARY SYSTEMS 17
FWP10.8.010.9 SYSTEM CONTROL 17
FWP10.8.020.A AUXILIARY BATTERY 17

FWP10.9 VISUAL FIRE ALARM 18
FWP10.9.010.A SYSTEM 18
FWP10.9.020.9 LABEL 18
FWP10.9.030.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 18

FWP10.10 AUDIO/VISUAL ADVISORY SYSTEM 19
FWP10.10.010.9 GENERAL 19
FWP10.10.020.9 AUDIO ADVISORY SYSTEM 19
FWP10.10.030.A AVA SYSTEM CONTROL PANEL 20
FWP10.10.040.9 VOICE MESSAGE MODULE 20
FWP10.10.050.A AVA SYSTEM POWER SUPPLY MODULE 21
FWP10.10.060.9 MIXER PREAMPLIFIER 21
FWP10.10.070.9 POWER AMPLIFIER 21
FWP10.10.080.9 INPUT SELECTION PANEL, MONITOR PANEL AND VOLUME CONTROL PANEL 21
FWP10.10.090.9 LINE FAULT MONITORING UNIT 22
FWP10.10.100.9 AUTOMATIC AUDIO INPUT CHANGE-OVER UNIT 22
FWP10.10.110.9 LOUDSPEAKERS 22
FWP10.10.120.9 DESKTOP MICROPHONE 22
FWP10.10.130.A FLASHING DIRECTIONAL SIGN BOXES AND FLASHING EXIT SIGN BOXES 23
FWP10.10.135.A FLASHING EXIT SIGN AND FLASHING DIRECTIONAL SIGN POWER SUPPLY 23
FWP10.10.140.A LOW LEVEL DIRECTIONAL SIGNS 23
FWP10.10.150.9 AVA SYSTEM CABLES AND WIRING 24
FWP10.10.160.9 EQUIPMENT CABINET 24

FWP10.11 ADDRESSABLE SYSTEM 25
FWP10.11.010.N PRODUCT REQUIREMENTS 25
FWP10.11.020.N SYSTEM REQUIREMENTS 25
FWP10.11.030.N ADDRESSABLE FIRE ALARM CONTROL PANEL 25
FWP10.11.040.N ADDRESSABLE REPEATER PANEL 26
FWP10.11.050.N ADDRESS SETTING FOR ADDRESSABLE DEVICES 26
FWP10.11.060.N ADDRESSABLE DEVICES 27
FWP10.11.070.N INTERFACE MODULES 27
FWP10.11.080.N FAULT ISOLATOR 28

FWP10.1 GENERAL

FWP10.1.010.9 COMPONENTS AND EQUIPMENT COMPATIBILITY

1. All the devices, components and equipment used in the system shall be of highest quality and suitable for humid tropical working conditions;
2. They shall be fully compatible with one another throughout the whole system;
3. Special attention should be drawn to the compatibility between automatic detectors and control equipment and the Sub-contractor shall supply information of the detectors and the required electrical interface with the control and indicating equipment;
4. All the components in such a system shall preferably be from one principal system manufacturer and form one compatible system approved by the relevant widely recognised independent regulatory body with the approval of FSD;
5. Certificate to prove compatibility shall be produced upon request. Confirmation from panel manufacturer on compatibility of connected components will normally be acceptable;
6. Devices mounted at locations susceptible to weather conditions shall be of weatherproof type construction.

FWP10.2 MANUAL FIRE ALARM POINTS

FWP10.2.010.9 CONSTRUCTION

1. Manual fire alarm call point unit shall be of direct operation type equipped with resettable frangible element complying with BS EN 54-11 or other international standards and acceptable to FSD;
2. The unit shall comprise an electrical contact which will operate automatically upon displacing the resettable frangible element at the operating face of the unit;
3. Cover of the unit shall be locked in position with a special tool and the frangible element shall be clipped firmly into place;
4. The words “Fire 火警”and its actuating method in English and Chinese shall be indelibly marked on the operating face of the unit;
5. Suitable means of earth continuity shall be provided at the mounting box of the unit connecting to steel conduits;
6. The unit and its mounting box shall be of pleasing appearance and styling, constructed by non-corrodible materials and finished in signal red colour;
7. Manual fire alarm call point located at outdoor or at location(s) susceptible to weather conditions or where specified on the Drawings shall be of weatherproof type to IP66 or better;
8. The unit shall be permanently marked with the following information:
   a. the number of the standard such as “BS EN 54-11”;
   b. the name or trademark of the manufacturer;
   c. the model designation;
   d. environmental category;
   e. the wiring terminal designations;
   f. any mark or code by which the manufacturer can identify the date or batch and place of manufacture.
9. Manual Fire Alarm Call Point(s) complete with proprietary transparent hinged protective cover shall be provided at the exit location(s) of the building where Door Release Button for Electro-Magnetic Door Lock are installed nearby, or where specified on the Drawings;
10. Manual Fire Alarm Call Point complete with transparent hinged protective cover shall be on the list of LPCB or other Product Certification Bodies recognized by FSD;
11. A permanent operation instruction plate shall be provided next to the Manual Fire Alarm Call point. The instruction plate shall be in red colour and fabricated from 3mm thick acrylic sheet of dimensions approximate 86mm (W) x 55mm (H). The Chinese characters and English letters shall be white colour and etched onto the surface of the acrylic sheet with height not less than 14mm and 6mm respectively.

    MANUAL FIRE ALARM CALL POINT

    火警鐘掣

FWP10.2.020.9 OPERATION

1. The method of operation shall be referred to Type A as specified in BS EN 54-11;

2. The manual fire alarm call points shall be suitable for 24 V DC operation;
3. Contacts shall be of silver or approved non-deteriorating alloy, normally-open or normally-closed type to suit the alarm system;
4. The voltage and current ratings of the contacts shall be marked in the unit, or clearly indicated in the corresponding installation instruction sheet;
5. A concealed test facility and a special tool shall be included. Use of the special tool is necessary to reset the displaced frangible element after operation.

FWP10.2.030.9 CERTIFICATION

1. Copies of type test / approval certificates from product certification bodies recognised by FSD shall be produced to prove the manual fire alarm point complies with BS EN 54-11 or other standards acceptable to FSD;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the manual fire alarm points delivered to the site or installed.

FWP10.2.040.9 MOUNTING

The manual fire alarm call point shall be mounted on wall or as specified in Project Specific Specification at position within 900mm to 1200mm above finished floor level. It shall be suitable for direct connection to the concealed wiring system therein.

FWP10.3 HEAT DETECTORS

FWP10.3.010.9 STANDARD

Automatic heat detectors shall be of point-type complying with, BS EN 54-5 or other standards acceptable to FSD.

FWP10.3.020.9 TYPE

Detectors shall be of combined fixed temperature and rate-of-rise type except in high temperature areas such as kitchens or boiler rooms where, because the risk of false alarms caused by rapidly rising temperatures is high, detectors without a rate-of-rise element should be used.

FWP10.3.030.A INSTALLATION

1. Detector units shall be of flush or surface mounting type as indicated in the Specification or Drawings;
2. Detector units in suspended ceilings shall be flush mounted and shall, in the case of modular constructed ceilings, be coordinated into the ceiling layout;
3. When detectors are provided in inaccessible area such as ceiling void or floor void, remote indicating lamp shall be provided and visible from any unobstructed position of the area. The above is exempted for addressable detectors if clear addressable text display of the location in English or Chinese is available at the Control and Indicating Equipment, without manual intervention or the display, in conjunction with layout plans are provided adjacent to the Control and Indicating Equipment;
4. For non-addressable system, remote indicator lamps can be provided outside doors of lockable rooms such as plantrooms, electrical equipment rooms, store rooms, dangerous good stores etc. which are unoccupied and normally kept locked to reduce the need for a large number of small zones;
5. Where detectors are mounted at levels above 4 m, they shall be capable of being removed and re-fixed from below by means of a special extended arm tool;
6. For detector installed at easily accessible height in public circulation area, detachable detector shall not be used without the CM's approval and shall be provided with means to guard against theft when required;
7. Removal of individual detector from the mounting base shall not affect operation of other alarm devices in the system;
8. Where the type of detector is not specified, heat detector shall be used except in areas where smoke detectors are required to satisfy FSD Requirements such as places having sleeping risk, for smoke management, compartmentation or ventilation / air-conditioning control system, etc.

FWP10.3.040.A CERTIFICATION

1. Copies of type test / approval certificates from product certification bodies recognized by FSD shall be produced to prove that the heat detector complies with BS EN 54-5 or other standards acceptable to FSD;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the heat detectors delivered to the Site or installed.

FWP10.4 SMOKE DETECTORS

FWP10.4.010.9 STANDARD

1. Automatic smoke detectors shall comply with, BS EN 54-7 or other standards acceptable to FSD;
2. They shall function correctly at continuous ambient temperature between 0°C to 48°C, relative humidity between 20% to 95% continuous without condensation;
3. They shall be designed to assume protection rating of IP 43;
4. They shall also be suitable for stable operation in the Hong Kong climate especially where high humidity conditions may exist without constant air-conditioning.

FWP10.4.020.A TYPE

1. Detector shall be photoelectric type unless otherwise specified;
2. If ionization type of detector is specified, it shall be of the type responding to both visible and invisible products of combustion and shall be of the radioactive isotope pattern having two ionisation chambers, one for detection and one for reference, connected in electronic circuits. Radiation level from the isotopes shall be within the safety limit specified by EURATOM i.e. less than 0.1 mr/h at a distance of 100 mm. The combined radiation activity of each smoke detector shall not exceed 555 kBq for commercial / industrial buildings and 370 kBq for residential buildings;
3. If multi-sensor type detector is specified, the installation shall comply with the criteria specified in relevant FSD Circular Letters;
4. Multi-sensor detector shall comprise a combination of heat sensor, optical / ionisation smoke sensor, flame sensor, carbon monoxide sensor, ultraviolet / infrared sensors, and / or other sensors as recommended by the manufacturer to suit a particular fire risk and growth of fire. Multi-sensors detector shall comprise at least one photoelectric smoke sensor and one heat sensor. The heat sensor shall be combined fixed temperature and rate-of-temperature-rise type. Multi-sensors detector shall conform to the appropriate standards for smoke detectors such as BS EN 54-7: 2001 or equivalent and shall be listed by Product Certification Bodies in accordance with FSD Circular Letter or approved by FSD. The Contractor shall submit technical details and certificate to the CM for approval. Only multi-sensor type detector suitable for the required application, environmental condition, fire growth characteristic, fire risk and hazard shall be selected and used.

FWP10.4.030.9 CONSTRUCTION

1. Detectors shall be housed in a corrosion-proof plug-in unit designed to be mounted pendant, surface or semi-recessed;
2. Removal of the unit from its base shall cause a fault alarm signal to be given;
3. Built-in wind-shields shall be provided to ensure that air currents of up to 10 m/s do not affect the proper operation of the detectors;
4. Each unit shall be fitted with an alarm condition indicator lamp and shall also have an auxiliary facility for connecting an extended alarm indicator lamp;
5. A built-in wire mesh shall be incorporated to prevent entry of insects into the interior.

FWP10.4.040.9 ELECTRONIC CIRCUITRY

1. For ionization type detector, the electronic circuitry may be of cold-cathode tube type, operating at low voltage d.c., or of solid-state type, operating at extra low voltage d.c.;
2. The quiescent current consumption of the unit shall be minimal and shall not exceed 100 microampere;
3. The printed circuit boards shall be varnished and protected against moisture and dust;
4. The internal electronic circuitry shall be of highest possible reliability and protected against voltage spikes and surges;
5. The detector shall be capable of operating satisfactorily under minimum variation of ±25% in supply voltage;
6. The circuitry shall also be protected against electromagnetic interference.

FWP10.4.050.9 ELECTRICAL CONTINUITY

The detector base shall be sealed with a plate during the installation period. This plate shall facilitate electrical continuity through the base such that the circuits can be tested or maintained.

FWP10.4.060.A INSTALLATION

1. Use of smoke detector in area vulnerable to false fire alarm shall be avoided where the FSD Requirements are complied with;

   Requirements on installation of smoke detectors shall be similar to requirements on heat detectors stated in FWP10.3.030.

2. Where detectors are mounted at levels above 4 m they shall be capable of being removed and re-fixed from below by means of a special extended arm tool.

FWP10.4.070.9 REVERSIBLE RESPONSE TIME DELAY

Where signal integration feature is specified as to avoid the unwanted alarms caused by transient interferences, the smoke detector shall be characterised by a reversible response time delay from 15 to 30 seconds depending on the concentration of smoke continuously present before an alarm is initiated. Upon clearance of the transient interference within the time delay, the smoke detector shall resume its quiescent state without any alarm initiation.

FWP10.4.080.9 RADIATION LEVEL

For ionization type detector, the Sub-contractor shall submit the total American 241 radiation level to Hong Kong Radiation Board for approval on behalf of the Employer where necessary before practical completion of the works. The Sub-contractor shall also make all necessary arrangements, if required by the Hong Kong Radiation Board, for inspection of the installation by the authorized representatives of the Board.

FWP10.4.090.9 PROBE UNITS

Probe units for air duct insertion mounting shall be of robust corrosion-proof construction and capable of accurately sampling the air flowing in the duct over a wide range of velocities. Insertion of the probe shall cause negligible air flow head loss. Probe units shall be suitable for use with smoke detectors as specified above and shall be installed in the centre of a straight section of ducting that has a length at least 6 times its width.

FWP10.4.100.A CERTIFICATION

1. Copies of type test / approval certificates from product certification bodies recognized by FSD shall be produced to prove that the smoke detector complies with BS EN 54-7 or other standards acceptable to FSD;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the smoke detector delivered to the Site or installed.

FWP10.5 CONTROL AND INDICATING EQUIPMENT (CONTROL PANELS)

FWP10.5.010.A DESCRIPTION

1. Control and indicating equipment (control panels) including main fire alarm control panels, sub-panels and repeater panels of conventional electronic type or addressable type for sprinkler system, automatic fire detection system, and manual fire alarm points and signals shall comply with BS EN 54-2 or other standards acceptable to FSD. It shall be of robust construction in non-corrodible materials, with hinged front door having cylinder-type lock and keys;
2. Where installed on external wall or place accessible to public, the control and indicating equipment shall be enclosed by a stainless steel box with glazed lockable door to restrict access to the control switches but allowing a full view of the visual indications;
3. The Sub-contractor shall submit the layout, design and construction of all the fire alarm control panels, sub-panels and repeater panels for the CM's approval.

FWP10.5.020.9 OPERATION

The equipment panel shall be equipped to suit the fire alarm system of which it forms a part and shall be compatible with all other system devices and components. Fire alarm signals may originate from manual fire alarm call points, heat detectors, smoke detectors, flow switches, pressure switches, FM200 extinguishing system alarm contacts, sprinkler system alarm contacts etc. as applicable. The connection of these devices in "zones" (alarm circuits) shall be as scheduled in FWP2 or on the Drawings.

FWP10.5.030.A EQUIPMENT

The control and indicating equipment and the alarm circuits are DC operated with battery backup, should generally include the following basic equipment:

1. "Supply On" visual indicator;
2. "System On" visual indicator;
3. "System Isolated" visual indicator with buzzer;
4. "Fire" alarm visual indicator for each zone, red;
5. Alarm re-set button for each zone;
6. Alarm silencing switch, with local and remote warning buzzers and visual indicating lights;
7. Relays, terminal strips, wiring, labels, etc. for the proper operation of the whole system including detectors and alarm bells, etc.;
8. Auxiliary relay or additional relay contacts for automatic starting of fire booster pump etc. as detailed in FWP2;
9. Test facilities for each alarm zone;
10. Isolating switch for each alarm zone with light indication;
11. Indicator light and warning buzzer showing whether auto-starting of generator (where provided) disabled or not, emergency stop buttons for FS/SP pumps pressed, water tanks empty etc. as shown on the Drawings;

12. Key switch, indicator light and warning buzzer for testing of direct line connection (where provided) to a Fire Services Communication Centre;
13. A minimum of 10% spare zones shall be allowed for conventional fire alarm control panel, sub-panel or repeater panel to cater for future expansion and modification.

FWP10.5.040.A ALARM OPERATION

Upon operation of one or more triggering devices, the fire alarm control panel shall give a fire alarm by:

1. All internal alarm sounders in or near the indicating equipment;
2. All external visual and audible alarm sounders of respective alarm zone;
3. A visible indication for each zone in which a trigger device operates;
4. A signal transmitted to a Fire Services Communication Centre, where a direct line connection is provided.

FWP10.5.050.A FAULT INDICATION

1. Automatic fire detection systems, and manual fire alarm systems where so indicated in FWP2, shall be arranged for continuous monitoring of all alarm circuits, including the wiring and the alarm signalling devices connected thereto;
2. The fire alarm control panel in this case shall be provided with suitable fault warning signals including an amber fault indicator for each alarm zone (alarm circuit) and a warning buzzer for sprinkler and automatic fire detection system;
3. Faults to be detected shall include open-circuits, short-circuits, and removal of signalling devices for sprinkler and automatic fire detection system;
4. Battery-operated systems shall be provided with a battery supply indicator mounted upon the indicating equipment.

FWP10.5.060.A INDICATOR LAMPS

1. Indicator lamps shall be of LED types and of voltage rating 20% higher than the applied voltage, and shall wherever possible be of extra low voltage type;
2. Where A.C. mains operation is required, indicator lamps shall be operated at extra low voltage via a step-down transformer and be suitably rated for long life and reliability;
3. Zone fire alarm visual indicators in conventional type panel shall be of twin LEDs.

FWP10.5.070.9 RELAYS

Relays shall be of "potted" type, or similarly protected against dust, and shall have solenoids with varnish-impregnated or plastic encapsulated windings.

FWP10.5.080.9 CONTACTS

Contacts shall be of silver and adequately rated. Additional contacts shall be provided as required for the operation of auxiliary controls.

FWP10.5.090.A POWER SUPPLIES

1. Power supplies to the fire alarm control panel, sub-panel and repeater panel shall comply with BS EN 54-4 or other standards acceptable to FSD and incorporate safety isolating transformers conforming to BS EN 61558 or other standards acceptable to FSD;

2. The control equipment shall incorporate battery charger set with appropriate voltage regulators suitable for the rating of the interconnected trigger devices and the equipment shall incorporate overload cut-out or limiting devices to protect the external circuit against excess current;

3. Protection against earth leakage currents shall be provided in accordance with the Electrical CoP, latest Edition, if the equipment contains apparatus or conductors operating at a voltage exceeding extra low voltage.

FWP10.5.100.A CERTIFICATION

1. Copies of type test / approval certificates from product certification bodies recognized by FSD shall be produced to prove that the control panel complies with BS EN 54-2 or other standards acceptable to FSD;

2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the fire alarm control panels delivered to the Site or installed.

FWP10.6 BATTERIES AND CHARGERS

FWP10.6.010.9 PERFORMANCE

1. The capacity of the battery and charger unit shall be as stated in FWP2 and the type shall be acceptable to FSD;
2. Unless otherwise specified, the battery and charger units shall be capable of maintaining the system in normal operation for a period at least 24 hours longer than the maximum period for which the premises are likely to remain unattended without recharging and thereafter shall remain capable of operating in the maximum "alarm" condition for at least 30 minutes;
3. If the system is connected by an alternative standby supply such as an automatically started emergency generator approved by FSD, the capacity of the battery and charger unit may be reduced to that capable of maintaining the system in normal operation for 6 hours and thereafter capable of operating in the maximum "alarm" condition for at least 30 minutes;
4. The Contractor shall submit calculation to demonstrate that the capacity of the battery and charger unit is able to cope with the power demand of the whole system.

FWP10.6.020.A BATTERY TYPE

1. The batteries shall be either one of the following types:
   a. Nickel-cadmium accumulator and ultra-low maintenance type requiring no water replenishment throughout the normal service life of the battery. The battery shall be of the highest quality materials complying with IEC 60623 and IEC 62259;
   b. Valve regulated sealed lead acid batteries complying with BSEN60896-21 & -22 and maintenance free.
2. The batteries shall have a minimum design life of 10 years rated at 20ºC and shall be of a type having a life of at least four years under the conditions of use likely to be experienced in the fire detection and fire alarm system;
3. The Sub-contractor shall provide copies of type test certificates from accredited laboratories to prove the batteries are in compliance with the specification requirements;
4. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the battery and charger delivered to the Site or installed;
5. Labels shall be fitted to all batteries indicating their date of installation. The labels shall be sited so that they can be read without disturbing the batteries.

FWP10.6.030.9 BATTERY VOLTAGE

Where applicable the alarm system battery shall be of sufficient voltage to operate the remote indicator unit at the Fire Services Communications Centre via the alarm transmitter unit and the Telephone Company lines. If necessary a separate battery complete with separate charger, not exceeding 50V, shall be provided for this purpose.

FWP10.6.040.A BATTERY CHARGERS

1. Battery chargers shall be of the automatic trickle charge type, suitable for a single phase 220V, 50 Hz A.C. supply with facility for manually-operated boost charge, capable of re-charging the battery from fully discharged to fully charged condition in not more than twenty four (24) hours. Battery overcurrent protection shall be provided to safeguard the battery against short-circuit. Instruments shall include voltmeter for output voltage and ammeter for output current. Auxiliaries shall include fuses, buzzer alarm and mute button, lamp test button, LED indicators for mains and charger supply healthy, battery fault, battery low-volt, and charger fault;
2. The charger unit shall consist of a rectifier with the AC mains input supplied via an isolation transformer and the ripples of its DC output smoothed out by a DC filter for the connected load under normal operation or after the battery having discharged in AC mains failure;
3. Battery chargers shall be compatible with the types of batteries used;
4. Battery chargers shall be capable of detecting AC mains supply failure and its own DC output failure for actuating changeover to battery supply when either one of the failure signals is detected;
5. Charging characteristics are within the battery manufacturer's specification for the range of battery temperatures reached with the ambient temperature (i.e. outside the standby power source enclosure from -5℃ to + 40℃);
6. Except for currents associated with battery monitoring, the battery shall not discharge through the charger when the charging voltage is below the battery voltage;
7. Power supply equipment is capable of recognizing and signalling the fault after loss of the battery charger, within 30 minutes of the occurrence, except when the charger is switched off or limited or interrupted when the power supply equipment is delivering a current greater than the rated maximum output voltage.

FWP10.6.050.9 FAULT WARNING

1. Battery chargers shall give visible and audible fault warnings when any AC mains supply failure, DC output failure, battery fault, battery low-volt, and charger fault is detected;
2. The output of the rectifier shall be sufficient for the system to give fault warnings upon failure of the battery.

FWP10.6.060.9 BATTERY / CHARGER MOUNTING

1. The battery and charger shall each be housed in a well ventilated cabinet made of galvanised sheet steel of at least 1.2 mm thick, complete with two layers of stoved enamel or one layer of stoved epoxy powder paint. Detail of the battery charger set shall be submitted for Approval;
2. In all cases, the battery shall be installed in a compartment separate from the charger.

FWP10.7 FIRE ALARM BELLS AND CIRCUITS

FWP10.7.010.9 BELL LOCATION

The fire alarm bells shall be located as shown on the Drawings. Necessary adjustment to the bell locations and quantities to comply with relevant audibility requirements basing on the alarm bell characteristics shall be proposed and submitted by the Sub-contractor to the Contract Manager for Approval prior to installation.

FWP10.7.020.A BELL PERFORMANCE

1. The sound generated by the bell shall be easily distinguishable from other bells;
2. Unless otherwise specified on the Drawings, each alarm bell shall be capable of producing a sound level of at least 90 dB(A) at 3 m from the location of installation;
3. The alarm bells shall produce an alarm sound level complying with FSD's requirement when the doors of the rooms are closed and with all the windows fully opened. For domestic buildings, the alarm sound level shall not be less than 60dB(A) and not less than 5dB(A) above any background noise likely to persist for a period longer than 30s when the building is in use, whichever is the greater, measured at 3 m from inside of the main entrance door. For non-domestic buildings, the alarm sound level shall not be less than 65 dB(A), and not less than 5dB(A) above any background noise likely to persist for a period longer than 30s, whichever is the greater except in areas not required by the FSD, measured at 3 m from inside of the main entrance door;
4. The contractor shall carry out measurement on Site to verify compliance with alarm sound level as specified above. Should the results do not meet the requirements, the Contractor shall submit alternative proposal to the CM for acceptance and issuance of Site Instruction.

FWP10.7.030.9 BELL CONSTRUCTION

1. Under-dome type iron clad bells, suitable for operation at 24 V DC system as stated on the Drawings and in FWP2 shall be used;
2. Alarm bells shall be of minimum 150 mm diameter gong;
3. Bells shall be of weatherproof construction if susceptible to weather conditions;
4. The bells shall have a suitable conduit entry.

FWP10.7.040.9 BELL FINISH

Bell domes shall be finished in signal red.

FWP10.7.050.9 BELL CIRCUITS

Bell circuits shall be separately fused at the control equipment.

FWP10.7.060.A ALARM TRANSMITTERS

1. The alarm transmitter, where called for in FWP2 shall be of polarity reversal type compatible with the Remote Indicator Unit at FSD Fire Control;
2. All costs of the direct telephone line connection including application, processing connection, installation charged by services provider and rental and maintenance charges within the Maintenance Period for the direct telephone line and for the remote indicating unit, shall be borne by the Sub-contractor.

FWP10.7.070.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the fire alarm bells delivered to the site or installed.

FWP10.8 AUXILIARY SYSTEMS

FWP10.8.010.9 SYSTEM CONTROL

Control for the operation of auxiliary systems, including fire booster pumps, fire damper release mechanisms, door release mechanisms, smoke extraction fans, fireman's lift, etc., where called for in FWP2, shall comply with the general requirements of this Specification and the Sub-contractor shall carry out all associated electrical control wiring and connections unless otherwise indicated.

FWP10.8.020.A AUXILIARY BATTERY

Where battery operation of auxiliary control systems is required, a separate battery and charger for these systems shall be provided and suitably labelled for identification. The main fire alarm system battery shall not be connected directly to any auxiliary circuits other than those essential to the detection and alarm system.

FWP10.9 VISUAL FIRE ALARM

FWP10.9.010.A SYSTEM

The visual alarm signal shall be in the form of a red flashing light and be located at prominent locations such that its effect can be seen from everywhere in the building when the fire alarm is activated. The visual fire alarm system shall conform to NFPA 72 or BS 5839- 1 and acceptable to FSD. Sample of the flashing red light shall be submitted for Approval.

FWP10.9.020.9 LABEL

Each red flashing light of the visual fire alarm system shall be provided with indication showing "FIRE ALARM 火警". The height of the English letters and Chinese characters shall not be less than 10 mm and 15 mm respectively, or the size of the characters is acceptable to FSD.

FWP10.9.030.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the visual fire alarm delivered to the site or installed.

FWP10.10 AUDIO/VISUAL ADVISORY SYSTEM

FWP10.10.010.9 GENERAL

1. The Sub-contractor shall design, supply and install the audio / visual advisory (AVA) system and the selection of proper, correct and compatible equipment and components to achieve the performance specified. Detailed design layouts and full technical information and calculations for the system shall be submitted for Approval;
2. AVA system shall comprise AVA system control panel, complete audio advisory system, audio advisory system power supply module, flashing exit sign boxes inside AVA system protected areas, flashing directional sign boxes, photo-luminous directional signs, batteries and chargers, cables and other items of equipment required for the complete and workable system;
3. All equipment and components offered shall be proven products with good quality to facilitate the safe evacuation of occupants in the premises during a fire condition. They shall be suitable for continuous operation at ambient temperature between 0ºC and 40ºC and relative humidity up to 99% saturation;
4. Labels shall be provided to all indicators, buttons, switches, internal wiring terminals and all other components to facilitate operation and proper maintenance. Descriptions shall be in both English and Chinese where applicable;
5. Servicing facilities and replacement spare parts shall be available locally for future maintenance of the system;
6. The Sub-contractor shall coordinate with other concerned parties for the selection of mixer preamplifiers, power amplifiers and loudspeakers if the loudspeakers are required to be connected to the public address system(s) provided by others. In such circumstance, the arrangement of speaker zones shall also fulfil the requirements of the public address system(s);
7. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the AVA system control and components, flashing exit sign boxes, flashing directional sign boxes and low level directional signs delivered to the site or installed.

FWP10.10.020.9 AUDIO ADVISORY SYSTEM

1. The audio advisory system shall be designed and installed in accordance with the FSD CoP and Circular Letters;
2. The audio advisory system shall comprise mixer preamplifiers, power amplifiers, input selection panel, monitor panel, volume control panel, line fault monitoring units, desktop microphone, loudspeakers, automatic audio input changeover unit (where loudspeakers are also required to be connected to a public address system), etc. and all necessary components;
3. Audio advisory system of digitized system architecture with integrated digital products fulfilling all necessary functions of the system can also be submitted for Approval. The Sub-contractor shall provide proper user interface to mimic the functions of AVA system control panel, mixer preamplifier, power amplifiers, input selection panel, monitor panel, volume control panel, line fault monitoring unit and automatic audio input changeover unit, etc.. Any equipment necessary for establishing the user interface, such as a central operator terminal and display monitor, shall be provided by the Sub-contractor;

4. The audio advisory system shall be designed to ensure matching of amplifier rating and connected equipment load. The variation in available power shall not exceed 3dB between the outlet nearest to the amplifier and any other outlet in the system. Suitable repeaters and signal conditioners shall be installed as necessary to maintain the sound power level. A load variation of 50% shall not affect the quality of sound or cause the output voltage at any outlet to vary by more than 6dB;
5. The arrangement of loudspeakers shall refer to the relevant clauses in BS5839-8;
6. Broadcasts shall be at least 10dB above background noise levels to optimize audibility and intelligibility. The design background noise levels shall refer to a recognized international standard such as BS5839-8 and take into account the conditions of the localities concerned;
7. The loudspeakers shall be so positioned as not to cause adverse interference with each other.

FWP10.10.030.A AVA SYSTEM CONTROL PANEL

1. The AVA system control panel shall comprise all necessary components including power supply module, desktop microphone with manual override switch, attention drawing signal (chime sound) module, voice message module, timers, relays and terminals where appropriate;
2. The AVA system control panel shall:
    a. be capable of receiving the fire alarm signal from fire alarm control panel, and also transmit the AVA system fault signals to fire alarm control panel;
    b. indicate power supply, charger and battery status and report faults such as “System Common Fault”, “Charger Fault” and “Speaker Line Fault”;
    c. be provided with emergency announcement control and “Power ON”, “Fire Signal ON”, “Microphone ON” and “Emergency Message ON” indication;
    d. interface with the fire alarm bells and flashing directional signs and flashing exit signs located at the AVA system protected areas / zones;
    e. be provided with a microphone input socket for connection to the desktop microphone;
    f. be provided with facilities for controlling the operation sequence of alarm devices / emergency announcement;
    g. be provided with other necessary facilities, indications and controls as required by the FSD.
3. Adequate dry contacts controlled by timers and control relays shall be provided and incorporated in the fire alarm bell circuit so as to alternate the alarm bells operation and emergency announcement as required by the FSD. At least 10% spare dry contacts shall be provided.

FWP10.10.040.9 VOICE MESSAGE MODULE

1. Voice message module with voice recording facilities shall be provided for broadcasting of pre-recorded message. The pre-recorded message shall be stored in non-volatile memory chip(s) controlled by the voice message module.
2. The message storage capacity (recording time) shall be at least two times of the capacity required for the recording and broadcasting of the following message in English, Cantonese and Putonghua:

    “This is a fire alarm message. Please keep clam. Follow the flashing light direction to the nearest exit. Do not use the lift.

這是一個火警警報，請保持冷靜，依照閃燈指示方向，走到最近的出口離開，切勿使用升降機。”

FWP10.10.050.A AVA SYSTEM POWER SUPPLY MODULE

1. AVA system power supply module shall conform to relevant requirements in BS5839-8 and comprise standby supply with rechargeable battery and automatic charger. The standby power shall be capable of maintaining normal operation of the AVA system under no-fire-alarm condition for at least six hours, after which sufficient capacity shall remain to provide an evacuation broadcast in all alarm zones for at least 30 minutes;
2. The batteries for the power supply module shall be rechargeable, maintenance free and with a design life of minimum 10 years rated at 20℃. The batteries shall conform to BS EN 60896-21 & -22 for valve regulated sealed lead-acid type or to IEC60623 and IEC62259 for nickel-cadmium accumulator and ultra-low maintenance type;
3. The batteries shall be properly stored in a battery cabinet made of galvanised sheet steel of at least 1.2 mm thick, complete with two layers of stoved enamel or one layer of stoved epoxy powder paint;
4. Calculation of AVA system loads and battery capacity shall be submitted for Approval.

FWP10.10.060.9 MIXER PREAMPLIFIER

1. The mixer preamplifier shall be fully solid-state in design and provided with the following facilities:
   a. Volume control for adjusting the output level;
   b. Individual volume control for voice message and desktop microphone input;
   c. Bass and treble tone controls;
   d. Output terminals complete with volume control with “OFF” position;
   e. Standard sockets with plugs and lock nuts for each input and output terminal;
   f. Facilities for proper operation of all required auxiliary equipment controls.

FWP10.10.070.9 POWER AMPLIFIER

1. The power amplifier shall be fully solid-state in design and provided with the following facilities:
   a. Volume control for adjusting the output level;
   b. A VU meter or LED / LCD indicators to indicate the output level;
   c. Balanced floating outputs of 70V and 100V for loudspeaker connections;
   d. Standard sockets with plugs and lock nuts for each input and output terminal.
2. The total load connected to each individual power amplifier shall be not more than 80% of its rated power output at the time of completion.

FWP10.10.080.9 INPUT SELECTION PANEL, MONITOR PANEL AND VOLUME CONTROL PANEL

1. Refer to ELE25.3.050, ELE25.3.060 and ELE25.3.070 for requirements of input selection panel, monitor panel and volume control panel respectively;

2. The function of input selection panel can be integrated into the mixer preamplifier subject to Approval;
3. The function of monitor panel and volume control panel can be integrated into the power amplifiers subject to Approval.

FWP10.10.090.9 LINE FAULT MONITORING UNIT

1. The line fault monitoring unit shall check the 'non-break' status of wiring of each speaker zone by automatically generating signals at preset time everyday. Open circuitry in speaker line(s) or accidental speaker removal from the line(s) shall be monitored;
2. The line fault monitoring unit shall provide "fault" and "System ON" indications for each speaker zone on the AVA System Control Panel.

FWP10.10.100.9 AUTOMATIC AUDIO INPUT CHANGE-OVER UNIT

1. When the loudspeakers are required to be connected to the audio advisory system and other public address system(s), an automatic speaker change-over unit shall be provided;
2. The loudspeakers shall be set as default speakers for the public address system(s) under no-fire-alarm condition. When a fire alarm signal is received, the audio lines connection shall be switched automatically to the audio advisory system for broadcasting;
3. The function of line fault monitoring unit as specified in FWP10.10.090 can be incorporated into the automatic audio input change-over unit.

FWP10.10.110.9 LOUDSPEAKERS

1. Refer to ELE25.3.090, ELE25.3.100 and ELE25.3.110 for requirements of ceiling speaker, horn speaker and column speaker respectively. Refer to ELE25.4.020 for mounting requirements of ceiling speakers;
2. The loudspeakers shall be of ceiling-mounted type or wall-mounted type as shown on the Drawings. They shall provide a crisp, clear reproduction of voice and alarm tone signal;
3. The loudspeakers casing shall be constructed of sheet steel or high impact ABS plastic in colour matching with false ceiling or wall finishes. Any loudspeaker mounted at outdoor location shall be of weatherproof construction;
4. Each zone of loudspeakers shall cover not more than one floor.

FWP10.10.120.9 DESKTOP MICROPHONE

1. Desktop microphone shall be single zone type complete with condenser microphone on gooseneck and with a built-in push-to-talk switch;
2. The microphone shall have a minimum cable length of 1m. The cable for microphone shall be terminated with a phone plug;
3. The built-in push-to-talk switch (emergency manual override switch) shall be activated to stop the pre-recorded message and alarm bell operation and allow the operator to give particular emergency announcement through the microphone.

FWP10.10.130.A FLASHING DIRECTIONAL SIGN BOXES AND FLASHING EXIT SIGN BOXES

1. Flashing exit sign boxes inside AVA system protected areas and directional sign boxes shall be installed at high level. The sign box shall be of full box or pendant acrylic panel design and shall be submitted for Approval;
2. The flashing exit sign boxes and flashing directional sign boxes shall:
    a. Be complete with coloured graphic, internally illuminated and conforming to BS5499-10;
    b. Be positioned between 2m and 2.5m above finished floor level measured to the base of the flashing lights and complete with suitable mounting brackets;
    c. Be pressed or rolled from quality steel sheet and complete with durable paint to form a rigid, robust, high quality body. The steel sheet thickness shall not be less than 1mm;
    d. Be of weatherproof construction at outdoor locations;
    e. Be of maintained type and internally illuminated evenly by LED lighting and complete with all necessary control gears and flashing modules for receiving fire alarm signal from fire alarm control panel as necessary.
3. Under no-fire-alarm condition, the flashing exit sign boxes and flashing directional sign boxes shall be illuminated in static mode. Upon receiving fire alarm signal, they shall operate in flashing mode. The flashing action of all exit sign boxes inside AVA system protected areas and directional signs on the same floor shall be synchronized;
4. Each zone of flashing exit sign boxes and directional sign boxes shall cover not more than one floor.

FWP10.10.135.A FLASHING EXIT SIGN AND FLASHING DIRECTIONAL SIGN POWER SUPPLY

1. The flashing exit sign boxes and flashing directional sign boxes shall be powered by 24V DC centralized battery and charger on each floor. The battery and charger cabinet shall be incorporated with flashing module as necessary for receiving fire alarm signal from fire alarm control panel and complete with voltmeter, ammeter, and LED alarm indicators;
2. The batteries shall be rechargeable and maintenance free and with a design life of minimum 10 years rated at 20℃ and comply to BS EN60896-21 & -22 for valve regulated sealed lead-acid type, or to IEC60623 and IEC62259 for nickel-cadmium accumulator and ultra-low maintenance type;
3. The capacity of the batteries shall be capable of maintaining the connected flashing exit sign boxes and directional sign boxes in alarm operation for at least 2 hours. Each centralized battery and charger set shall have at least 20% spare capacity over the connected loads. Calculation of battery and charger capacity shall be submitted for Approval.

FWP10.10.140.A LOW LEVEL DIRECTIONAL SIGNS

1. Low level directional signs shall be of non-radioactive photo-luminous type conforming to BS 5499-4 or other standards acceptable to FSD;
2. Low level directional signs shall be installed with the lower edges not higher than 200mm from the finished floor level of the protected areas to indicate the evacuation routes;
3. Low level directional signs shall be made of plastic material with coloured graphic;

4. Low level directional signs shall be framed with rust-proof metal or a material approved by the CM and fixed on walls, columns or fixtures by gloss stainless steel button screws or otherwise concealed fixing. A sample shall be submitted for Approval prior to installation.

FWP10.10.150.9 AVA SYSTEM CABLES AND WIRING

1. All cables of the AVA system for power supply, signalling and audio transmission shall be fire resisting types acceptable to FSD;
2. Wiring circuits for the flashing exit sign boxes and flashing directional sign boxes and the loudspeakers shall be of ring loop configuration such that any damage to the wiring at a single point shall not affect the proper operation of all flashing exit sign boxes and flashing directional sign boxes and loudspeakers;
3. No cable joint or connector shall be permitted between cable originating and terminating points;
4. Unless otherwise specified, audio cables shall be copper, stranded and sheathed type, and compatible with the types of loudspeakers / power amplifiers connected. Twin cables with low power loss and protected against interference shall be used for the amplifier output circuits to the loudspeakers.

FWP10.10.160.9 EQUIPMENT CABINET

1. Refer to ELE25.3.080 for requirements of equipment cabinet;
2. Equipment cabinet shall be equipped with multiple power socket rack, etc., where appropriate, for power supply to the housed equipment.

FWP10.11 ADDRESSABLE SYSTEM

FWP10.11.010.N PRODUCT REQUIREMENTS

1. The addressable system shall comprise all addressable components including fire alarm control panels, zone indication panels, repeater panels, fire detectors of various types, manual fire alarm call points, interface modules, etc. and other non-addressable components such as flow switches, micro-switches (for subsidiary valves), fire alarm bells, strobes and audible / visual notification appliances, batteries and chargers, and other items of equipment required for the complete and workable system;
2. All system components shall be listed by Product Certification Bodies acceptable to FSD;
3. Only the addressable devices supplied from a manufacturer who can provide / release their programming information, hardware locks and password information to the CM and the management and maintenance staff shall be acceptable; nevertheless, the programming information are limited to those required for routine maintenance, diagnosis and repair work, and for future upgrading and modification works such as relocation, change, deletion, addition, etc.;
4. The Sub-contractor shall ensure the compatibility of any devices / components in the system produced by different manufacturers;
5. The Sub-contractor shall provide adequate training courses to not less than ten persons nominated by the CM to enable them to understand and familiarise with the use, programming and re-programming of the addressable system for routine maintenance, diagnosis, and repair works, and also for future upgrading and modification works such as relocation, change, deletion, addition, etc.

FWP10.11.020.N SYSTEM REQUIREMENTS

1. The addressable fire alarm control panel shall be provided with information for continuous monitoring and control of detector status, and annunciates the need for immediate service from the addressable devices for decision of control actions;
2. Addressable devices shall provide loop monitoring for error such as short circuit, open circuit, detector removed and detector communication failure;
3. The system loop design shall be such that the actuation of any detection device or when there is any fault in the loop shall not cause the loop to be disabled for the alarm and trouble signals to be followed;
4. The Sub-contractor shall supply and install surge arresters for the addressable fire alarm control panels to prevent false fire alarms and malfunctioning of the fire alarm and control system due to power and lightning surge.

FWP10.11.030.N ADDRESSABLE FIRE ALARM CONTROL PANEL

1. In addition to the specification for control and indicating equipment as stated in FWP10.5, the addressable fire alarm control panel shall be of intelligent analogue addressable type with its own microprocessor and memory. The panel shall comply with BS EN 54-2 and the system requirements as stipulated in BS 5839-1. The power supplies to be fire alarm control panel shall be an integral product of the control panel and comply with BS EN 54-4;
2. Battery charging shall be a function of the power supplies. Batteries shall be a type fully compatible with the addressable fire services alarm control panel;

3. The panel shall drive four wire loops of addressable analogue fire sensing, signalling, monitoring and communication devices. The loop shall be self-powered for all sensing, signalling, monitoring and communication functions. Upon a communication failure anywhere on the loop or power failure, a failure alarm shall be reported. Each loop shall have a minimum of 20% spare for intelligent sensors / detectors and 10% spare for addressable modules. Each addressable panel shall have minimum one spare loop and the capability to cater for future expansion and modification by connecting to an addressable sub-panel;
4. The panel shall be able to connect to addressable devices and conventional alarm initiating circuits as shown on the Drawings. Independent modules for alarm zones (e.g. manual fire alarm call point zone, detector zone, sprinkler flow switch zone) and trouble zones (e.g. subsidiary valve shut off) shall be provided on a floor-by-floor or zone-by-zone basis;
5. Location, type, address and condition of each device in the system shall be displayed through a built-in LCD panel automatically in case of alarm or trouble. The display on the LCD panel shall be in a user friendly format. It shall also be time stamped;
6. Devices on loop circuits shall be identified by display of their addresses, locations and types, and by their conditions (Alarm, Pre-alarm, Fault) on the built-in LCD panel. Individual red alarm and common yellow trouble LEDs shall be provided for each initiating and for each indicating zone;
7. Zone indication panel(s) shall be provided in adjacent to the main addressable fire alarm control panel to display all individual zone indication lights with description labels in Chinese and English.

FWP10.11.040.N ADDRESSABLE REPEATER PANEL

1. Addressable repeater panel shall be a zone indication panel for alarm indication and status monitoring supplied and installed at location as shown on the Drawings;
2. Power to the addressable repeater panel can be supplied either from the fire alarm control panel or equipped with its own battery and charger depending on the location of the repeater panel as shown on the Drawings. The capacity and details of power supply shall be submitted for Approval.

FWP10.11.050.N ADDRESS SETTING FOR ADDRESSABLE DEVICES

1. The address setting mechanism for each addressable device / detector shall be approved by the CM;
2. The address of each device shall be easily set and changed. The allowable address shall be adequate to cater for the whole fire alarm system with ample spare capacity for future expansion;
3. For one to one replacement or relocation of any addressable device / detector, no re-programming on the fire alarm control panel shall be required. When any installed devices / detectors need to be replaced, no programming tool including notebook computer or field programmer, etc. shall be required. The system shall be resumed to normal within few minutes after the faulty devices are replaced by the new ones;
4. The Sub-contractor shall supply adequate sets of necessary tools, kits, electronic instruments for initial setting, adjustment and subsequent resetting, retesting and re-commissioning of all addressable devices.

FWP10.11.060.N ADDRESSABLE DEVICES

1. Addressable devices shall provide information for continuous monitoring and control of detector status and annunciate the need for immediate services. The decision on the control actions shall be from the fire alarm control panel and not on individual detector;
2. In addition to the specification for heat and smoke detectors as stated in FWP10.3 and FWP10.4, the addressable detectors shall be of intelligent analogue addressable type and fully compatible with the addressable fire alarm control panel;
3. The addressable detectors shall be provided with the following features as a minimum:
    a. Remote adjustment of detector sensitivity to suit the occupancy and / or the environment of a detector at any time;
    b. Sensor monitoring with automatic compensation of sensor alarm threshold due to aging, humidity and accumulation of dirt and dust with time;
    c. Adjusting time lag from the time of reaching alarm threshold to the time of issuing or communicating a fire alarm;
    d. Different alarm levels are provided such as detection level, maintenance or regular servicing level, fire alarm level, etc. to give an early warning for maintenance to avoid false fire alarm;
    e. Alarm condition simulation for testing purpose;
    f. Loop monitoring for error such as short circuit, open circuit, detector removed and detector communication failure.

FWP10.11.070.N INTERFACE MODULES

1. Monitor Module
    a. Monitor module shall allow the addressable fire alarm control panel to interface with and monitor individual non-addressable monitoring alarms such as a non-addressable manual fire alarm call point, sensors, detectors, water flow switches, sprinkler supervisory devices, etc.;
    b. The monitor module shall provide addressable inputs for all N.O. or N.C. contact for continuous monitoring. In addition to the supervised state of the monitored device, the measurement of the supervision shall be sent to the addressable fire alarm control panel;
    c. The monitor module shall be provided with a supervised initiating circuit. An open-circuit or short-circuit fault shall be indicated at the addressable fire alarm control panel.
2. Control Module
    a. Control module shall supervise and monitor wiring to appliances of small connected load like fire alarm bells, flashing light units, indicator units, and interface relays;
    b. Upon command from the addressable fire alarm control panel, the control module shall disconnect the supervision and connect the external power supply to the device and a signal shall then be sent to the panel to indicate that the command was executed;
    c. The connected alarm load shall be closely monitored for any open and short circuit conditions at the control module. The output circuit connected to the loading shall be short circuit protected.

FWP10.11.080.N FAULT ISOLATOR

1. Fault isolator shall detect and isolate a short-circuited segment of a fault-tolerant loop whilst allowing the rest of the addressing circuit to function normally;
2. Fault isolator shall be provided for addressable device including detectors, manual fire alarm call points, monitor modules and control modules in accordance with relevant FSD Circular Letters to limit the number of devices lost in the event of a short circuit.

FWP11 ELECTRICAL WORKS

FWP11.1 GENERAL INSTALLATION 3

FWP11.1.010.9 SPECIFICATION 3
FWP11.1.020.9 ELECTRICITY SUPPLY 3
FWP11.1.030.9 SERVICE CONDITIONS 3
FWP11.1.040.9 WIRING SYSTEMS 3
FWP11.1.050.9 CONDUCTOR SIZES 3
FWP11.1.060.9 CONDUIT SYSTEMS 3
FWP11.1.070.9 MICC CABLES 4
FWP11.1.080.9 EXPOSED PLASTICS 4
FWP11.1.100.9 IDENTIFICATION OF CONDUCTORS, CABLES AND CABLE DUCTS 4
FWP11.1.110.9 CABLES CONNECTED TO OR IN CONTACT WITH BARE CONDUCTORS OR BUSBARS 4
FWP11.1.120.9 EARTHING AND BONDING PROVISION 5
FWP11.1.130.9 POWER FACTOR AND TOTAL HARMONIC DISTORTION 5

FWP11.2 MOTORS FOR PUMP DRIVES 6

FWP11.2.010.C CONSTRUCTION 6
FWP11.2.020.A RATING 6
FWP11.2.030.9 METHOD OF STARTING 6
FWP11.2.040.A NOISE LEVELS 6
FWP11.2.050.9 WARNING NOTICE 7
FWP11.2.060.A EFFICIENCY 7
FWP11.2.070.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 7

FWP11.3 MOTOR STARTERS 8

FWP11.3.010.A DIRECT-ON-LINE, STAR-DELTA AND AUTO-TRANSFORMER STARTERS 8
FWP11.3.020.A SOFT STARTER 9
FWP11.3.030.B VARIABLE SPEED DRIVE UNIT FOR BOOSTER PUMP SYSTEM 10

FWP11.4 PUMP CONTROL CUBICLE 14

FWP11.4.010.9 LOCATION 14
FWP11.4.020.9 CONSTRUCTION 14
FWP11.4.030.9 FITTINGS 14
FWP11.4.040.9 FINISH 14
FWP11.4.050.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 14

FWP11.5 PUMP CONTROL CUBICLE COMPONENTS 15

FWP11.5.010.A ISOLATING SWITCH 15
FWP11.5.020.B AMMETER AND CURRENT TRANSFORMER 15
FWP11.5.030.9 PUSH-BUTTON AND SELECTOR SWITCH 15
FWP11.5.050.9 TIME SWITCH 15
FWP11.5.060.9 INDICATION LIGHT 15
FWP11.5.070.A CONTROL RELAY 15
FWP11.5.080.9 TERMINAL BLOCK 16
FWP11.5.090.B PROGRAMMABLE LOGIC CONTROLLER 16
FWP11.5.100.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY 17

FWP11.6 CONTROLS AND GAUGES 18
FWP11.6.010.9 LEVEL CONTROL SWITCH FOR WATER TANKS 18
FWP11.6.020.A LEVEL REGULATOR FOR WASTE WATER, STORM WATER AND SEWAGE SUMP TANKS 18
FWP11.6.030.9 LEVEL REGULATOR FOR DEEP BORE WELLS 18
FWP11.6.040.A FLOW SWITCHES 18
FWP11.6.050.A PRESSURE SWITCHES 19
FWP11.6.060.A PRESSURE GAUGES 19
FWP11.6.070.9 EMERGENCY STOP SWITCH 19
FWP11.6.080.9 PRESSURE TRANSDUCER FOR BOOSTER PUMP SYSTEM 20

FWP11.7 L.V. SWITCHGEAR AND ASSOCIATED EQUIPMENT 21
FWP11.7.010.9 GENERAL 21

FWP11.8 BUSBAR CHAMBERS AND BUSBAR TRUNKING SYSTEMS 22
FWP11.8.010.9 GENERAL 22

FWP11.9 CABLES 23
FWP11.9.010.9 GENERAL 23
FWP11.9.020.9 CABLES FOR FIRE SERVICE INSTALLATIONS 23

FWP11.10 INSTALLATION OF POWER CABLES 24
FWP11.10.010.9 GENERAL 24

FWP11.11 WIRING SYSTEM INSTALLATION IN STEEL CONDUITS 25
FWP11.11.010.9 GENERAL 25

FWP11.12 WIRING SYSTEM INSTALLATION IN STEEL TRUNKING 26
FWP11.12.010.9 GENERAL 26

FWP11.13 WIRING SYSTEM INSTALLATION IN PLASTIC CONDUIT OR PLASTIC TRUNKING 27
FWP11.13.010.9 GENERAL 27

FWP11.14 EARTHING AND PROTECTION AGAINST INDIRECT CONTACT 28
FWP11.14.010.9 GENERAL 28

FWP11.15 WIRING ACCESSORIES 29
FWP11.15.010.9 GENERAL 29

FWP11.16 TESTING AND MAINTENANCE 30
FWP11.16.010.9 GENERAL 30

FWP11.1 GENERAL INSTALLATION

FWP11.1.010.9 SPECIFICATION

1. The electrical equipment, installation materials, cables, wiring, and installation practice, shall comply with the Drawings and Specification;
2. For fire services installations, the use of fire resistant cables shall be in accordance with Fire Services CoP unless otherwise specified.

FWP11.1.020.9 ELECTRICITY SUPPLY

Unless otherwise specified, the complete electrical installation shall be suitable for operation under the supply system with nominal frequency of 50 Hz and nominal voltage of 380 V, 3 phase and 220 V, single phase within the variation limits as declared by the local Supply Companies.

FWP11.1.030.9 SERVICE CONDITIONS

The complete electrical installation shall be suitable for use under Hong Kong climatic condition with relative humidity and ambient temperature as shown below:

1. Relative Humidity: up to 0.99 saturation;
2. Ambient temperature: peak from minus 5°C to plus 40°C for 4 hours continuously with an average from 0°C to plus 35°C over a 24 hour period.

FWP11.1.040.9 WIRING SYSTEMS

1. All wirings in water pump rooms shall be in surface conduit/trunking system or by armoured cables as detailed in this Specification or as shown on the Drawings;
2. Wiring and cabling systems in other areas shall be of the type or types detailed elsewhere in this Specification and as shown on the Drawings;
3. Unless Approved for the purpose, cables and wires shall not be located in damp, wet and excessively hot locations, or exposed to gases, fumes, vapours, liquids and other agents having a detrimental effect on the conductors.

FWP11.1.050.9 CONDUCTOR SIZES

1. Conductor sizes for alarm circuit wiring to automatic detectors shall be in accordance with AFA Rules and may be smaller than the minimum called for in the Specification provided that satisfactory operation of the system is achieved and that the wiring is capable of being installed, and subsequently maintained, easily and without damage as well as approved by the Contract Manager. The installed conductor size shall also be in accordance with the recommendations of the panel and detector manufacturer;
2. Conductor sizes for other applications shall strictly comply with the Drawings and Specification.

FWP11.1.060.9 CONDUIT SYSTEMS

1. Conduits shall be of steel or PVC as specified in the Specification or Drawings;
2. Conduits shall be completely separated from those for all other services. Separate channels shall be used for any wiring using duct systems;

3. Conduits shall be routed and installed in such a way as to give maximum protection against mechanical damage. Where it is unavoidable to run conduits across other services conduits, water pipes, air conditioning ducts, etc., they shall be installed first and fixed closest to the structure;

4. Conduit routes shall avoid areas of high risk such as lift wells, open staircases and unenclosed vertical shafts;

5. Galvanized iron draw-wires of adequate size shall be provided in all empty conduits.

FWP11.1.070.9 MICC CABLES

1. MICC cables shall not be used on circuits involving the switching of inductive or capacitative loads where there is a possibility of insulation damage due to high voltage surges;

2. Where bare MICC cables are run on galvanized steel cable trays, and in other situations where contact between dissimilar metals may lead to electrolytic corrosion, electrical contact shall be prevented by using plastic-coated fixing saddles supplemented by properly fixed plastic spacers, or by other Approved means.

FWP11.1.080.9 EXPOSED PLASTICS

The use of wiring, cables or installed materials having plastic sheathing or finish or constructed predominantly of plastic, and not enclosed in metal, shall be avoided wherever possible. Plastic cable trunking, etc. will not be acceptable. MICC cables shall be of non-PVC-sheathed type.

FWP11.1.100.9 IDENTIFICATION OF CONDUCTORS, CABLES AND CABLE DUCTS

1. Identification of conductors and cables on L.V. and M.V. power circuits shall be in accordance with the Electrical CoP, except that ELV alarm circuit wiring shall be identified by the basic colour in red. If other colours are to be used, they shall be submitted for Approval. Colour tracers may be used, in addition, to distinguish cables one from another;

2. All surface conduits, cable ducts and cable trays, armoured cables, MICC cables etc., forming part of the Fire Service Installation provide by the Contractor, shall be colour coded in red in such a way as to permit ready identification. Banding by means of paint will be acceptable where this can be carried out permanently and effectively. Durable high quality red plastic self-adhesive tape may be used for armoured and MICC cables, applied at intervals not exceeding 3 m;

3. Suitable identification plates shall be provided on all electrical equipment giving voltage, current, wattage or other ratings and manufacturer's name, trademarks or other descriptive markings by which the organisation responsible for the product may be identified;

4. Each disconnecting means required for all electrical equipment and each electrical source of supply shall be legibly marked to indicate its purpose unless located and arranged such that the purpose is clearly self evident;

5. All markings and identifications shall be of sufficient durability to withstand the environmental effects.

FWP11.1.110.9 CABLES CONNECTED TO OR IN CONTACT WITH BARE CONDUCTORS OR BUSBARS

Cables connected to or in contact with bare conductors or busbars shall be in accordance with ELE8.2.060 of HKHA Electrical Installation Specification.

FWP11.1.120.9 EARTHING AND BONDING PROVISION

The Sub-contractor shall provide all necessary earthing, equipotential and supplementary bonding in accordance with the Electrical CoP. The Sub-contractor shall provide 25 mm² PVC insulated copper bonding conductors from the termination gland at the main incoming fuse combination unit to the pump discharge pipes which shall be bonded by Approved clamps.

FWP11.1.130.9 POWER FACTOR AND TOTAL HARMONIC DISTORTION

1. For circuit with circuit protective device rating at or above 400A, single or three phase, the Sub-contractor shall be responsible for providing equipment as necessary to any pump control cubicle or motor for fresh and flush water pump installation, with or without variable speed drives, to improve the power factor to a minimum of 0.85 and restrict the total harmonic distortion of current to the value in accordance with the BEC;
2. Capacitor bank shall comply with IEC 60831-1 and IEC 60831-2 and shall be housed in a separate metal enclosure. Harmonic filter shall conform to IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4 and IEC 61000-4-5 or other similar recognised international standards.

FWP11.2 MOTORS FOR PUMP DRIVES

FWP11.2.010.C CONSTRUCTION

1. All electric motors shall be of squirrel-cage induction type and comply with BS EN 60034-1 or IEC 60034-1;
2. The stator windings shall be copper wire with Class F insulation to BS EN 60085 or IEC 60085 terminated in stud terminals;
3. The motors shall be totally-enclosed fan-cooled to BS EN 60034-6 or IEC 60034-6 IC411 and ingress protection to BS EN 60034-5 or IEC 60034-5 IP55 or better with cast iron frame, metal or polypropylene fan cover and metal terminal box. For motors of 15 kW or less, aluminium alloy frame will also be acceptable;
4. Unless otherwise specified, the motors shall be foot-mounted to BS EN IEC 60034-7 or IEC 60034-7;
5. The motors driving fire services pumps shall be of minimum Class IE3 to BS EN 60034-30-1 or IEC 60034-30-1 regardless of their rating;
6. For fresh water and flush water supply systems, the motors for pump drives at 75 kW below and at 75 kW to 200 kW shall be of minimum Class IE3 and Class IE4 respectively, to BS EN 60034-30-1 or IEC 60034-30-1 fulfilling the requirements stipulated in the BEC.

FWP11.2.020.A RATING

1. The motors driving the fire services pumps including drencher and street fire hydrant pumps shall be rated to give 20% more power in addition to the hydraulic power required for the rated flow of the system while sprinkler pump motors shall be 10% more unless otherwise specified;
2. The motors driving other pumps including fire services feed pumps shall be rated to give 15% more power in addition to the hydraulic power required for the rated flow of the system unless otherwise specified.

FWP11.2.030.9 METHOD OF STARTING

The method of motor starting shall be selected according to the characteristics of the pump and shall comply with the Electricity Supply Co's limitations on starting current. Unless otherwise indicated, the type of starter shall be as follows:

1. Up to 7.5 kW - Direct-on-line;
2. 11 kW to 55 kW - Star-delta;
3. Over 55 kW - Soft starter, for fresh/flush water pump motors and other pump motors; auto-transformer, for fire services water pump motors.

FWP11.2.040.A NOISE LEVELS

1. The mean sound pressure level at free field conditions over a reflecting plane at one metre from the surface of every single machine due to transmission through air for fresh, booster fresh and flush water installation shall not exceed 70 dB(A) for motors of 75 kW or below;
2. The method of measurement of noise and vibration level generated by the motors shall comply with BS EN 60034-9 or IEC 60034-9 and BS EN IEC 60034-14 or IEC 60034-14 respectively;

3. Manufacturers' type-test certificates and reports to verify the noise levels of motors shall be produced upon request by the CM.

FWP11.2.050.9 WARNING NOTICE

Motors under automatic control shall be provided with a prominent red notice on white ground, of durable material, with a size of not less than 300 x 300 mm inscribed in English and Chinese characters as follows:

DANGER 危險

THIS MOTOR IS AUTOMATICALLY CONTROLLED AND MAY START WITHOUT WARNING - ISOLATE BEFORE INSPECTION

此機乃自動操作 - 維修前請先關掣

Lettering shall be at least 25 mm high. The notice shall be displayed adjacent to each pumpset or each pair of pumpsets.

FWP11.2.060.A EFFICIENCY

The nominal full-load motor efficiency, tested to BS EN 60034-2-1 or IEC 60034-2-1, shall be no less than those as specified in FWP11.2.010 sub-clauses (5) and (6).

FWP11.2.070.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence as PRE.BS1.205 to verify the place of manufacture and authenticity of the motors for fire services pump drives delivered to the site or installed.

FWP11.3 MOTOR STARTERS

FWP11.3.010.A DIRECT-ON-LINE, STAR-DELTA AND AUTO-TRANSFORMER STARTERS

1. Type:
    a. Unless otherwise indicated, each motor provided with an independent motor starter shall comply with BS EN IEC 60947-4-1or IEC 60947-4-1;
    b. The coordination requirement shall be type "2";
    c. The short circuit protective device shall be in accordance with the recommendation made by the motor starter manufacturer in order to achieve the specified type of coordination.
2. Contactors:
    a. The contactors in the motor starter circuit shall comply with BS EN IEC 60947-4-1 or IEC 60947-4-1 suitable for a rated operational current at a utilisation category AC-3 of not less than the full load line current of the motor, capable of carrying out an intermittent duty of class 120;
    b. The rating of contactors for the star and delta circuit connections shall be selected in accordance with the contactor / starter manufacturer's recommendation;
    c. The star and delta contactors shall be electrically interlocked so that it is impossible for both contactors to close or be closed at the same time;
    d. The mechanical endurance of the contactors shall not be less than 1 million no-load operating cycles;
    e. The timers for star-delta and auto-transformer starters shall be adjusted for a maximum of 10 seconds with clear calibration;
    f. For auto-transformer starter, it shall comply with BS EN 60076 or IEC 60076 with class E insulation and shall be rated for a duty not less than 15 starts per hour.
3. Thermal overload relay:
    a. A thermal overload relay complying with BS EN IEC 60947-4-1or IEC 60947-4-1 shall be provided in each motor starter;
    b. The thermal overload relay shall have thermal elements for all three phases, trip contacts, adjustable trip current setting and manual reset push. It shall also provide protection against phase failure;
    c. The inverse time operating characteristics of the relay shall be submitted for Approval.
4. Certification and Evidence of Country / Place of Manufacture and Authenticity
    a. The Sub-contractor shall provide copies of type test certificates from accredited laboratories in prove the motor starters are in compliance with the specification requirements;
    b. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the motors starters for fire services pumps delivered to the Site or installed.

FWP11.3.020.A SOFT STARTER

1. The soft starter shall employ microprocessor-controlled power electronics to regulate the starting torque of a motor in order to minimize mechanical shock during starting and stopping;
2. The soft starter shall conform to BS EN 60947-4-2 or IEC 60947-4-2 and utilization category of the soft starter shall be AC-53a or AC-53b. When utilization category AC-53b is adopted for the soft starter as stipulated in BS EN 60947-4-2 or IEC 60947-4-2, a bypass contactor shall be provided in the starter circuit to take up the motor load during the steady state operation of the motor. The transfer of the load from the soft starter to the bypass contactor and vice versa shall be automatically initiated;
3. The soft starter shall be type-tested to of BS EN 60947-4-2 or IEC 60947-4-2. Manufacturer's type test certificate shall be submitted for Approval;
4. The soft starter shall conform to IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4 and IEC 61000-4-5, or other similar recognised international standards for electromagnetic compatibility requirements;
5. The duty of the soft starter shall be compatible with the power requirements of the electric motor concerned;
6. The soft starter's control circuit shall be completely independent of the power supply circuit for the motor and the same control module shall be used for all power ratings;
7. The soft starter shall be installed in the concerned motor control panel and protected by fast acting semi-conductor fuses against short circuit faults. The semi-conductor fuses shall conform to BS EN 60269-1 or IEC 60269-1 and BS EN 60269-4 or IEC 60269-4;
8. The pre-set starting current of the soft starter shall be compatible with the starting torque-speed characteristics of the concerned motor and loading;
9. A built-in LCD / LED display shall be provided for the soft starter to assist in setting-up and trouble-shooting. At least the following monitoring functions shall be indicated through the LCD / LED display:
    a. Fault conditions;
    b. Motor current;
    c. Starter operation status.
10. All adjustable parameters shall be set by a keypad on the control module. The keypad shall be accessible without the need to open the cover of the motor control panel;
11. Modes of operation:
    a. The soft starter shall be provided with the following modes of operation and the transition shall be smooth with minimum current inrush and torque surges. Operation shall be as stipulated below:
        i. Soft start:

            The soft starter shall provide an acceleration ramp such that motor shall accelerate linearly with closed loop control during starting. The acceleration ramp time shall be adjustable up to 30 seconds;

        ii. Current limitation:

It shall be provided with current limiting capability on the starting current of the motor. The maximum starting current limit of the motor shall be adjustable up to 5 times rated current;

iii. Soft stop:

A deceleration ramp shall be applied to the motor such that free-wheeling is prevented for a smooth deceleration with closed loop control during motor stopping. The deceleration ramp time shall be adjustable up to 60 seconds.

b. The soft starter shall be rated for a duty not less than 15 starts and 15 stops per hour.

12. Protection:

a. The following protective devices shall be provided for the soft starter:

i. Motor overload even in a bypass configuration (adaptive to the motor thermal characteristics);

ii. Phase unbalance / loss;

iii. Phase reversal;

iv. Underload.

b. All protective features shall be active even when the motor load is transferred to the bypass contactor;

c. The soft starter shall perform self-diagnosis for internal faults during operation.

13. Certification and Evidence of Country / Place of Manufacture and Authenticity:

a. The Sub-contractor shall provide copies of type test / certificates from accredited laboratories to prove the soft starter is in compliance with the specification requirements;

b. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the soft starters for fire services pumps delivered to the Site or installed.

FWP11.3.030.B VARIABLE SPEED DRIVE UNIT FOR BOOSTER PUMP SYSTEM

1. Variable speed drive (VSD) unit for booster pump system shall comprise the following components, either integrated as a complete unit or utilising compatible individual components collectively to perform both motor starter and multi-pump sequence controller functions:

a. A variable frequency drive with static frequency inverter for each pump which generates a sinus evaluated pulse with stable modulated output voltage for varying pump motor speed;

b. A multi-pump control microprocessor , which can either be an integrated part of the VSD unit or utilise a separate programmable logic controller. It shall provide functions including setting of constant water output pressure, control of motor speed, automatic changeover of pumps, selection of various pump operation modes, protection against various faults, and storage of fault event records;

c. A VSD control monitor for viewing pump control parameters and inputting settings.

2. Product requirements:

a. The VSD unit shall perform automatic multi-pump functions and comply with booster pump system operating and installation requirements as described in FWP2.2.2.020, either through its integrated multi-pump control microprocessor or through a programmable logic controller;

b. The VSD unit shall comply with the general EMC (electromagnetic compatibility) regulations to BS EN IEC 61800-3 or similar recognised international standards;

c. The VSD unit shall incorporate with appropriate measure(s) to avoid undesirable high frequency noise generated from the driving motor and / or the VSD unit and to prevent interference with other electronic devices;

d. The VSD unit shall contain buttons for switching on / off and allow manual operating mode for individual pump;

e. The VSD unit shall include / equipped with a control monitor, either an LCD panel with associated buttons or a touch screen Human Machine Interface (HMI) display, for viewing pump control parameters and inputting settings with password protection as follows:

   i. Discharge pressure value setting;

   ii. Operating frequency setting;

   iii. Switch interval for cyclic changeover setting;

   iv. Power on, run and fault indication;

   v. Running pressure value indication;

   vi. Running frequency indication;

   vii. Hours of operation log indication;

   viii. Error messages indication.

f. The VSD unit shall provide automatic protections to the booster pump system as follows:

   i. To shut off all pumps at zero suction, high pressure overshoot and loss of pressure at discharge;

   ii. To protect pump motor from over-voltage, under-voltage, over-current, overload, overheat and loss of phase;

   iii. To protect frequency inverter from overheat;

   iv. To conduct automatic test-run at adjustable periods.

g. The VSD unit shall activate audio and visual alarm for the following faults:

   i. Low suction pressure;

   ii. Pump motor failure;

   iii. Frequency inverter failure;

   iv. Pressure transducer failure;

   v. System failure.

h. The VSD unit shall provide dry contacts for the following remote monitoring outputs:

   i. Pump running status;

   ii. Common fault signal.

i. The VSD unit shall keep record of at least 5 nos. of last fault events for retrieval;

j. The VSD unit shall have dust and water ingress protection to at least IP55 for enclosure and cable connection;

k. The VSD unit shall be able to recover automatically after power failure.

3. Installation Requirements:

a. Every VSD unit equipped with built-in multi-pump control microprocessor shall be able to set as master and perform full multi-pump control functions independently, unless a separate programmable logic controller is utilised to provide necessary control functions for multi-pump operation. When a programmable logic controller is utilised, an identical duplicate shall be provided in parallel with selector knob for easy changeover in case the master unit in use is found faulty;

b. Every VSD unit shall be compatible with its connected motor so as not to result in excessive power loss or heat generation at the motor over entire speed range;

c. All VSD units in a booster pump system shall be identical and automatically form an integrated multi-pump control system via interconnecting control cables;

d. Input parameters on any VSD unit in the booster pump system shall be automatically synchronized to other VSD units;

e. Pump running and fault status indications from each VSD unit shall be displayed on the pump control cubicle;

f. VSD units shall be collectively enclosed in a fan-ventilated booster pump cubicle, mounted on wall in an integrated design at factory;

g. All non-armoured cables connecting from VSD unit to unit and from pressure transducer to VSD unit shall be enclosed in watertight flexible conduits and terminated in rigid box with glands and nuts;

h. Control cables connecting to the VSD units shall be separated from power supply cables. The power supply cables shall be kept as short as possible and not be installed in parallel to the control cables;

i. VSD multi-pump control shall be commissioned by the manufacturer's representative and set up with the optimum parameters in order to attain the best operating efficiency of the booster pump system.

4. Maintenance Requirements:

a. User interface of the VSD control monitor for viewing pump control parameters and inputting settings shall be clear and simple to use;

b. Complete documentary of user manuals covering operation and maintenance procedures, and where necessary for future maintenance, data disk containing software, firmware, etc. for VSD unit shall be provided in the O&M Manual of Water Pump Installation. An extra on-site user manual shall be properly bound in plastic folder and kept in a durable wall hanging box inside each booster pump room;

c. Training shall be provided by the manufacturer's representatives on equipment setting, operational and maintenance aspects including essential trouble-shooting techniques;

d. In case any mal-function found, replacement of only faulty parts in VSD unit shall be possible, instead of total replacement.

5. Reliability:

a. The VSD unit shall be the product of a manufacturer who has continuously manufactured similar type of products in the past 3 years;

b. The VSD unit shall have proven record of reliability of a minimum continuous period of one year prior to the time of material submission for Approval, in relevant application in local or overseas to the satisfaction of the CM.

6. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the variable speed drive unit for fire services booster pumps delivered to the Site or installed.

FWP11.4 PUMP CONTROL CUBICLE

FWP11.4.010.9 LOCATION

In each fixed fire pump/intermediate booster pump room, sprinkler pump room, water pump room and those as shown on the Drawings, a pump control cubicle for each of the pumping systems shall be provided.

FWP11.4.020.9 CONSTRUCTION

1. The pump control cubicle shall be suitable for wall mounting with a degree of protection of at least IP42to BS EN 60529;
2. The whole cubicle except for its front panels shall be made of galvanized sheet steel not less than 1.5 mm thick and formed in such a way as to give a rigid structure without cross struts. The cubicle opening shall be rolled up with curled edges in order to stop water ingress slipped into inner side of the cubicle. The front panels shall be of double-door construction and made of galvanized sheet steel not less than 2.0 mm thick;
3. The outer doors of the front panels shall be hinged permitting not less than 110 degrees opening and inserted with a durable clear transparent panel sealed by rubber gaskets. They shall be fitted with multi-point swing handle latches of watertight zinc alloy bodies with cam levers and locking bars but with no locks. The edges of the outer doors shall be fitted with neoprene rubber gaskets which at closing position, shall be tightly rested on the curled edges of the cubicle opening;
4. The inner doors of the front panels shall be hinged permitting 90 degrees opening and recessed in the cubicle with indication lights, selector switches, ammeters, isolating switches, etc. fitted on. The back sides of the inner panels shall be fitted with insulation boards to prevent direct exposure of live parts when opened. At closing position, the inner doors shall be fastened on the cubicle by stainless steel screws;
5. The cubicles shall have ventilation louvers for heat dissipation at lateral panels.

FWP11.4.030.9 FITTINGS

The pump control cubicle shall be complete with isolating switch, selector switch, indicating lights, starters, relays etc. as shown on the Drawings.

FWP11.4.040.9 FINISH

The inside and outside surfaces of the pump control cubicle shall be painted with one coat of primer, followed by a coat of stoved polyester-epoxy powder finish of an Approved colour which for fire services installations shall be of gloss signal-red.

FWP11.4.050.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the pump control cubicles for fire services pumps delivered to the site or installed.

FWP11.5 PUMP CONTROL CUBICLE COMPONENTS

FWP11.5.010.A ISOLATING SWITCH

Unless otherwise specified, a triple pole isolating switch with removable neutral link shall be provided for the main supply to each pump motor. The isolating switch shall be in compliance with BS EN IEC 60947-3 or IEC 60947-3 suitable for a rated operational current at a utilisation category of AC 23 of not less than the rated current of the motor circuit. It shall be fixed inside the control cubicle and operated by a handle fitted on the hinged front panel. Positive "ON" and "OFF" indication shall be provided.

FWP11.5.020.B AMMETER AND CURRENT TRANSFORMER

Ammeter of moving iron type complete with a selector switch shall be provided in each control cubicle to indicate the current supplied to the motor. The ammeter shall comply with IEC 60051-1 and IEC 60051-2 with class index 2.5 and shall be of flush mounting type with 75 mm dial and external zero adjustment. The full scale deflection of the ammeter shall be about 200% of the rated current of the motor. Where necessary, current transformers of encapsulated type complying with BS EN 61869-2 or IEC 61869-2 with an accuracy class 1 shall be provided for the supply to the ammeter.

FWP11.5.030.9 PUSH-BUTTON AND SELECTOR SWITCH

Push-button and selector switch for mounting on to control cubicle shall conform to EN 60947-1 and EN 60947-5-1 and shall be of splash-proof type with a thermal current rating of not less than 5A and the contacts shall be silver-plated. Push-button shall have a diameter of not less than 20 mm and shall be flush with its guard ring to prevent inadvertent operation. Selector switch shall be of rotary type with a handle of not less than 25 mm long.

FWP11.5.050.9 TIME SWITCH

Where specified, a time switch used for starting the pumping system at a pre-determined time of a day shall be provided. The time switch shall be provided with 24-hour dial and battery backup or of other types as approved by the Contract Manager.

FWP11.5.060.9 INDICATION LIGHT

Unless otherwise specified or Approved, indication/pilot light shall conform to EN 60947-1 and EN 60947-5-1 and shall have built-in transformer complete with a 6V LED lamp and a plastic lens of suitable colour.

FWP11.5.070.A CONTROL RELAY

Control relay, including time-delay relay shall be of contactor type in compliance with BS EN 61810-1 or IEC 61810-1 or other standards as approved by the CM. The relay shall have a thermal current rating of not less than 5A and its contacts shall be silver-plated. Shading ring shall be provided in the magnetic circuit to eliminate noise and vibration. The relay shall have a mechanical endurance of not less than 5 million operations.

FWP11.5.080.9 TERMINAL BLOCK

All control cables connected to the cubicle shall be terminated in feed-through terminal blocks with screw clamp connections and conforming to the following requirements and sleeve type cable markers shall be fitted to both ends of each length of cable:

1. Electrical and mechanical characteristics to be type tested to BS EN 60947-7-1 or IEC 60947-7-1;
2. Voltage rating 750V;
3. Moulding material to be melamine with low flammability as certified to UL94;
4. Designed for mounting directly on assembly rail to EN 50035;
5. All current carrying parts to be copper coated with tin lead alloy. Clamping yokes and screws to be zinc plated steel with additional protection by a chromate layer.

FWP11.5.090.B PROGRAMMABLE LOGIC CONTROLLER

1. Execution:
    a. Upon Approval, Programmable Logic Controller (PLC) can be used in the following scenarios:
        i. to form part of the pump control wiring circuit in lieu of conventional control relays and time switches;
        ii. to work with variable frequency drives for booster pump system to perform the specified automatic multi-pump functions as described in FWP2.2.2.020 and FWP11.3.030.
    b. The Sub-contractor shall complete the programming of the PLC and provide a comprehensive instruction manual for adjusting the pump control such as timer settings, etc. The sequence of control and values of settings in connection with the pump-set operation shall be saved as a switching program in a piece of EPROM (Erasable Programmable Read Only Memory). The steps for programming the switching program shall be literally printed in the instruction manual. Two programmed EPROMs (one socketed in the PLC and one spare) shall be provided for every pump control wiring circuit. Detailed instruction for replacing the EPROM and rebooting the PLC shall be included in the instruction manual;
    c. The Sub-contractor shall provide one spare set of PLC including the associated components such as expansion modules and power supply modules for every three sets of PLC of the same make and model to enable one-to-one replacement. However, one spare set of PLC shall be provided if the number of PLC of the same make and model installed is less than three. The spare unit(s) shall be tested, kept in original packings, and stored in lockable partitioned space inside pump control cubicle(s). Label(s) showing the storage location(s) of spare unit(s) shall be affixed prominently in cubicle(s) not storing the spare unit(s);
    d. The Sub-contractor shall provide two (2) times of free on-site services for modification of the PLC programming upon request of the CM within the Maintenance Period.
2. Product Requirements:
    a. The PLC shall be the product of a reputable manufacturer and commonly available in the local market;
    b. The PLC shall be capable of counting, regulating, archiving and performing timer and logic operation functions;

c. The PLC shall be expandable in the number of digital and analogue input / output ports, 35 mm DIN rail mounted, fitted with socketed EPROM module for ease of replacement, and provided with serial port for personal computer connection if required for programming and control setting adjustment;

d. The programmed PLC shall be password protected and possesses integrated data latch to protect current settings against loss in the event of a power failure;

e. Operating voltage: DC 24V;

f. Operating ambient temperature: 0°C to 55°C;

g. Operating ambient relative humidity: 5% to 95%; transient condensation permissible;

h. Storage temperature: -10°C to 70°C;

i. Radio interference suppression to BS EN 55011 (limit value class B);

j. Degree of protection: IP20 to BS EN 60529;

k. Certification to BS EN 60730-1, IEC 61131-2, UL or equivalent.

FWP11.5.100.9 EVIDENCE OF COUNTRY / PLACE OF MANUFACTURE AND AUTHENTICITY

The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the pump control cubicle components for fire services pumps delivered to the site or installed.

FWP11.6 CONTROLS AND GAUGES

FWP11.6.010.9 LEVEL CONTROL SWITCH FOR WATER TANKS

1. Level control for any water tank shall be achieved by the use of weight and ball float, operating a remote mercury switch;
2. Unless otherwise specified, the mercury switch shall be housed in a weatherproof type box to IP 54 or above, which is of non-metallic and corrosion resistant material. The mercury switch inside the weatherproof box shall be accessible for inspection / servicing through an openable cap;
3. Alternatively, or where specified, mercury switch encapsulated in corrosion proof float with "ON" and "OFF" control, as described in FWP11.6.020 below, may be used;
4. Level control switch shall cope with the chlorine concentration when used in the rainwater collection tank. The Sub-contractor shall demonstrate the compliance to the satisfaction of the CM;
5. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the level control switches for fire services system delivered to the site or installed.

FWP11.6.020.A LEVEL REGULATOR FOR WASTE WATER, STORM WATER AND SEWAGE SUMP TANKS

Level control for waste water, storm water and sewage sump tanks shall be designed, constructed and installed in accordance with the requirements as described in FWP2.4.1.020.

FWP11.6.030.9 LEVEL REGULATOR FOR DEEP BORE WELLS

Level control for deep bore well shall be of electrode type or magnetic type. Detailed information of the level control device shall be submitted for Approval prior to ordering.

FWP11.6.040.A FLOW SWITCHES

1. For fire services alarm:
    a. Flow switches for fire services alarm shall be of vane type or as approved by the CM, and shall be listed by LPCB or complied with other appropriate standards accepted by FSD;
    b. They shall be capable of withstanding a test pressure of 15 bar or 1.5 times of the maximum working pressure whichever is higher for not less than 2 hours without showing any sign of leakage;
    c. The sensitivity of the flow switch shall be such that it will respond to the water flow when even only one sprinkler head is in operation;
    d. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the flow switch delivered to the site or installed.
2. For general purposes:
    a. Flow switches for general purposes shall be of paddle type with magnetic switching mechanism or as approved by the CM;
    b. Paddles shall be made of stainless steel;

c. Body materials shall be suitable for the purposes of applications against corrosion;

d. The products shall be robust and durable for daily switching operations;

e. They shall sustain a maximum operating pressure of 20 bar and be taken part in the water system tests mentioned in FWP14.1.060.

3. Contacts shall be suitable for the working voltage and current of the circuits controlled, and shall be plated with silver or Approved alloy.

FWP11.6.050.A PRESSURE SWITCHES

1. Pressure switches shall have contacts plated with silver or Approved alloy rated to suit the working voltage and current of the circuits controlled and shall have independent adjustments for the cut-in and cut-out points and for the operating differential;
2. The maximum working pressures of all pressure switches shall be at least 300 kPa above the maximum pressure of the water inside the pipework at the positions of installation of the switches;
3. For fire services systems, pressure switches shall be of LPCB approved type or approved by similar widely recognised independent regulatory body accepted by FSD;
4. For sprinkler systems, pressure switch shall be supplied and installed with necessary ancillary facilities and isolating valves for maintenance and hydrostatic pressure test purpose complying with LPC Sprinkler Rules;
5. For flush water supply system, pressure switches shall be constructed of corrosion resistant material;
6. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the pressure switch delivered to the site or installed.

FWP11.6.060.A PRESSURE GAUGES

1. Pressure gauges shall comply with BS EN 837-1 and have dials not less than 100 mm diameter;
2. Pressure gauges, except those for sprinkler installation, shall be calibrated in kPa to a maximum of not less than 1-1/3 times and not more than 2 times the operating pressure. Divisions of scale shall not exceed 20 kPa for a maximum scale value of 1,000 kPa, 50 kPa for a maximum scale value of 1,600 kPa and 100 kPa for maximum values in excess of 1,600 kPa;
3. Pressures gauges fitted to sprinkler installation shall have maximum scale value and divisions of scale complying with LPC Sprinkler Rules;
4. Pressure gauges for general application shall have brass cases. For fluid filled pressure gauges fitted to sprinkler pump set, their cases shall be of stainless steel of grade 304 or grade 316;
5. An isolating valve / cock shall be provided for each pressure gauge.

FWP11.6.070.9 EMERGENCY STOP SWITCH

An emergency stop switch of mushroom head push stop lock out type, coloured red shall be provided adjacent to each pump to stop the motor in case of emergency.

FWP11.6.080.9 PRESSURE TRANSDUCER FOR BOOSTER PUMP SYSTEM

1. Pressure transducer for booster pump system shall match with the variable speed drive (VSD) unit and fully cover the required operating parameters of the booster pump system using VSD control;
2. Unless otherwise Approved, enclosure and wetted parts of pressure transducer shall be made of Grade 316 stainless steel.

FWP11.7 L.V. SWITCHGEAR AND ASSOCIATED EQUIPMENT

FWP11.7.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE3 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.8 BUSBAR CHAMBERS AND BUSBAR TRUNKING SYSTEMS

FWP11.8.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE6 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.9 CABLES

FWP11.9.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE7 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.9.020.9 CABLES FOR FIRE SERVICE INSTALLATIONS

1. Cables for fire service installations shall comply with the requirements stipulated in Fire Services COP, FSD's Circular Letters, and relevant BS or other international standards acceptable to the Director of Fire Services;
2. All cables in concealed conduits for fire services installations such as fire alarm and detection system where applicable, in domestic blocks or premises without sprinkler protection, shall be fire-resistant cables.

FWP11.10 INSTALLATION OF POWER CABLES

FWP11.10.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE8 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.11 WIRING SYSTEM INSTALLATION IN STEEL CONDUITS

FWP11.11.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE11 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.12 WIRING SYSTEM INSTALLATION IN STEEL TRUNKING

FWP11.12.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE12 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.13 WIRING SYSTEM INSTALLATION IN PLASTIC CONDUIT OR PLASTIC TRUNKING

FWP11.13.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE13 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.14 EARTHING AND PROTECTION AGAINST INDIRECT CONTACT

FWP11.14.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE17 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.15 WIRING ACCESSORIES

FWP11.15.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE20 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP11.16 TESTING AND MAINTENANCE

FWP11.16.010.9 GENERAL

The Sub-contractor shall comply with all the latest requirements on equipment, materials and installation practice/method as specified in Worksection ELE30 of HKHA Electrical Installation Specification, within the scope of the works specified under this Sub-contract. Electrical installation mentioned therein shall mean electrical works for fire services and water pump installation.

FWP12 PORTABLE EQUIPMENT

FWP12 PORTABLE HAND-OPERATED AND FIXED AUTOMATICALLY OPERATED APPROVED APPLIANCES 2

FWP12.1 GENERAL 3

FWP12.1.010.A DEFINITION 3
FWP12.1.020.9 APPROVAL 3
FWP12.1.030.9 FIXING 3
FWP12.1.040.9 CONTRACT MAINTENANCE 3
FWP12.1.050.A ACCEPTANCE 3

FWP12.2 FIRE BLANKETS AND SAND BUCKETS 4

FWP12.2.010.B LOCATION 4
FWP12.2.030.B SAND BUCKETS 4
FWP12.2.040.B FIRE BLANKETS 4
FWP12.2.050.9 APPROVAL LETTERS 4

FWP12.3 PORTABLE FIRE EXTINGUISHERS 5

FWP12.3.010.B TYPE 5
FWP12.3.020.B STANDARDS 5
FWP12.3.030.9 OPERATION 5
FWP12.3.040.9 APPROVAL LETTERS 5
FWP12.3.050.A TYPE TEST CERTIFICATES 5
FWP12.3.060.9 MARKING AND LABEL 6

FWP12.4 FIXED SPRAYER UNITS 7

FWP12.4.010.B TYPE 7
FWP12.4.020.9 IDENTIFICATION SYMBOLS 7
FWP12.4.030.9 APPROVAL LETTERS 7

FWP12 PORTABLE HAND-OPERATED AND FIXED AUTOMATICALLY OPERATED APPROVED APPLIANCES

FWP12.1 GENERAL

FWP12.1.010.A DEFINITION

1. Portable hand-operated approved appliances include extinguishers, fire blankets, sand buckets and any fire service equipment manufactured, used or designed to be used as an independent unit for the purpose of extinguishing, attacking, preventing or limiting a fire;
2. Fixed automatically operated approved appliances include fixed sprayer units and any fire service equipment manufactured, used or designed to be used as an independent unit for the purpose of extinguishing, attacking, preventing or limiting a fire, but automatic in operation and fixed in position.

FWP12.1.020.9 APPROVAL

1. Only portable equipment in the lists approved by the Director of Fire Services shall be accepted;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the portable fire extinguishers delivered to the site or installed.

FWP12.1.030.9 FIXING

All mounting fixtures and labour for installation shall be provided.

FWP12.1.040.9 CONTRACT MAINTENANCE

The Sub-contractor shall include for a Class 3 "Registered Fire Service Installation Contractor" for inspection, repair and maintenance of the portable equipment during the Contract and Maintenance Period.

FWP12.1.050.A ACCEPTANCE

Portable fire extinguishers and fixed sprayer units manufactured before the preceding year of completion of the Worksshall not be accepted unless prior Approval from the CM is obtained.

FWP12.2 FIRE BLANKETS AND SAND BUCKETS

FWP12.2.010.B LOCATION

Supply and distribute fire blankets and sand buckets in the positions shown on the Drawings.

FWP12.2.030.B SAND BUCKETS

1. Sand buckets shall conform to the requirements of the FSD;
2. Sand buckets with cover shall be of not less than 10 litres capacity and shall be made of galvanized steel and painted red.

FWP12.2.040.B FIRE BLANKETS

Fire blankets shall be of heavy duty and reusable type compliant with BS 7944. They shall be approved by FSD and listed in the latest HKSAR Government Gazette.

FWP12.2.050.9 APPROVAL LETTERS

Approval letters for fire blankets issued by FSD shall be produced for the CM’s inspection.

FWP12.3 PORTABLE FIRE EXTINGUISHERS

FWP12.3.010.B TYPE

1. The portable fire extinguishers shall be rechargeable hand operated extinguishers of water, carbon dioxide, dry powder, clean agent or other approval agent type with capacity as specified. Fire extinguishers containing any "Scheduled Substances" under the Ozone Layer Protection Ordinance (Cap. 403) are not acceptable;
2. Fire extinguishing agents shall comply with the following maximum allowable concentration of heavy metal:
    a. Cadmium (Cd): <0.003 mg/L
    b. Copper (Cu): <2 mg/L
    c. Lead (Pb): <0.01 mg/L
    d. Mercury (Hg): <0.006 mg/L
    e. Zinc (Zn): <3 mg/L

FWP12.3.020.B STANDARDS

All portable fire extinguishers shall be of FSD approved type listed in the latest HKSAR Government Gazette and shall comply with the standards as indicated below:

a. Water type fire extinguisher:	BS EN 3: Part 7 to 10 or UL 626 or GB 4351 or other standards acceptable to FSD
b. Carbon dioxide fire extinguisher:	BS EN 3: Part 7 to 10 or UL 154 or GB 4351 other standards acceptable to FSD
c. Dry powder type fire extinguisher:	BS EN 3: Part 7 to 10 or UL 299 or GB 4351 or other standards acceptable to FSD
d. Clean agent fire extinguisher:	BS EN 3: Part 7 to 10 or UL 2129 or GB 4351 or other standards acceptable to FSD

FWP12.3.030.9 OPERATION

All extinguishers shall operate without inversion. They shall be so designed with clear indication on whether they have been operated. A device shall be incorporated in the extinguishers to prevent inadvertent operation.

FWP12.3.040.9 APPROVAL LETTERS

Approval letters for portable fire extinguishers issued by FSD, shall be produced for the CM's inspection.

FWP12.3.050.A TYPE TEST CERTIFICATES

Test certificates for each type test complete with reports and drawings, where applicable, shall be produced upon request, to prove compliance with the recognised standards listed above to the satisfaction of the CM.

FWP12.3.060.9 MARKING AND LABEL

1. All portable fire extinguishers shall be secured tightly with a label indicating the updated maintenance information in accordance with FSD's requirements. The label shall be made of durable label approved by the Contract Manager;

2. Extinguishers shall be marked with the abbreviation of Hong Kong Housing Authority i.e. HKHA. The letters of the marking shall be 18 mm high and 12 mm wide and shall be painted on conspicuous position of the body subject to the Contract Manager’s Approval.

FWP12.4 FIXED SPRAYER UNITS

FWP12.4.010.B TYPE

1. Fixed sprayer units shall be of self-contained automatically operated clean agent type, fitted with a sprinkler head or other actuation device complying with UL, FM, NFPA, BS or other relevant standards and approved by FSD.
2. The temperature rating of the actuation device shall meet the protection requirements specified by and to the acceptance of FSD.
3. Fixed sprayer units containing HCFC Blend A (NAFS-III), HCFC-123 (FE-232), HCFC-124 (FE-241), PFB (CEA-410) or any "Scheduled Substances" under the Ozone Layer Protection Ordinance (Cap. 403) are not acceptable for new fixed installations.
4. Fixed sprayer units shall be listed in the HKSAR Government Gazette. The protected volume and particular risk to be protected for each type of approved fixed sprayer unit shall be referred to in the Government Gazette.

FWP12.4.020.9 IDENTIFICATION SYMBOLS

For rooms fitted with automatic extinguishers, identification symbols prescribed in Director of Fire Services Circular Letters shall be provided and fixed to each entrance door.

FWP12.4.030.9 APPROVAL LETTERS

Approval letters for fixed sprayer units issued by FSD shall be produced for the CM's inspection.

FWP13 MISCELLANEOUS

FWP13.1 PAINTING 2

FWP13.1.010.9 SCOPE 2
FWP13.1.020.9 GENERAL 2
FWP13.1.030.9 UPVC PIPES 2
FWP13.1.040.9 DIRECTIONAL ARROWS 2
FWP13.1.050.9 IDENTIFICATION COLOUR CODE INDICATION 2
FWP13.1.055.9 COLOUR BANDS 4
FWP13.1.065.9 LETTERING TO RAINWATER COLLECTION AND BREAK WATER TANKS 4
FWP13.1.070.9 AS-NEW CONDITION 4

FWP13.2 LABELS AND NOTICES 5

FWP13.2.010.9 LOCATION 5
FWP13.2.020.9 STATUTORY REQUIREMENTS 5
FWP13.2.030.9 MATERIAL FOR LABELS 5
FWP13.2.040.9 INSCRIPTION 5
FWP13.2.050.9 WARNING NOTICES 5
FWP13.2.080.9 FIXING 5

FWP13.3 DRAWINGS AND DIAGRAMS 6

FWP13.3.010.9 WORKING DRAWINGS AND FRAMED SCHEMATIC DIAGRAMS 6
FWP13.3.020.9 AS-FITTED DRAWINGS 6
FWP13.3.030.9 INSTRUCTION MANUALS AND TESTING AND COMMISSIONING REPORTS 7
FWP13.3.040.A RECOMMENDED SPARES 8

FWP13.4 SPARES AND TOOLS 9

FWP13.4.010.9 WATER PUMP AND RAINWATER HARVESTING SYSTEM INSTALLATION 9
FWP13.4.020.A FIRE SERVICES INSTALLATION 9

FWP13.1 PAINTING

FWP13.1.010.9 SCOPE

1. Pipework, installation and equipment shall be painted for the purpose of corrosion protection, restoration of the paint-work to "as-new" condition and identification of the various services or as specified;
2. Pipework, installation and equipment shall not be painted except the following or where specified:
    a. Ductile iron pipes inside pump rooms and water tank rooms;
    b. Galvanised mild steel (GMS) pipes outside pipe ducts and suspended ceilings; and
    c. Carbon steel pipes and mild steel pipes.

FWP13.1.020.9 GENERAL

1. The Sub-contractor shall comply with the requirements on materials and workmanship for painting as specified in Worksection FIN7 unless otherwise specified;
2. Pipework, installation and equipment shall be painted with the correct identification colours, colour code indications and, where appropriate, directional arrows;
3. Pipework, installation and equipment to be painted shall be cleaned, prime coated with the appropriate primer and completed with two coats of synthetic paint in semi-gloss finishing in accordance with the manufacturer's recommendation. For GMS pipework, anti-corrosive primer suitable for galvanised steel shall be used;
4. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the paints delivered to the site.

FWP13.1.030.9 UPVC PIPES

1. UPVC pipes shall not be painted except those exposed to sunlight, which shall be painted with white acrylic paint;
2. Self-adhesive colour bands shall be applied on each section of pipework for identification.

FWP13.1.040.9 DIRECTIONAL ARROWS

1. Directional arrows shall be painted on the pipes (except sprinkler pipes of less than 100 mm in diameter, drains, valves and fittings) on two visible sides at intervals not more than 6 m apart;
2. Directional arrows shall be white for dark background colours and shall be black for light background colours;
3. The length of the directional arrows shall be 150 mm and can be reduced to 75 mm for pipes equal to or less than 50 mm in diameter. The minimum body width of the arrow shall be 25 mm.

FWP13.1.050.9 IDENTIFICATION COLOUR CODE INDICATION

1. Unless otherwise specified, the identification colours, the colour code indications and the colour codes shall follow BS 1710 and BS 4800.

2. Unless otherwise specified, pipework shall be identified by painting or self-adhesive colour bands at suitable intervals not more than 6m apart as follows:

Service Type	Basic Identification Colour Approx 150 mm wide for each ring	Colour Code Indication Approx 100 mm wide for each ring			Basic Identification Colour Approx 150 mm wide for each ring
Fresh cold water	Green 12 D 45	White 00 E 55	Blue 18 E 53	White 00 E 55	Green 12 D 45
Fresh hot water	Green 12 D 45	White 00 E 55	Crimson 04 D 45	White 00 E 55	Green 12 D 45
Flushing water	Green 12 D 45	Green 12 D 45			Green 12 D 45
Fire Services pipes	-	Red 04 E 53			-
Rainwater pipes	Green 12 D 45	Black 00 E 53			Green 12 D 45
Drain pipes	-	Black 00 E 53			-

3. Equipment and fittings shall be painted as follows:

Service Type	Colour Code Identification
Fresh water pumps	Manufacturer's standard colour or Blue (18 E 53)
Flush water pumps	Manufacturer's standard colour or Green (12 D 45); no painting on stainless steel components
Fire Services pumps	Red (04 E 53)
Rainwater irrigation pumps	Manufacturer's standard colour or Black (00 E 53); no painting on stainless steel components
Valve body and handle	Manufacturer's standard colour
Pump Control Panel (fresh water)	Blue (18 E 53)
Pump Control Panel (flush water)	Green (12 D 45)
Pump Control Panel (fire services water)	Red (04 E 53)
Pump Control Panel (rainwater)	Black (00 E 53)

4. GMS and ductile iron pipes inside pump rooms and water tank rooms shall be painted in lieu of colour bands as follows:

Service Type	Colour Code Identification
Fresh Water	Blue (18 E 53)
Flushing Water	Green (12 D 45)
Rainwater pipes	Green (12 D 45) with black (00E 53) colour ring of approx. 100mm wide at suitable intervals not more than 6m apart

Fire services Water	Red (04 E 53)

FWP13.1.055.9 COLOUR BANDS

1. Colour bands shall be made of good quality, durable and self-adhesive PE sheet;
2. Colour bands for outdoor application shall be coated with UV inhibitor;
3. Colour bands shall be wrapped around the pipes with minimum 25 mm overlap;
4. Colour bands shall have minimum 3 years reputable local job references. The Contractor shall submit all relevant information and samples for Approval prior to ordering;
5. Combustible colour bands shall not be used in the Protected Means of Escape as defined in the Code of Practice for Fire Safety in Buildings published by the Building Department.

FWP13.1.065.9 LETTERING TO RAINWATER COLLECTION AND BREAK WATER TANKS

The following English letters with Chinese characters which shall be 75 mm high shall be painted on one conspicuous side of the rainwater collection tank and break water tank respectively by Main Contractor:

"Rainwater Collection Tank 雨水貯水缸"

"Break Water Tank 分隔水缸"

FWP13.1.070.9 AS-NEW CONDITION

At the time of handover the whole installation shall be in "as-new" condition. The Sub-contractor shall, during the course of the contract, protect all plant and equipment, and shall restore/repaint as necessary before contract completion.

FWP13.2 LABELS AND NOTICES

FWP13.2.010.9 LOCATION

Labels and/or notices shall be provided for all equipment, apparatus, fuses, terminals, lamps, switchgear, gauges, valves etc. wherever their provision will facilitate operation and maintenance of the installation, and where specified elsewhere.

FWP13.2.020.9 STATUTORY REQUIREMENTS

Labels and notices required by statutory requirements shall be inscribed accordingly whereas other labels shall indicate name and purpose of the equipment together with ratings and commissioned set values where applicable.

FWP13.2.030.9 MATERIAL FOR LABELS

Unless otherwise specified, labels shall be made of multi-layer bi-colour plastic material with red outer layer and white inner layer for fire services installation and with black outer layer and white inner layer for water pump installation. The labels shall be resistant to discolouring even under exposure to sunlight. Lettering shall be engraved on the plastic material by cutting away the outer layer to the outline of the required letters, exposing the inner layer underneath. The Sub-contractor shall be responsible for replacement of any label which is found discoloured at any time within Maintenance Period.

FWP13.2.040.9 INSCRIPTION

Inscription of labels and engraving shall be in both English and Chinese characters. Details shall be submitted for Approval prior to engraving.

FWP13.2.050.9 WARNING NOTICES

Notices, with at least 25 mm high lettering, as detailed in FWP11.2.050 shall be prominently displayed adjacent to each surface pump set or pair of surface pump sets, or in a prominent location above underground sumps and wells for submersible or semi-submersible pump sets.

FWP13.2.080.9 FIXING

1. Labels and notices shall be fixed by screws. Where drilling and tapping of the equipment is impracticable, adhesive may be used subject to prior Approval;
2. For pipelines or valves, where applicable, labels shall be fixed on plastic claim loops.

FWP13.3 DRAWINGS AND DIAGRAMS

FWP13.3.010.9 WORKING DRAWINGS AND FRAMED SCHEMATIC DIAGRAMS

Floor plan and sectional elevation of the building showing fire services installations, schematic diagram of the pipe installation and schematic diagram of the electrical control system shall be provided and fixed properly to the satisfaction of the Contract Manager in the locations hereunder. The diagram shall be of A2 size minimum, unless otherwise Approved and each diagram shall be treated, such as with acrylic varnish, to prevent deterioration and mounted in an anodised aluminium frame with transparent plastic front plate of 3 mm minimum thickness and wooden backing board of 5 mm minimum thickness:

	Diagram		Location of Diagram
1.	Fire Services Installation:		
	a.	Schematic diagram of the piping installation.	Fire control room/ sprinkler control room/ pump room.
	b.	Schematic wiring diagram of fire alarm system.	Adjacent to the fire services alarm control panel.
	c.	Schematic/block diagram of AFA system including alarm initiating zone module, output and input circuit modules	Adjacent to AFA annunciator panel
	d.	Schematic wiring diagram of fire pump control system.	Adjacent to the fire services pump control cubicle.
2.	Water Pump Installation:		
	a.	Schematic diagram of the piping installation.	Adjacent to the pump control cubicle.
	b.	Schematic wiring diagram for water pump control system.	Adjacent to the pump control cubicle.
3.	Rainwater Harvesting System Installation:		
	a.	Schematic diagram of the piping installation	Adjacent to the rainwater harvesting system control panel
	b.	Schematic wiring diagram for water level and pump control system	Adjacent to the rainwater harvesting system control panel

Floor plans and sectional elevations of building showing the locations of the fire services installation provided inside fire control room shall be of A3 size and fixed by folders. The folders shall be housed in a proper container constructed by acrylic plastic and mounted on wall.

FWP13.3.020.9 AS-FITTED DRAWINGS

Separate set of as-fitted drawings including Approved conduit shop drawings shall be provided for each of the systems/installations listed in FWP13.3.010 above, incorporating all amendments made during the course of this Contract on completion of the Works. The complete Approved set shall consist of three (3) print copies, three (3) set of electronic copy in AutoCAD Format and Adobe Portable Document Format and one (1) sepia of each of the drawings conforming approximately to one or other of the following standard sizes:

1. 841 x 1189 mm (AO)

2. 594 x 841 mm (A1)
3. 420 x 594 mm (A2)
4. 210 x 297 mm (A4)

Boxes with proper numbering shall be provided for printed drawings and labelled with the project name, fire services and water pump installation together with comprehensive drawing list.

FWP13.3.030.9 INSTRUCTION MANUALS AND TESTING AND COMMISSIONING REPORTS

1. The Sub-contractor shall submit the following documents and technical literature to the Contract Manager for the whole installation and equipment provided under this Sub-contract, including, but not limited to, the following (See PRE.BS1.200):
   a. Table of Content with numbering and index;
   b. System description;
   c. Operation instructions;
   d. Maintenance instructions;
   e. Highlights on special precautions/procedures/methods required on the use, operation, cleaning, servicing, maintenance, repair and replacement of any proprietary material and equipment installed. Requirements on proper use and operation, durability, safety and statutory side shall also be stated clearly;
   f. Supplier list for major equipments;
   g. Catalogue, user manual, operation and maintenance manual for the installation such as motor, pump (including pump curve showing the operating point), sprinkler control valve, AFA panel and motor starter, etc.;
   h. Plant and equipment catalogue and user manual as required by the Contract Manager;
   i. Priced list of recommended spares (see FWP13.3.040 below);
   j. Priced list of special tools;
   k. Copy of the certificate of warranty for those material, equipment and installation with warranty period last beyond Maintenance Period;
   l. Testing and commissioning reports of the installation and equipment provided;
   m. Emergency call and maintenance services;
   n. Other items as required by the Contract Manager.
2. Draft copies in Box files with proper numbering shall be provided and labelled with the project name and, fire services and water pumps installation for comment and Approval;
3. After Approval, the Sub-contractor shall submit three (3) sets of electronic copy (in compact disc) for all items above in Adobe Portable Document Format to the Contract Manager;
4. For the Rainwater Harvesting System, the Sub-contractor shall submit, in addition to the whole documents and technical literature a “Water Safety Plan” which addresses the requirements stipulated in Section 4.1 of Code of Practice for Prevention of Legionnaires' Disease.

FWP13.3.040.A RECOMMENDED SPARES

The priced list of "Recommended Spares" referred to in FWP13.3.030 above shall include the following:

1. All bearings and bearing bushes;
2. All gaskets and jointing;
3. All seals;
4. All filter cartridge and chemicals for rainwater harvesting system installation, etc.;
5. Other items as required by the Contract Manager.

FWP13.4 SPARES AND TOOLS

FWP13.4.010.9 WATER PUMP AND RAINWATER HARVESTING SYSTEM INSTALLATION

1. The Sub-contractor shall provide, for each Pump Room and rainwater harvesting system treatment facility room, one (1) complete set of spare fuses for each rating of fuse-switches or switch fuses installed including those fuses installed in the control circuit;
2. The Sub-contractor shall provide on the wall inside the Pump Room and rainwater harvesting system treatment facility room a wooden board with brass hooks and other device for holding the spare fuses for fuse switches or switch fuses;
3. The board shall be smoothed on both front and edges, and shall be painted to Approval;
4. Spare fuses for control circuit shall be properly fixed inside the control panel/cubicle;
5. The Sub-contractor shall provide the following spares for the rainwater harvesting system installations:
    a. One (1) complete set of spare filter cartridges for each cartridge filter installed in each rainwater harvesting system treatment facility room.

FWP13.4.020.A FIRE SERVICES INSTALLATION

1. Tenders shall be deemed to have included sets of spare parts and special tools including spare sprinkler heads, replacement break glass plates, indicator lamps, special keys, fuses etc. as required by the Statutory Regulations and Standards in FWP1 of this Specification and for operation and maintenance of the plant and installation within the entire Maintenance Period. In addition, a complete list of all replaceable parts with model number, part number and price shall be submitted together with the tender for purchase and use after the expiration of the Maintenance Period;
2. The Sub-contractor shall provide the following spares for the fire services installations in each building:
    a. Ten (10) of hose reel nozzles for each separate fire hydrant / hose reel system;
    b. Two (2) keys of the manual fire alarm point for each alarm system;
    c. Twenty-four (24) sprinkler heads for Ordinary Hazard installations and two (2) sprinkler spanners for each type of sprinkler used in each sprinkler system;
    d. One (1) complete set of spare fuses for each rating of fuse-switches or switch fuses installed in each Pump Room including fuses for control circuits;
    e. Five (5) percent of the quantities of installed manual fire alarm call points, heat detectors, smoke detectors for each addressable system;
    f. Five (5) percent of the quantities of installed interface modules for each addressable system.

FWP14 TESTING, COMMISSIONING AND MAINTENANCE

FWP14.1 INITIAL TESTING AND COMMISSIONING 3

FWP14.1.010.9 PRE-TEST CLEANING 3
FWP14.1.020.9 PERFORMANCE TESTS, ADJUSTMENTS AND COMMISSIONING 3
FWP14.1.030.9 PERIOD OF NOTICE 3
FWP14.1.040.9 TEST INSTRUMENTS 3
FWP14.1.050.9 LABOUR AND MATERIALS 4
FWP14.1.060.9 WATER SYSTEM TESTS 4
FWP14.1.070.9 ELECTRICAL AND ALARM SYSTEMS TESTS 5
FWP14.1.080.9 GAS EXTINGUISHING SYSTEMS TESTS 5
FWP14.1.090.9 FSD INSPECTION AND WITNESS OF TESTS 5
FWP14.1.100.9 PUMP ROOM NOISE LEVEL TESTS 6
FWP14.1.105.9 72-HOUR RECORDING OF FRESH AND FLUSH WATER PUMP OPERATIONS 6
FWP14.1.110.9 TESTING AND COMMISSIONING REPORT 6
FWP14.1.120.A WATER QUALITY TESTS FOR RAINWATER HARVESTING SYSTEM INSTALLATION 6
FWP14.1.130.9 TRAINING FOR RAINWATER HARVESTING SYSTEM INSTALLATION 8

FWP14.2 MAINTENANCE PERIOD 9

FWP14.2.010.9 DEFINITION 9

FWP14.3 GENERAL MAINTENANCE 10

FWP14.3.010.9 SCOPE 10
FWP14.3.020.9 REPAIRS AND REPLACEMENTS 10
FWP14.3.030.9 CONSUMABLES 10
FWP14.3.040.9 REGULAR MONTHLY VISITS 10
FWP14.3.050.9 RECORD OF SITE ATTENDANCES 10
FWP14.3.060.9 SIGNING RECORD BOOK 10
FWP14.3.070.9 RESPONSE TIMES 11
FWP14.3.080.9 CONTACT POINTS 11
FWP14.3.090.9 COMPETENCE OF ENGINEERS 11
FWP14.3.100.9 24 HOUR ON-CALL SERVICE 12

FWP14.4 PARTICULAR MAINTENANCE 13

FWP14.4.010.9 FIRE DETECTION AND ALARM SYSTEM 13
FWP14.4.015.9 AUDIO / VISUAL ADVISORY SYSTEM 14
FWP14.4.020.9 FIXED FIRE PROTECTION SYSTEMS USING GAS EXTINGUISHING AGENTS 14
FWP14.4.030.A WATER PUMP INSTALLATION AND FIXED FIRE SERVICES SYSTEMS USING WATER 14
FWP14.4.040.9 PORTABLE EQUIPMENT 16
FWP14.4.060.9 RAINWATER HARVESTING SYSTEM INSTALLATION 16
FWP14.4.070.9 PRV FAULT INDICATION SYSTEM 18

FWP14.5 ANNUAL AND FINAL MAINTENANCE, TESTING AND HANDOVER 20

FWP14.5.010.9 FIRE DETECTION AND ALARM SYSTEM 20
FWP14.5.015.9 AUDIO / VISUAL ADVISORY SYSTEM 20
FWP14.5.020.9 FIXED FIRE PROTECTION SYSTEMS USING GAS EXTINGUISHING AGENTS 20

FWP14.5.030.9 WATER PUMP INSTALLATION AND FIXED FIRE SERVICES SYSTEMS USING WATER 20
FWP14.5.040.9 PORTABLE EQUIPMENT 21
FWP14.5.050.9 TESTS AT EXPIRY OF MAINTENANCE PERIOD 21
FWP14.5.060.9 FINAL ACCEPTANCE TEST AND CERTIFICATE OF MAINTENANCE FOR FIRE SERVICES INSTALLATIONS 21
FWP14.5.070.9 HANDOVER 21

FWP14.6 RESPONSIBILITIES 22
FWP14.6.010.9 SAFETY OF INSTALLATIONS 22
FWP14.6.020.9 INTERRUPTION OF FIRE SERVICES 22
FWP14.6.030.9 REPLACEMENTS 22
FWP14.6.040.9 CONDITIONS OF CONTRACT 22

FWP14.1 INITIAL TESTING AND COMMISSIONING

FWP14.1.010.9 PRE-TEST CLEANING

Before installations are subjected to inspection, testing and subsequent handover, the entire installation shall be thoroughly cleaned internally and externally. All water installations shall be flushed out with clean water. During the flushing operation provision shall be made to exclude filters, pumps, meters and any other item of plant which could be damaged during the cleaning operation.

FWP14.1.020.9 PERFORMANCE TESTS, ADJUSTMENTS AND COMMISSIONING

1. The Sub-contractor shall carry out complete performance tests for all equipment and systems installed by him, make all necessary adjustments, including setting all controls and checking the operation of all protective and safety devices, and commission the installations, in accordance with the manufacturers' instructions, the requirements of the statutory rules and regulations and to the satisfaction of the Contract Manager before the installations will be accepted;
2. Prior to any tests, the Sub-contractor shall submit detailed procedures and a programme for testing and commissioning for Approval;
3. The test shall be witnessed by an authorised representative of the Contract Manager and a report shall be submitted for record purposes.

FWP14.1.030.9 PERIOD OF NOTICE

Forty-eight (48) hours notice shall be given by the Sub-contractor to the Contract Manager of his intention to carry out installation tests.

FWP14.1.040.9 TEST INSTRUMENTS

1. In addition to PRE.BS1.630 which specifies the provision of a set of measuring instruments for BSPASS and the Contract Manager's Representatives' use, which will be under the custody of the CMR, the Sub-contractor shall provide all necessary instruments used for measurement and testing of the installation. Except for manual / electric hydraulic pump with pressure gauge given in sub-clause (2)(o) and smoke canister for testing smoke detectors given in sub-clause (2)(p) below, the instruments used shall be calibrated with traceability to internationally or nationally recognized standards;
2. Instruments required for inspection and testing purpose whenever necessary shall include, but are not limited to, the following:
    a. Measuring tape;
    b. Vernier caliper;
    c. Clamp-on ammeter;
    d. Multimeter;
    e. Multi-function electronic meter for measurement of current, voltage;
    f. Insulation resistance tester;
    g. Earth loop impedance tester;
    h. Pressure gauge;

i. Fire hydrant flow gauge;

j. Sound level meter;

k. Dial gauge;

l. Digital stop watch;

m. Male instantaneous coupling to BS 336;

n. Manual / electric hydraulic pump with pressure gauge;

o. Smoke canister for testing smoke detectors;

p. Carpenter (spirit) level.

3. Each piece of instrument shall carry an indelible identification mark, and a label showing the due date for calibration (except otherwise calibration is specified not necessary);

4. The Sub-contractor shall submit evidence of calibration such as calibration certificates and records of calibration results of the instruments used for the Contract Manager's Approval when required. The Contract Manager may reject any instrument(s) which, in his opinion, is not suitable for the inspection or test and the Sub-contractor shall replace the instruments when required.

FWP14.1.050.9 LABOUR AND MATERIALS

1. The Sub-contractor shall despatch competent and experienced commissioning engineers and technicians to carry out the testing and commissioning of the installations;

2. All labour and materials necessary for carrying out the work shall be provided by the Sub-contractor, except that the Main Contractor will supply electricity and water as required;

3. The Sub-contractor shall supply any necessary diesel or other fuel oil for engine-driven pumps, sufficient test gases required for the discharge tests of the gas extinguishing system installations etc;

4. The Sub-contractor shall also replenish all fire extinguishing media and other materials expended or used during the tests and ensure that the entire installations are in "as new" condition at the conclusion of the tests.

FWP14.1.060.9 WATER SYSTEM TESTS

1. Water systems and circuits shall be tested hydraulically to a minimum pressure of 1000 kPa or 1.5 times the working pressure whichever is higher applied at the highest point of the system and held for a period of not less than 15 minutes for fire services installation (except sprinkler installation) and 24 hours for water feed pump installation without leaks appearing. For sprinkler installation, the hydraulic test for pipework shall be in accordance with the LPC Sprinkler Rules;

2. After flushing out the pipework, a flow test shall be performed on the hydrant/hose reel system in accordance with the Fire Services CoP;

3. A water supply test with the drain and test valves fully opened shall be made on the sprinkler system in accordance with the LPC Sprinkler Rules. An alarm test on the water gong shall also be carried out by opening the test valve to ensure that the alarm shall continuously sound in 30 seconds after the flow in the system is detected;

4. The Sub-contractor shall provide whatever hoses or drainage channels are required to safely remove the test water discharged while carrying out these tests in order to ensure that no damage to the building and property will be caused by the test water;

5. All welded joints shall be hammer tested and remain firm;

6. Following the above, a normal working test shall be carried out, during which time adjustments and regulation of valves shall be effected.

FWP14.1.070.9 ELECTRICAL AND ALARM SYSTEMS TESTS

1. Electrical Wiring systems shall be tested generally as required by the latest edition of the Electrical CoP and the HKHA Electrical Installation Specification. Low-voltage wiring shall be insulation tested to a d.c. voltage of twice the normal working voltage of the system. Any tests that are liable to cause damage to the delicate components such as those incorporating electronic circuits shall be carried out with the components disconnected;
2. For electrical power circuits other than those for fire services, tests shall include but not be limited to the measurement of power ratings, power factor and total harmonic distortion in order to ensure the systems are in compliance with the BEC;
3. Smoke detectors shall be checked for correct sensitivity settings by means of manufacturer's test set and for operation by simulated smoke tests using freon;
4. Rate-of-rise heat detectors shall be tested by gentle application of a heat source such as a hair dryer. Fixed temperature heat detectors must not be tested other than using simulated tests;
5. Battery capacity shall be tested by discharging through the alarm circuits and being charged via the incorporated charger unit. The specific gravity of the electrolyte shall be tested with a clean hydrometer;
6. The input d.c. supply to the alarm supervisory circuitry shall be checked for correct voltage and stability such as to match the signal and alarm triggering devices;
7. Audio / Visual Advisory (AVA) system control panel, audio equipment and speakers shall be adjusted and tested such that sufficient sound pressure level can be achieved in all the protected areas;
8. Flashing directional sign boxes shall be tested to verify the proper operation of the AVA System zoning.

FWP14.1.080.9 GAS EXTINGUISHING SYSTEMS TESTS

1. Gas extinguishing system manifolds shall be tested in accordance with FWP9.7.090. Pipework shall be tested to a minimum of 1.5 times the operating pressure of the system;
2. Apart from the performance and electrical tests as indicated above, a discharge test using 10% of the required quantity of the extinguishing agent shall also be performed to ensure continuity of pipework and freedom of discharge through nozzles.

FWP14.1.090.9 FSD INSPECTION AND WITNESS OF TESTS

Additional tests, where not specified in the Specification, shall also be carried out to meet the requirements of the Fire Services CoP to the satisfaction of FSD. The Sub-contractor shall make all necessary applications to FSD and attend upon their representative for the purpose of these tests and inspections.

FWP14.1.100.9 PUMP ROOM NOISE LEVEL TESTS

1. Pump room noise levels shall be measured at the nearest noise sensitive receiver and corrected in accordance with the requirements stipulated in the "Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites", hereinafter referred to as the "Technical Memorandum", issued by the Environmental Protection Department. A measurement report which shall be endorsed by an independent consultant employed by the Sub-contractor shall be submitted to the Contract Manager for Approval;
2. Sound level meters used for the measurements shall comply with the Standard specified in the "Technical Memorandum";
3. Both air and structure borne noises emanated from pump rooms shall be measured to verify their compliance with the requirements stipulated in the "Technical Memorandum" in all circumstances.

FWP14.1.105.9 72-HOUR RECORDING OF FRESH AND FLUSH WATER PUMP OPERATIONS

1. After completion of installation and tenant intake, 72-hour recording of fresh and flush water pump operations over Saturday and Sunday shall be carried out for each building block by the Sub-contractor using automatic recorders to confirm the properness of the pump control settings. The records shall show clearly the time and duration of individual pump operations and be submitted to the Contract Manager for approval;
2. Any control irregularities identified shall be remedied and further recordings shall be carried out until a proper 72-hour pump operation pattern is achieved to the satisfaction of the Contract Manager.

FWP14.1.110.9 TESTING AND COMMISSIONING REPORT

A testing and commissioning report shall be forwarded to the Contract Manager within fourteen days after completion of commissioning the installation. The report shall be verified and endorsed by the Supervising Engineer in accordance with FWP1.5.020 sub-clause (1).

FWP14.1.120.A WATER QUALITY TESTS FOR RAINWATER HARVESTING SYSTEM INSTALLATION

1. The Sub-contractor shall carry out the first water quality test for the rainwater harvesting system installation after system commissioning to ensure that the water quality requirement has been satisfied. If rain is unavailable for the test, the Sub-contractor shall coordinate with the Contractor to pour fresh water supplied by the Contractor at catchment areas selected by the CM to facilitate the test. The second water quality tests shall be carried out after the tenth rainy day or at a specified date before the Contract Completion as instructed by the CM to monitor the stability of the water treatment performance subsequent to the first water quality test. Afterwards, regular water quality tests shall then be carried out during the Maintenance Period according to the frequency as specified in sub-clause (3) of FWP14.4.060;
2. The Sub-contractor shall make sure the harvested water quality to conform to the parameters of water quality requirement as follows or the latest requirements / standards as specified by the Water Authority, whichever is the stringent:

Water Quality Parameters	Unit	Limits	Standard Method

E. coli	cfu/100 ml	Non-Detectable	DoE(1983) Sec. 7.8 & 7.9 with in-situ urease test
Legionella Bacteria Count	cfu/ ml	< 10	ISO11731 or BS EN ISO 11731 or AS 3896
Heterotrophic Colony Count (HCC)	cfu/ ml	<100,000	AS 4276.3 or BS 6068-4.5 or BS EN ISO 6222 or APHA 9215B
Total Suspended Solids (TSS)	mg/l	≤ 5	APHA 20e 2540 D
Total Dissolved Solids (TDS)	mg/l	≤ 10	APHA 20e 2540 C
Total Residual Chlorine (TRC)	mg/l	1-5 (exiting treatment system) 0.2-5 (at user end)	DPD Colorimetric Based on APHA/USEPA Hach Pocket Colorimeter (Digital)
Dissolved Oxygen	mg O_2/l	≥ 2	APHA 20e 4500-O G, YSI 52 D.O. meter
5-day Biochemical oxygen demand (BOD_5)	mg O_2/l	≤ 10	APHA 20e 5210 B
Turbidity	NTU	≤ 5	APHA 20e 2130 D
pH	--	6-9	APHA 20e 4500-H+ B
Colour	Hazen units	≤ 20	APHA 20e 2120 B
Odour	Threshold Odour Number (TON)	≤ 100	APHA 20e 2150 B
Ammoniacal Nitrogen	mg/l as N	≤ 1	APHA 20e 4500-NH, B, C, E
Synthetic Detergent	mg/l	≤ 5	APHA 20e 5540 B, C, D

All testing parameters as specified above shall be tested by an accredited laboratory. If water sampling results are satisfactory, system can be operated with the current water treatment set point. For any incidence of unacceptable water quality, the system shall be suspended until the problem is solved and to the satisfaction of the CM;

3. The methods for collecting water samples and preservation and handling of water samples for testing Legionella and HCC shall comply with relevant internationally recognised standards, such as AS 2031, BS 7592 or BS EN ISO 5667-3;

4. The test plan and schedule detailing the sampling points and time shall be submitted to relevant government departments or the designated consultant for comments and acceptance if necessary as directed by the CM;

5. A testing report issued by the accredited laboratory shall be forwarded to the CM within fourteen days after completion of the water quality test.

FWP14.1.130.9 TRAINING FOR RAINWATER HARVESTING SYSTEM INSTALLATION

1. The Sub-contractor shall provide 2 training courses as instructed by the CM on the operation and maintenance of the whole rainwater harvesting system installation;
2. The Sub-contractor shall submit the operation and maintenance manual for the rainwater harvesting system installation and obtain an Approval for the manual by the CM prior to the commencement of the training courses;
3. One training course shall cover detailed operational procedures and steps and precautions for training operational and maintenance staff. The other training course shall cover brief description of the system and precautions for briefing management staff and / or non-technical staff. Training notes / manuals are required in both English and Chinese. At least 5 seats shall be given for each training course. Training Venue shall be on Site or other venues as instructed by the CM.

FWP14.2 MAINTENANCE PERIOD

FWP14.2.010.9 DEFINITION

The Sub-contractor shall furnish maintenance for the complete fire services installation and water pump installation for a period of twenty-four (24) months following the certified competition date of the Main Works or any Section(s) of the Main Works.

FWP14.3 GENERAL MAINTENANCE

FWP14.3.010.9 SCOPE

General maintenance shall comprise all items included in this sub-section.

FWP14.3.020.9 REPAIRS AND REPLACEMENTS

All repairs and replacements necessary to maintain the installations in good working order, including supply of materials and labour, carried out in accordance with the manufacturers' recommendations/instructions to the satisfaction of the Contract Manager.

FWP14.3.030.9 CONSUMABLES

Supply of all normally consumable items including lubricants, cleaning materials, fire extinguishing media, fuses, lamps etc. as required.

FWP14.3.040.9 REGULAR MONTHLY VISITS

Regular monthly maintenance visits covering full inspection, lubrication, cleaning, adjustment, testing, and keeping all equipment in first class operating condition.

FWP14.3.050.9 RECORD OF SITE ATTENDANCES

1. To record all site attendance, on arrival and departure, for regular service visits or emergency breakdown call, together with details of the work carried out, in the record book held at the estate office;
2. To note comments, insert in the record book, and action accordingly;
3. A report in duplicate shall be sent to the Contract Manager immediately following a major repair, repeated breakdowns of service due to system or equipment fault of similar nature, or as and when required by the Contract Manager;
4. The report shall include the cause necessitating such a repair, the reasons for such a breakdown of service and the time and date of remedial action taken, of completion of repair and of the resumption of normal service;
5. A list of equipment replaced shall be attached to the report.

FWP14.3.060.9 SIGNING RECORD BOOK

1. For each routine or call out visit, during the Maintenance Period, the workman, on arrival at the Estate, shall report to the Estate Office and sign a "Fire Services and Water Pump Maintenance Record Book", which shall be submitted by the Sub-contractor and shall be kept by the officer-in-charge of the Estate;
2. At the time of signing, they shall note any message written in the book concerning the performance of the Fire Services and Water Pump Installations in the Estate, and shall take such action as may be required;
3. When leaving the Estate, the workman shall report to the officer-in-charge and enter in the "Fire Services and Water Pump Maintenance Record Book" a brief report on any work completed, or on the fact that they have found the system operating satisfactorily;
4. In general, the "Fire Services and Water Pump Maintenance Record Book" shall include, but not limited, to the following items:
    a. The name of the responsible person;

b. Brief details of any servicing arrangement;

c. Dates and times of all alarms (genuine, practices, test or false) together with their causes where known;

d. Dates, times and types of all defects and faults;

e. Dates and types of all test and servicing;

f. Dates and times of all periods of disconnection;

g. All alteration to the system.

FWP14.3.070.9 RESPONSE TIMES

Immediate answering of breakdown calls, whether true or false, and attendance to such calls in accordance with the requirements stipulated below -

Description	Requirements
Arrival for maintenance in the case of interruption of fresh water supply	Within 1 hour
Arrival for maintenance in the case of interruption of flush water supply	Within 2 hours
Resumption of fresh water supply	Within 9 hours after inspection
Resumption of flush water supply	Within 20 hours after inspection
Arrival for maintenance for incidents not affecting fresh or flush water supply	Within 2 hours (3 hours if call from outlying islands) during normal working hours; Within 3 hours out of normal working hours

FWP14.3.080.9 CONTACT POINTS

In connection with FWP14.3.040 to FWP14.3.060 above, the Sub-contractor shall submit the name and telephone number of the responsible persons to be contacted 24-hours a day together with the proposed schedule for the monthly regular maintenance visits at the start of the Maintenance Period.

FWP14.3.090.9 COMPETENCE OF ENGINEERS

1. Despatch competent and experienced maintenance personnel equipped with the appropriate testing instruments, tools, equipment etc. to inspect, service, test, adjust and maintain the fire service, rainwater harvesting system and water pump installation in a satisfactory operating condition. Allow for carrying out such inspection, service, testing, adjustment and maintenance at a time outside normal office hours including general holidays;

2. Particularly in the case of complex fire service, rainwater harvesting system and water pump installations, arrange for at least two senior servicemen being thoroughly familiarised with all aspects of such installation to be responsible for inspection, maintenance and testing of the installation. In this type of installation the Sub-contractor must be prepared to provide a high level of service, allowing for more frequent servicing of environmentally sensitive equipment and when necessary, to ensure prompt rectification of the faults resulting in unacceptably high rate of false alarms all at the expense of the Sub-contractor.

FWP14.3.100.9 24 HOUR ON-CALL SERVICE

1. The Sub-contractor shall provide 24 hour on-call service at any time during the Maintenance Period;
2. The Contract Manager may instruct the Sub-contractor, in the Maintenance Period, via telephone, mobile phone, paging service or any other means as advised by the Sub-contractor and Approved by the Contract Manager, to attend to reported breakdowns, and the Sub-contractor shall dispatch competent technicians or such other suitable personnel, who shall arrive at site and shall carry out any necessary inspection, testing and repair work within the time specified under FWP14.3.070 and under all weather conditions. In the event that it is not possible to meet the requirement as stipulated in FWP14.3.070, the Sub-contractor shall explain immediately to the Contract Manager or his or her representatives the reason for such non-conformance;
3. The Sub-contractor shall submit to the Contract Manager for this purpose at least two names of English speaking representatives, who can be reached at any time of the day, with contact telephone numbers of direct lines, mobile phones or paging service for Approval;
4. Prior Approval shall also be obtained for any subsequent changes of representatives, contact telephone numbers etc. during the Maintenance Period at least two weeks before the change is effected.

FWP14.4 PARTICULAR MAINTENANCE

FWP14.4.010.9 FIRE DETECTION AND ALARM SYSTEM

1. The Sub-contractor shall visit the installation at least once every three months to carry out tests, repairs and adjustment. All environmentally sensitive devices e.g. smoke and heat detectors, electronic sensors, relay contacts, plug and socket contacts, printed circuit boards, edge connectors etc. shall be inspected, cleaned, adjusted, and calibrated. During the visits, the following tests and checks should be made:
2. A test sequence shall be carried out in accordance with the manufacturer's instructions. The test sequence shall prove:
    a. That the condition of the wiring, controls and indicating equipment of all zone circuits are in good working order;
    b. That the alarm condition on each zone will activate the common alarm circuits. If manual fire alarm call points are fitted the alarm conditions shall also be initiated by the operation of one such call point in each zone. A different manual fire alarm call point shall be used on each occasion and a record must be kept by the Sub-contractor;
    c. That activating the common alarm circuits will result in the operation of the alarm bells and the satisfactory transmission of the alarm signal to the appropriate Fire Services Communication Centre if equipped with a direct line connection;
    d. Also that activating the common alarm circuits will result in the starting/stopping of the ventilating fans and/or fire booster pumps as desired and result in the operation of any Fireman's lift, if control circuits for such operation are provided in the system.
3. The operation of alarm bells and the transmission of the alarm signal may be suppressed during tests 1 and 2. Tests 3 and 4 will prove that all system alarms and relevant controls are operating correctly;
4. In the course of the test sequence, the correct operation of all indicators including fault warnings and all alarm bells shall be noted and checked. All indicating lamps shall be checked and, if found defective, shall be replaced by the Sub-contractor at his expense;
5. About 20% of the detectors, chosen at random, with at least one unit in each zone shall be subjected to a simulated functional test. Smoke detectors shall be tested with freon and rate-of-rise heat detectors with an artificial heat source e.g. hair dryer respectively;
6. Battery and chargers shall be examined and tested to ensure they are in good and proper serviceable condition. Battery terminals and connectors shall be tightened and the former shall be cleaned and protected with petroleum jelly. Electrolyte shall be topped up as necessary and its specific gravity shall be measured and corrected to the appropriate value if required. Battery shall also be discharged and recharged to ensure compliance with the AFA Rules;
7. The d.c. power supply to the alarm supervisory circuitry shall be checked and adjusted for correct voltage and stability;
8. In addition to above, the direct line connection to the Fire Services Communication Centre shall be tested once every 2 weeks by the Sub-contractor.

FWP14.4.015.9 AUDIO / VISUAL ADVISORY SYSTEM

1. The Sub-contractor shall visit the installation at least once every three months to carry out the following tests including necessary repairs and adjustment:

   a. All components, including cables, panels, power supply equipment and batteries, etc. shall be tested and examined as specified in FWP14.4.010 and ELE30;

   b. The audio advisory system shall be tested and examined as specified in ELE25.5.

FWP14.4.020.9 FIXED FIRE PROTECTION SYSTEMS USING GAS EXTINGUISHING AGENTS

The Sub-contractor shall visit each installation at least once every three months and carry out the following tests including necessary repairs and adjustments:

1. All electrical components, including cables, detectors, relays, alarm panel and bells, batteries etc. shall be tested and examined as specified in FWP14.4.010;
2. All automatic/manual release mechanism shall be checked and serviced in accordance with the manufacturer's instructions to ensure their proper operation. The Sub-contractor shall be responsible for ensuring that all such mechanisms are properly lubricated and kept free from corrosion;
3. All pipes and fittings shall be checked for leakage and corrosion and repaired or repainted as necessary. All valves shall be checked for freedom of operation and nozzles shall be cleaned by removing the dust, dirt and other obstacles deposited on them;
4. All cylinders containing the chemical extinguishing agents shall be checked to ensure that the contents are up to the specified standard and are so marked with paint on the outside of cylinders. The Sub-contractor shall recharge any cylinders to the specified content level if carbon dioxide cylinders are found to exhibit a 10% loss of content by weight except where the discharge (usually total) is due to genuine fire, false alarm or accident caused by others. However, where the discharge is due to a faulty detector or other part of the equipment the Sub-contractor shall recharge the system at his own expense;
5. All warning notices and operating instructions shall be checked to ensure that they are fixed in the proper position, are in a readable condition and are both in English and Chinese unless otherwise confirmed in writing by the Contract Manager;
6. All time delay and lock-off devices shall be inspected and tested to ensure that they are in correct working condition;
7. The coincident unit shall be checked for proper function by actuating detectors of two separate zones;
8. All ancillary functions of the system such as shutting off air-conditioning/ventilation plant, lowering fire shutters or curtains etc. shall be checked for proper operation.

FWP14.4.030.A WATER PUMP INSTALLATION AND FIXED FIRE SERVICES SYSTEMS USING WATER

The Sub-contractor shall submit for the CM’s approval the maintenance schedule indicating the dates for routine maintenance, and inspection check lists, for the quarterly, half-yearly and annual maintenance service before commencement of the Maintenance Period.

The Sub-contractor shall visit the fire services and water pump installation, including water pumps and the associated electrical works and controls, at least once every three months and carry out the following inspection, tests, adjustment and repairs:

1. All electrical components including cables, alarm panel and bells, batteries, control relays, starters etc. shall be inspected and tested as specified in FWP11 and FWP14.4.010 above;
2. All pipes and fittings shall be checked for leakage and corrosion and repaired or repainted as necessary. All valves shall be checked for freedom of operation, all control valves kept locked in the "open" position by strapping as applicable, inlet valves correctly bonded to earth, water supplies maintained in service etc.;
3. Inspection shall be carried out to ensure that all sprinkler heads are maintained in good working condition, clean and free from corrosion and are not covered with distemper, paint, dust, fluff etc.. Any sprinkler heads found defective and suspected of being defective shall be replaced;
4. Water and air pressure gauges must be inspected to ensure that correct pressures are maintained. Gauges shall be calibrated at regular intervals. Water levels and air pressure in pressure tanks must be checked to ensure that they are maintained in proper condition;
5. An alarm test shall be made on the sprinkler system by opening the test valve and the time taken to sound the alarm gong noted. The alarm shall be allowed to ring for about 30 seconds in order to ascertain that it is not ringing intermittently. Any repairs or adjustment which may prove to be necessary after the test shall be carried out with no delay;
6. The alarm and functional signals shall be checked to ensure that they are properly transmitted to the central control and supervisory panel;
7. All metallic elevated, priming and pressure tanks constructed by the Sub-contractor shall be inspected for sediments, rust and corrosion. The Sub-contractor shall remove sediments, rust and repaint the corroded parts as necessary;
8. The Sub-contractor shall grease the valves, the bearing and other relevant mechanical parts of the pumps, motors and engines as recommended by the manufacturers. A test run of at least 10 minutes shall be performed on each pump to ensure the pumping systems are in satisfactory operating condition. Engine driven pumps shall be capable of being started in 30 seconds or less. All manual and automatic starting and control mechanism, components, switches etc. shall be checked for proper functioning;
9. The Sub-contractor shall replace, as required, all parts such as bearings, valve seats, mechanical seal etc. due to wear and tear. In addition the Sub-contractor shall maintain in good working order the engines, the motors and also the electrical power supply to the pumps to and from its electrical isolator or switch-fuse, including changeover switches (if any), starters, fixed and flexible conduits between isolator/switch-fuse and cables therein. The Sub-contractor shall also maintain all pump control pressure and level switches in good order and inspect circuitry as previously indicated for electrical systems;
10. All strainers shall be cleaned by the Sub-contractor;
11. In addition to the above, the Sub-contractor shall carry out half-yearly the following maintenance service, including but not be limited to:
    a. Check condition of tie-rods and vibration eliminator;
    b. Check coupling alignment and cushions wear,
    c. Dismantle, clean and re-fix all ball float valves and replace rubber pad as necessary;
    d. Check and secure mounting of guide pipe and condition of bracket;
    e. Operate pump to check abnormal noise of pump set under operation;

f. Check condition of grease nipple for use;

g. Check abnormal vibration of operating pump set due to deterioration of mounting plate/ spring isolator/concrete plinth;

h. Check abnormal vibration due to breakage of mounting bracket/spring pipe hanger;

i. Operate pump to check proper operation of all pressure switches, level switches including sump tank low level switch and roof tank high/low level switches and adjust them as necessary;

j. Measure the pressure and flow rate of the pump and check the readings with last record to ascertain impeller/diffuser and wearing ring condition;

k. Check abnormal water leakage from the mechanical seal and replace the worn-out seal as necessary;

l. Check and keep free flow in the water drain pipe for seal leakage and clean it as necessary;

m. Check operation condition and any leakage of drain plug and vent cock, etc.;

n. Check the pressure of water hammer arrester, if any, and recharge it according to manufacturer's recommendation when necessary.

FWP14.4.040.9 PORTABLE EQUIPMENT

1. Portable equipment if supplied and installed by the Sub-contractor shall be inspected and checked annually to ensure that they are in good working condition;

2. Any fire extinguishers and fixed sprayer units losing 10% of its nominal content by weight shall be recharged / replaced to the required standard.

FWP14.4.060.9 RAINWATER HARVESTING SYSTEM INSTALLATION

1. The Sub-contractor shall provide the following maintenance service during the Maintenance Period:

   a. Check the condition of all components for the rainwater harvesting system installation according to the schedule as specified in sub-clause (2) of FWP14.4.060 and repair/replace the faulty component(s) as necessary;

   b. Conduct the water quality tests on the testing parameters according to the frequency as specified in sub-clause (3) of FWP14.4.060;

   c. Submit a monthly operation and maintenance report which shall record the operation data of the rainwater harvesting system installation including electricity, rainwater and fresh water consumption and the maintenance activities conducted for each month, every two month or each quarter;

   d. All monthly, bimonthly or quarterly activities shall be recorded in record book as specified in FWP14.3.060;

   e. Replenish all the necessary chemicals for the chlorine dosing system.

2. The maintenance schedules shall include, but not be limited to, the following components. The Sub-contractor shall submit a specific maintenance schedule including all the offered equipment and recommendations from the manufacturers for the Contract Manager's Approval.

System Component	Inspection / Maintenance	Required Schedule
a. Gutters / downpipes	Check that there is no leakage or blockage due to build up of debris;	Monthly (Apr – Sept) Bi-monthly (Oct – Mar) or the other months as

	Clean the gutters if necessary.	advised by the Contract Manager.
b. Gutter mesh / grating	Check the condition of the gutter mesh / grating and clean if necessary.	Monthly (Apr – Sept) Bi-monthly (Oct – Mar) or the other months as advised by the Contract Manager.
c. Vortex filter	Check the condition of the vortex filter and clean if necessary.	Monthly (Apr – Sept) Bi-monthly (Oct – Mar) or the other months as advised by the Contract Manager.
d. Pre-settlement tank	Check that there is no build up of sediments, drain and clean if necessary; Clean and remove all rubbish inside the stainless steel wire mesh bucket.	Monthly (Apr – Sept) Bi-monthly (Oct – Mar) or the other months as advised by the Contract Manager.
e. Cartridge filter	Check the condition of the filter and clean if necessary.	Monthly (Apr – Sept) Bi-monthly (Oct – Mar) or the other months as advised by the Contract Manager.
f. 2-way valves / pressure reducing valves	Check the condition of the 2-way valves / pressure reducing valves and clean if necessary.	Monthly (Apr – Sept) Bi-monthly (Oct – Mar) or the other months as advised by the Contract Manager.
g. Pipeworks and hangers	Check that there is no leakage and overflows are clear of obstruction; Inspect the integrity of hangers.	Annually in March or the other month as advised by the Contract Manager.
h. Rainwater collection tank / break tank	Check that there is no leakage and no build up of sediments; Drain and clean if necessary.	Monthly (Apr – Sept) Bi-monthly (Oct – Mar) or the other months as advised by the Contract Manager.
	Cleansing of water tanks.	Half-yearly in March and October or the other months as advised by the Contract Manager.
i. Chlorine dosing system	Check that there is no leak on the storage tank and check the condition of the chemical feed pump and clean if necessary.	Annually in March or the other month as advised by the Contract Manager.
	Check that the residual chlorine sensor operate properly in response to residual chlorine values.	Annually in March or the other month as advised by the Contract Manager.
	Calibrate the residual chlorine sensor.	As recommended by the manufacturer.

j. Pumps and pump control	Check that there is no leakage and no corrosion; Carry out test run; Carry out maintenance if necessary.	Annually in March or the other month as advised by Contract Manager.
k. Control and monitoring system	Check that the equipments are operating in satisfactory conditions, including the alarm functions where applicable.	Annually in March or the other month as advised by Contract Manager.
l. Water / power meters	Check that the meters can operate properly.	Annually in March or the other month as advised by Contract Manager.
	Replace the meters.	Every 5 years.
m. Level switch	Check that the level switch responds correctly to the water level in the tank.	Annually in March or the other month as advised by the Contract Manager.
n. Markings and warning notices	Check that warning notices, signs and pipework identification are correct and in place.	Annually in March or the other month as advised by the Contract Manager.

3. Sampling and testing of water quality parameters of treated rainwater shall be conducted monthly during rainy season (Apr – Sept) and quarterly during dry season (Oct – Mar).

   a. Testing reports issued by the accredited laboratory shall be forwarded to the Contract Manager within fourteen days after completion of the water quality test;

   b. If the testing results indicate that the testing samples exceeded the water quality standards as specified in sub-clause (2) of FWP14.1.120, the use of the rainwater harvesting system installation shall be suspended until the problem is resolved and to the satisfaction of the Contract Manager. System operation shall be investigated and subsequent re-sampling and testing shall be performed to confirm the results. Investigation report with remedial proposals shall be submitted for the Contract Manager's Approval prior to implementation of the proposed rectification works. The Sub-contractor shall be responsible for all the costs for investigation and rectification works;

   c. Proper measures to prevent health risk or nuisances to the public (e.g. limit the irrigation time and frequency or suspension of the use of Rainwater Harvesting System) shall be carried out according to the nature of the problems and possible consequences.

FWP14.4.070.9 PRV FAULT INDICATION SYSTEM

1. The Sub-contractor shall dispatch competent and trained technicians to carry out routine maintenance and servicing works for the PRV fault alarm indication system in order to maintain its proper working condition to the satisfaction of the CM;

2. A brief outline of the routine maintenance and servicing works required to be carried out by the Sub-contractor is given in this clause, which is by no means exhaustive. The Sub-contractor shall base on his own engineering judgement and recommendation of the manufacturers to include any other items of work which are essential to the proper and efficient operation of the system. Detailed maintenance proposal shall be submitted to the CM for approval;

3. The Sub-contractor shall provide the following maintenance service during the Maintenance Period:

Inspection / Maintenance	Required Schedule
a. Check the general conditions of the PRV fault alarm panel b. Check the proper functioning of indicating lights and buzzers at the central fault indication panels c. Check the connection of controlling cables / pipes d. Check any mechanical damages to cables e. Check any leakage from connection pipes and valves f. Check the setting of pressure switch	Quarterly
g. Check the proper functioning of pressure switch: (i) For ratio type pressure reducing valves at down-feeding pipework, close off the pressure switch valve at downstream side and open the pressure switch valve at upstream side to check if fault alarm is triggered and resume the position of the pressure switch valves after checking (ii) For pilot type pressure reducing valves at the incoming water supply pipework, apply a test pressure from the end cap valve to check if fault alarm is triggered and resume the normal setting after checking. h. Re-adjust pressure setting if required i. Check the proper functioning of local PRV fault indicating light adjacent to the pressure switch	Half-yearly

FWP14.5 ANNUAL AND FINAL MAINTENANCE, TESTING AND HANDOVER

FWP14.5.010.9 FIRE DETECTION AND ALARM SYSTEM

At the annual and final inspection, the Sub-contractor shall, in addition to the quarterly inspection and testing, take down all smoke detectors, clean them "in-situ" in accordance with the manufacturer's instructions, test them for correct operation with the manufacturer's test set before reinstating them for service. Any defective detectors shall be replaced or "factory cleaned" to the manufacturer's recommendation before reinstated for service. Any smoke detectors subjected to dust and dirt accumulating shall also be despatched for factory cleaning as instructed by the Contract Manager. All detectors removed for factory cleaning shall be replaced with spare units or alternatively a separate surveillance system shall be provided to cover the unprotected areas as resulted. All expenses for the above work shall be born by the Sub-contractor.

FWP14.5.015.9 AUDIO / VISUAL ADVISORY SYSTEM

The Sub-contractor shall carry out the same extent of work as the quarterly inspection, testing and maintenance services stipulated in FWP14.4.015.

FWP14.5.020.9 FIXED FIRE PROTECTION SYSTEMS USING GAS EXTINGUISHING AGENTS

The Sub-contractor shall carry out the same amount of work as the quarterly inspection, testing and maintenance services.

FWP14.5.030.9 WATER PUMP INSTALLATION AND FIXED FIRE SERVICES SYSTEMS USING WATER

At the annual and final inspection, the Sub-contractor shall, in addition to the quarterly inspection and testing, carry out the following inspection, tests, adjustment and repairs as required:

1.

a. Inspection and testing and by means of wet drill on the hydrant and hosereel installation shall be carried out in accordance with the FSD requirement. The wet drill shall consist of coupling lengths of hose to two or more hydrants and opening the valve to produce water at the nozzles. Great care and precise liaison with all concerned must be exercised by the Sub-contractor to guard against flooding and water seepage. The Sub-contractor shall be liable to bear the full cost of any damage due to flooding and seepage. Hydrants not used at the wet drill shall each be fitted with a blank cap over the outlet, and checked by opening and closing the valve and spindle to ensure that they are free in operation;

b. Testing of the pressure and flow of the water supply on the hydrant and hosereel installation should be done from the outlets at the highest point. The opening of two or more outlets and directing the water from the roof tanks should be sufficient to indicate the state of the water supply, but if there is any doubt as to the flow or pressure of the water, a more accurate test with suitable gauges should be carried out.

2. Each length of hose shall be uncoiled, laid out straight and examined;

3. The test shall be made with the drain and test valves in accordance with LPC Sprinkler Rules;
4. The concrete water tanks constructed by the Main Contractor shall be inspected for rusting and sediments. The sub-contractor shall inform the Contract Manager in writing if any cleaning and rectification on the tanks are necessary.

FWP14.5.040.9 PORTABLE EQUIPMENT

The Sub-contractor shall carry out annual and final inspection as FWP14.4.040.

FWP14.5.050.9 TESTS AT EXPIRY OF MAINTENANCE PERIOD

At the end of the Maintenance Period the Sub-contractor shall repeat the following tests to the satisfaction of the Contract Manager.

1. All function test for water pumps and pump control cubicles;
2. Cleaning all strainers.

FWP14.5.060.9 FINAL ACCEPTANCE TEST AND CERTIFICATE OF MAINTENANCE FOR FIRE SERVICES INSTALLATIONS

At the end of the Maintenance Period, the Sub-contractor shall ensure that the installations are in an "as-new" condition and shall carry out a final acceptance test for the fire services, rainwater treatment and water pump installation. A Certificate of Maintenance (FS 251) shall be submitted to FSD with a copy to the Contract Manager within 14 days after the annual and final tests. The certificate together with a list of the fire services installation and equipment shall also be copied, framed and displayed in a prominent area of each building concerned under the direction of the Contract Manager.

FWP14.5.070.9 HANDOVER

The services installations will not be deemed as acceptable for handover to the Contract Manager until each installation is in good working order and all "as-fitted" drawings, instruction and maintenance manuals, spare parts lists, test reports, test certificates etc. have been submitted to the Contract Manager.

FWP14.6 RESPONSIBILITIES

FWP14.6.010.9 SAFETY OF INSTALLATIONS

The Sub-contractor shall be responsible for all repairs necessary to maintain the installations in a safe, reliable and operative condition at all times. Ensure that servicing staff carry out necessary repairs immediately, utilising manufacturer's original replacement parts. Any component taken down for servicing shall be reinstated within 2 hours or otherwise replaced by a spare unit at the Sub-contractor's expense.

FWP14.6.020.9 INTERRUPTION OF FIRE SERVICES

The Sub-contractor shall ensure minimum interruption to the functioning of the fire service installation during each inspection, testing, repair or maintenance service. He shall inform FSD of the commencement and completion of each job whenever the disconnection, reconnection or testing of the fire services communication direct line is involved. Where any part of the fire service installation is out of service temporarily during the progress of work, the Sub-contractor shall place a suitable notice in a prominent position on the Control Panel so that the client is aware of the situation and FSD will not be called out unnecessarily. This is, however, not to be construed as an authority to leave any part inoperative for an undue length of time.

FWP14.6.030.9 REPLACEMENTS

1. The Sub-contractor shall, as and when instructed thereof by the Contract Manager, repair or replace at his own cost any part of the system proved to be defective by reason of Sub-contractor's negligence, faulty design, inadequate routine maintenance and supervision, workmanship or materials. No claim whatsoever shall be made by the Sub-contractor for such repair or replacement if it is within the scope of the Sub-contractor's responsibility;
2. Any renewals or repairs necessitated by reason of negligence or misuse of the equipment or by reason of any other cause beyond the Sub-contractor's control (with the exception of ordinary wear and tear) shall be carried out at an additional cost with prior notice to the Contract Manager.

FWP14.6.040.9 CONDITIONS OF CONTRACT

1. The maintenance and servicing works as described in FWP14 form part of the Main Works under Clause 8.3(2)(c) of the General Conditions of Main Contract;
2. The Sub-contractor's attention is drawn to Clause 5.13 of the General Conditions of Main Contract, which appertains throughout the Maintenance Period, and before commencing any work ordered under Clause 10.1 of the General Conditions of Main Contract, the Sub-contractor shall, at his own expense, make all suitable arrangements to avoid damage to property or installations provided by others.

FWP15 SYSTEM COMPONENTS

FWP15.1 SYSTEM COMPONENTS 2

FWP15.1.010.9 CARTRIDGE FILTER 2
FWP15.1.020.9 CHLORINE DOSING 2
FWP15.1.030.A FLOW METER 3
FWP15.1.040.9 WATT-HOUR METERS 3
FWP15.1.050.9 CONTROL SYSTEM 3
FWP15.1.060.9 PRE-SETTLEMENT TANK 4
FWP15.1.070.9 2-WAY VALVE 4

FWP15.1 SYSTEM COMPONENTS

FWP15.1.010.9 CARTRIDGE FILTER

1. Cartridge filter shall be capable to remove 90% of all suspended particulate with diameter equals ten-micron or above;
2. The filter cells shall be assembled in cartridges for easy replacement on site;
3. The filter cells shall be so arranged that the water stream passes uniformly and proportionally through the filter cells. Provision shall be made to retain filter in position and prevent migration and settlement;
4. Filter vessel shall be made of stainless steel of BS EN 10088-1 grade 1.4301 (grade 304) or equivalent. All stainless steel components shall be mirror polished and electro polished to resist adhesion of dirt and scale;
5. Vessel shall be equipped with both automatic air vent and manual air vent;
6. Pressure gauges shall be mounted on vessel for reading the differential pressure before and after the filter for sensing blockage of filter;
7. Working pressure of cartridge filter shall not be less than 10 bar and the testing pressure shall be of 1.5 times of the working pressure;
8. Cartridge filter shall be preassembled and tested by the manufacturer with satisfactory results prior to delivery. Test report for each delivered cartridge filter shall be submitted to the Contract Manager for Approval.

FWP15.1.020.9 CHLORINE DOSING

1. The chlorine dosing system shall comprise of a chemical feed pump, probe type residual chlorine sensor, a chemical storage tank and associated pipework. The chlorine dosing system shall have adequate and adjustable chemical feed rate to achieve the required residual chlorine level under the system flow rate;
2. The chemical feed pump shall be of positive displacement reciprocating diaphragm design with a manually adjustable feed rate;
3. The chemical feed pump shall be gear-driven by close-coupled a.c. motor suitable for operation on the local power supply system. Each pump set shall be a self-contained package unit consisting of a pump, a driving motor and a totally enclosed gear case;
4. The probe type residual chlorine sensor shall conform to the standards of CE, UL listed and CUL;
5. The probe type residual chlorine sensor shall be able to continuously monitor the concentration of chlorine in the collected water at the rainwater collection tank and control the chlorine dosing system to automatically adjust the chemical feed rate once the residual chlorine level deviates from the pre-set values;
6. The probe type residual chlorine sensor shall cope with the concentration of chlorine and the Sub-contractor shall demonstrate the compliance to the satisfaction of the Contract Manager;
7. The chemical storage tank shall be made of a suitable material to contain sodium hypochlorite solution. The tank shall be capable to be replaced without interrupting the rainwater harvesting system installation;
8. Chlorination shall be effected by injecting dosage at the bottom of rainwater collection tank.

FWP15.1.030.A FLOW METER

1. Flow meters shall be provided as shown on the Drawings. The installation of the flow meter shall follow the manufacturer's recommendation with sufficient length of straight pipe run both at the upstream and downstream piping;
2. The flow meter shall be of electromagnetic or ultrasonic type, and of the cumulative type, i.e. a cumulative volume of water passing through the device in litre or cubic meter, and shall be suitable for the chemical and physical properties of the fluids to be measured and suitable for both horizontal and vertical installations;
3. Each flow meter shall consist of the flow sensor, an integral signal converter / transmitter and a digital display unit. The flow sensor shall be installed in / on the water pipework without obstructing the flow. The protection class of the sensor and converter / transmitter housing shall be at least to IP 67 and IP 65 respectively. The flow meter shall have a constant accuracy to a maximum error of ±0.5% of the actual flow for flow velocity of greater than or equal to 0.5 m/s;
4. The flow meter shall conform to BS EN IEC 61000-3-2, BS EN IEC 61000-6-1, BS EN IEC 61000-6-2, BS EN IEC 61000-6-3 and BS EN IEC 61000-6-4 or similar international standards on Electro-magnetic Compatibility (EMC) compliance for industrial and commercial applications.

FWP15.1.040.9 WATT-HOUR METERS

1. Watt-hour meters shall be provided by the Sub-contractor to monitor the electricity consumption of chlorine dosing equipment in Rainwater Harvesting System Treatment Facility Room and rainwater irrigation pumps when installed at strategic locations approved by the Contract Manager;
2. Watt-hour meters shall comply with IEC 62053-11 and shall have Class 2 accuracy calibrated at the normal working voltage and frequency.

FWP15.1.050.9 CONTROL SYSTEM

1. A control and metering system shall be provided and installed in each plant room for rainwater harvesting system installation to allow standalone control and monitoring of the entire rainwater harvesting system installation. The following functions, but not be limited to, shall be available and performed by the control system:
    a. Automatic control and monitoring upon receipt of monitoring signals from different equipment;
    b. Manage all circuits or signals from different equipment to be monitored, including chlorine dosing system, level control switches of the rainwater collection tank, 2-way valves and rainwater irrigation pump sets;
2. The control system shall monitor the status of rainwater collection tank level control switches to provide on/off control for the 2 number of inter-connected 2-way valves to control water being either fed from the rainwater collection tank or fresh water break tank as specified in FWP2.3.2.010;
3. The Sub-contractor shall provide a local control panel to monitor and allow manual control of the equipment at Rainwater Harvesting System Treatment Facility Room, which shall include, but not limited to the following:
    a. Local on/off switches for chlorine dosing system;
    b. Position indication for the 2-way valves (harvested rainwater / potable water / isolation);

c. Audible and visual fault alarms for any fault of equipment monitored by the control panel, chlorine dosing system, rainwater collection tank level control switches and 2-way valves. The fault signal when triggered shall be transmitted to the security guard counter;

d. Full / empty status of rainwater collection tank;

e. Malfunction of chlorine dosing system;

f. Empty status of chlorine dosing system (if bleaching agent tank used);

g. Blockage of cartridge filter;

h. Opening status of inlet valve of rainwater collection tank;

i. Pressure reducing valve clogging.

4. The Sub-contractor shall provide a local control panel to monitor and allow manual control of the equipment at Rainwater Irrigation Pump Room, which shall include, but not be limited to the following:

   a. Local on/off switches for rainwater irrigation pump sets;

   b. Operation status indication lamps for rainwater irrigation pump sets;

   c. Audible and visual fault alarms for rainwater irrigation pump sets. The fault signal when triggered shall be transmitted to the security guard counter;

   d. Audible and visual alerts for the need to prime rainwater irrigation pump sets.

FWP15.1.060.9 PRE-SETTLEMENT TANK

1. A pre-settlement tank shall be provided by the Main Contractor inside the rainwater collection tank. Debris and leaves shall be separated from the collected rainwater there with sand and mud settling at the bottom of the pre-settlement tank. The collected rainwater shall overflow into the adjacent storage compartment through a coarse stainless steel screen. Stainless steel shall be of Grade 1.4301 (Grade 304) in accordance with BSEN 100881-1;

2. The Sub-contractor shall provide a perforated or wire mesh stainless steel bucket inside the pre-settlement tank. The bucket shall be easily taken out for removal of the collected debris. Stainless steel shall be of Grade 1.4301 (Grade 304) in accordance with BSEN 100881-1;

3. The bucket of the pre-settlement tank shall be divided into two (or more) mesh buckets each of different mesh sizes if it is too large to perform maintenance. The one closer to the inlet shall have larger mesh and its height shall be lower than the water inlet to avoid possible blocking by accumulated debris. The design of the bucket shall be approved by the Contract Manager.

FWP15.1.070.9 2-WAY VALVE

1. 2-way valve shall be an assembly consist of a valve, an actuator and a controller in a cartridge assembly;

2. 2-way valve shall be of on-off control operated by the actuator via controller and allow/prevent water flowing through the valve at on/off position respectively;

3. Valve shall be controlled by level control switches at rainwater collection tank as specified in FWP2.3.2.010;

4. The valve assembly shall operate at low voltage and be of low power consumption;

5. The valve assembly shall operate silently and without water hammer.

FWP16 LIFT PIT DEWATERING SYSTEM

FWP16.1 SCOPE OF WORK 2
FWP16.1.010.9 APPLICATION 2
FWP16.1.020.9 PROVISIONS 2

FWP16.2 DEWATERING PUMPS 3
FWP16.2.010.9 SUBMERSIBLE DEWATERING PUMP 3
FWP16.2.020.9 RESIDUE DEWATERING PUMP 3

FWP16.3 SYSTEM COMPONENTS 4
FWP16.3.010.9 UPVC BALL VALVE 4
FWP16.3.020.9 UPVC BALL CHECK VALVE 4
FWP16.3.030.9 STAINLESS STEEL CAMLOCK COUPLING 4
FWP16.3.040.9 PVC BRAIDED HOSE 4

FWP16.4 FLOODING ALARM 5
FWP16.4.010.9 FLOODING SENSORS 5
FWP16.4.020.9 FLOODING ALARM PANEL 5

FWP16.5 TESTING COMMISSIONING AND MAINTENANCE 6
FWP16.5.010.9 TESTING AND COMMISSIONING 6
FWP16.5.020.9 MAINTENANCE 6

FWP16.1 SCOPE OF WORK

FWP16.1.010.9 APPLICATION

1. The Specification in this Worksection FWP16 is applicable only for the Lift Pit Dewatering System;
2. During incidental water flooding of the lift pits in the domestic and non-domestic blocks, the lift pit dewatering system shall enable automatic dewatering at sump pit of lift pit access corridor as shown on the Drawings and initiate alarms at the flooding alarm panel.

FWP16.1.020.9 PROVISIONS

1. The Sub-contractor shall supply and install the following items for the Lift Pit Dewatering System for each lift pit access corridor as shown on the Drawings –
   a. Two sets of submersible dewatering pumps completed with integrated float switches at the sump pit;
   b. System components including but not limited to UPVC ball valves, UPVC ball check valves, stainless steel camlock couplings, PVC braided hoses and stainless steel hose clamps. UPVC pipes and fittings connecting the dewatering pumps and the system components shall refer to FWP3.1.2.045;
   c. Flooding sensors completed with stainless steel mounting strip at the sump pit;
   d. A flooding alarm panel completed with battery and charger at G/F guard counter or at a location shown on the Drawings;
   e. Signal wiring of PVC cables in concealed conduits, connecting between the cable changing box and the flooding alarm panel; and
   f. Cable changing box to IP55 constructed of epoxy coated galvanised steel sheet on the wall above the sump pit for connecting the PVC signal cables to the multicore cables for the flooding sensors. The multicore cables shall run on galvanized steel cable tray and anchored on a stainless steel flat strip fixed into the sump pit as shown on the Drawings.
2. The Sub-contractor shall supply the following items for each individual block at G/F fresh water pump room–
   a. One set of residue dewatering pump kept in a lockable cabinet; and
   b. One set of rubber hose of a length of 50 m or the length from the nearest water point at G/F to the sump pit at the lift access corridor whichever is the longer; the rubber hose shall be fitted with heavy duty stop cock and discharge nozzle and rolled in a hose reel trolley; the internal bore of the hose tubing shall be not less than 15 mm.
3. The Sub-contractor shall submit technical literatures and/or samples of the above materials for Approval prior to ordering;
4. The Sub-contractor shall coordinate with the Main Contractor for the connection of the system components to piping provided by the Main Contractor for discharging the pumped water to external drain point;
5. The Sub-contractor shall coordinate with the sub-contractor for electrical installation for positioning of 16 A industrial type and 13 A weatherproof type switched socket outlets provided by the sub-contractor for electrical installation;
6. The Sub-contractor shall perform testing and commissioning of all installed and supplied items and provide routine maintenance during Maintenance Period.

FWP16.2 DEWATERING PUMPS

FWP16.2.010.9 SUBMERSIBLE DEWATERING PUMP

1. The submersible dewatering pump shall be a free standing basin water uplifting pump;
2. The pump shall be of robust and durable construction with epoxy coated cast iron or stainless steel casing and with a top lifting handle;
3. The pump shall be equipped with level adjustable waterproof float switch for automatic pump cut-in and cut-out operation; the activation level of float switch for pump cut-in shall be not more than 600 mm measured from bottom;
4. The pump discharge outlet shall be fitted for connection of a 50 mm diameter PVC hose by stainless steel pipe clamps;
5. The pump shall enable to discharge water at a nominal flow rate of 4 litre/s at a pump head necessary for discharging the pumped water from the level of sump pit at the lift pit access corridor up to the ceiling height of G/F and then to an external drain point. The nominal pump head is shown on the Drawing which subject to the detailed calculation and pump curve submitted by the Sub-contractor;
6. The pump shall be equipped with dry induction motor and mechanical seal;
7. The pump motor shall be of single phase and with built-in thermal auto-cut protection;
8. The pump shall be supplied with factory connected submersible PVC cable of not less than 3 m long with industrial type 16 A power plug.

FWP16.2.020.9 RESIDUE DEWATERING PUMP

1. The residue dewatering pump shall be a portable free standing submersible pump and fitted with a residue adaptor where necessary, to enable draining residue water in a sump pit down to 1 mm water level;
2. The pump shall be of lightweight robust construction with casing of glass-fibre reinforced resin or materials approved by CM, with a top lifting handle;
3. The pump shall be equipped with a top discharge bore with hose coupling of 25 mm in diameter;
4. The pump shall enable to discharge water at a nominal flow rate of 0.5 litre/s at a pump head of 2 m;
5. The pump motor shall be of single phase with built-in thermal auto-cut protection;
6. The pump shall be supplied with factory connected submersible PVC cable of not less than 5 m long with 13 A power plug.

FWP16.3 SYSTEM COMPONENTS

FWP16.3.010.9 UPVC BALL VALVE

1. The UPVC ball valve shall consist of a spherical valve element allowing for a straight flow path and low fluid resistance;
2. The body, stem and spherical valve element of the valve shall be constructed of UPVC;
3. The valve shall be operated by handle lever for shut-off;
4. The valve shall be of true union type so that the valve part can be removed without disconnecting the pipes, by unscrewing the union nuts on both side;
5. The valve shall be of socket end connection by adhesive;
6. The valve shall have a working pressure of not less than 10 bar;
7. The valve shall be affixed with a label indicating “Normally Open 常開”.

FWP16.3.020.9 UPVC BALL CHECK VALVE

1. The UPVC ball check valve shall consist of a spherical solid ball element allowing for a straight flow path and low fluid resistance;
2. The valve body and ball of the valve shall be constructed of UPVC;
3. The valve shall be of true union type so that the valve part can be taken down for cleansing without disconnecting the pipes, by unscrewing the union nuts on both side;
4. The valve shall be of socket end connection by adhesive;
5. The valve shall have a working pressure of not less than 10 bar.

FWP16.3.030.9 STAINLESS STEEL CAMLOCK COUPLING

1. The stainless steel camlock coupling shall consist of a pair of male and female fittings;
2. The camlock coupling shall be constructed of stainless steel to AISI 316 grade or equivalent;
3. The female fitting with cam levers shall have screwed male end connection with threads complying with BS EN 10226-1, 2, 3;
4. The male fitting shall have a hose shank for connection of flexible hose;
5. Safety clips shall be equipped to lock cam levers to prevent disconnection.

FWP16.3.040.9 PVC BRAIDED HOSE

1. The PVC braided hose shall be constructed of flexible clear PVC sheath embedded with braided steel reinforcement wire;
2. The sheath shall be not less than 6 mm thick for a hose of bore of 50 mm in diameter;
3. The working pressure of the hose shall be not less than 4 bar;
4. The PVC braided hose shall connect to the dewatering pump and the male fitting of camlock coupling by hose clamps made of stainless steel to AISI 316 grade or equivalent.

FWP16.4 FLOODING ALARM

FWP16.4.010.9 FLOODING SENSORS

1. Each flooding sensor shall be a micro-switch encapsulated in waterproof and corrosion proof float body made of polypropylene or equivalent;
2. Two flooding sensors shall be anchored by submersible multi-core PVC sheathed cables at different levels on a flat strip made of AISI grade 316 stainless steel, fixed into the sump pit at the lift pit access corridor as shown on the Drawings;
3. The flooding sensors shall trigger alarm signals for initial flooding alarm and sump pit overflow alarm respectively.

FWP16.4.020.9 FLOODING ALARM PANEL

1. The flooding alarm panel shall be lockable and made of epoxy coated galvanised steel sheet;
2. The panel shall be equipped with LED alarm indicators, buzzer, mute button, lamp test button and reset key switch;
3. The panel display arrangement of the alarm signals and labelling shall be in accordance with the Drawings;
4. The panel shall be operated from a 24V battery and charger as specified in FWP10.6.020, FWP10.6.040, FWP10.6.050 and FWP10.6.060.

FWP16.5 TESTING COMMISSIONING AND MAINTENANCE

FWP16.5.010.9 TESTING AND COMMISSIONING

Testing and commissioning for the installation shall generally be in accordance with Works Sub-section FWP14.1 where appropriate, with the exception of the following Clauses – FWP14.1.060, FWP14.1.080, FWP14.1.090, FWP14.1.100, FWP14.1.105, FWP14.1.120 and FWP14.1.130 which are not applicable to the installation.

FWP16.5.020.9 MAINTENANCE

1. General maintenance shall be carried out in accordance with Works Sub-section FWP14.3 where appropriate;
2. Particular maintenance shall be carried out in accordance with FWP14.4.030 where appropriate. During the quarterly inspection, notwithstanding the routine maintenance as specified, the Sub-contractor shall undertake the following procedures:
   a. Connect rubber hose of the hose reel trolley to the nearest water point in G/F;
   b. Fill water to the sump pit in the access corridor by the rubber hose;
   c. Test automatic operation of each submersible dewatering pump one by one;
   d. Check proper functioning of ball check valves. Where necessary, unscrew the union nuts and take down the valves for cleansing;
   e. Check proper functioning and indication of the flooding sensors and the flooding alarm panel;
   f. Use the residue dewatering pump to empty residue water out of the sump pit;
   g. Replace any defective items within the Maintenance Period.
3. Annual and final maintenance, testing and handover shall be carried out in accordance with FWP14.5.030, FWP14.5.050 and FWP14.5.070 where appropriate.

FWP17 MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIMEP)

FWP17 MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIMEP) 2

FWP17.1 SCOPE OF WORKS 2
FWP17.1.010.N EXTENT OF APPLICATION 2

FWP17.2 PARTICULAR REQUIREMENTS OF MIMEP MODULE 3
FWP17.2.020.N WATER PUMP SET MODULE 3
FWP17.2.030.N FIRE HYDRANT RISER MODULE 3
FWP17.2.040.N PRESSURE REDUCING VALVE SET MODULE 4
FWP17.2.050.N SPRINKLER SUBSIDIARY STOP VALVE SET MODULE 4
FWP17.2.060.N SPRINKLER CONTROL VALVE SET MODULE 4
FWP17.2.070.N DRENCHER DELUGE VALVE SET MODULE 4

FWP17 MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MiMEP)

FWP17.1 SCOPE OF WORKS

FWP17.1.010.N EXTENT OF APPLICATION

1. The Sub-contractor shall design, assemble and install the off-site / on-site prefabricated MiMEP modules, including but not limited to the following items, for on-site assembly and installation:
   a. Two sets of fresh water pump for each domestic block;
   b. Two sets of flush water pump for each domestic block;
   c. A fresh water booster pump system on roof for each domestic block;
   d. Two sets of fire services feed pump for each domestic block;
   e. One set of night duty pump for fresh water for each domestic block;
   f. Fire hydrant risers;
   g. Pressure reducing valves at the incoming water supply pipework;
   h. Pressure reducing valves in Fire Services Systems;
   i. Sprinkler subsidiary valve sets;
   j. Sprinkler control valve sets;
   k. Drencher deluge valve sets.
2. The complete MiMEP module shall mean, not only the major equipment, all associated electrical works, pipework and system components such as pressure switches, pressure gauges, flexible connectors, valves and strainers as shown on the Drawings, but all the incidental supporting frame / hanger, lifting lugs and sundry components necessary for the complete on-site assembly and installation, whether or not these supply components are mentioned in detail in the tender documents.

FWP17.2 PARTICULAR REQUIREMENTS OF MiMEP MODULE

FWP17.2.020.N WATER PUMP SET MODULE

1. The module shall comprise pump, motor, header pipes, sectional pipework, valves, fittings, baseplate and the mounting framework as appropriate;
2. The baseplate and anti-vibration provisions should be integrated into the water pump set module as far as practicable subject to the consideration of volume, weight, transportation and delivery of the modules;
3. The baseplate shall be sufficiently rigid and properly supported as detailed in FWP6.6.020.8 such that it will not deflect during transportation and delivery. The pump set and baseplate shall be fixed in place by locking anchor bolts cast or grouted in the concrete inertia block at Site or pump base and passing through holes accurately pre-drilled in the baseplate;
4. The baseplate shall be fixed with necessary framework of the same construction material for the suitable mounting / support of piping, electrical and piping accessories etc. Footings of framework shall be designed with pre-drilled holes for direct mounting onto the concrete inertia block / floor slab with rubber or neoprene pads for vibration isolation;
5. Suitable mechanical or flange joints shall be allowed for the interface connections between the pump set module and the in-situ water pipes at the plant room. Other pipe joint arrangement can be proposed for the approval by the CM;
6. For fresh water booster pump system on roof, the control cubicle, variable speed drive units, pneumatic pressure vessels and related provisions should be integrated into the pump set module subject to the consideration of volume, weight, transportation and delivery of the modules;
7. The following items may be exempted from MiMEP implementation. The Sub-contractor shall submit respective substantiation to demonstrate the site constraints and limitations for approval by the CM.
    a. Fresh / flush water feed pumps connecting to outlet pipe of nominal size above 80mm;
    b. Fire services feed pumps connecting to outlet pipe of nominal size above 50mm;
    c. Night duty pumps connecting to outlet pipe of nominal size above 50mm.

FWP17.2.030.N FIRE HYDRANT RISER MODULE

1. The module shall comprise pipework and fittings for the on-site assembly of a hydrant outlet or pressure reducing hydrant outlet;
2. The riser shall be pre-cut to the length that suit the floor to floor height of each individual landing for on-site or off-site assembly of a hydrant outlet or pressure reducing hydrant outlet and associated pipe brackets;
3. In case of off-site assembly, the Sub-contractor shall carry out and report on dimensional checking and chemical composition analysis against inferior materials and faulty workmanship on hydrant outlets / pressure reducing hydrant outlets delivered to the off-site workshop / off-site prefabrication yard according to the mechanism as detailed in FWP7.1.040;
4. All hydrant outlets / pressure reducing hydrant outlets shall comply with Clauses FWP7.1.020, FWP7.1.040 and FWP7.1.070.

FWP17.2.040.N PRESSURE REDUCING VALVE SET MODULE

1. The module shall comprise two sets of pressure reducing valve, pipework, fittings, gate valves, pressure gauges, pressure switches, associated accessories including identification plates, earth bonding and steel framework as an integrated assembly for direct mounting to the building structure;
2. All pipework, components and devices shall be assembled and properly fixed to the framework and completed with hangers, brackets, saddles, guide etc. Pipework supports shall be welded, screwed or bolted to the framework. The framework shall be designed with pre-drilled holes for onsite direct fixing to building structures;
3. Pressure reducing valve of nominal sizes above 80mm may be exempted from MiMEP implementation. The Sub-contractor shall submit substantiation to demonstrate the site constraints and limitations for approval by the CM.

FWP17.2.050.N SPRINKLER SUBSIDIARY STOP VALVE SET MODULE

1. The module shall comprise subsidiary stop valve, pipework, fittings, flow alarm switch, monitor modules, gate valves, associated accessories including earth bonding and steel framework as an integrated assembly for direct mounting to the building structure;
2. Sprinkler subsidiary valve of nominal sizes above 100mm may be exempted from MiMEP implementation. The Sub-contractor shall submit substantiation to demonstrate the site constraints and limitations for approval by the CM.

FWP17.2.060.N SPRINKLER CONTROL VALVE SET MODULE

1. The module shall comprise the completed sprinkler control valve set as detailed in FWP2.1.5.070.8 and associated accessories including wirings of completed circuits within the module, identification plates, earth bonding and steel framework as an integrated assembly for direct mounting to the building structure;
2. All pipework, components and devices shall be assembled and properly fixed to the framework and completed with hangers, brackets, saddles, guide etc. Pipework supports shall be welded, screwed or bolted to the framework. The framework shall be designed with pre-drilled holes for onsite direct fixing to building structures. Provisions shall be allowed to facilitate the transportation, delivery, assembly and services connection on Site;
3. Sprinkler control valve of nominal sizes above 100mm may be exempted from MiMEP implementation. The Sub-contractor shall submit substantiation to demonstrate the site constraints and limitations for approval by the CM.

FWP17.2.070.N DRENCHER DELUGE VALVE SET MODULE

1. The module shall comprise the drencher deluge valve set completed with pressure gauges, valves, alarm devices, manual actuation devices, water motor gongs, testing facilities etc. and associated accessories including wirings of completed circuits within the module, identification plates, earth bonding and steel framework as an integrated assembly for direct mounting to the building structure;
2. All pipework, components and devices shall be assembled and properly fixed to the framework and completed with hangers, brackets, saddles, guide etc. Pipework supports shall be welded, screwed or bolted to the framework. The framework shall be designed with pre-drilled holes for onsite direct fixing to building structures. Provisions shall be allowed to facilitate the transportation, delivery, assembly and services connection on Site;
3. Drencher deluge valve of nominal sizes above 100mm may be exempted from MiMEP implementation. The Sub-contractor shall submit substantiation to demonstrate the site constraints and limitations for approval by the CM.

AP1.FWP APPENDIX 1 - FWP

AP1 APPENDIX FWP/I 2

AP1.FWP.APPEND1.B LIST OF TECHNICAL STANDARDS 2

AP1 APPENDIX FWP/I

AP1.FWP.APPEND1.B LIST OF TECHNICAL STANDARDS

Standard	Year of Standards	Description	Sections	Clauses
2014/68/EU	-	The Pressure Equipment Directive	FWP5	5.2.055
				5.2.056
AS 2031	2012	Water quality - Sampling for Microbiological Analysis	FWP14	14.1.120
AS 3896	2017	Waters—Examination for Legionella spp. including Legionella pneumophila	FWP14	14.1.120
AS 4276.3	2021	Water microbiology, Method 3: Enumeration of heterotrophic microorganisms - Pour plate, spread plate, membrane filtration and most probable number techniques	FWP14	14.1.120
ASME B36.10M	2018	Welded and Seamless Wrought Steel Pipe	FWP9	9.7.020
ASTM A53/A53M:	2022	Standard specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless	FWP9	9.7.020
	2020			
	2018			
	2012			
ASTM A536	2019	Standard specification for ductile iron castings	FWP3	3.2.3.050
	2014			
ASTM D395	2018	Standard Test Methods for Rubber Property—Compression Set	FWP3	3.2.3.050
	2016			
ASTM D412	2021	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension	FWP3	3.2.3.050
	2016			
ASTM D573	2019	Standard Test Method for Rubber—Deterioration in an Air Oven	FWP3	3.2.3.050
	2015			
ASTM D2240	2021	Standard Test Method for Rubber Property—Durometer Hardness	FWP3	3.2.3.050
	2015			
BS 143 and 1256	2000	Threaded pipe fittings in malleable cast iron and cast copper alloy	FWP3	3.1.2.020
BS 336	2010	Specification for fire hose couplings and ancillary equipment	FWP7	7.1.020
				7.1.040
			FWP14	14.1.040
BS 381C	1996	Specification for colours for identification, coding and special purposes	FWP9	9.5.070
				9.7.110
BS 1710	2014	Specification for identification of pipelines and services	FWP13	13.1.050
BS 3505	1986	Specification for unplasticized	FWP3	3.1.2.045

Standard	Year of Standards	Description	Sections	Clauses
		polyvinyl chloride (PVC-U) pressure pipes for cold potable water		3.1.2.050
BS 3799	1974	Specification for steel pipe fittings, screwed and socket-welding for the petroleum industry	FWP9	9.7.030
BS 4800	2011	Schedule of paint colours for building purposes	FWP13	13.1.050
BS 5041-1	1987	Fire hydrant system equipment - Specification for landing valves for wet risers	FWP7	7.1.020 7.1.040 7.1.070
BS 5154	1991	Specification for copper alloy globe, globe stop and check, check and gate valves	FWP4 FWP7	4.1.020 7.1.020
BS 5163-1	2004	Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice	FWP4	4.1.020
BS 5252	1976	Framework for colour coordination for building purposes	FWP9	9.5.070 9.7.110
BS 5306-1	2006	Code of practice for fire extinguishing installations and equipment on premises. Hose reels and foam inlets	FWP6	6.1.010
BS 5499-4	2013	Safety signs. Code of practice for escape route signing	FWP10	10.10.140
BS 5499-10	2014	Guidance for the selection and use of safety signs and fire safety notices	FWP10	10.10.130
BS 5839-1	2017 (Incorporating Corrigendum No. 1)	Fire Detection and Fire Alarm Systems for Buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises	FWP1 FWP2 FWP10 FWP PSS	1.3.020 2.1.6.010 10.9.010, 10.11.030 2.1.6.010
BS 5839-8	2013	Fire Detection and Fire Alarm Systems for Buildings. Code of practice for the design, installation, commissioning and maintenance of voice alarm systems	FWP10	10.10.020 10.10.050
BS 6068-4.5	1999	Water Quality. Enumeration of Culturable Micro-Organisms. Colony Count by Inoculation in A Nutrient Agar Culture Medium	FWP14	14.1.120
BS 6920	2014	Suitability of non-metallic materials and products for use in contact with water intended for human consumption with regard to their effect on the quality of the water.	FWP3 FWP4	3.1.2.010 3.1.5.030 4.1.040 4.1.080 4.1.100

Standard	Year of Standards	Description	Sections	Clauses
BS 7592	2022	Sampling for Legionella bacteria in water systems. Code of practice	FWP14	14.1.120
BS 7944	1999	Type 1 heavy duty fire blankets and type 2 heavy duty heat protective blankets	FWP12	12.2.040
BS 8000-15	1990	Workmanship on building sites. Code of practice for hot and cold water services (domestic scale)	FWP3	3.2.4.070
BS EN 3-7	2004+A1: 2007	Portable fire extinguishers. Characteristics, performance requirements and test methods	FWP12	12.3.020
BS EN 3-8	2021 2006	Portable fire extinguishers. Requirements for the construction, pressure resistance and mechanical tests for extinguishers with a maximum allowable pressure equal to or lower than 30 bar, which comply with the requirements of EN 3-7	FWP12	12.3.020
BS EN 3-9	2006	Portable fire extinguishers. Additional requirements to EN 3-7 for pressure resistance of CO2 extinguishers	FWP12	12.3.020
BS EN 3:- 10	2009	Portable fire extinguishers. Provisions for evaluating the conformity of a portable fire extinguisher to EN 3-7	FWP12	12.3.020
BS EN 54-2	1997+A1:2006	Fire detection and fire alarm systems. Control and indicating equipment	FWP10	10.5.010 10.5.100 10.11.030
BS EN 54-4	1998	Fire detection and fire alarm systems. Power supply equipment	FWP10	10.5.090 10.11.030
BS EN 54-5	2017+A1:2018 2001	Fire detection and fire alarm systems. Heat detectors. Point heat detectors	FWP10	10.3.010 10.3.040
BS EN 54-7	2018 2001	Fire detection and fire alarm systems. Smoke detectors. Point smoke detectors that operate using scattered light, transmitted light or ionization	FWP10	10.4.010 10.4.100
BS EN 54-11	2001	Fire detection and alarm systems. Manual call points	FWP8 FWP10	8.2.030 10.2.010 10.2.020 10.2.030
BS EN 545	2010	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Water Pipelines - Requirements and Test Methods	FWP3	3.1.2.010
BS EN 593	2009+A1: 2011	Industrial valves. Metallic butterfly valves	FWP4	4.3.010
BS EN 671-1	2012	Fixed fire fighting systems. Hose	FWP7	7.1.080

Standard	Year of Standards	Description	Sections	Clauses
		systems. Hose reels with semi-rigid hose		7.1.100
BS EN 681-1	1996	Elastomeric seals. Material requirements for pipe joint seals used in water and drainage applications. Vulcanized rubber	FWP4	3.1.3.050 4.1.080
BS EN 837-1	1998	Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing	FWP11	11.6.060
BS EN 1074-1	2000	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. General requirements	FWP4	4.1.020
BS EN 1074-2	2000	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Isolating valves	FWP4	4.1.020
BS EN 1092-1	2018	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges	FWP3	3.1.3.050 3.1.4.010 3.1.4.020 3.1.4.030
			FWP6	6.3.010 6.3.020 6.3.030
BS EN 1092-2	1997	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges	FWP3	3.1.2.010 3.1.4.020 3.1.5.040
			FWP4	4.2.030 4.3.030 4.4.030 4.8.010
			FWP6	6.3.010 6.3.020 6.3.030
BS EN 1515-1	2000	Flanges and their joints. Bolting. Selection of bolting	FWP4	4.2.030
BS EN 1561	2011	Founding. Grey cast irons	FWP3	3.1.5.030
			FWP4	4.1.080 4.6.030 4.8.020
			FWP6	6.2.020 6.2.040 6.2.050
BS EN 1563	2018	Founding. Spheroidal graphite cast irons	FWP3	3.1.5.030 3.2.3.050

Standard	Year of Standards	Description	Sections	Clauses
			FWP4	4.1.020
				4.1.080
				4.6.030
				4.8.020
BS EN 1982	2017	Copper and copper alloys. Ingots and castings	FWP3	3.1.5.030
			FWP4	4.1.080
				4.6.030
				4.8.020
				4.12.030
				4.12.040
			FWP6	6.2.020
				6.2.050
BS EN 10029	2010	Hot-rolled steel plates 3 mm thick or above. Tolerances on dimensions and shape	FWP3	3.1.4.030
BS EN 10048	1997	Hot rolled narrow steel strip. Tolerances on dimensions and shape	FWP3	3.1.4.030
BS EN 10051	2010	Continuously hot-rolled strip and plate / sheet cut from wide strip of non-alloy and alloy steels. Tolerances on dimensions and shape	FWP3	3.1.4.030
BS EN 10088-1	2014	Stainless steels. List of stainless steels		
			FWP3	3.1.2.050
				3.1.4.010
				3.1.5.030
			FWP15	15.1.010
BS EN 10088-3	2014	Stainless steels. Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes	FWP3	3.1.2.010
				3.2.3.040
				3.2.4.050
				3.2.4.070
			FWP4	4.1.080
				4.6.030
				4.8.020
				4.12.040
			FWP6	6.2.020
				6.2.030
				6.2.040
				6.2.050
BS EN 10095	1999	Heat resisting steels and nickel alloys	FWP3	3.1.4.030
BS EN 10216-1	2013	Seamless steel tubes for pressure	FWP3	3.1.2.040

Standard	Year of Standards	Description	Sections	Clauses
		purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties	FWP9	9.7.020
BS EN 10217-1	2019	Welded steel tubes for pressure purposes. Technical delivery conditions. Electric welded and submerged arc welded non-alloy steel tubes with specified room temperature properties	FWP3	3.1.2.040
			FWP9	9.7.020
BS EN 10220	2002	Seamless and welded steel tubes. Dimensions and masses per unit length	FWP3	3.1.2.040
BS EN 10226-1	2004	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation	FWP3	3.1.2.020
				3.1.4.010
				3.1.5.040
				3.2.3.030
			FWP4	4.2.030
				4.9.030
			FWP9	9.7.040
			FWP16	16.3.030
BS EN 10226-2	2005	Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation	FWP3	3.1.4.010
				3.1.5.040
				3.2.3.030
			FWP4	4.2.030
				4.9.030
			FWP9	9.7.040
			FWP16	16.3.030
BS EN 10226-3	2005	Pipes threads where pressure-tight joints are made on the threads. Verification by means of limit gauges	FWP3	3.1.4.010
				3.1.5.040
				3.2.3.030
			FWP4	4.2.030
				4.9.030
			FWP9	9.7.040
			FWP16	16.3.030
BS EN 10241	2000	Steel threaded pipe fittings	FWP3	3.1.2.020
BS EN 10242	1995	Threaded pipe fittings in malleable cast iron	FWP3	3.1.2.020
BS EN 10253-1	1999	Butt-welding pipe fittings. Wrought carbon steel for general use and without specific inspection requirements	FWP3	3.1.2.040
BS EN 10253-2	2007 2021	Butt-welding pipe fittings. Non alloy and ferritic alloy steels with specific inspection requirements	FWP9	9.7.030
BS EN 10255	2004	Non-alloy steel tubes suitable for	FWP3	3.1.2.020

Standard	Year of Standards	Description	Sections	Clauses
		welding and threading. Technical delivery conditions	FWP9	9.7.020
BS EN 10283	2019	Corrosion resistant steel castings	FWP3	3.1.5.030
			FWP4	4.1.080
				4.6.030
				4.8.020
			FWP6	6.2.020
				6.2.030
				6.4.010
BS EN 10312	2002	Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions	FWP3	3.1.2.050
BS EN 12163	2016	Copper and copper alloys. Rod for general purposes	FWP4	4.1.080
				4.6.030
				4.8.020
BS EN 12164	2016	Copper and copper alloys. Rod for free machining purposes	FWP4	4.1.080
BS EN 12165	2016	Copper and copper alloys. Wrought and unwrought forging stock	FWP4	4.9.020
BS EN 12288	2010	Industrial valves. Copper alloy gate valves	FWP4	4.1.020
				4.2.050
			FWP7	7.1.020
BS EN 12334	2001	Industrial valves. Cast iron check valves	FWP4	4.1.020
BS EN 12845	2003	Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance	FWP1	1.3.020
	2015		FWP2	2.1.5.120
				2.2.2.030
			FWP4	4.11.010
			FWP PSS	1.3.020
				2.1.5.010
				2.1.5.120
				2.2.2.030
BS EN 13789	2010	Industrial valves. Cast iron globe valves	FWP4	4.1.020
BS EN 13831	2007	Closed expansion vessels with built-in diaphragm for installation in water	FWP5	5.2.055
				5.2.056
BS EN 14901-1	2014+A1:2019	Ductile iron pipes, fittings and accessories. Requirements and test methods for organic coatings of ductile iron fittings and accessories. Epoxy coating (heavy duty)	FWP3	3.1.2.010

Standard	Year of Standards	Description	Sections	Clauses
BS EN 15004-1	2019	Fixed firefighting systems. Gas extinguishing systems. Design, installation and maintenance	FWP9	9.1.020
BS EN 15004-5	2020	Fixed firefighting systems. Gas extinguishing systems. Physical properties and system design of gas extinguishing systems for HFC 227ea extinguishant	FWP9	9.1.020
BS EN 16767	2016	Industrial valves. Metallic check valves	FWP4	4.1.020
BS EN 55011	2016+A2:2021	Industrial, scientific and medical equipment. Radio-frequency disturbance characteristics. Limits and methods of measurement	FWP11	11.5.090
BS EN 60034-1	2010 2022	Rotating electrical machines. Rating and performance	FWP11	11.2.010
BS EN 60034-2-1	2014	Rotating electrical machines. Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)	FWP11	11.2.060
BS EN 60034-5	2001 2020	Rotating electrical machines. Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification	FWP11	11.2.010
BS EN 60034-6	1994	Rotating electrical machines. Methods of cooling (IC Code)	FWP11	11.2.010
BS EN 60034-9	2005 2021	Rotating electrical machines. Noise limits	FWP11	11.2.040
BS EN 60034-11	2004 2020	Rotating electrical machines. Thermal protection	FWP6	6.3.040
BS EN 60034-30-1	2014	Rotating electrical machines. Efficiency classes of line operated AC motors (IE-code)	FWP11	11.2.010
BS EN 60076	-	Power transformers	FWP11	11.3.010
BS EN 60085	2008	Electrical insulation. Thermal evaluation and designation	FWP11	11.2.010
BS EN 60269-1	2007+A2:2014	Low-voltage fuses. General requirements	FWP11	11.3.020
BS EN 60269-4	2009+A2:2016	Low-voltage fuses. Supplementary requirements for fuse-links for the protection of semiconductor devices	FWP11	11.3.020
BS EN 60529	1992+A2:2013	Degrees of protection provided by enclosures (IP code)	FWP11	11.4.020 11.5.090
BS EN 60730-1	2016+A1:2019 2016+A2:2022	Automatic electrical controls. General requirements	FWP11	11.5.090

Standard	Year of Standards	Description	Sections	Clauses
BS EN 60896-21	2004	Stationary lead-acid batteries. Valve regulated types. Methods of test	FWP10	10.6.020 10.10.050, 10.10.135
BS EN 60896-22	2004	Stationary lead-acid batteries. Valve regulated types. Requirements	FWP10	10.6.020 10.10.050. 10.10.135
BS EN 60947-4-2	2012	Low-voltage switchgear and controlgear. Contactors and motor-starters. AC semiconductor motor controllers and starters	FWP11	11.3.020
BS EN 60947-7-1	2009	Low-voltage switchgear and controlgear. Ancillary equipment. Terminal blocks for copper conductors	FWP11	11.5.080
BS EN 61558-1:	2005+A1: 2009 2019	Safety of power transformers, power supplies, reactors and similar products. General requirements and tests	FWP10	10.5.090
BS EN 61558-2 Series	-	Safety of power transformers, power supply units and similar products	FWP10	10.5.090
BS EN 61810-1	2015+A1:2020	Electromechanical elementary relays. General and safety requirements	FWP11	11.5.070
BS EN 61869-2	2012	Instrument transformers. Additional requirements for current transformers	FWP11	11.5.020
BS EN IEC 60034-7	1993 2022	Rotating electrical machines. Classification of types of constructions, mounting arrangements and terminal box position (IM Code)	FWP11	11.2.010
BS EN IEC 60034-14	2018	Rotating electrical machines. Mechanical vibration of certain machines with shaft heights 56 mm and higher. Measurement, evaluation and limits of vibration severity	FWP11	11.2.040
BS EN IEC 60947-3	2021	Low-voltage switchgear and controlgear. Switches, disconnectors, switch-disconnectors and fuse-combination units	FWP11	11.5.010
BS EN IEC 60947-4-1	2019	Low-voltage switchgear and controlgear. Contactors and motor-starters. Electromechanical contactors and motor-starters	FWP11	11.3.010
BS EN IEC 61000-3-2	2019 2019+A1:2021	Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)	FWP15	15.1.030
BS EN IEC 61000-6-1	2019	Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments	FWP15	15.1.030
BS EN IEC 61000-6-2	2019	Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments	FWP15	15.1.030

Standard	Year of Standards	Description	Sections	Clauses
BS EN IEC 61000-6-3	2021	Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments	FWP15	15.1.030
BS EN IEC 61000-6-4	2019	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments	FWP15	15.1.030
BS EN IEC 61800-3	2018	Adjustable speed electrical power drive systems. EMC requirements and specific test methods	FWP11	11.3.030
BS EN ISO 1452-2	2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Pipes	FWP3	3.1.2.045 3.1.2.050
BS EN ISO 1452-4	2009	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC U). Valves	FWP4	4.1.080
BS EN ISO 5457	1999+A1:2010	Technical product documentation. Sizes and layout of drawing sheets	FWP1	1.2.040
BS EN ISO 5667-3	2018	Water quality. Sampling. Preservation and handling of water samples	FWP14	14.1.120
BS EN ISO 6222	1999	Water Quality. Enumeration of culturable micro-organisms. Colony count by inoculation in a nutrient agar culture medium	FWP14	14.1.120
BS EN ISO 9445-1	2010	Continuously cold-rolled stainless steel. Tolerances on dimensions and form. Narrow strip and cut lengths	FWP3	3.1.4.030
BS EN ISO 9445-2	2010	Continuously cold-rolled stainless steel. Tolerances on dimensions and form. Wide strip and plate / sheet	FWP3	3.1.4.030
BS EN ISO 9906	2012	Rotodynamic pumps. Hydraulic performance acceptance tests. Grades 1, 2 and 3	FWP6	6.7.010
BS EN ISO 11731	2017	Water quality. Enumeration of Legionella	FWP14	14.1.120
BS ISO 2017-1	2005	Mechnical vibration and shock. Resilient mounting systems. Technical information to be exchanged for the application of isolation systems	FWP6	6.6.030
BS ISO 7121	2016	Steel ball valves for general-purpose industrial applications	FWP4	4.9.020
EN 50035	1978	Specification for low voltage switchgear and controlgear for industrial use. Mounting rails. G-profile for the fixing of terminal blocks	FWP11	11.5.080
EN 60947-1	2007+A2:2	Low-voltage switchgear and	FWP11	11.5.030

Standard	Year of Standards	Description	Sections	Clauses
	014	controlgear. Part 1. General rules		11.5.060
	2021			
EN 60947-5-1	2004+A1:2009	Low-voltage switchgear and control gear - Part 5-1: control circuit devices and switching elements - electromechanical control circuit devices	FWP11	11.5.030
	2017			11.5.060
GB 4351	2023	Portable fire extinguishers	FWP12	12.3.020
IEC 60034-1	2017 2022	Rotating electrical machines – Part 1: Rating and performance	FWP11	11.2.010
IEC 60034-2-1	2014	Rotating electrical machines - Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)	FWP11	11.2.060
IEC 60034-5	2000+A1:2006	Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification	FWP11	11.2.010
	2020			
IEC 60034-6	1991	Rotating electrical machines - Part 6: Methods of cooling (IC Code)	FWP11	11.2.010
IEC 60034-7	1992+A1:2000	Rotating electrical machines – Part 7: Classification of types of construction, mounting arrangements and terminal box position (IM Code)	FWP11	11.2.010
	2020			
IEC 60034-9	2003+A1:2007	Rotating electrical machines – Part 9: Noise limits	FWP11	11.2.040
	2021			
IEC 60034-14	2018	Rotating electrical machines – Part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity	FWP11	11.2.040
IEC 60034-30-1	2014	Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE-code)	FWP11	11.2.010
IEC 60051-1	2016	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 1: Definitions and general requirements common to all parts	FWP11	11.5.020
IEC 60051-2	2018	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 2: Special requirements for ammeters and voltmeters	FWP11	11.5.020
IEC 60076	-	Power transformers	FWP11	11.3.010
IEC 60085	2007	Electrical insulation - Thermal evaluation and designation	FWP11	11.2.010

Standard	Year of Standards	Description	Sections	Clauses
IEC 60269-1	2006+A1:2009+A2:2016	Low-voltage fuses - Part 1: General requirements	FWP11	11.3.020
IEC 60269-4	2009+A1:2012+A2:2016	Low-voltage fuses - Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices	FWP11	11.3.020
IEC 60623	2017	Secondary cells and batteries containing alkaline or other non-acid electrolytes. Vented nickel-cadmium prismatic rechargeable single cells	FWP10	10.6.020, 10.10.050, 10.10.135
			FWP PSS	10.10.050
IEC 60831-1	2002	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V – Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation and operation	FWP11	11.1.130
IEC 60831-2	2014	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V – Part 2: Ageing test, self-healing test and destruction test	FWP11	11.1.130
IEC 60947-3	2008+A1:2012+A2:2015 2020	Low-voltage switchgear and control gear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	FWP11	11.5.010
IEC 60947-4-1	2018	Low-voltage switchgear and control gear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	FWP11	11.3.010
IEC 60947-4-2	2011 2020	Low-voltage switchgear and control gear - Part 4-2: Contactors and motor-starters - Semiconductor motor controllers, starters and soft-starters	FWP11	11.3.020
IEC 60947-7-1	2009	Low-voltage switchgear and control gear - Part 7-1: Ancillary equipment - Terminal blocks for copper conductors	FWP11	11.5.080
IEC 61000-4-2	2008	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	FWP11	11.1.130 11.3.020
IEC 61000-4-3	2010 2020	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	FWP11	11.1.130 11.3.020
IEC 61000-4-4	2012	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient / burst immunity test	FWP11	11.1.130 11.3.020

Standard	Year of Standards	Description	Sections	Clauses
IEC 61000-4-5	2014+A1:2017	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	FWP11	11.1.130 11.3.020
IEC 61131-2	2017	Industrial-process measurement and control. Programmable controllers. Equipment requirements and tests	FWP11	11.5.090
IEC 61810-1	2015+A1:2019	Electromechanical elementary relays - Part 1: General and safety requirements	FWP11	11.5.070
IEC 61869-2	2012	Instrument transformers - Part 2: Additional requirements for current transformers	FWP11	11.5.020
IEC 62053-11	2003+A1:2016	Electricity metering equipment (a.c.) - particular requirements - part 11: electromechanical meters for active energy (classes 0,5, 1 and 2)	FWP15	15.1.040
IEC 62259	2003	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Nickel-cadmium prismatic secondary single cells with parial gas recombination	FWP10 FWP PSS	10.6.020 10.10.050, 10.10.135 10.10.050
ISO 9001	2015	Quality management systems. Requirements	FWP PSS	2.1.3.010
ISO 11731	2017	Water quality - Enumeration of Legionella	FWP14	14.1.120
JIS G5501	2020	Grey iron castings	FWP6	6.2.020 6.2.040 6.2.050
JIS H5120	2020	Copper and copper alloy castings	FWP6	6.2.020 6.2.050
NFPA 72	2019 2022	National Fire Alarm and Signaling Code	FWP10	10.9.010
NFPA 2001	2018 2022	Standard on clean agent fire extinguishing systems	FWP9	9.1.020 9.3.010 9.4.020 9.5.010
UL 94	2013	UL Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances	FWP11	11.5.080
UL 154	2005	UL Standard for Safety Carbon-Dioxide Fire Extinguishers	FWP12	12.3.020
UL 299	2012	UL Standard for Safety Dry Chemical Fire Extinguishers	FWP12	12.3.020
UL 626	2005	UL Standard for Safety Water Fire Extinguishers	FWP12	12.3.020
UL 2129	2017	UL Standard for Safety Halocarbon Clean Agent Fire Extinguishers	FWP12	12.3.020

Standard	Year of Standards	Description	Sections	Clauses
UL 2166	2017	UL Standard for Safety Halocarbon Clean Agent Extinguishing System Units	FWP9	9.1.020

AP2.FWP APPENDIX 2 - FWP

AP2 APPENDIX FWP/II 3

AP2.FWP.APPEND1.A DECLARATION OF VALIDITY OF WSD SUBMISSION FORMS (FOR FIRE SERVICES AND WATER PUMP INSTALLATION) 3

AP2.FWP.APPEND2.A DECLARATION OF THE COMPLETED WATER SERVICES WORKS FOR FIRE SERVICES AND WATER PUMP INSTALLATION 4

LTE LIFT & EXCALATOR INSTALLATION

LTE1 GENERAL REQUIREMENTS

LTE1.1 SCOPE OF SPECIFICATION AND DEFINITIONS 3

LTE1.1.010.9 SCOPE OF SPECIFICATION 3
LTE1.1.020.9 SPECIFICATION AND DRAWINGS 3
LTE1.1.030.9 DEFINITIONS AND INTERPRETATIONS 3

LTE1.2 STATUTORY OBLIGATIONS AND REGULATIONS AND GENERAL PRACTICE 4

LTE1.2.010.A STATUTORY REGULATIONS 4
LTE1.2.020.9 GENERAL PRACTICE 5
LTE1.2.030.9 CASE OF CONFLICT 5
LTE1.2.040.9 CODE OF PRACTICE FOR ENERGY EFFICIENCY OF BUILDING SERVICE INSTALLATIONS 6

LTE1.3 THE WORKS 7

LTE1.3.010.9 GENERAL 7
LTE1.3.020.9 SITE OF THE WORKS 7
LTE1.3.030.9 SCOPE OF THE WORKS 7
LTE1.3.035.9 TIME FOR COMPLETION AND DATE FOR HAND-OVER 7
LTE1.3.040.9 SETTING OUT THE WORKS 7
LTE1.3.050.A BUILDING WORKS TO BE PROVIDED BY THE SUB-CONTRACTOR 7
LTE1.3.060.N GUIDED SUSPENDED WORKING PLATFORM FOR LIFT INSTALLATION WORKS 8
LTE1.3.070.N PROTECTION OF LIFT ARCHITRAVE 9

LTE1.4 SUPERVISION AND SITE RECORDS 11

LTE1.4.010.9 APPOINTMENT OF SUPERVISING ENGINEERS AND SITE SUPERVISORS 11
LTE1.4.020.9 SUPERVISING ENGINEERS 11
LTE1.4.030.9 SITE SUPERVISORS 12
LTE1.4.040.9 SITE RECORDS 12

LTE1.5 MATERIALS AND EQUIPMENT 13

LTE1.5.010.9 GENERAL 13
LTE1.5.020.9 PROVEN RELIABILITY 13
LTE1.5.040.9 TEST CERTIFICATES / SUBSTANTIATION DOCUMENTS 15
LTE1.5.050.9 SERVICE CONDITIONS 16
LTE1.5.060.9 ASBESTOS NOT TO BE USED WITHOUT PRIOR APPROVAL 16
LTE1.5.080.9 ON SITE WELDED COMPONENTS 16
LTE1.5.090.9 STAINLESS STEEL 16

LTE1.6 PACKING, STORAGE AND DELIVERY 17

LTE1.6.010.9 PACKING 17
LTE1.6.020.9 STORAGE AND DELIVERY 17
LTE1.6.030.A PROTECTION OF THE WORKS 17
LTE1.6.040.9 TRANSPORTATION OF EQUIPMENT AND PLANT 18
LTE1.6.050.9 REPLACEMENT 18

LTE1.7 ELECTRICITY SUPPLY AND ELECTRICAL INSTALLATION .. 19

LTE1.7.010.9 ELECTRICITY SUPPLY 19
LTE1.7.020.9 WIRING 19

LTE1.7.021.9 CABLE COLOUR CODES 19
LTE1.7.022.9 CORE IDENTIFICATION OF POWER CABLES 19
LTE1.7.030.9 BONDING 19
LTE1.7.040.9 LIFT WELL LIGHTING 20
LTE1.7.050.A EMERGENCY LIGHTS 20
LTE1.7.060.9 LIFT TRAVELLING CABLE 20
LTE1.7.070.9 SUPPRESSION OF RADIO AND TELEVISION INTERFERENCE 21
LTE1.7.080.9 ELECTRICAL MEASUREMENTS 21

LTE1.8 TESTING AND MAINTENANCE 22
LTE1.8.010.A TESTS AND CERTIFICATES 22
LTE1.8.020.9 FINAL TEST 23
LTE1.8.030.A MAINTENANCE AND SERVICING 23

LTE1.9 MISCELLANEOUS 26
LTE1.9.010.9 SILENCE OF OPERATION 26
LTE1.9.020.9 PAINTING AND FINISH 26
LTE1.9.030.9 METRIC UNITS 26
LTE1.9.040.9 WEIGHT OF EQUIPMENT 27
LTE1.9.050.9 TECHNICAL INFORMATION SUPPLIED WITH TENDER AND SUB-CONTRACTOR'S RESPONSIBILITY 27
LTE1.9.060.9 NUISANCE 27
LTE1.9.070.9 TEMPORARY USE 27
LTE1.9.080.9 INSTRUMENTS 27
LTE1.9.090.9 BUILDING SERVICES PERFORMANCE ASSESSMENT SCORING SYSTEM 28
LTE1.9.100.9 PERFORMANCE ASSESSMENT SCHEME 28
LTE1.9.110.9 SAMPLE WING 28
LTE1.9.120.9 OPERATION AND MAINTENANCE MANUAL AND "AS-FITTED" DRAWINGS 28

LTE1.1 SCOPE OF SPECIFICATION AND DEFINITIONS

LTE1.1.010.9 SCOPE OF SPECIFICATION

This Specification covers the lift and escalator installation undertaken for the Hong Kong Housing Authority.

LTE1.1.020.9 SPECIFICATION AND DRAWINGS

The lift and escalator installation shall comply in every respect with this Specification unless otherwise specified in the Project Specific Specification (PSS) and on the Drawings for a particular project, or modified by the written instructions of the Contract Manager.

LTE1.1.030.9 DEFINITIONS AND INTERPRETATIONS

In this Specification, the word "shall" is mandatory, the word "will" is informative, the word "should" is advisory and the word "provide" means supply and fix, or supply and install including testing and commissioning. In addition, the following words shall have meanings herein assigned:

1. "Sub-contractor"

   The person, firm or company contracting for the Lift Installation, the Escalator Installation or the Lift and Escalator Installation including his or their personal representative, successors or permitted assigns.

2. "Electrical Sub-contractor"

   The person, firm or company contracting for the Electrical Installation including his or their personal representatives, successors or permitted assigns.

3. "Fire Services Sub-contractor"

   The person, firm or company contracting for the Fire Services and Water Pump Installation including his or their personal representatives, successors or permitted assigns.

4. "Regulations"

   Any Ordinances or Regulations published by the Government, by-laws of any local or duly constituted authority and rules or regulations of public bodies and companies which may be applicable to the Sub-contract Works.

5. "Machine-room-less Lift"

   A lift installation where all its driving machinery and safety components are installed inside the lift well and the requirement for a lift machine room is not necessary.

LTE1.2 STATUTORY OBLIGATIONS AND REGULATIONS AND GENERAL PRACTICE

LTE1.2.010.A STATUTORY REGULATIONS

The Sub-contractor shall comply with all Regulations and requirements including those of the Government of the Hong Kong Special Administrative Region, the Hong Kong Fire Services Department (FSD), the Building Authority, the Electrical and Mechanical Services Department (EMSD) and the relevant Power Supply Company, together with any revisions or amendments made thereto, and shall be responsible for giving notifications to the appropriate Authorities and for paying all fees all in accordance with the Sub-contract. The following are particularly relevant:

1. Statutory Obligations:
    a. Lifts and Escalators Ordinance (Cap. 618);
    b. Building (Construction) Regulations, Building (Planning) Regulations and Buildings Ordinance (Cap. 123);
    c. Electricity Ordinance (Cap. 406);
    d. Noise Control Ordinance (Cap. 400);
    e. Security and Guarding Services Ordinance (Cap. 460);
    f. Factories and Industrial Undertakings (Guarding and Operation of Machinery) Regulations (Cap. 59Q);
    g. Building Energy Efficiency Ordinance (Cap. 610);
    h. Fire Service (Installations and Equipment) Regulations and Fire Services Ordinance (Cap. 95);
    i. Occupational Safety and Health Ordinance (Cap. 509);
    j. Other subsidiary legislation made under the above ordinances.
2. Codes of Practice, Circular Letters and Design Manuals:
    a. Code of Practice on the Design and Construction of Lifts and Escalators, issued by the Electrical and Mechanical Services Department (hereinafter referred to as the Lift COP);
    b. Code of Practice for the Design and Construction of Buildings and Building Works for the Installation and Safe Use of Lifts and Escalators, issued by the Building Authority (hereinafter referred to as the Lift Building Works COP);
    c. Code of Practice for Fire Safety in Buildings, issued by the Building Authority (hereinafter referred to as the FS Code);
    d. Circular Letters relating to lifts and escalators, issued by the Electrical and Mechanical Services Department;
    e. Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment (hereinafter referred to as the Fire Services COP), and Circular Letters issued by the Fire Services Department;

f. Code of Practice for the Electricity (Wiring) Regulations, issued by the Electrical and Mechanical Services Department (hereinafter referred to as the Electrical CoP);

g. Code of Practice for Lift Works and Escalator Works (hereinafter referred to as the Works Code);

h. Design Manual: Barrier Free Access 2008;

i. Code of Practice for Safety at Work (Lift and Escalator), issued by Occupational Safety and Health Branch, Labour Department;

j. Code of Practice for Energy Efficiency of Building Services Installation issued by the Electrical and Mechanical Services Department (hereinafter referred to as the BEC).

LTE1.2.020.9 GENERAL PRACTICE

All materials and workmanship shall comply, where applicable, with all relevant sections, together with any revisions or amendments made thereto, of the following:

1. Hong Kong Housing Authority Specification Library;
2. Approved national/international standards or appropriate British Standard Specifications. The technical standards quoted in this specification are summarized in Appendix LTE/I;
3. The Supply Rules issued by the relevant Power Supply Company currently in operation in Hong Kong;
4. Guidelines on Safety of Lift Shaft Works issued by the Construction Industry Council.

LTE1.2.030.9 CASE OF CONFLICT

1. In case of conflict among the requirements of this Specification and any other requirements referred to in LTE1.2.010 and LTE1.2.020, interpretation shall be in accordance with the following order of preference:

   a. Law of Hong Kong;

   b. The Lift COP, Lift Building Works COP, BEC, Works Code, FS Code and Fire Services COP;

   c. The Drawings;

   d. This Specification Library of Lift and Escalator & its PSS Clauses;

   e. Other Hong Kong Housing Authority Specification Libraries;

   f. Supply Rules;

   g. Approved national / international standards or British Standard Specifications.

2. Notwithstanding sub-clause (1), in the event where the Drawings or this Specification stipulates more stringent requirements than, but still in compliance with, the COPs in sub-clause (1)(b) above, the Drawings or the Specification shall take the precedence over the COPs. Such requirements shall include, but not be limited to, the following clauses:

Clause No.	Description
LTE2.1.010	Guide rail shall have machined guide surface.
LTE2.2.010	Oil buffer for lifts of contract speed exceeding 1.0 m/s.

LTE2.4.030	Compensation shall be provided for lift with travel exceeding 30 metres.
LTE2.6.030	Metal screen for counterweight shall be at least 2500 mm above lift pit floor.
LTE2.8.020	Clear car height below false ceiling shall be 2450 mm or as required.
LTE2.8.040	Lift car ventilation fan shall provide at least 20 air changes/hour.
LTE2.8.050	Lift car ventilation fan shall provide at least 20 air changes/hour.
LTE2.8.080	Lift car lighting level at least 120 lux.
LTE2.8.090	At least two lighting fittings as specified shall be used to provide emergency lighting as well as normal lighting.
LTE2.11.010	The horizontal distance between car sill and landing sill shall not exceed 30 mm. Clear height of car and landing doors shall be not less than 2100 mm.
LTE2.11.060	Electrical safety device to prove positive locking of mechanical car door lock be provided even the horizontal distance between the wall of the well and the sill or entrance frame of the car being within 150 mm. Each car door panel shall be provided with a separate door closed proving device for centre-opening 2–panel car doors.
LTE2.11.110	Emergency landing opening shall be provided with normal landing door.
LTE2.12.050	Audible signals and verbal annunciation.
LTE3.11.020	Auxiliary brake shall be provided for every escalator.
LTE3.20.010	Size of pictograph shall be at least 100 mm x 100 mm.

LTE1.2.040.9 CODE OF PRACTICE FOR ENERGY EFFICIENCY OF BUILDING SERVICE INSTALLATIONS

1. The Sub-contractor shall provide necessary information and documents to the Contract Manager in accordance with BEC's requirements;
2. The Sub-contractor shall attend, provide necessary equipment and carry out on site checks as required by the Contract Manager to verify the electrical measurements of lifts and escalators.

LTE1.3 THE WORKS

LTE1.3.010.9 GENERAL

The Works under this Sub-contract is for the whole of the labour and all materials necessary to form a complete installation and such test, adjustments, commissioning, maintenance and servicing as prescribed. It shall include the responsibility for design work including the selection and suitability of purpose of material or equipment in compliance with the Specification and for the detailed design of the permanent works in accordance with the Sub-contract. It shall also include not only the major item of plant and equipment shown or specified but all the incidental sundry components necessary for the complete execution of the Sub-contract Works and for the proper operation of the installation, including the necessary labour, whether or not these sundry components are mentioned in detail in the Sub-contract.

LTE1.3.020.9 SITE OF THE WORKS

The Site of the Works is specified in Project Specific Specification.

LTE1.3.030.9 SCOPE OF THE WORKS

The Scope of the Works is specified in Project Specific Specification.

LTE1.3.035.9 TIME FOR COMPLETION AND DATE FOR HAND-OVER

The time for completion of the Works and date for hand-over of related working areas are specified in Project Specific Specification.

LTE1.3.040.9 SETTING OUT THE WORKS

The Sub-contractor shall set out the Works and shall be responsible for the accuracy of the same, including the positioning of all doors, guides, machines and machine bases.

LTE1.3.050.A BUILDING WORKS TO BE PROVIDED BY THE SUB-CONTRACTOR

Building works to be provided by the Contractor and others are detailed in Part I - Preliminaries of the Specification included in the Sub-contract documents. The following works in connection with the lift and escalator installation shall be provided by the Sub-contractor:

1. Supporting steel works, inserts, fixing brackets etc. for supporting the lift machine in the lift machine room or in the lift well;
2. Shaft dividing steel work for supporting guide brackets etc.;
3. Mounting brackets, bearing plates etc. required for the installation of the escalator;
4. Anchor bolts, inserts, fixing brackets etc. for landing door and guide rail brackets (except embedded anchor channels including its studs for guide rail installation) etc;
5. Permanent lights and socket outlets in each lift well and escalator machine pit;
6. Ferrules projecting at least 50 mm above finished floor or slab to prevent objects from falling through openings situated above lift well and blind hoistway working platform.

LTE1.3.060.N GUIDED SUSPENDED WORKING PLATFORM FOR LIFT INSTALLATION WORKS

1. For lift installation with travel greater than 15m except lifts with side counterweight configuration, provide Guided Suspended Working Platform (GSWP) for each lift well for lift installation works. Unguided Suspended Working Platform will not be considered unless formal approval is obtained from the CM. For Works inside lift well, complying with all applicable requirements under the Factories and Industrial Undertakings Ordinance, Occupational Safety and Health Ordinance, the Code of Practice for Safety at Work (Lift and Escalator), the Code of Practice for Metal Scaffolding Safety, the Code of Practice on Safe Use and Operation of Suspended Working Platforms and the Guidelines on Safety of Lift Shaft Works issued by Construction Industry Council;
2. Design and provide the GSWP in such a manner that it can be used by the Main Contractor, Nominated Sub-contractors as well as other contractors appointed under separate contract by the Employer including the employees and all other persons having the like right for the purpose of the Works (but not further or otherwise) be entitled, in particular the Main Contractor for the purposes of providing builder's work inside the lift well;
3. Provide training to the representatives of the Main Contractor to operate the GSWP for carrying out the builder's work inside lift well;
4. The CM has the right to request an independent safety consultant to assess and audit the adequacy and suitability of the safety provisions on Site;
5. Design, install, maintain and operate the GSWP complying with all applicable requirements as stipulated in the Factories and Industrial Undertakings (Suspended Working Platforms) Regulation, the Code of Practice on Safe Use and Operation of Suspended Working Platforms, the Guidelines on Safety of Lift Shaft Works issued by Construction Industry Council as well as the relevant requirements issued by the Labour Department and the Electrical and Mechanical Services Department. Adopt safety measures and special precautions, including but not limited to, the following:
    a. The platform, its lower frame, and every member thereof should be of rigid and sound construction;
    b. A climber and an automatic safety device operating with not less than 9 mm-diameter suspension rope and not less than 9 mm-diameter safety rope respectively should be used. The lower part of the travelling suspension ropes that passing through the platform areas shall be provided with protective guard so as to avoid jamming;
    c. The automatic safety device shall be capable of performing the functions of an overspeed governor and a rope slack device;
    d. An overload device shall be installed on the drive mechanism, which is capable of stopping the operation of the platform when it is overloaded;
    e. An opened-outward interlocking door shall be installed at the front edge of the platform. When the door is in open position, the climber could not be set into operation;
    f. A trip bar or similar device capable of stopping the operation of the platform when coming into contact with an obstacle or object shall be installed at the front bottom edge of the platform;
    g. Suspension rope, safety rope and independent lifeline shall be anchored to separate anchorage points;
    h. Suspension rope, safety rope and independent lifeline shall be protected against sparks from welding / hot work process, if any;

i. An upper limit switch shall be installed on the suspension rope or on top of guide rail to stop the movement of the platform when it reaches a position of not less than 2m from the lift well ceiling / top structure;

j. The front edge of the platform shall be designed and constructed such that the gap between the front edge of the platform and the floor edge of a lift well opening will not exceed 100mm. If the gap is more than 100mm, a landing gangway with railing shall be provided. The Lift Nominated Sub-contractor shall allow the safe access to and egress from the platform, and provide all necessary measures such as toe-board, fencing, railing etc. to prevent any working personnel or objects falling from height;

k. If an overhead protection is erected on the platform, the overhead protection shall not be fixed or bolted onto the frame of the platform. The overhead protection shall be freely lifted upwards;

l. A visual and audio signal system shall be installed at bottom of the platform to give visual and audio signs when the platform is travelling inside a lift well;

m. The pedal brake of the platform shall be press-to-release type or equivalent device which should grip the guiderail and stop the movement of the platform;

n. The operating switches and emergency stop on the control station of the platform should be designed against the unintentional or accidental operation by the operator. Clear label shall be provided on the switches on the control panel;

o. The appliance shall be inspected regularly to ensure its safety. It shall be tested and thoroughly examined by a Registered Professional Engineer in Mechanical Engineering or Marine & Naval Architecture. Relevant certificates after inspection, testing and examination indicating that it is in safe working order shall be obtained before it's being operated;

p. The GSWP inside lift well shall be constructed under the supervision of a competent person as interpreted in Factories and Industrial Undertakings Ordinance. Risk assessment and method statement of erection and detail drawings of the GSWP shall be prepared in the initial planning stage for approval by the CM;

q. Do not stack any materials or debris on the working platforms at any times. The GSWP shall be kept clear of debris;

r. The GSWP inside a lift well shall be installed and be able to reach the area inside lift well for lift installation and the building supportive work, including but not limited to, every lift landing opening for works such as door sills, architraves, landing doors installations;

s. Complete the power supply from the isolator located on the lowest landing provided by the Main Contractor to the lift machine room or connection box at designated area in the lift well. Travelling cables shall be used as the power and signal cables connecting between the lift machine room or connection box in the lift well and the GSWP. The installation shall be in accordance with the recommendation of the GSWP's manufacturer.

6. When GSWP has undergone substantial repair or re-erection, including erection following its removal to a different location, the GSWP has to be further load tested and thoroughly examined by the Competent Examiner as stipulated in the Factories and Industrial Undertakings (Suspended Working Platforms) Regulation.

LTE1.3.070.N PROTECTION OF LIFT ARCHITRAVE

The Sub-contractor shall coordinate with the Main Contractor to provide the following works:

1. Submit the method statement for the installation procedure (including builder's work and appropriate protection after installation) of lift architrave by the Main Contractor to the CM for his approval before carrying out the installation of lift architrave on Site.
2. Upon receiving the approval from the CM on the method statement, install the lift architrave as follows:
    a. Construction Sample for lift architrave
        i. Provide and fix lift architrave;
        ii. Provide all necessary builder's work for the lift architrave with associated temporary work by the Main Contractor;
        iii. Review with the CM or his representatives the procedure and workmanship for grouting, installation and finished surface condition of lift architrave;
        iv. Remove the protection sheet on the lift architrave for the CM or his representatives' inspection of any apparent damage or scratch found on the surface finish of the lift architrave;
        v. Provide appropriate protection to the lift architrave after removal of the protection sheet by the Main Contractor;
        vi. Upon receiving approval from the CM on the lift architrave installed on Site, submit all necessary document including site photos of the lift architrave to the CM for record by the Main Contractor
    b. Lift architrave
        i. Provide and fix lift architrave;
        ii. Provide all necessary builder's work for the lift architrave with associated temporary work by the Main Contractor.

LTE1.4 SUPERVISION AND SITE RECORDS

LTE1.4.010.9 APPOINTMENT OF SUPERVISING ENGINEERS AND SITE SUPERVISORS

1. Immediately upon the award of the Sub-contract, the Sub-contractor shall appoint Supervising Engineer(s) and Site Supervisor(s) specified in LTE1.4.020 and LTE1.4.030 who shall be both English and Cantonese speaking and in the Sub-contractor's full-time employment for the supervision of the Sub-contract Works to the satisfaction of the Contract Manager;
2. Immediately after the award of the Sub-contract, the name, qualifications and curriculum vitae of the Supervising Engineer(s) and Site Supervisor(s) shall be submitted for Approval to the satisfaction of the Contract Manager;
3. None of the Supervising Engineer(s) and Site Supervisor(s) shall be removed from their respective duties without prior Approval;
4. In the event of any of them being unsatisfactory, in the opinion of the Contract Manager, or misconducting themselves, they shall be removed forthwith and be replaced by suitable substitutes to the Contract Manager's satisfaction within seven days from the Contract Manager's instruction in writing.

LTE1.4.020.9 SUPERVISING ENGINEERS

1. Unless otherwise specified, the Sub-contractor is to employ for the supervision of all works on Site, at least one qualified Supervising Engineer. The Supervising Engineer shall generally represent the Sub-contractor in all respects of the Sub-contract and assume the following duties:
    a. Coordinate and supervise the work in the Sub-contractor's office and the Site;
    b. Develop, in conjunction with the Main Contractor, schedules of installation drawings, builder's work drawings, material submission and delivery, statutory submissions, the programme of works and testing and commissioning programme, for approval by the CM;
    c. Liaise with the CM and other parties;
    d. Attend at the office of the CM for the finalisation of drawings and equipment selection;
    e. Attend progress meetings and coordination meetings;
    f. Monitor and supervise installation drawings submission, builder's work drawings submission, material submission and delivery, statutory submissions in accordance with the respective submission schedules approved by the CM. Submit progress reports to the CM monthly or at shorter intervals when such requested by the CM;
    g. Check and confirm the installation drawings, builder's work drawings and material submissions are suitable for the installation works and in compliance with the requirements of the Sub-contract;
    h. Examine, verify and confirm in writing to the CM on a monthly basis that the material delivered to the Site under the Sub-contract has been approved by the CM;
    i. Certify all material delivery vouchers in accordance with PRE.B12.280 of the Main Contract;
    j. Prepare, in conjunction with the Main contractor, the delivery method statements for delivery of plant and equipment;

k. Supervise all site test and commissioning of the Sub-contract Works and submit the test and commissioning reports on time to confirm that he is satisfied with the completeness, workmanship and performance of the installations which comply fully with the Sub-contract requirements.

2. Qualification requirements:

   At least one year of proven post qualification experience at supervisory level in the installation and maintenance of lifts and escalators with the following qualification:

   a. Registered Professional Engineer (Electrical, Mechanical, Building Services and Control, Automation and Instrumentation Discipline) under the Engineers Registration Ordinance;

   b. Member of the Hong Kong Institution of Engineers (Electrical, Mechanical, Building Services and Control, Automation and Instrumentation Discipline) elected after 5 December 1975; or

   c. Member (electrical, mechanical, building services and Control, Automation and Instrumentation discipline) of an overseas engineering institution which has signed agreements for the mutual recognition of qualifications with the Hong Kong Institution of Engineers.

3. The Supervising Engineer(s) shall be highly competent and experienced, and shall be given a high level of delegated authority such that they can take decisions, including those involving expenditure.

LTE1.4.030.9 SITE SUPERVISORS

1. Unless otherwise specified, the Sub-contractor is to employ at least one qualified Site Supervisor. The Site Supervisor shall be stationed on site;

2. Qualifications requirements:

   At least three years practical experience in the supervision of the installation and maintenance of lifts and escalators with Diploma/Certificate in Electrical, Electronic, Mechanical or Building Services Engineering.

LTE1.4.040.9 SITE RECORDS

1. The Sub-contractor is to arrange for a full set of prints to be kept on the Site showing the progress of the Works. Such prints shall be kept up-to-date. Daily labour strength report shall be submitted to the Contract Manager after the Sub-contractor's takeover of the lift well, machine rooms or escalator areas;

2. The Sub-contractor shall keep the Site records together with all relevant delivery vouchers of all plant and materials delivered to and removed from the Site for the inspection by the Main Contractor and the representatives of the Contract Manager.

LTE1.5 MATERIALS AND EQUIPMENT

LTE1.5.010.9 GENERAL

1. The design, construction and installation of lifts and escalators shall comply with the Regulations and requirements stated in LTE1.2.010 and LTE1.2.020, in particular the Lift COP, Lift Building Works COP and BEC;
2. Type approval/approval-in-principle for the proposed lifts/escalators and their safety components shall be obtained from the Director of Electrical and Mechanical Services and shall be available before commencement of installation.

LTE1.5.020.9 PROVEN RELIABILITY

1. All lift and escalator materials and equipment shall have proven reliability and in-service records established locally and / or overseas as specified in the ensuing sub-clauses. The manufacturer of individual major lift and escalator materials and equipment as listed in sub-clause (2) and (3) shall have at least 5 years' experience in manufacturing the respective categories of materials and equipment;
2. Major lift materials and equipment refer to traction machine, motor, controller, safety gear, guide rail, ascending car over speed protection means (ACOPM), unintended car movement protection means (UCMPM), governor, buffer, ropes, guide shoes, travelling cable, car sling and cage, car and landing doors and door locking devices;
3. Major escalator materials and equipment refer to motor, reduction gear, controller, truss, landing plate, step, balustrade, steel chain and handrail;
4. The materials and equipment (except those stipulated in sub-clause (5)) which serve as in-service records of the lift / escalator system proposed shall comply with the following:
    a. Be of the same places of manufacture and in the same product ranges as those of the materials / equipment proposed;
    b. Be of the same drive type as that proposed;
    c. Be of the same rated load / capacity and rated speed specified or of higher and comparable rated load / capacity and rated speed;
    d. Comply with the following requirements:

Lift / Escalator Type	Location of In-service Records	Minimum No. of Lifts / Escalators serving as In-service Records	Minimum Time Period of Continuous and Satisfactory Operation and Maintenance up to the Time of Tender Submission
Lift of rated speed below 3.5 m/s and escalator of any speed	Hong Kong, Mainland China or overseas	4 nos. (of which at least 2 nos. are in the same project and any 2 nos. must be installed in Hong Kong) [See Note 1]	1 year [See Note 2]
Lift of rated speed 3.5 m/s	Hong Kong,	4 nos. (of which at least 2 nos. are	1 year

and above	Mainland China or overseas	in the same project)	[See Note 2]
Machine-room-less lift	Hong Kong, Mainland China or overseas	2 nos.	1 year [See Note 2]

Note 1: For traction machine and lift / escalator motor using innovative and green technology that can reduce the running active electrical power below the maximum allowable electrical power value stated in the BEC by 20% or more, the required 4 nos. of lifts / escalators serving as in-service records can be installed in Hong Kong, Mainland China or overseas provided that the electrical power performance can be verified by a test report issued by an approved independent testing institution;

Note 2: For controller and associated equipment such as inverter, converter and filtering facility, compliance to the following requirements can be regarded as an acceptable alternative to the one year in-service record requirement:

i. The Sub-contractor shall provide an undertaking to keep adequate quantity of new spare parts of the controller and associated equipment in stock in Hong Kong for immediate replacement in case of breakdown of the installed controller and associated equipment;

ii. The Sub-contractor shall provide an undertaking to replace immediately instead of repair any faulty parts of the installed controller and associated equipment so as to keep the down-time of the lift / escalator operation to the minimum in case of breakdown during the Maintenance Period;

iii. The Sub-contractor shall provide an undertaking to upgrade / update the controller and associated equipment software whenever upgrades / updates are released by the manufacturer within the Maintenance Period.

e. Be compatible with other materials / equipment of the lift / escalator system proposed.

5. The materials and equipment which serve as in-service records of guide rail, safety gear, buffer (oil / spring type) and car safety gear acting upwards, counterweight safety gear or rope gripper serving as ascending car over speed protection means of the lift system proposed or other equipment of which no part is in operation under normal circumstances shall comply with the following:

a. Be of the same places of manufacture and in the same product ranges as those of the materials / equipment proposed;

b. Be of the same design, rated load / capacity and rated speed specified or of higher and comparable rated load / capacity and rated speed;

c. Have been installed in Hong Kong, Mainland China or overseas in at least two numbers of lifts / escalators;

d. Have been in continuous and satisfactory operation and maintenance for at least six months up to the time of tender submission;

e. Be compatible with other materials / equipment of the lift / escalator system proposed.

6. For new safety requirements which are not required in existing lift / escalator systems but are required as the result of amendment of relevant Code(s) of Practice or Regulation(s), in-service record is generally not required at the time of implementation. However, when either one of the following conditions occurs, satisfactory in-service records shall be required:

    a. The new safety requirements have been provided by the Sub-contractor in the number of lifts / escalators and in continuous operation for the period as stipulated in sub-clauses (4) or (5) above in Housing Authority projects;

    b. Three years after the effective date for implementing the relevant amendment of Code(s) of Practice or Regulation(s).

7. If there is change of place of manufacture for materials / equipment with previously established in-service records, and the Sub-contractor is capable of producing certificates from the original manufacturer confirming that the materials / equipment to be supplied from the proposed new source have exactly the same design, material, construction and quality assurance / control standards together with an undertaking from the original manufacturer that they will be fully responsible for the product despite the change of manufacture, the requirement of two numbers installed in Hong Kong for one year for lifts of rated speed below 3.5 m/s and escalators of any speed as specified in sub-clause (4)(d) shall be waived;

8. The Sub-contractor shall submit full details and particulars of in-service records to substantiate conformance to the above requirements. The Sub-contractor shall arrange, upon request, site inspection of the lift and escalator installations which serve as in-service records. Failure to submit required details or allow sufficient time for assessment and site inspection may result in rejection of the tender;

9. For Mainland China and overseas in-service records, records of any accident, replacement and major repair and photos of the concerned material / equipment and proof of satisfactory operation and maintenance in writing by one of the following parties shall also be provided:

    a. Owner of the lift / escalator installation; or

    b. Property Management Agent of the property served by the lift / escalator installation; or

    c. Supplier / Contractor / Installer of the lift / escalator installation; or

    d. Maintenance Agent of the lift / escalator installation.

10. If the required information for Mainland China and overseas in-service record is provided by any of the parties listed in sub-clause (9)(c), service log of the past 12 or 6 months shall also be submitted depending on the applicability of sub-clause (4)(d) or (5)(d) to the material / equipment concerned. The Sub-contractor shall certify the authenticity of all the documents provided.

LTE1.5.040.9 TEST CERTIFICATES / SUBSTANTIATION DOCUMENTS

Test certificate for lift and escalator equipment complete with test reports and drawings where applicable, or other substantiation documents, shall be submitted to the CM to prove the compliance with the Specification. In case the original documents are not produced in English or Chinese, an English or Chinese translation of the whole document, including related test reports and drawings, shall be produced and duly certified true by the issuing organization or an approved authority when required.

LTE1.5.050.9 SERVICE CONDITIONS

In addition to the service conditions as specified in the relevant BS, all lift and escalator equipment shall also be suitable for use under Hong Kong climatic conditions with relative humidity and ambient temperature as shown below:

1. Relative humidity: up to 0.99 saturation;
2. Ambient temperature: peak from minus 5°C to plus 40°C for 4 hours continuously with an average from 0°C to plus 35°C over only 24 hours period.

LTE1.5.060.9 ASBESTOS NOT TO BE USED WITHOUT PRIOR APPROVAL

Asbestos or equipment containing asbestos, including asbestos brake lining, shall not be used without the prior approval from the Contract Manager.

LTE1.5.080.9 ON SITE WELDED COMPONENTS

1. The Sub-contractor shall submit a list of on-site welded components that are to be installed inside lift well for Contract Manager's record before commencement of the works;
2. The welding work for those on-site welded components shall be carried out by licensed welder or the holder of the Intermediate Trade Test Certificate in welding issued by Vocational Training Council or such equivalent training bodies as Approved;
3. The worker shall have experience on welding lift components for a period, or an aggregate period of, not less than one year. Experiences before or after passing the trade test are both acceptable;
4. The Sub-contractor shall maintain and submit a register of all the projects handled by individual trade tested welder to substantiate the compliance with the requirements stipulated in sub-clause (3) above for Contract Manager's approval before commencement of the works.

LTE1.5.090.9 STAINLESS STEEL

1. Unless otherwise stated, stainless steel shall be of EN 10088-1 grade 1.4401 (grade 316) or equivalent;
2. Supplier of stainless steel shall provide mill certificates of the material to be used in the works.

LTE1.6 PACKING, STORAGE AND DELIVERY

LTE1.6.010.9 PACKING

1. All equipment, apparatus, materials and parts shall be delivered to the Site in a new condition, properly packed and protected against damage due to handling, adverse weather or other circumstances and they shall be kept in the packing cases or under protective coverings provided by the Sub-contractor until unpacking for use;
2. In the case of items of equipment and materials which originate outside Hong Kong:
    a. All items of equipment and materials shall be adequately and securely packed for safe transportation with due regard to the climatic conditions encountered in transit and on arrival, and also to the site conditions during storage on Site. Suspension ropes and governor ropes shall be put in properly sealed packages to avoid ingress of moisture when delivered from factory and shall be kept sealed until installation on Site;
    b. The Sub-contractor shall, at the time of shipping each consignment of equipment, provide to the Contract Manager in duplicate, packing lists and Bills of Lading which shall contain full statements of the packages consigned, with particulars of the dimensions, weights, contents, shipping marks and approximate value of each package; and
    c. BS 1133 and its Supplements shall be used as a guide for the standard of packing and package required. All bright, polished or plated parts shall be treated with suitable rust inhibitor.

LTE1.6.020.9 STORAGE AND DELIVERY

1. Storage area at the Site for lift and escalator equipment will be made available by the Main Contractor twelve (12) months before the contract completion date for the respective Section of the Main Contract;
2. All lift and escalator equipment for each Section shall be delivered to the Site no later than seven (7) months before the contract completion date for the respective Section of the Main Contract, in order to cope with any possible advanced completion of the Main Works;
3. Notwithstanding the preceding paragraph, the Sub-contractor shall arrange storage and delivery of the equipment to suit the progress of the Main Works.

LTE1.6.030.A PROTECTION OF THE WORKS

1. The Sub-contractor shall liaise with the Main Contractor to suitably protect, encase, cover up etc. as may be appropriate, all equipment, instruments, etc. installed by him against damage due to building operations, adverse weather or other causes and shall hand over the entire installation in a new and perfect condition to the satisfaction of the Contract Manager;
2. Exposed finishing surface of architrave, landing door, call button panel and landing indicator panel for all landings shall be delivered to site with protection sheet.

LTE1.6.040.9 TRANSPORTATION OF EQUIPMENT AND PLANT

1. The Sub-contractor shall liaise with the Main Contractor to ensure that there is adequate access available for transportation and delivery of the equipment and plant to be supplied by him at the time of transportation of the equipment to the required position;
2. The Sub-contractor shall submit the details of equipment delivery and hoisting route including any building work reserves required ten (10) months before the contract completion date for the respective Section of the Main Contract to the Contract Manager, via the Main Contractor, for approval. Should the Main Contractor be delayed or incur additional costs due to the Sub-contractor's failure to submit the required information in time then any expense arising will be the liability of the Sub-contractor.

LTE1.6.050.9 REPLACEMENT

Any items suffering damage in transit or on the Site shall be rejected and replaced without extra cost to the Employer. No item so rejected will be considered as a reason for failure to meet the time for completion of the Sub-contract Works.

LTE1.7 ELECTRICITY SUPPLY AND ELECTRICAL INSTALLATION

LTE1.7.010.9 ELECTRICITY SUPPLY

Unless otherwise specified, the equipment shall be rated for operation under the supply system with nominal frequency of 50Hz and nominal voltage of 380V, 3-phase and 220V, 1-phase within the variation limits as declared by the local Power Supply Companies.

LTE1.7.020.9 WIRING

1. All cables, trunkings, conduits and conduit fittings necessary for the power, lighting and indicator circuits shall comply with and be installed in accordance with the latest issue plus amendments of the Electrical CoP, the Lift COP and Hong Kong Housing Authority Specification Library;
2. All wirings installed in lift machine rooms, lift wells and escalator machine pits, other than travelling cables, shall be enclosed in galvanised steel conduits or steel trunkings.

LTE1.7.021.9 CABLE COLOUR CODES

1. Electric cables complying with a national / international product standard shall have their design, construction and manufacture adhered to that particular standard in all aspects except the cable colour codes which shall be in line with the Electrical CoP unless otherwise stated;
2. For lift and escalator installation based on the new cable colour codes, the workers employed for carrying out the relevant electrical works shall have satisfied the Electrical & Mechanical Services Department's training requirements for the new cable colour codes.

LTE1.7.022.9 CORE IDENTIFICATION OF POWER CABLES

Function of core	Colour code	Number code
Phase conductor of a single phase circuit	Brown	L
Phase conductor of a three-phase circuit	Phase L1: Brown Phase L2: Black Phase L3: Grey	L1 or L2 or L3 according to the phase concerned
Neutral conductor	Blue	N

Note: Cores used as protective conductors shall have an exclusive colour identification of green-and-yellow, unless otherwise stated.

LTE1.7.030.9 BONDING

1. All exposed conductive parts of the lift and escalator equipment shall be effectively bonded by protective conductors in accordance with the Lift COP and Electrical CoP;
2. The exposed conductive parts shall include the machine frames, controller frames, governor frames, guide rails, face plates of landing fixtures, casing of electrical safety devices, and other similar exposed conductive parts which carry electrical equipment;

3. For lift architrave with landing indicator having provided with proper bonding, no additional bonding is required and the Sub-contractor shall ensure the electrical continuity between architrave and landing indicator. For lift architrave without landing indicator, the Sub-contractor shall provide proper bonding through the building structural reinforcement or other appropriate means.

LTE1.7.040.9 LIFT WELL LIGHTING

1. The Sub-contractor shall install lighting in each lift well in surface steel conduit system. The lighting for each lift well shall comprise one lighting fitting not more than 500 mm from the lowest point in the lift well and the highest point of guided travel of the lift car with intermediate lighting fittings at 7 m maximum spacing. The position of each lighting fitting shall be such that servicing personnel can conveniently replace the lamp while standing on the top of the car;
2. The lighting fittings shall be at least 2x11W compact fluorescent bulkhead fittings with polycarbonate diffuser and controlled by 2-way lighting switches at lift machine room or maintenance access panel for machine-room-less lift, and at entrance to lift pit. Lighting switches at lift pit shall be of watertight construction. Sample of the lighting fitting shall be submitted for the Contract Manager's approval.

LTE1.7.050.A EMERGENCY LIGHTS

1. Emergency lights of adequate illuminance shall be provided by the Sub-contractor in the lift machine room or at the maintenance access panel for machine-room-less lift, and in the lift car. These lights shall be operated by batteries automatically on failure of normal power supply and those lights in the lift machine room or at the maintenance access panel for machine-room-less lift shall be capable of being manually operated by a switch located at a convenient position in the lift machine room or at the maintenance access panel for machine-room-less lift respectively;
2. The batteries shall be capable of maintaining a supply to the connected emergency load for a minimum of two hours continuously, and shall be completed with self-contained and self-maintained trickle charger located within the lift machine room or lift well and at least one for each lift. The charger shall be capable of fully re-charging the batteries in not more than 12 hours. A switch shall be provided to simulate normal power failure for testing the emergency operation of the lights which are operated by batteries shall be provided.

LTE1.7.060.9 LIFT TRAVELLING CABLE

1. Lift travelling cable shall be of flat or circular PVC or rubber insulated type complying with BS EN 50214. Test certificate issued by an approved independent testing institution or the manufacturer shall be submitted to the CM to verify the compliance with the required standard;
2. Travelling cable of the flat type shall only be used where the freely suspended length does not exceed 35 m and the rated speed not exceeding 1.6 m/s unless the cable has integral strain-bearing members;
3. The travelling cable terminal box at lift car shall be positioned at car top;
4. Subject to the approval of the CM, travelling cable in full compliance with relevant national / international standards stipulated in the Lift COP, with the exception of constructional configuration, may be acceptable;
5. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the lift travelling cables delivered to the site or installed.

LTE1.7.070.9 SUPPRESSION OF RADIO AND TELEVISION INTERFERENCE

The lift and escalator installation shall be adequately suppressed against radio and television interference to limits laid down in BS EN 55014-1, or EN 12015 and EN 12016. Interference suppression components shall not be used in any part of the circuit where their failure might cause an unsafe condition.

LTE1.7.080.9 ELECTRICAL MEASUREMENTS

1. Multi-function electronic meter shall be provided by the Electrical Sub-contractor for each lift / escalator to facilitate electrical measurements;
2. Electrical measurements including but not limited to those on voltages, currents, kW, kVA, kWh, power factor and total harmonic distortion shall be carried out in the final testing for each lift / escalator according to BEC's requirements.

LTE1.8 TESTING AND MAINTENANCE

LTE1.8.010.A TESTS AND CERTIFICATES

1. The Sub-contractor shall employ lift / escalator engineer(s) registered under the Lifts and Escalators Ordinance to undertake tests and examination of the complete installation, which shall include those specified in Clause 6.3 of BS EN 81-20 and clause 7.3 of BS EN 115-1, where relevant, and those recommended by the lift / escalator manufacturer;
2. A statement of conformity shall be provided relating to type tests issued by an approved independent testing institution for the equipment mentioned in BS EN 81-20 upon the CM's request;
3. For lift installation, progressive safety gear shall be tested with 100% loaded car to be operated by the governor at governor tripping speed unless complete type test certificate of the safety gear in accordance with Clause 5.3 of BS EN 81-50 from an approved independent testing institution is submitted to the satisfaction of the CM. In the latter case, the safety gear may be tested at reduced speed with 125% loaded car. Before the test, the suspension ropes shall have been checked for even tensioning. After the test, the ropes shall be re-checked for even tensioning, the lift installation shall be inspected and the lift components such as guide rail and safety gear gripping elements shall be reconditioned or replaced as necessary. Rope tension measuring device or alternative method by means of measuring the rope termination springs within the acceptable tolerance of 5mm in length or method recommended by the lift manufacturer shall be used to check even tensioning of the ropes;
4. Safety certificate and examination report in a prescribed form as required by the Director of Electrical and Mechanical Services shall be submitted and properly signed by the Sub-contractor and his registered lift / escalator engineer as evidence that the installation has been properly tested;
5. The Sub-contractor shall be responsible for all necessary submissions to the EMSD and / or other authorities for the lift and escalator installation;
6. The Sub-contractor shall be required to separately demonstrate to the satisfaction of the CM the installation complies with the provision of LTE1.2.010 (1) of this Specification and the BEC;
7. All tests shall be conducted at the discretion of and in the presence of the CM;
8. The Sub-contractor shall obtain a use permit for each lift / escalator issued by the Electrical and Mechanical Services Department, before the installation is accepted by the CM;
9. The original lift / escalator use permit shall be permanently displayed inside each lift car or adjacent to each escalator when handed over to the CM on completion of the installation;
10. The Sub-contractor shall arrange for and pay any necessary fees for inspections and shall make such tests as are called for by any Regulations or Authorities and shall obtain all permits required. Any tests carried out shall be in the presence of the authorized representative of any such authority;
11. The CM will notify the Sub-contractor the nature of identity of the management agent(s) of the lifts / escalators at least one month before the completion date of respective lifts / escalators;

12. The Sub-contractor shall employ a Registered Electrical Worker registered under the Electricity Ordinance to prepare, sign and submit the test reports including the "WR1(A)" Form for the following electrical works:

    a. The lift well and escalator pit lighting and power socket circuitries starting from the power supply point installed by the electrical worker employed by the lift contractor.

13. The Sub-contractor shall employ a Registered Electrical Worker registered under the Electricity Ordinance to prepare, sign and submit the test reports for the following electrical works:

    a. The power supply circuitries from the main power supply point to the lift and escalator control panels.

LTE1.8.020.9 FINAL TEST

1. After having satisfied himself of the performance of the installation, the Sub-contractor shall demonstrate to the satisfaction of the Contract Manager that the installation, or part thereof as the case may be, complies with all the requirements of the Sub-contract Works;

2. The Sub-contractor shall provide the Contract Manager with at least seven (7) days' advance notice of such testing and shall provide all necessary facilities and instrument for the witnessing and checking of such tests, but this shall not relieve the Sub-contractor of his responsibility for testing and satisfying himself of the adequacy of the installation beforehand;

3. The Sub-contractor shall make complete records of the tests as carried out and when the tests have been successfully completed, he shall provide the Contract Manager with test records and reports; including those specified in the BEC, in duplicate in a form to be approved by Contract Manager;

4. Should the test results indicate that the plant or equipment is not functioning in a satisfactory manner or providing the requirements of the Specification, the Sub-contractor shall carry out at his own expense any alterations, replacements or adjustments as may be required to correct the faulty work. The Contract Manager's decision as to what constitutes a satisfactory test shall be final.

LTE1.8.030.A MAINTENANCE AND SERVICING

1. The maintenance and servicing work required under this clause shall be deemed to include both preventive and corrective maintenance and servicing. Before commencing any work ordered under GCC Clause 10.1 of the Main Contract, the Sub-contractor shall, at his own expense, make all suitable arrangements to avoid damage to installations provided by others;

2. Further to the Sub-contractor's responsibility under Clause 7.1 of the General Conditions of the Sub-contract to maintain the Sub-contract Works, the Sub-contractor shall provide maintenance and servicing to the entire installation for a period of 24 months from the date of completion to the Main Works or of the relevant Section or part thereof as certified by the CM under the Main Contract Conditions. Such maintenance and servicing works shall include the following:

    a. To be responsible for any repairs necessary to maintain the equipment in good working order at all times;

    b. To dispatch competent and specially trained workmen once weekly during normal working hours to inspect, clean and lubricate as required, and where necessary adjust and maintain all machinery, controllers, doors, locks, guide rails, guide shoes, ropes, bearings and safety devices etc. in a smooth, quiet and safe operating condition;

c. To supply all required lubricants, cleaning materials, rope preservatives etc.;

d. To supply and replace all burnt out indicator lamps;

e. To provide 24-hour on-call service at any time during the Maintenance Period. The CM may instruct the Sub-contractor in the Maintenance Period via telephone, mobile phone, paging service or any other means as advised by the Sub-contractor and approved by the CM, to attend to reported breakdowns, and the Sub-contractor shall dispatch competent technicians or such other suitable personnel to carry out emergency maintenance or to attend to any reported breakdown within 25 minutes where trapping of passengers is involved and within 45 minutes where no trapping of passengers is involved, after receiving the call and under all weather condition. The Sub-contractor shall submit to the CM for this purpose, the contact telephone number(s) of the Service Call Centre or at least two names of English speaking representative, who can be reached at any time of the day, with contact telephone numbers of direct lines, mobile phones or paging service for approval. Prior approval shall also be obtained for any subsequent changes of representatives, contact telephone numbers etc. during the Maintenance Period at least two weeks before the change is effected;

f. To renew wire ropes as necessary to maintain an adequate factor of safety;

g. To provide quarterly reports on the condition of the equipment for approval by the CM;

h. To carry out periodic testing and examination of safety equipment of the installation as may be required by the provisions of any Regulation in force relating thereto and to provide copies of such test certificate, duly signed by a registered lift engineer or a registered escalator engineer as appropriate, regardless whether the lifts / escalators have been exempted from such Regulation;

i. To provide, repair or replace at no cost to the Employer such mechanical and electrical parts of the installation which the Sub-contractor or the CM considers necessary for the safe and proper operation of the installation;

j. To carry out, at the end of the Maintenance Period, a further test to demonstrate the performance characteristic of the installation, and any defects found shall be rectified by the Sub-contractor at his own cost as soon as practicable.

3. The maintenance and servicing works described above form part of the Works under GCC Clause 8.3(2)(c) of Main Contract;

4. Providing always that any renewals or repairs necessitated by misuse of the equipment or by reason of any other cause beyond the Sub-contractor's control with the exception of ordinary wear and tear shall be carried out by the Sub-contractor if so required by the Employer at an additional cost to be valued by the Surveyor;

5. All work under this maintenance and servicing provision shall be performed by competent personnel under the supervision and in the direct employment of the Sub-contractor;

6. A report in duplicate shall be sent to the CM immediately following a major repair, repeated breakdowns of service due to system or equipment fault of similar nature, or as and when required by the CM. The report shall include the cause necessitating such a repair, the reason of such a breakdown of service and the time and date of remedial action taken, of completion of repair and the normal service resumed. A list of equipment replaced shall be attached to the report. At least three months before the end of the Maintenance Period, a report on the rope conditions according to Table 3 of the Works Code shall be sent to the CM. Reports on routine visits are not required except where necessary to draw attention to defects which could not be rectified during the routine visit;

7. The registered engineer / contractor shall ensure that details are properly recorded in the digital log-book in the specified mean as required by the Director of Electrical and Mechanical Services, in accordance with the Lifts and Escalators Ordinance and the Works Code;

8. For each routine or callout visit on arrival at the Estate, the workman shall report to the Estate Management Office and enter in the digital log-book:

    a. At the time of signing, he shall note any message written in the digital log-book concerning the performance of any part of the lifts / escalators in the Estate, and shall take such action as may be required;

    b. The workman shall also inspect the lifts / escalators in the Estate at the time of this regular inspection and make any repairs, replacements of adjustments as required, irrespective of whether or not such repair or re-adjustment is noted in the digital log-book;

    c. When leaving the Estate, the workman shall report to the Estate Management Office and enter in the digital log-book a brief report on any repairs, replacements or adjustments which have been carried out or on the fact that they have found the lifts / escalators operating satisfactorily.

LTE1.9 MISCELLANEOUS

LTE1.9.010.9 SILENCE OF OPERATION

1. The installation shall be reasonably silent in operation under the conditions which they will be called upon to operate and, in any case shall be such that no unreasonable noise or vibration arising from the operation of the installation is discernible from the lift wells, machine rooms, landing doors, escalator machine pits or similar space in which the equipment is housed. The Sub-contractor shall take all necessary steps to ensure that the equipment provided by him is silent as described above and shall include in his Tender for such sound-absorbing, or anti-vibration materials or devices as are necessary to ensure a satisfactory degree of silence and absence of vibration in the structure of the building in full compliance with the Noise Control Ordinance. The Contract Manager's decision as to what constitutes satisfaction in this respect shall be final;
2. The Sub-contractor shall provide anti-vibration devices wherever lift or escalator equipment with moving part(s), including but not limited to diverter pulley, are mounted directly or indirectly onto the building structure;
3. If on completion the installation is not, in the Contract Manager's opinion, sufficiently silent the Sub-contractor shall, at no cost to the Employer, carry out such modifications or additions as may be required, until the system is made silent to the Contract Manager's satisfaction and the compliance with the Noise Control Ordinance.

LTE1.9.020.9 PAINTING AND FINISH

1. All ferrous metal work supplied by the Sub-contractor in out of the way locations such as lift well, lift pit, machine room and exterior of lift car, etc. shall be properly wire-brushed, cleared of rust, scale, dirt and grease prior to the application of rust inhibiting primer, with particular attention paid to the priming of outer surfaces of car doors, inner surfaces of landing doors, metal work associated with door assemblies, the underside and the framework of lift cars. Any part of the equipment, including guide rails, which requires greasing or oiling and any components which for functional reasons are supplied unpainted by the manufacturers shall not be painted;
2. All normally visible ferrous metal surfaces such as car ceiling, landing door and architraves etc. shall, unless otherwise specified, be finished with one coat of rust inhibiting primer and two finishing coats of synthetic paint to a colour to be selected by the CM;
3. Non-ferrous surfaces and stainless steel surfaces shall not be painted;
4. The Sub-contractor shall comply with the requirements on materials and workmanship for painting as specified in Worksection FIN7 unless otherwise specified;
5. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the paints delivered to the site.

LTE1.9.030.9 METRIC UNITS

Only materials in metric units shall be used unless otherwise specified.

LTE1.9.040.9 WEIGHT OF EQUIPMENT

Before ordering equipment the Sub-contractor shall provide the Contract Manager with full details of the weight, dimensions and positioning of the equipment to be installed and the reaction forces imposed on the structural supports for the purpose of determination of floor loadings, etc..

LTE1.9.050.9 TECHNICAL INFORMATION SUPPLIED WITH TENDER AND SUB-CONTRACTOR'S RESPONSIBILITY

1. All technical information supplied with the tender, including the tenderer's proposed design and the materials offered, is for tender assessment only;
2. Acceptance of the tender will not relieve the Sub-contractor of his responsibility for the proper working of the installation to meet the specified requirements in compliance with the Sub-contract documents to the entire satisfaction of the Contract Manager. In the event of the installation being, in the opinion of the Contract Manager, not in compliance with the specified requirements, the Sub-contractor shall modify his design, replace any unsatisfactory materials and do everything necessary for compliance with the specified requirements at his own cost.

LTE1.9.060.9 NUISANCE

The Sub-contractor shall comply with all Regulations and prevent nuisance from noise, water, smoke, dust, rubbish, mosquito breeding and all other similar causes.

LTE1.9.070.9 TEMPORARY USE

The Sub-contractor shall ensure that the installation shall not be used prior to the issue of the Certificate of Completion for purposes other than testing and commissioning of the installation unless otherwise approved by the Contract Manager.

LTE1.9.080.9 INSTRUMENTS

1. In addition to PRE.BS1.630 which specifies the provision of a set of measuring instruments for BSPASS and Contract Manager's Representatives' use, which will be under the custody of the CMR, the Sub-contractor shall provide all necessary instruments used for measurement and testing of the installation. The instruments used shall be capable of carrying out the measurement, test and inspection with the necessary accuracy and precision and calibrated with traceability to internationally or nationally recognised standards;
2. Each instrument shall carry an indelible identification and shall be attached with a label showing the due date for calibration;
3. The instruments shall include but are not limited to the following:
    a. Multi-meter;
    b. Clamp meter;
    c. Multi-function electronic meter for measurement of current, voltage, power factor, kW, kVA, kVAr and kWh;
    d. Equipment for measurement of total harmonic distortion;
    e. Insulation tester;
    f. Lux meter;
    g. Carpenter (spirit) level;
    h. Sound level meter;
    i. Force gauge;

j. Feeler gauge;

k. Measuring tape;

l. Vernier callipers;

m. Tachometer;

n. Test weight;

o. Ride comfort meter.

4. Upon request, the Sub-contractor shall submit calibration certificates or other evidence of calibration and records of calibration results for the Contract Manager's inspection;

5. The Contract Manager may reject any instrument(s) which in his opinion are not suitable for the measurement, test or inspection, and the Sub-contractor shall replace them with Approved types immediately when required.

LTE1.9.090.9 BUILDING SERVICES PERFORMANCE ASSESSMENT SCORING SYSTEM

The Housing Authority has adopted a Building Services Performance Assessment Scoring System (BSPASS) to assess the performance of building services Nominated Sub-contractors undertaking works for the Authority. BSPASS will be operated in this Sub-contract and assessments will be conducted at quarterly intervals or other intervals as required by the Contract Manager. The Sub-contractor shall provide all necessary attendance, and all necessary measuring instruments, in addition to those specified in PRE.BS1.630, etc. to facilitate the BSPASS assessment as stipulated in the relevant BSPASS manuals. In addition, the Sub-contractor shall also provide labours for the opening up and re-fixing of the works, the operation of the equipment and the testing, etc. as required by the assessment.

LTE1.9.100.9 PERFORMANCE ASSESSMENT SCHEME

The Housing Authority has adopted a Performance Assessment Scheme (PAS) to assess the performance of new lift/escalator installations for the Authority. PAS will be operated in this Sub-contract and assessment will be conducted at completion of the lift/escalator installations as required by the Contract Manager. Upon the Contract Manager's notification, the Sub-contractor's authorised representative shall attend such assessment. The Sub-contractor shall also provide labours for the opening up and re-fixing of the work, the operation of the equipment and the testings required by the Contract Manager. The necessary measuring equipment shall also be provided by the Sub-contractor.

LTE1.9.110.9 SAMPLE WING

During the construction for domestic building blocks, a specified sample wing located on a typical floor will be required to be completed by the Main Contractor including the flats, the corridor and the lift lobby etc. The Sub-contractor shall complete the installation of the architraves, the landing doors and landing door sills for the lift lobby in the specified sample wing in coordination with the Main Contractor to cope with the sample wing construction programme. The Sub-contractor shall be responsible to replace any architraves and landing door sills which are found damaged or deformed and to carry out the necessary adjustments to restore to as-new condition before building completion.

LTE1.9.120.9 OPERATION AND MAINTENANCE MANUAL AND "AS-FITTED" DRAWINGS

1. The Sub-contractor shall submit to the Contract Manager, the operation and maintenance manual which should include the following:

a. Manufacturer's operation and service instructions for each item of equipment;

b. Special precautions/procedures/methods required on the use, operation, cleaning, servicing, maintenance, repair and replacement of proprietary materials and equipment installed. Requirements on proper use and operation, durability, safety and statutory side shall be stated clearly;

c. Catalogues and user manuals of equipment as required by the Contract Manager;

d. Electronic and hard copies of the testing and commissioning reports of the installation. Electronic copy of the reports shall be in Adobe Portable Document Format (PDF) in compact disc;

e. Original and duplicate of the certificate of warranty for any material, equipment or installation with warranty period last beyond Maintenance Period;

f. A comprehensive list of spare parts and special tools for individual equipment as recommended by the manufacturer for safe operation and proper maintenance of the complete installation.

2. The Sub-contractor shall submit to the Contract Manager, the "as-fitted" drawings chopped "as-fitted", which should include, but not be limited to, lift schedule, elevation and section, machine room layout plan, installation details with loading indicated at structural anchor points, sectional views of lift wells showing overhead run-bys, positions of safe spaces and locations of limit switches, and a register of major equipment showing the equipment identification, capacity, operating range, setting, power requirement, serial number, etc. "As-fitted" drawings shall be of A1 size only.

LTE2 LIFT INSTALLATION

LTE2.1 GUIDES AND FIXING 5

LTE2.1.010.9 GUIDE RAILS 5
LTE2.1.020.9 GUIDE BRACKETS 5

LTE2.2 CAR AND COUNTERWEIGHT BUFFERS 6

LTE2.2.010.9 BUFFERS 6
LTE2.2.020.9 TYPE TEST 6

LTE2.3 COUNTERWEIGHTS 7

LTE2.3.010.9 GENERAL REQUIREMENTS 7
LTE2.3.020.9 GUIDE SHOES 7

LTE2.4 SUSPENSION 8

LTE2.4.010.9 ROPES 8
LTE2.4.020.9 TEST PIECES FOR SUSPENSION ROPES 9
LTE2.4.030.A ROPE COMPENSATION 9

LTE2.5 TERMINAL STOPPING AND FINAL LIMIT SWITCHES 11

LTE2.5.010.A TERMINAL STOPPING AND FINAL LIMIT SWITCHES TO BE PROVIDED 11
LTE2.5.020.A TERMINAL STOPPING 11
LTE2.5.030.A FINAL LIMIT 11

LTE2.6 GUARDING 12

LTE2.6.010.9 GENERAL REQUIREMENTS 12
LTE2.6.020.9 LIFT WELL PARTITION 12
LTE2.6.030.9 COUNTERWEIGHT 12
LTE2.6.040.A CAR TOP 12

LTE2.7 CAR FRAMES 13

LTE2.7.010.9 GENERAL REQUIREMENTS 13
LTE2.7.020.9 CAR GUIDE SHOES 13

LTE2.8 CAR ENCLOSURES 14

LTE2.8.010.9 NON-COMBUSTIBLE MATERIALS TO BE USED 14
LTE2.8.020.9 CAR TO BE COMPLETELY ENCLOSED 14
LTE2.8.030.9 PLATFORM LOADING 14
LTE2.8.040.A INTERNAL CONSTRUCTION OF PASSENGER LIFT (P) CARS 14
LTE2.8.050.A INTERNAL CONSTRUCTION OF PASSENGER LIFT (F) AND FREIGHT LIFT CARS 15
LTE2.8.060.9 TOE GUARD 15
LTE2.8.070.9 MAINTENANCE FACILITIES 16
LTE2.8.080.9 CAR ILLUMINATION AND PARKING 16
LTE2.8.090.9 EMERGENCY LIGHTING 16
LTE2.8.100.9 EMERGENCY SIGNAL 16
LTE2.8.110.A EMERGENCY TRAP DOOR 16

LTE2.9 CONTROL AND INDICATOR IN CAR 18

LTE2.9.010.9 CONTROL PANEL IN CAR 18
LTE2.9.020.9 ATTENDANT CONTROL 18
LTE2.9.030.9 ILLUMINATED INDICATOR 19

LTE2.9.040.9 OVERLOAD DEVICE 19
LTE2.9.050.A PUSH BUTTONS 19
LTE2.9.060.9 CAR TOP CONTROL 19
LTE2.9.070.9 STOP SWITCH TO BE PROVIDED 20
LTE2.9.080.9 SOCKET TO BE PROVIDED IN PIT 20
LTE2.9.100.9 INTERCOM SYSTEM 20
LTE2.9.110.9 LIFT CONTROL FEATURES IN CASE OF FAILURE OF NORMAL POWER SUPPLY FOR BUILDING WITH THE PROVISION OF EMERGENCY GENERATOR 21
LTE2.9.120.9 LIFT CONTROL FEATURES IN CASE OF FAILURE OF NORMAL POWER SUPPLY FOR BUILDING / LIFT TOWER WITHOUT THE PROVISION OF EMERGENCY GENERATOR NOR OTHER EMERGENCY POWER SUPPLY 21
LTE2.9.130.9 LIFT CONTROL FEATURES IN CASE OF SUPPLY VOLTAGE DIP WITHOUT ACTUATION OF EMERGENCY GENERATOR 22

LTE2.10 CCTV SYSTEM FOR LIFT CAR 23

LTE2.10.010.9 GENERAL 23
LTE2.10.020.A CCTV VIDEO CAMERA 23
LTE2.10.030.A CCTV MONITOR 24
LTE2.10.040.A VIDEO CABLE INSIDE LIFT WELL 24
LTE2.10.050.9 PROVISION FOR LIFT FLOOR NUMBER DISPLAY SYSTEM FOR DOMESTIC BUILDING BLOCKS 25

LTE2.11 CAR DOORS AND LANDING DOORS 26

LTE2.11.010.A GENERAL REQUIREMENTS 26
LTE2.11.020.A CAR DOOR 26
LTE2.11.030.A LANDING DOOR 26
LTE2.11.040.9 PASSENGER LIFT (P) 27
LTE2.11.050.9 PASSENGER LIFT (F) AND FREIGHT LIFT 27
LTE2.11.060.9 CAR DOOR LOCKING DEVICE 27
LTE2.11.070.9 LANDING DOOR LOCKING DEVICE 28
LTE2.11.080.9 DOOR LOCKING DEVICES TO BE INACCESSIBLE FROM LANDING AND CAR 28
LTE2.11.090.A PROTECTIVE DEVICE 28
LTE2.11.100.9 LANDING DOOR KEY 29
LTE2.11.110.9 EMERGENCY LANDING OPENING IN LIFT WELL 29
LTE2.11.120.A ARCHITRAVES 29
LTE2.11.130.9 APRON SHEET BELOW EACH LANDING 30
LTE2.11.140.9 DOOR SILLS 30
LTE2.11.150.9 MAXIMUM LIFT DOOR OPENING AND CLOSING TIME 30
LTE2.11.160.9 TYPE TEST 30
LTE2.11.170.9 WORKING PLATFORM INSIDE BLIND HOISTWAY FOR HOISTING ROPE INSPECTION 31
LTE2.11.180.9 APRON SHEET BELOW CAR PLATFORM 32

LTE2.12 LANDING FIXTURES AND INDICATORS 33

LTE2.12.010.9 POSITIONING 33
LTE2.12.020.A CALL BUTTON 33
LTE2.12.030.9 LANDING INDICATORS 33
LTE2.12.040.9 MANUAL HOMING SWITCH 34
LTE2.12.045.9 MANUAL PARKING SWITCH 34
LTE2.12.050.9 AUDIBLE SIGNALS AND VERBAL ANNUNCIATION 35

LTE2.13 CAR CAPACITY AND LOADING 37
LTE2.13.020.9 PASSENGER LIFT (F) AND FREIGHT LIFT 37
LTE2.13.030.9 ADJUSTABLE DEVICE FOR BY-PASSING OF INTERMEDIATE LANDING CALLS 37

LTE2.14 LOAD PLATES, NOTICE BOARDS AND INSTRUCTIONS 38
LTE2.14.010.9 LOAD PLATE 38
LTE2.14.020.A NOTICES AND WARNING SIGNS 38
LTE2.14.030.9 EMERGENCY RELEASE EQUIPMENT AND INSTRUCTIONS 41

LTE2.15 SAFETY GEAR AND GOVERNOR 42
LTE2.15.010.9 PROVISION OF SAFETY GEAR 42
LTE2.15.020.9 GENERAL REQUIREMENTS OF SAFETY GEAR 42
LTE2.15.030.9 TYPE TEST OF SAFETY GEAR 42
LTE2.15.040.9 OVERSPEED GOVERNOR 42
LTE2.15.050.9 ELECTRICAL CHECKING ON OPERATION OF OVERSPEED GOVERNOR 42
LTE2.15.060.9 GOVERNOR ROPES 42
LTE2.15.070.9 TYPE TEST OF GOVERNOR 43
LTE2.15.080.9 ASCENDING CAR OVERSPEED PROTECTION MEANS 43
LTE2.15.090.9 UNINTENDED CAR MOVEMENT PROTECTION MEANS 43

LTE2.16 OVERLOAD DEVICE 44
LTE2.16.010.9 PROVISION OF OVERLOAD DEVICE 44
LTE2.16.020.9 OPERATION OF OVERLOAD DEVICE 44
LTE2.16.030.9 FLOATING PLATFORM TYPE NOT ACCEPTABLE 44

LTE2.17 LIFT MACHINERY FOR ELECTRIC LIFT 45
LTE2.17.010.9 LIFT MOTOR 45
LTE2.17.020.9 REDUCTION GEAR 45
LTE2.17.030.9 BEARINGS 45
LTE2.17.040.9 HAND WINDING FACILITIES 45
LTE2.17.050.9 BRAKES 45
LTE2.17.060.9 ELECTRIC SERVICE LIFT 46
LTE2.17.080.9 REGENERATIVE POWER 46

LTE2.18 CONTROLLER 47
LTE2.18.010.9 CONSTRUCTION 47
LTE2.18.020.9 GENERAL REQUIREMENTS 47
LTE2.18.030.9 MICROPROCESSOR-BASED CONTROL 48

LTE2.19 AUTOMATIC CONTROL SYSTEM 49
LTE2.19.010.9 DOWN COLLECTIVE CONTROL FOR SINGLE LIFT ("SIMPLEX" DOWN COLLECTIVE CONTROL) 49
LTE2.19.020.9 DOWN COLLECTIVE CONTROL FOR TWO INTER-CONNECTED LIFTS ("DUPLEX" DOWN COLLECTIVE CONTROL) 49
LTE2.19.025.9 DOWN COLLECTIVE CONTROL FOR MORE THAN TWO INTER-CONNECTED LIFTS 49
LTE2.19.030.9 FULL COLLECTIVE CONTROL FOR SINGLE LIFT 50
LTE2.19.040.9 FULL COLLECTIVE CONTROL FOR TWO INTER-CONNECTED LIFTS 50

LTE2.19.045.9 FULL COLLECTIVE CONTROL FOR MORE THAN TWO INTER-CONNECTED LIFTS 51
LTE2.19.050.9 DOUBLE DUPLEX DOWN COLLECTIVE CONTROL 51

LTE2.20 LIFT POWER SYSTEM AND LEVELLING 53
LTE2.20.010.9 GENERAL REQUIREMENT 53
LTE2.20.050.9 LEVELLING ACCURACY 53
LTE2.20.060.9 AUTOMATIC RE-LEVELLING 53
LTE2.20.070.9 MAXIMUM ALLOWABLE ELECTRICAL POWER, TOTAL HARMONIC DISTORTION AND TOTAL POWER FACTOR OF LIFTS 53
LTE2.20.080.A MAXIMUM STARTING KVA, MAXIMUM STARTING KW AND MAXIMUM REGENERATIVE POWER OF LIFTS 53

LTE2.21 LIFT ALARM SYSTEM 54
LTE2.21.010.9 GENERAL REQUIREMENTS 54
LTE2.21.020.9 CABLING FACILITIES BY ELECTRICAL SUB-CONTRACTOR 55
LTE2.21.030.9 FLOOD ALARM SYSTEM FOR LIFT TOWER 55

LTE2.22 FIRE SERVICES REQUIREMENTS 57
LTE2.22.010.9 FIREMAN'S LIFTS 57

LTE2.23 REQUIREMENTS ON RIDING COMFORT 58
LTE2.23.010.9 RIDING COMFORT 58

LTE2.24 REQUIREMENTS ON HOMING OPERATION IN LIFT TOWER 59
LTE2.24.010.9 HOMING OPERATION IN LIFT TOWER 59

LTE2.25 PARTICULAR REQUIREMENTS FOR MACHINE-ROOM-LESS LIFT 60
LTE2.25.010.9 STATUTORY REQUIREMENTS 60
LTE2.25.020.9 GENERAL REQUIREMENTS 60
LTE2.25.030.9 LIFT WELL VENTILATION 60
LTE2.25.040.9 LIFT CONTROL PANEL 61
LTE2.25.060.9 LIFTS FOR OUTDOOR APPLICATION 61

LTE2.26 MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIMEP) 63
LTE2.26.010.N EXTENT OF APPLICATION 63
LTE2.26.020.N ACCESSORIES AT LIFT PIT 63
LTE2.26.030.N ACCESSORIES AT LIFT CAR TOP 63

LTE2.1 GUIDES AND FIXING

LTE2.1.010.9 GUIDE RAILS

1. The lift car and counterweight shall each be guided by at least two rigid steel guide rails throughout their travel. Oil pans shall be provided and placed underneath the guide rails in the lift pit to collect oil drained from the guide rail in case of guide lubricated by oil;
2. Every such guide rail shall:
    a. Comply with BS 5655: Part 9 or BS EN 81-20 or ISO 7465 or other approved international standards;
    b. Be of adequate strength; and
    c. Have machined guide surface.
3. Test report issued by the manufacturer to verify the guide rail in compliance with BS 5655: Part 9 or BS EN 81-20 or ISO 7465 or other approved international standards shall be submitted to the CM;
4. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the guide rails delivered to the site or installed.

LTE2.1.020.9 GUIDE BRACKETS

1. Guide brackets shall be provided at suitable intervals in accordance with Clause 5.7.2.1.3 of the Lift COP, Section E, Part 1 and shall be embedded into the walls enclosing the liftway or fixed to such walls by one of the following methods:
    a. All holes for anchor bolts shall be drilled by rotary drill - this method shall be used as the standard practice for fixing guide rail brackets in reinforced concrete walls of more than 100 mm thick;
    b. Bolts grouted and embedded into the walls - this method shall only be used in special conditions, e.g. brick walled liftway, or reinforced walls of 100 mm thick or less, or as and when specified in the Project Specific Specification. The Sub-contractor shall submit builder's work drawings detailing the exact dimensions and locations of the holes for the bolts required. The Sub-contractor shall ensure that the holes reserved by the Main Contractor are properly and correctly positioned.
2. Wood or fibre blocks or plugs shall not be used for securing any guide brackets;
3. The fixing of the guides to their brackets and to the building shall permit compensation, either automatically or by simple adjustment, of effects due to normal settling of the building or shrinkage of concrete.

LTE2.2 CAR AND COUNTERWEIGHT BUFFERS

LTE2.2.010.9 BUFFERS

1. Buffers shall be installed at the bottom limit of travel for cars and counterweights in accordance with the following requirements:
   a. Buffers of timber or rubber shall not be used;
   b. Spring buffers or oil buffers shall be used for lifts having a contract speed not exceeding 1.00 m/s;
   c. Oil buffers shall be used for lifts having a contract speed exceeding 1.00 m/s;
   d. Reduced buffer stroke shall not be used unless approved by the CM.
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the buffers delivered to the site or installed.

LTE2.2.020.9 TYPE TEST

The buffers shall be type tested to the requirements of Clause 5.5 of BS EN 81-50 by an approved independent testing institution. Type test certificate to this effect shall be submitted to the CM.

LTE2.3 COUNTERWEIGHTS

LTE2.3.010.9 GENERAL REQUIREMENTS

The counterweight shall be of metal and constructed from multiple sections, contained and secured with a steel frame, and shall equal to the weight of the complete car and approximately 40% of the rated load.

LTE2.3.020.9 GUIDE SHOES

1. At least four guide shoes, capable of being easily renewed or having renewable linings, shall be provided on the counterweight;
2. Guide shoes for counterweight shall be resiliently mounted. For lift speed of 2.5 m/s or above, the guide shoes for the counterweight shall be of the roller type. Any necessary lubrication shall be applied by automatic means.

LTE2.4 SUSPENSION

LTE2.4.010.9 ROPES

1. Lift car suspension shall be by means of steel wire ropes of best quality, the size and number being in accordance with Clause 5.5.1.2 and Clause 5.5.1.3 of the Lift COP, Section E, Part 1;
2. The factor of safety for all suspension ropes shall comply with Clause 5.5.2.2 of the Lift COP, Section E, Part 1;
3. Mill test certificate with test results issued by the manufacturer to verify that the steel wire rope is in compliance with EN 12385-1 and EN 12385-5, or ISO 4344 or other approved international standards shall be submitted to the CM. The Sub-contractor shall provide an undertaking confirming that the submitted mill test certificate specifically refers to the ropes delivered to the Site. The Sub-contractor shall provide supporting photographs and documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the ropes delivered to the site or installed. The mill test certificate, the undertaking, the supporting photographs and the documentary evidence shall be submitted together with the ropes when delivered to the Site. Supporting photographs taken in workshop or warehouse before delivery to site is also acceptable;
4. The breakage or slackening of any one of the ropes shall cause the motor to stop by means of an electrical safety device in accordance with Clause 5.11.2 of the Lift COP, Section E, Part 1;
5. All pulley assemblies in the suspension rope system shall be completed with 'Temperature Indicating Strip' of appropriate temperature rating. The strips shall be of self-adhesive type, give irreversible colour change and permanently record the highest temperature of the pulley assemblies;
6. For lifts where the lift machine is more than 60 m above the lowest landing floor, either of the following requirements shall be complied with:
    a. Not less than 5 independent ropes shall be used for suspension and the nominal diameter of the ropes shall not be less than 10 mm;
    b. Not less than 8 independent ropes shall be used for suspension and the nominal diameter of the ropes shall not be less than 8 mm.
7. Ropes shall be lubricated during manufacture. During operation, the ropes shall be re-lubricated as necessary and the following shall be observed:
    a. The rope manufacturer’s instruction / recommendation on rope lubrication shall be followed;
    b. Surface deposit and dirt accumulated on the rope surface shall be removed prior to the application of the lubricant to ensure that the paths for lubricant penetrations are not obstructed;
    c. The brand and grade of lubricant recommended by the rope manufacturer or their approved equivalent shall be used. Any contaminated lubricant shall not be used;
    d. Rope lubrication shall be carried out prior to other lift maintenance and servicing work in order to allow an adequate idle time after application of lubricant before putting the lift into operation to ensure adequate absorption of lubricant into the core of the ropes;
    e. If automatic lubrication device is used, it shall be proprietary made and the following shall be ensured:

i. The device is applying lubricant over all the ropes;

ii. The lubricant reservoir is not contaminated during use;

iii. The ropes are not over lubricated.

8. If the installed lifts are left idle continuously for 30 days or more after the issue date of the "Permit to Work on a Car Top before its First Run" by Registered Lift Engineer and before use permits are obtained, appropriate measures such as intermittent lift operations and lubrication as necessary shall be taken at least once every month during the lift idling period to prevent wearing of the ropes. Records of the above measure(s) as carried out shall be entered in the log-book.

LTE2.4.020.9 TEST PIECES FOR SUSPENSION ROPES

1. For all suspension ropes to be delivered to the Site, an additional length of at least 3m shall be allowed in each suspension rope to serve as test piece;
2. At a time before or during rope installation, the Sub-contractor shall in the presence and under the supervision of the CM or his representatives cut out from each batch of suspension ropes delivered to site at least 3 numbers of test pieces randomly selected by the CM or his representatives and send one of them to a laboratory for carrying out breaking force test in accordance with EN 12385-1 or BS EN 12385-1 and EN 12385-5 or BS EN 12385-5. The laboratory shall be accredited under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) for breaking force test of steel wire ropes in accordance with BS EN 12385-1. Laboratories accredited under the HOKLAS for tensile test of metallic materials, steel or structural fixings within the test category of construction materials may be accepted if the breaking force test is conducted by 2018. Only local laboratories will be accepted;
3. The test piece to be sent to the laboratory shall be properly packed, signed, sealed and photographed under the supervision of the Contract Manager or his representatives. The test record to be submitted to the Contract Manager shall include the photographic record showing receipt by the laboratory of the intact package before open up and testing of the test piece;
4. The expense and costs of the test shall be borne by the Sub-contractor;
5. If the test piece fails the test, the entire batch of suspension ropes shall be replaced at the Sub-contractor's expense and the CM may at his discretion call for further tests on the replaced ropes. All associated costs so arisen shall be borne by the Sub-contractor and no extension of time to the Contract period will be allowed;
6. After cutting out the test pieces from the ropes, the Sub-contractor shall re-seal the ropes to be installed on Site in order to prevent ingress of moisture and they shall be kept sealed until installation on Site.

LTE2.4.030.A ROPE COMPENSATION

1. For travel over 30 m, compensation shall be provided by the Sub-contractor;
2. For lift speed at or below 2.5 m/s, quiet operating chains can be used as the means of compensation;
3. For speed exceeding 2.5 m/s, steel wire rope shall be hung between car and counterweight, passing round an idler tensioning pulley in lift pit and the tension shall be checked by an electric device in accordance with Clause 5.11.2 of the Lift COP, Section E, Part 1;
4. If rope compensation is used for lift with rated speed at or below 2.5 m/s, it shall also comply with the above requirements;

5. For the use of quiet operating chain for compensation, a guiding device system shall be provided. The guiding device system shall include a set of four rollers at a suitable location on each side of the chain loop at the lift pit, or equivalent and approved by the CM, to guide the movement and restrain excessive sway of the chain. Additional safety wire or wire grips shall be provided at the chain termination fixing to the U-clip, bolt and nuts.

LTE2.5 TERMINAL STOPPING AND FINAL LIMIT SWITCHES

LTE2.5.010.A TERMINAL STOPPING AND FINAL LIMIT SWITCHES TO BE PROVIDED

Each lift shall be provided with terminal stopping and final limit switch(es). They shall be positively operated by the movement of the car. These switches whether mounted on the car frame or in the lift well, shall be properly enclosed.

LTE2.5.020.A TERMINAL STOPPING

The switch shall be arranged to stop the lift car automatically from any speed attained in normal operation within the top runby and bottom runby, independently of the operating device, the final limit switch and the buffers.

LTE2.5.030.A FINAL LIMIT

The method of operation of the switch shall comply with Clause 5.12 of the Lift COP, Section E, Part 1.

LTE2.6 GUARDING

LTE2.6.010.9 GENERAL REQUIREMENTS

All dangerous accessible rotating and moving parts which would cause injury upon bodily contact, including but not limited to traction sheave, handwinding wheels, brake drums, pulleys, ropes etc., shall be effectively guarded against contact of bodily parts with metallic see-through guards. Guarding for handwinding wheels shall be easily removable without the use of tools. Removable metallic see-through guards shall be used for rotating and moving parts which require inspection during lift running. Where applicable, components should be designed to be inherently safe, obviating the need for external or removable guards.

LTE2.6.020.9 LIFT WELL PARTITION

1. Where two or more lifts are fixed in a common lift well, the Sub-contractor shall provide a rigid metal screen having a minimum height of 2500 mm across the whole depth of lift pit fixed at the bottom between any two lifts;
2. Where the horizontal distance between the edge of the roof of a car and an adjacent or its counterweight is less than 300 mm, rigid metal screen to partition each lift from the adjacent lift shall be erected by the Sub-contractor from the lift pit to the full height of the lift well and across whole depth of the lift well.

LTE2.6.030.9 COUNTERWEIGHT

1. Counterweights shall be guarded by means of a rigid metal screen extending from a position 300 mm above the lift pit floor to a position at least 2500 mm above the lift pit floor. It is permissible to raise the bottom of the counterweight screen to clear the compensating chain/rope/means or other equipment. The bottom of the counterweight screen shall be as low as possible and shall be at least 300 mm below the lowest parts of the counterweight resting on a fully compressed counterweight buffer;
2. Where oil buffers are fitted in the pit or when the compensating ropes or chains are used, metal screens for counterweight shall be so positioned that access for the maintenance and servicing of oil buffers and compensation ropes shall be provided.

LTE2.6.040.A CAR TOP

1. Balustrade / Guardrail shall be provided to prevent accidental falling of people from car top where the horizontal distance between the edge of the car roof and the corresponding wall of the lift well exceeds 300 mm;
2. If the clearance between car landing sill and the wall of the lift well exceeds 150 mm, front guardrail and toe-board facing the door side, in addition to guardrails and toe-boards at other edges, shall be installed at the car top, and foothold shall be provided on the front of the car top. The guardrail shall be so designed and constructed to allow safe access to and egress from the car top.

LTE2.7 CAR FRAMES

LTE2.7.010.9 GENERAL REQUIREMENTS

1. Every lift car body shall be carried in a steel car frame sufficiently rigid to withstand the forces which will be applied in normal lift operation, in safety gear operation or impact of the car on its buffer without permanent deformation of the car frame;
2. The deflection of the members carrying the platform shall not exceed 1/1000 of their span under static conditions with the rated load evenly distributed over the platform;
3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the car slings delivered to the site or installed.

LTE2.7.020.9 CAR GUIDE SHOES

1. At least four renewable guide shoes, two at the top and two at the bottom of the car frame shall be provided;
2. For lift speed exceeding 1 m/s, the guide shoes shall be resiliently mounted. For lift speed of 2.5 m/s or above, the guide shoes for the lift car shall be of the roller type. Any necessary lubrication shall be applied by automatic means.

LTE2.8 CAR ENCLOSURES

LTE2.8.010.9 NON-COMBUSTIBLE MATERIALS TO BE USED

Lift cars shall be constructed of non-combustible materials.

LTE2.8.020.9 CAR TO BE COMPLETELY ENCLOSED

1. The car of every lift shall be completely enclosed at the sides and on top and shall, save for any opening affording access thereto or for ventilation or emergency trap door, not have any openings or open work panels in the sides;
2. The interior height of car shall be 2,600 mm unless otherwise specified.

LTE2.8.030.9 PLATFORM LOADING

1. Car platforms shall be of framed construction. Platforms for Passenger Lift (P) cars and Passenger Lift (F) cars shall be designed on the basis of rated load, this being evenly distributed. Platforms for freight cars shall be designed to suit the particular conditions of loading;
2. At least two coats of epoxy paint coating primer shall be applied to all parts of car platform, followed by at least two coats of finishing epoxy paint coating for marine application in accordance with the paint manufacturer's recommendation. The same coating system shall also be applied to the internal surfaces of any cavities forming the integral part of the car platform;
3. If the car platform is made of stainless steel, epoxy paint is not required.

LTE2.8.040.A INTERNAL CONSTRUCTION OF PASSENGER LIFT (P) CARS

1. All Passenger Lift (P) car walls, skirting and doors shall be constructed of at least 1.5 mm thick stainless steel sheet. Mild steel sheet lined with stainless steel shall not be acceptable. Car walls and doors shall be adequately stiffened by stainless steel ribs where required to provide a robust mechanical construction for heavy and rugged usage;
2. Handrails constructed of stainless steel shall be provided on three sides of the lift car extending to within 150 mm of all corners. The top of the handrail shall be at 900 mm above finished car floor. The handrails shall comply with Figure 15 of Design Manual: Barrier Free Access 2008;
3. The finishes of the stainless steel sheets shall be hairline, satin, wavy line pattern or mirror finish, as approved by the CM and as shown on the Drawings. All fasteners for the fixing of stainless steel sheets shall be of stainless steel;
4. Hairline stainless steel ceiling or other ceiling as specified on the Drawing shall be provided by the Sub-contractor. For the emergency trap door where a cladding plate matching the ceiling is provided, the cladding plate shall be securely fixed by stainless steel rivets or stud welding at four points or more. Compact fluorescent or Light Emitting Diode (LED) down lights shall be recess mounted;

5. A concealed high / low speed fan / blower shall be recessed above the car ceiling. Stainless steel air diffuser(s) complete with suitably angled deflectors shall be provided to discharge air evenly to the lift car. The opening of the diffuser should be adequately sized such that the air flow of the fan will not be obstructed. The fan shall be guarded against contact by finger from inside the lift car and from the lift car top. The fan shall be able to produce at least twenty air changes per hour of lift car volume with the lift car stationary and car door closed. The sound pressure level inside lift car with car door closed shall not exceed 60 dB(A) when the fan is producing air flow rate at twenty air changes per hour;
6. Car floor homogeneous tiles as indicated in the Drawings shall be supplied, cut to sizes and laid by the Main Contractor. The Sub-contractor shall make allowance for the weight of tiles and tile adhesive in sizing of lift equipment and shall obtain the exact weight from the Main Contractor. The Sub-contractor shall calculate the exact decoration load based upon the design materials and fixing details that suit the particular lift design in sizing of lift equipment;
7. A floor cover plate of at least 1 mm thick stainless steel sheet shall be provided on top of the car platform;
8. Prior to the application of tile adhesive by Main Contractor to the floor cover plate, the joint between car wall / skirting and the floor cover plate shall be sealed with a suitable mastic sealant or by other approved means to make a watertight joint.

LTE2.8.050.A INTERNAL CONSTRUCTION OF PASSENGER LIFT (F) AND FREIGHT LIFT CARS

1. Lift car walls, skirting, car doors, handrails and floor cover plate shall be constructed of stainless steel sheet. Mild steel sheet lined with stainless steel shall not be acceptable;
2. Thickness of the stainless steel sheet for car wall, skirting and car door shall be not less than 1.5 mm. The finishes of stainless steel sheet shall be of hairline, satin or wavy line pattern, as approved by the CM. The car walls and doors shall be adequately stiffened by stainless steel ribs where required to provide a robust mechanical construction for heavy and rugged usage;
3. Floor coverings shall be slip-proof stainless steel chequer plate of at least 3 mm thick;
4. All fasteners for the fixing of stainless steel sheets shall be stainless steel;
5. The ceiling shall be painted finish with cream white colour. For the emergency trap door where a cladding plate matching the ceiling is provided, the cladding plate shall be securely fixed by stainless steel rivets or stud welding at four points or more;
6. The joint between the skirting and car panels, and between the skirting and car frame, shall be sealed with a suitable mastic sealant or by other approved means to make a watertight joint;
7. Handrails shall be provided on the three sides of the lift car extending to within 150 mm of all corners. The top of the handrails shall be at 900 mm above car floor. The handrails shall comply with Figure 15 of Design Manual: Barrier Free Access 2008;
8. Fully recessed fluorescent lights shall be completed with vandal-proof polycarbonate, white opal diffuser fixed to the casing with secret-head screws.

LTE2.8.060.9 TOE GUARD

1. Each lift car shall be fitted with a toe guard in accordance with Clause 4.4 of the Lift COP, Section E, Part 1;

2. The toe guard shall be constructed of stainless steel, at least 1.5 mm thick and hairline finish;

3, A 150 mm high black and yellow warning strip by spray painting shall be provided at the top edge of the toe guard as shown on the Drawing.

LTE2.8.070.9 MAINTENANCE FACILITIES

1. A 13A 3-pin shuttered type socket outlet to BS 1363-1 and BS 1363-2 shall be provided on both the top and bottom of the lift car;

2. A permanent light, suitably protected and separately switched, shall also be fitted on both the top and the bottom of the lift car.

LTE2.8.080.9 CAR ILLUMINATION AND PARKING

1. Lift car shall be illuminated to a level of not less than 120 lux at car floor level and on control devices. At least two independent sets of lighting control gear circuits and fittings shall be used;

2. The car shall park at the landing of its final call unless otherwise specified;

3. When no call is registered within an adjustable period of 2 minutes with the lift doors closed, the lift car's ventilation fan shall be shut off automatically until the lift car is activated again by passenger call. The automatic switch-off function to the ventilation fan shall not be operative during breakdown of the lift and with any passengers being trapped inside the lift car.

LTE2.8.090.9 EMERGENCY LIGHTING

1. Every lift car shall be provided with emergency lighting automatically illuminated in the event of failure of power supply to the lift;

2. At least two lighting fittings of independent control gear circuits in lift car shall be used to provide emergency lighting as well as normal lighting. The lamps shall be fed from the battery (in LTE1.7.050) automatically upon failure of normal lighting supply;

3. The emergency lighting shall be able to provide an illumination level of at least 5 lux at car floor level and on control devices.

LTE2.8.100.9 EMERGENCY SIGNAL

1. Every lift car shall be provided with an emergency signal which shall be operative from the lift car, visible and audible at the lift lobby on the main entrance floor;

2. The power supply to the emergency signal shall be fed from the batteries complying with LTE1.7.050 sub-clause (2).

LTE2.8.110.A EMERGENCY TRAP DOOR

1. Each lift car shall be provided with an emergency trap door of minimum size 400 mm x 500 mm, which shall be in the roof. Construction details of the emergency trap door shall be submitted for the CM's approval prior to fabrication;

2. Emergency trap door shall:

   a. Not open towards the inside of the car;

   b. Be clear of any apparatus mounted above the roof of the lift car;

   c. Be held by suitable locking device which can be opened from outside the lift car without a key and from inside the lift car with a key suited to the triangle defined in Clause 5.3.9.3 of Lift COP, Section E, Part 1;

d. Be provided with an electric safety device which functions as follows:

   i. Operate the alarm sounder and prevent operation of the lift and ventilation fan at car top under any one or both of the following conditions:

      - When the locking device in sub-clause (2)(c) ceases to be effective;
      - When the panel is open.

   ii. Stop the alarm sounder and restore operation of the lift and ventilation fan only when the locking device is effective and has been manually relocked.

LTE2.9 CONTROL AND INDICATOR IN CAR

LTE2.9.010.9 CONTROL PANEL IN CAR

1. Each lift car shall have a flush mounted control panel on the right hand side of the car door when viewed from the car. The control panel shall be mounted such that essential lift control buttons (call registration buttons, alarm button and door open/close buttons) on this main control panel or the secondary car control panel shall be not less than 900 mm and not more than 1200 mm above the finished car floor;
2. The material for the panel shall be stainless steel with a thickness not less than 2.5 mm. The control panel shall be fixed onto the car panel by stainless steel secret-head screws;
3. The control panel shall comprise:
   a. Push buttons for the landings served;
   b. The alarm button shall be yellow in colour and identified by the symbol 🔔 in accordance with Clause 5.4.2.3.4 of the Lift COP, Section E, Part 1 and with protection from being pushed accidentally. The alarm button shall also be in tactile bell shape;
   c. Door open and door close push buttons;
   d. The alarm, door open, and door close push buttons shall have labels, either engraved or embossed in both English and Chinese characters as follows:

      "Alarm 警鐘"

      "Door Open 開門"

      "Door Close 關門"

   e. A service ON/OFF key switch shall be provided, and shall have label, either engraved or embossed in both English and Chinese characters as follows:

      "Service Switch 維修掣"

      When the service switch is operated, the lift shall remain inoperative to facilitate service, cleaning and standby mode. The service switch shall be rendered ineffective unless the car has stopped or parked at a lift landing;

   f. A secondary car control panel shall, where shown on the Drawings, be flush mounted on the left hand side of the car door when viewed from the car. The panel shall comprise all control buttons as the main panel. Essential lift control buttons (call registration buttons, alarm buttons and door open buttons) on this secondary car control panel or the main car control panel shall be not less than 900 mm and not more than 1200 mm above the finished car floor.

LTE2.9.020.9 ATTENDANT CONTROL

1. Lifts shall be equipped with attendant control. The control panel mentioned in LTE2.9.010 shall also incorporate the following with proper labels:
   a. An attendant control switch; and
   b. A non-stop button for the purpose of by-passing landing calls, but the landing calls shall remain registered until answered. This button shall only be operative when the above attendant switch is switched on; and
   c. An adjustable with step / modulating control fan speed switch.

i. Fan speed switch shall be proprietary made by the switch manufacturer or of a type approved by the manufacturer. It shall be installed in accordance with the recommendation from the switch manufacturer;

ii. Fan speed switch shall be of a type suitable for use as speed control for ventilation fan;

iii. Fan speed switch shall be properly fixed on the control panel by screw or other fixing method as recommended by the switch manufacturer.

2. The button and switches specified in this clause shall be housed in a recessed stainless steel box with hinged lid which shall be key-locked.

LTE2.9.030.9 ILLUMINATED INDICATOR

An illuminated indicator, indicating the landing at which the car is stopped or passing, and up and down directional indication, and displaying pre-programmed messages/symbols shall be provided in the car. The indication fixture shall comply with LTE2.12.030 and pre-programmed with additional messages same as those verbal annunciations specified in LTE2.12.050 sub-clauses (5) and (6).

LTE2.9.040.9 OVERLOAD DEVICE

An overload device shall be installed for each lift (see LTE2.16).

LTE2.9.050.A PUSH BUTTONS

1. Unless otherwise specified, all push buttons shall be flush with the control panel, and shall be vandal-resistant design and suitable for heavy duty. The push buttons shall have a minimum dimension of 20 mm and shall be vandal-resistant design and suitable for heavy use and integral with tactile braille and LED illuminators and shall be approved by the Contract Manager;

2. Except for lift(s) serving both domestic and non-domestic floors, the control of buttons for lift(s) in non-domestic premises shall be equipped with contact-less function/feature, i.e. built-in sensor type and unless otherwise specified in the Specification. The contact-less function/feature shall be excluded for alarm button inside lift car and shall be disabled for fireman's lift when the fireman's switch is activated;

3. Braille and tactile markings of Arabic numerals and symbols shall be placed on the control buttons. Tactile markings shall have a minimum dimension of 15 mm high and be raised 1 mm minimum, and shall be of high contrasting colour background. Tactile marking in "star" shape shall be provided at the left hand side of the push button for the main entrance floor;

4. The Sub-contractor shall confirm with supporting document that a confirmation letter has been issued from a recognised organisation of the visually impaired to certify that the messages of the Braille and tactile markings on the model or type of the push buttons to be provided have already been proof read to be correct and readable for use by the visually impaired.

LTE2.9.060.9 CAR TOP CONTROL

A control station shall be fitted on top of the car and shall include:

1. A lighting switch and fan switch, with on/off position indicators, to control the lights and the fan in the lift car;

2. A bi-stable inspection switch marked "NORMAL" (正常) and "INSPECTION" (慢車) which when operated shall ensure that:

a. It is not possible to control the car, including any automatic doors, from any other position;

b. The car shall only travel at a speed not exceeding 0.63 m/s;

c. The car shall not move until all safety devices are in, and remain in, the safe position;

d. The movement of the car shall be dependent on a continuous pressure simultaneously on a "Common" push button and a "Up" or "Down" push button. These push buttons shall be protected against accidental operation and with the direction of movement clearly indicated. The words "UP" (上), "DOWN"(落) and "COMMON"(共通) or "U", "D" and "C" indicating the intended direction of motion shall be provided on or near the buttons.

3. A stopping device of "mushroom head, push to stop, pull to run" type, coloured red and marked with the word "STOP" (停止) which when operated shall stop the car immediately and it shall not be possible to move the car, including any automatic doors, from any other position, so placed that there can be no risk of error as to the stop position;

4. A switch lock on the inspection/operation switch at the car top or other similar device shall be installed.

LTE2.9.070.9 STOP SWITCH TO BE PROVIDED

Stop switches as specified in LTE2.9.060 (3) shall also be provided at the following locations:

1. Compartment separate from motor room or lift well where lift equipment is housed;

2. Where a lift machine and its controller are installed at different levels exceeding 600 mm, a stop switch shall be provided near the machine;

3. In the pit for each lift;

4. At the top of the pit cat ladder adjacent to the pit lighting switch.

LTE2.9.080.9 SOCKET TO BE PROVIDED IN PIT

A 13A 3-pin watertight socket outlet of the type specified in ELE20.3.020 shall be provided at the lift pit in compliance with Clause 5.10.7.2 of the Lift COP, Section E, Part 1.

LTE2.9.100.9 INTERCOM SYSTEM

1. Separate intercom system powered by battery shall be installed for each lift for communications between the lift car, the guard counter or location(s) as shown on the Drawings, the lift machine room or maintenance access panel for machine-room-less lift, and the lift car top. The intercom system shall be activated for communications by either pressing the alarm push button in the lift car once or by lifting the intercom handset(s) at the guard counter or location(s) as shown on the Drawings, or the lift machine room or maintenance access panel for machine-room-less lift, or the lift car top. Intercom handset shall be provided at each lift car top;

2. The associated equipment inside the lift car shall be flush mounted and complete with the intercom symbol shown in Fig. 3 of BS 5655: Part 7;

3. The intercom system shall function together with the lift alarm system as detailed in LTE2.21.

LTE2.9.110.9 LIFT CONTROL FEATURES IN CASE OF FAILURE OF NORMAL POWER SUPPLY FOR BUILDING WITH THE PROVISION OF EMERGENCY GENERATOR

1. In the event of failure of normal power supply and the emergency generator being actuated, all fireman's lifts in a building shall resume their normal operation immediately. Non-fireman's lifts in the same building shall be stopped and be sequentially started within 45 seconds to return to the home landing one at a time before the next lift is started and remain stationary at that level to release the passengers. The lift doors shall be opened to release passengers and shall then be closed and remain closed while the "DOOR OPEN" button shall remain operative. Emergency power will be available for the sequential returning of the lifts to the home landing while the fireman's lifts are in operation. To prevent the simultaneous starting of the non-fireman's lift and all the fireman's lifts, the starting of the non-fireman's lift shall be momentarily delayed when all the fireman's lifts are being started or about to be started. However, momentary delay of the movement of a non-fireman's lift during sequential returning is not allowed after the lift has started to move. The operation of the fireman's lifts shall not be affected in any case;
2. Under surge and starting load condition, the emergency generator provided by the Electrical Sub-contractor will maintain the transient state voltage dip within 15% with 1.5 seconds recovery time. The lift system shall be capable for operation in safe working order under this transient variation limit;
3. A pair of voltage-free contacts actuated when the emergency generator is ready to pick up the connected load will be provided by the Electrical Sub-contractor. A pair of voltage-free contacts actuated by fire alarm signal will be provided by the Fire Services Sub-contractor. These pairs of voltage-free contacts will be terminated inside respective surface mounted boxes inside the lift machine room or near the lift control panel;
4. After the lift homing operation has completed, all non-fireman's lifts shall remain stationary at the home landing. They shall resume their normal operation automatically upon the reset of the above voltage-free contacts of the emergency generator system due to resumption of normal power supply. However, lift operation shall not be resumed before the reset of the above voltage-free contacts of fire alarm signal;
5. The Sub-contractor shall be responsible for all connection and control after these voltage-free contacts;
6. For each non-fireman's lift, the Sub-contractor shall provide a pair of voltage-free contacts actuated when the lift homing operation has completed. Connection and control after these voltage-free contacts will be carried out by the Electrical Sub-contractor to trip off the power supply of the corresponding sub-distribution board serving the lighting and small power of the lift.

LTE2.9.120.9 LIFT CONTROL FEATURES IN CASE OF FAILURE OF NORMAL POWER SUPPLY FOR BUILDING / LIFT TOWER WITHOUT THE PROVISION OF EMERGENCY GENERATOR NOR OTHER EMERGENCY POWER SUPPLY

For lifts in a building / lift tower without the provision of emergency generator nor other emergency power supply, a complete battery back-up system normally maintained by trickle charger from A.C. source shall be provided to support passenger release operation in case of failure of normal power supply. The battery back-up system shall be of adequate capacity to move the lift car as described below and shall be capable of being fully recharged from total depletion within 24 hours:

1. For building – move the lift car to a landing for passenger release;

2. For lift tower – move the lift car to the landing at entrance / exit level for passenger release.

LTE2.9.130.9 LIFT CONTROL FEATURES IN CASE OF SUPPLY VOLTAGE DIP WITHOUT ACTUATION OF EMERGENCY GENERATOR

1. In the event of supply voltage dip to less than 90% of normal and the emergency generator is not being actuated, the lifts in a building shall either continue their normal operation during the voltage dip or automatically resume normal operation after the voltage dip. In the latter case, the controller should carry out self-diagnosis and run other safety automatic routines as required by the manufacturer immediately after the voltage dip, return to home or the nearest landing either in up or down direction to resume normal operation. If self-diagnosis tests fail, the lift should not resume normal operation unless the system is checked by maintenance personnel;

2. When the lift restarts after resumption of normal supply, audio message specified in LTE2.12.050 sub-clauses (5) and (6) and visual signal must be provided in the lift car to inform the trapped passengers the status of the lift. The visual signal shall be the messages same as those verbal annunciations specified in LTE2.12.050 sub-clauses (5) and (6) shown in dot-matrix LED type car position indicator.

LTE2.10 CCTV SYSTEM FOR LIFT CAR

LTE2.10.010.9 GENERAL

1. Colour Closed Circuit Television System (CCTVS) shall be provided for monitoring the lift cars with CCTV monitors in the lift machine room or at the maintenance access panel for machine-room-less lift. The Sub-contractor shall provide for each lift a CCTV camera at car top and a CCTV monitor in the lift machine room or at the maintenance access panel for machine-room-less lift complete with the associated wiring, video cables, amplifier, splitters, conduits etc. as required for lift car monitoring;
2. The Sub-contractor shall also provide for each lift a video cable terminated at a connection unit at high level of the main entrance floor lift lobby or otherwise as shown on the Drawings for connection to the local CCTV monitoring system by Electrical Sub-contractor. The corresponding CCTV monitors will be provided at the location(s) as shown in the Drawings by Electrical Sub-contractor;
3. If the Sub-contractor does not have a licence under the Security and Guarding Services Ordinance (Cap. 460) to carry out the CCTV installation and maintenance works in lifts described in this Specification, he shall sub-contract the works to a licensed security company and shall submit the name of the licensed security company to the Contract Manager.

LTE2.10.020.A CCTV VIDEO CAMERA

The Sub-contractor shall supply and install in each lift a CCTV camera complete with a spur unit fused at 5A at the car ceiling as the power supply;

1. General
    a. The camera shall be recess mounted under the lift car ceiling / false ceiling as shown in the Drawings. The metallic dome shaped vandal resistant camera housing shall be in the form of three-quarter of a sphere not greater than 120 mm diameter. The camera lens is fixed at the bottom of the spherical housing. The direction of the camera can be adjusted by turning the spherical housing with respect to the base through an eyeball action. It shall be small and housed in a robust camera housing. There shall be locking mechanism to fix the angle. Sample of the housing shall be submitted to the CM for approval prior to ordering;
2. Lens
    a. All video camera shall be equipped with auto-iris lenses;
    b. If the lens is motorised for remote control, the response time of the following adjustment shall not be more than:
        i. Full range iris control : 1.5 seconds;
        ii. Full range focus control (1 m to infinity) : 11 seconds;
        iii. Zoom control : speed of zoom shall be such as to double the field of view in 2.5 seconds.

        Operation of motorised drives for these controls shall not cause any radio frequency radiation or interference to the video signal, e.g. patterning, noise streaks, etc;

c. All video camera shall be equipped with fixed focal length lens unless otherwise specified. If motorized varifocal lens is required, the focal length shall not be less than 2.8mm to 12mm.

3. All power, control and video cables entering or leaving the camera externally shall be protected by a conduit;

4. The environmental protection rating of CCTV camera in lift car shall be at least IP42;

5. Compatibility

   The camera in lift car shall be compatible with the CCTV monitoring system provided by the Electrical Sub-contractor.

LTE2.10.030.A CCTV MONITOR

1. The Sub-contractor shall provide for each lift a LED type CCTV monitor adjacent to each lift alarm panel in the lift machine room or maintenance access panel for machine-room-less lift for monitoring the lift car. The CCTV monitor shall be compatible with the CCTV camera in lift car;

2. The video monitor shall be capable to handle both digital and analogue television / video signal. It shall be of either LCD panel lit with LED backlight or self-illuminated OLED panel;

3. The LED colour video monitor shall meet, but not be limited to, the following performance requirements:

(a)	Screen Size	24 inch (minimum viewable not less than 23.8") or otherwise specified on the Drawings
(b)	Horizontal and Vertical Viewing Angle	150° or larger
(c)	Native Resolution	1920 (H) x 1080 (V) or better
(d)	Brightness	Not less than 250 cd/m^2
(e)	Contrast Ratio	1000 : 1 or better
(f)	Input Terminal	HDMI, VGA
(g)	Power Source	220V AC $\pm$ 10%, 50/60 Hz
(h)	Support Languages for On-screen instruction	English and Traditional Chinese

4. The CCTV monitor shall be completed with adjustable tilting angle wall mounted bracket and desk mounted support depending on the application on Site.

LTE2.10.040.A VIDEO CABLE INSIDE LIFT WELL

1. The Sub-contractor shall provide all necessary cabling and accessories including video cables, conduits, connection units, amplifier, splitters etc. as required so that the video signal from the CCTV cameras can be adequately transmitted to the CCTV monitors in the lift machine room or at the maintenance access panel for machine-room-less lift for monitoring the lift car;

2. The Sub-contractor shall provide for each lift a video cable from a connection unit at lift car ceiling to the lift travelling cable termination box. The Sub-contractor shall then connect the video cable in surface conduit from the lift travelling cable termination box to a connection unit at high level of the main entrance floor lift lobby or as shown on the Drawings. The video cable shall be integrated with the lift travelling cable or clipped to the lift travelling cable by cable tie clips at separation not exceeding 1000 mm. Sample of the cable tie clip shall be submitted to the CM for approval;
3. Video cable shall be of CAT/5, CAT/6 or fibre optic;
4. High-definition multimedia interface (HDMI) cables

   The HDMI cable shall be of premium high-speed HDMI cable. The cable shall be suitable for reliable transfer of 4K@60Hz resolution video. The cable bandwidth support is 18Gbps and is optimized for HDMI version 2.0.

LTE2.10.050.9 PROVISION FOR LIFT FLOOR NUMBER DISPLAY SYSTEM FOR DOMESTIC BUILDING BLOCKS

1. For interfacing with the lift floor number display system, the Sub-contractor shall provide, for each lift in domestic building blocks, lift signals for floor location, up/down travel direction and lift alarm in the form of the following voltage free contacts rated at 500 mA maximum current and 25V maximum voltage, terminated in an interface metal box in Meter Room on Ground Floor or otherwise as shown on Drawings:
   a. One pair of N.O. contacts for each landing floor, to be closed only when the lift is at the floor which the contact is assigned. At any one time, only one pair of these contacts shall be closed;
   b. Two pairs of N.O. contacts for lift travel up/down directions, one to be closed when the lift is going up and the other to be closed when the lift is going down. Simultaneous closing of the two contacts shall not occur;
   c. One pair of N.O. contacts for lift alarm, to be closed when the lift emergency alarm push button is pressed.
2. An additional voltage free contacts for each lift shall also be provided in the interface metal box for connection to the central alarm system:
   a. One pair of N.O. contacts for lift alarm, to be closed when the lift emergency alarm push button is pressed.
3. All terminals for the dry contacts shall be properly labelled to indicate their functions;
4. The Sub-contractor is allowed to locate, if required, the equipment for converting serial data link from the lift controller to dry contact format in Meter Room on Ground Floor, subject to approval by the Contract Manager;
5. Subject to the Contract Manager's approval, it is acceptable that digital signals are used in lieu of the above dry contact signals, should an agreement be reached between the Sub-contractor and the Electrical Sub-contractor. In this case, the details of communication protocol, data format and the hardware interface shall be clearly defined by the two parties and submitted to the Contract Manager for approval.

LTE2.11 CAR DOORS AND LANDING DOORS

LTE2.11.010.A GENERAL REQUIREMENTS

1. Any projections or recesses in the exposed parts of the car doors or landing doors shall not exceed 3 mm in order to avoid shearing and the clearance between sliding parts of the door and any fixed part of the car or landing entrance shall not exceed 6 mm to avoid trapping that may cause bodily injury;
2. Sliding car doors and landing doors shall be guided on two parallel edges of the door. The distance between the car and landing sills shall not exceed 30 mm;
3. The clear height of all car doors and landing doors shall be not less than 2100 mm unless otherwise specified;
4. Under normal circumstances, lift car doors shall not be opened automatically unless the car has attained the levelling accuracy specified in LTE2.20.050;
5. Door hangers and tracks together with their fixing for car and landing door shall be of steel or approved material of equivalent strength and be of robust construction. Means shall be provided to prevent the hangers from misaligning, jumping the tracks and jamming or displacement at the extremities of their travel;
6. Two guide blocks shall be fitted at the bottom of each door panel at appropriate positions to prevent twisting of door panel even after wear. Each guide block unit shall incorporate a robust safety flange extending downwards in the event of the collapse or breaking a drift of the normal rubbing surface of the guide block, the safety flange will prevent the bottom of the door panel from being pushed into the lift well. The guide blocks and the associated fixing screws shall be constructed with durable and corrosion resistant materials;
7. Rollers shall be constructed of steel with sealed ball or roller bearings. An outer plastic lining on roller is acceptable;
8. Ropes shall be steel wire ropes to BS EN 12385-4 or equal and approved;
9. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the car doors and landing doors delivered to the Site or installed.

LTE2.11.020.A CAR DOOR

1. Each car entrance shall be provided with a car door which shall extend the full height and width of the car opening. The top track of the door shall not obstruct the car entrance. The stainless steel car door finishes shall be of hairline, satin or wavy line pattern, unless otherwise stated in the Project Specific Specification or Drawings;
2. Anti-hand / Anti-finger trapping device for minimizing the risk of dragging children's hands / fingers into the gaps between the car door panels and uprights shall be provided. The device shall immediately send a signal to stop the car door operation when it detects an obstacle in the door opening operation. The device shall be the type accepted by EMSD.

LTE2.11.030.A LANDING DOOR

1. All landing openings in lift well enclosures shall be protected by doors which shall extend the full height and width of the landing opening. The top track of landing door shall not obstruct the entrance to the lift car. Every such door shall have a fire resistance rating of not less than 120 minutes with regard to integrity;

2. The landing doors on all floors, including G/F, shall be constructed of at least 1.5 mm thick stainless steel. The finishes of the stainless steel landing door shall be of hairline, satin or wavy line pattern, as approved by the CM. Mild steel sheet lined with stainless steel shall not be acceptable. Sample of stainless steel shall be submitted for Approval prior to manufacture. The landing doors shall be adequately stiffened by stainless steel ribs where required to provide a robust mechanical construction for heavy and rugged usage.

LTE2.11.040.9 PASSENGER LIFT (P)

Doors shall be two panels, centre opening with fully automatic power opening and closing. The speed of the door panels shall be reduced when approaching the ends of their travels during closing. Car door shall be re-opened upon actuation of the landing call button and before the car door has fully closed.

LTE2.11.050.9 PASSENGER LIFT (F) AND FREIGHT LIFT

1. Doors shall be centre opening, fully automatic power operated, horizontally sliding. For lifts with a rated load less than 1600 kg, the doors shall be two panels. The speed of the door panels shall be reduced when approaching the ends of their travels during closing. Car door shall be re-opened upon actuation of the landing call button and before the car door has fully closed;
2. The door panel shall be framed and reinforced to form a robust construction suitable for heavy and rugged usage;
3. For freight lifts, a timer shall be incorporated in the door opening circuitry to function as follows:
    a. Whenever the "DOOR OPEN" button on the car control panel is pressed, the doors shall remain open for a pre-set period of time adjustable by a timer between 30 seconds and 5 minutes. By the end of the period, a buzzer shall sound prior to the closing of the doors;
    b. Pressing of the "DOOR OPEN" button a second time shall set the timer for another period of time. However, pressing of the "DOOR CLOSE" button on the same control panel shall cause the doors to close immediately. The doors shall not remain open for the pre-set period of time, but operate normally unless the "DOOR OPEN" button is pressed.
4. An instruction in Chinese and English characters not less than 13 mm high engraved on a stainless steel plate of at least 1.5 mm thick notifying the user of this facility, shall be displayed conspicuously adjacent to the car control panel for freight lift.

LTE2.11.060.9 CAR DOOR LOCKING DEVICE

1. Every set of car door shall be provided with electrical safety device(s) which shall prevent the lift car from being started or kept in motion unless all car door panels are closed. It shall not be possible under normal operation to open a car door whilst the car is in motion. Operation of the lift with car door open is permitted under the conditions laid down in Clause5.3.8.2 and 5.3.15.1 of the Lift COP, Section E, Part 1;
2. For centre-opening 2-panel car doors, each car door panel shall be provided with a separate door closed proving device;
3. Every set of car door shall be provided with an effective mechanical locking device and mechanically locked by at least 7 mm so that the door cannot be opened from inside the car unless the car is within the levelling zone (i.e. stopped or is levelling);

4. The positive locking of the mechanical car door lock shall be proved by an electrical safety device in conformity with Clause 5.11.2 of the Lift COP, Section E, Part 1 and shall precede the movement of the car;
5. The car door locking device shall be protected against deliberate misuse. The locking elements and their fixings shall be resistant to shock and shall be made of, or reinforced with, metal;
6. The engagement of the locking elements shall be achieved in such a way that a force in the opening direction of the door shall not diminish the effectiveness of locking. In the event that the locking action is effected by the action of spring, the spring shall act by compression and shall be guided and of such dimension that the coil is not compressed solid at the moment of unlocking. In the event of the spring no longer fulfilling its function, gravity shall not cause unlocking;
7. The locking device shall be protected against the risk of accumulation of dust, and tampering by external objects from below which could hinder its proper functioning;
8. The car door locking device shall comply with the minimum mechanical strength requirement as detailed in Clause 5.3.9.2 of the Lift COP, Section E, Part 1 such that at its locked position, the car door cannot be opened by itself, or by forcing open the door panels at any position by hands from inside the car, and/or by shaking of car door.

LTE2.11.070.9 LANDING DOOR LOCKING DEVICE

1. Landing door locking device shall be provided as detailed in Clause 5.3.8.1 and 5.3.9.1 of the Lift COP, Section E, Part 1;
2. The locking device shall be protected against the risk of accumulation of dust, and tampering by external objects from below which could hinder its proper functioning.

LTE2.11.080.9 DOOR LOCKING DEVICES TO BE INACCESSIBLE FROM LANDING AND CAR

All door locking devices and door switches, together with any associated actuating rods, levers or contacts, shall be so situated or protected as to be reasonably inaccessible from the landing and the car.

LTE2.11.090.A PROTECTIVE DEVICE

1. Safety edge shall be fitted to the leading edge of each car door panel to stop, reverse and fully re-open the car door panel in the event that the safety edge strikes an obstruction while closing. The requirements for the safety edge are as follows:
    a. The safety edge shall be so designed and installed that for centre opening doors the striking of an obstruction by either leading edge when closing shall cause it to function;
    b. The safety edge shall extend from not more than 25 mm above the sill (measured to the extended position of the safety edge) to a height of at least 1800 mm above the sill;
    c. The safety edge shall be fully retractable;
    d. The effect of the safety edge shall not be neutralized until the last 20 mm of travel of each door panel;
    e. The safety edge when striking an obstruction shall reverse the doors within the compliance (retractable length) of the safety edge;
    f. The safety edge when fully extended shall not protrude the door by more than 50 mm;

g. The safety edge shall not reduce the clear entrance width specified on the Drawings when the car door is fully open;

h. The force necessary to operate the safety edge shall not exceed 14.7 N;

i. The safety edge shall be of robust ridged surface aluminium construction.

2. In addition to the safety edge, a non-contacting detection device with multiple infrared beams shall be provided to give full protection along the leading edge of the car doors. Upon detecting an obstruction the device shall cause the closing door to stop before hitting the obstruction and reverse immediately to the fully open position. The requirements for the detection device are as follows:

a. The detection device shall be of curtain type composed of not less than 24 infrared beams, or other technology approved by the CM;

b. The detection field of the curtain shall cover the entire car opening width and extend from not more than 50 mm above the sill to a minimum height of 1800 mm above the sill;

c. The detection device shall be inoperative when the fireman's switch of the fireman's lift is activated.

LTE2.11.100.9 LANDING DOOR KEY

The Sub-contractor shall supply two landing door keys for each block upon completion of the installation.

LTE2.11.110.9 EMERGENCY LANDING OPENING IN LIFT WELL

1. Where emergency landing openings are required in the lift well, these openings shall be securely locked and electrically interlocked with the lift safety circuit. These openings shall be of same size as the normal landing entrance and be provided with normal landing doors complete with architraves;

2. The following warning notice in English and Chinese characters not less than 25 mm high shall be embossed onto a 1 mm thick stainless steel plate which shall be fixed onto the door by strong adhesive, with the lower edge of the notice plate at least 1500 mm above finished floor level:

DANGER

UNAUTHORIZED ACCESS PROHIBITED

LIFTWELL RESCUE DOOR

CLOSE AND LOCK THIS DOOR

危險

不得擅進

升降機槽救生門

請關閉並緊鎖此門

LTE2.11.120.A ARCHITRAVES

1. The Sub-contractor shall provide on all landing entrances, unless otherwise specified, architrave fabricated from at least 1.5 mm thick stainless steel sheet. Finishes of the landing architrave shall be of hairline, satin or wavy line pattern, as approved by CM;

2. All surfaces of architrave shall be formed true and gaps between sections shall not be allowed. Bolts shall not be visible on the exposed surfaces of the architraves;

3. A stainless steel tactile-braille plate for the blind people shall be provided and fixed on both sides of the architraves on all floors at 1200 mm above finished floor level. The tactile markings shall be Arabic numerals of minimum 60 mm high and raised 1 mm. The tactile-braille plates shall be 100 mm square with raised letter or numeral and corresponding Braille. The Braille messages provided on the tactile-braille plates at the architraves on each floor shall also tally with those provided on the lift push buttons. The tactile-braille plates shall be fixed by both strong adhesive and spot-welding or stainless steel rivet at four corners of the plate;
4. The design and construction of the architrave shall have no sharp edges or projections which will cause bodily injury to passengers.

LTE2.11.130.9 APRON SHEET BELOW EACH LANDING

1. The Sub-contractor shall provide a galvanized steel sheet of at least 1.5 mm thick below each landing threshold to comply with Lift COP and Clause 3.5 of the Lift Building Work COP;
2. A 150 mm high black and yellow warning stripe by spray painting shall be provided at the top edge of apron sheet as shown on the Drawing.

LTE2.11.140.9 DOOR SILLS

1. Door sills shall be of robust construction and shall be rigidly fixed to withstand the passage of loads to be introduced into the car. The thickness of any section of the sill shall be not less than 3 mm;
2. Car door sills shall be constructed of stainless steel;
3. Landing door sills for Passenger Lift (P) shall be constructed of extruded aluminium except the ones at ground floor or at main entrance access which shall be constructed of stainless steel;
4. Landing doors sills for Passenger Lift (F) and freight lift shall be constructed of stainless steel.

LTE2.11.150.9 MAXIMUM LIFT DOOR OPENING AND CLOSING TIME

Maximum lift door opening and closing time shall not exceed the following time specified:

Total Door Width	Opening Time	Closing Time
800 mm	2.0 sec.	2.0 sec.
900 mm	2.2 sec.	2.3 sec.
1000 mm	2.3 sec.	2.7 sec.
1100 mm	2.5 sec.	3.0 sec.

LTE2.11.160.9 TYPE TEST

The landing door locking device shall be type tested to the requirement of Clause 5.2 of BS EN 81-50 by an approved independent testing institution. The landing door shall be certified in accordance with the certification requirement in the FS Code. In addition, fire test report for stainless steel landing door with at least 1.5 mm thick and 1100 mm wide by 2100 mm high achieving the required fire resistance rating shall be provided. Documentary evidence on the above certification shall be submitted to the Contract Manager.

LTE2.11.170.9 WORKING PLATFORM INSIDE BLIND HOISTWAY FOR HOISTING ROPE INSPECTION

1. The access door to the working platform shall be a normal lift landing door complete with door locking device and architrave. The door shall be electrically interlocked with the lift safety circuit. The landing sill shall be installed such that the top level of the landing sill shall be the same level as that of the structural level of the working platform;

2. To avoid unauthorized entry to the working platform, on opening of the access door, the alarm sounders in the lift pit and the main entrance floor lift lobby shall sound continuously. A key-operated access door alarm overriding switch complete with appropriate label shall be provided in the lift machine room to override the door alarm system of the access door to the working platform. When the switch is put on the "override" position, the alarm sounders in the lift pit and the main entrance floor lift lobby shall not be activated by the operation of the access door to the hoisting rope inspection platform. A buzzer shall be provided adjacent to the door alarm overriding switch and the buzzer shall sound when the access door alarm overriding switch is put on the "override" position. The buzzer shall be silent if the overriding switch is put back to the "normal" position. The normal operation of the alarm button(s) inside the lift car cage shall not be affected by the operation of the access door alarm overriding switch;

3. On the access doors to the working platforms, the following warning notice in English and Chinese characters not less than 25 mm high and engraved on a 1 mm thick stainless steel sheet shall be provided. The notice plate shall be fixed by strong adhesive or rivets onto the access door, with the lower edge of the notice plate at least 1500 mm above finished floor level:

DANGER

UNAUTHORIZED ACCESS PROHIBITED

LIFTWELL

CLOSE AND LOCK THIS DOOR

危險

不得擅進

升降機槽

請關閉並緊鎖此門

4. Protection guards up to a height of 2.5 metres should be provided for all accessible moving hoisting or governor ropes. The design of the guards shall not affect the inspection work on the related ropes;

5. Ferrules which project at least 50 mm above the slab shall be provided for openings on the floor of the working platform. The gaps between the slab and the ferrules shall be water-sealed to prevent any water from directly dropping into the lift pit;

6. An emergency stopping device accessible on opening the access door, approximately 1.3 m above the floor of the working platform shall be provided to stop the lift and keep it stopped. This device shall be of the "push-to-stop, pull-to-run" type;

7. Wall mounted fluorescent light fittings shall be provided and mounted at 1800 mm above the working platform finished floor level such that the lux level on the floor level of the working platform should be at least 200 lux. A 5A lighting control switch accessible on opening the access door shall be provided;

8. A 13A socket outlet shall be provided.

LTE2.11.180.9 APRON SHEET BELOW CAR PLATFORM

A 150 mm high black and yellow warning strip by spray painting shall be provided at the top edge of apron sheet as shown on the Drawing.

LTE2.12 LANDING FIXTURES AND INDICATORS

LTE2.12.010.9 POSITIONING

1. A landing fixture shall be mounted adjacent to each lift landing entrance or between the landing entrances of duplex control lifts or group control lifts on the same floor or as shown on the drawings;
2. Landing indicators shall be provided at each lift landing and on other floors as shown on the Drawings.

LTE2.12.020.A CALL BUTTON

1. The landing fixture shall consist of landing call button(s) and illuminated call acceptance signal. The landing call button(s) with LED illuminators shall be mounted such that the call button top is 1200 mm above finish floor level unless otherwise specified on Drawings and shall be vandal-resistant and suitable for heavy use and approved by Contract Manager;
2. Except for lift(s) serving both domestic and non-domestic floors, the control of button(s) for lift(s) in non-domestic premises shall be equipped with contact-less function/feature i.e built-in sensor type and unless otherwise specified in the Specification. The design and mechanism of contact-less function/feature shall be the same as that provided inside the lift car;
3. The buttons shall be flush mounted on a stainless steel plate of with thickness not less than 2.5 mm. The plate shall be fixed by stainless steel secret-head screws;
4. The base box for call button shall be galvanised steel of thickness not less than 1.5 mm. Sample of the call button with the base box shall be submitted for the Contract Manager's approval;
5. Up/Down directional indications shall be engraved or embossed on the buttons or the mounting plate.

LTE2.12.030.9 LANDING INDICATORS

1. Landing indicator of dot-matrix type amber colour LED display, minimum 128 x 16 dots, actuated by reliable solid state circuitry shall be provided above each lift landing. The indicator shall be of robust design and impact resistance to a degree equivalent to that of polycarbonate material;
2. The indicator shall be able to display at least 32 messages. The dot-matrix display system shall be pre-programmed with the following messages/symbols to inform passengers the corresponding status of the lift:
    - Landing at which the car is stopped or passing
    - '超載 Overload';
    - '滿載 Full Load';
    - '暫停使用 Out of Service';
    - '消防員使用中 Used by Firemen';
    - '求助警鐘 Lift Alarm';
    - '例行保養,暫停使用 Routine Maintenance (Out of Service)';

- '維修中,暫停使用 Under Maintenance (Out of Service)';
- '清潔中,暫停使用 Cleaning in Progress (Out of Service)';
- '停置狀態,暫停使用 Parking Mode (Out of Service)';
- '升降機故障 Lift Breakdown';
- '火警,請勿使用升降機 Fire (Do Not Use The Lift)';
- Scrolling [UP] and [DOWN] arrow to indicate the lift travelling direction; and
- Other messages/symbols as required by the Contract Manager.

The height of each character in the dot-matrix indicator shall be 50 mm minimum. The luminous intensity of the indicator shall be at least 3500 μcd.

3. Fire alarm dry contact /signal shall be provided by FS contractor in lift machine room for displaying the message '火警,請勿使用升降機 Fire (Do Not Use The Lift)';
4. Messages/symbols of dot-matrix indicator shall be re-programmable such that changes, if required, can be effected to suit requirements arise after completion of the Works. Two (2) times of free messages/symbols revision within the Maintenance Period for the Contract shall be deemed to be included;
5. On floors served by only one lift, the landing indicators as described above for the other lifts shall be installed at their normal position where shown on the Drawings;
6. The base box for the landing indicators shall be galvanised steel of thickness not less than 1.5 mm thick. The box shall be adequately stiffened as necessary to avoid deformation after grouting by the Main Contractor. Sample of the floor indicator with the base box as well as the dot-matrix graphic layout and the pre-programmed messages shall be submitted for the Contract Manager's approval.

LTE2.12.040.9 MANUAL HOMING SWITCH

1. For each lift, a manual homing ON/OFF bi-stable switch to effect the home landing operation in compliance with Clause 5.12.1.12 of the Lift COP, Section E, Part 1 shall be provided at home landing floor for each lift;
2. The switch shall be flush mounted, and properly labelled in both English and Chinese on a stainless steel cover plate of at least 1.5 mm thick with glass vision panel. The cover plate shall be hinged and lockable with a key;
3. Common key shall operate all locks on the cover plates for the homing switches of the same building block. Two master keys shall be provided for each building block to the Contract Manager upon completion of the earliest Section of the Sub-contract Works.

LTE2.12.045.9 MANUAL PARKING SWITCH

1. Except for single lift, a manual parking ON/OFF key switch to effect lift parking mode in compliance with the BEC shall be provided for each lift at the position immediately below the manual homing switch;
2. The manual parking ON/OFF key switch shall be flush mounted on a stainless steel cover plate of at least 1.5 mm thick, and shall have label, engraved or embossed in both English and Chinese characters as follows:

   "Parking Switch 停置掣"

3. Common key shall operate all parking switches of the same building block. The master keys for the parking switches shall be provided for each building block to the Contract Manager upon completion of the earliest Section of the Sub-contract Works;

4. When the parking switch is operated, the following automatic functions shall be performed for the lift:

   a. The message/symbol '停置狀態, 暫停使用 Parking Mode (Out of Service)' shall be displayed at all landing indicators;

   b. Car call buttons and landing call buttons shall become inoperative, and new car calls and landing calls shall not be registered;

   c. The lift shall continue to operate until the already registered car calls and landing calls are answered;

   d. The lift shall then return to the home landing for parking;

   e. The lift doors shall open, then close after a few seconds and remain closed;

   f. The alarm button and the door open button in the car shall remain operative;

   g. The ventilation fan in the car shall be shut off;

   h. Only one lighting circuit for the car shall remain on and the rest shall be shut off;

   i. The CCTV camera in the car shall remain operative;

   j. The fireman's switch upon operation shall override the functions of the parking switch.

LTE2.12.050.9 AUDIBLE SIGNALS AND VERBAL ANNUNCIATION

1. An audible signal shall be provided at the lift entrance to indicate the lift car arrival and its direction of travel. The audible signal shall sound once for up direction and twice for down direction, and shall activate before the arrival of the lift;

2. Before arrival and opening of lift doors, a verbal annunciation of "樓層 stopping floor; 請勿貼近機門 stand clear of door" in Cantonese, Putonghua and English shall be initiated inside the lift car;

3. An audible signal, distinguishable from that for sub-clause (1), such as buzz sound, shall be provided to signify the closing action of the doors on departure to alert people;

4. After closing of lift doors on departure, another verbal annunciation of "往上/下 going up/down" in Cantonese, Putonghua and English shall be provided before initiating the verbal annunciation in sub-clause (2);

5. When the lift restarts after resumption of normal supply, a verbal annunciation of " 升降機正在重新啟動 Lift is restarting" in Cantonese, Putonghua and English shall be initiated inside the lift car repeatedly until the lift restarted;

6. When the lift is searching for or going to home/the nearest landing to resume normal operation, another verbal annunciation of "升降機正前往最近樓層 Lift is travelling to the nearest landing" in Cantonese, Putonghua and English shall be initiated inside the lift car repeatedly until the car arrived home/the nearest landing. When home/the nearest landing is arrived, another verbal annunciation of "升降機已回復正常操作，請按開門或目的地樓層按鈕 Lift has resumed normal operation, please press door open or destination floor button" in Cantonese, Putonghua and English shall be initiated once inside the lift car;

7. Script content of the verbal annunciations shall be re-programmable such that changes, if required, can be effected to suit requirements arise after completion of the Works. Two (2) times of free script revision within the Maintenance Period for the Contract shall be deemed to be included;

8. Volume of the audible signals and verbal annunciations in sub-clauses (1), (2), (3), (4), (5) and (6) shall be adjustable such that changes can be effected at no cost to the Employer to suit operational needs after completion of the Works. For sub-clauses (1) and (3), an automatic timer-controlled volume adjusting device shall be provided to produce two pre-set volume levels respectively for day and night operation modes;

9. The speaker for the audible signals and verbal annunciations shall be located at high level above the car control panel in the lift car.

LTE2.13 CAR CAPACITY AND LOADING

LTE2.13.020.9 PASSENGER LIFT (F) AND FREIGHT LIFT

The minimum rated load for Passenger Lift (F) and freight lift shall be based on a load of not less than that for a Passenger Lift (P) of the same net inside floor area.

LTE2.13.030.9 ADJUSTABLE DEVICE FOR BY-PASSING OF INTERMEDIATE LANDING CALLS

An adjustable device for bypassing of intermediate landing calls without their cancellation during a lift journey shall be provided for the lifts and preset to operate at 90% of the contract load value.

LTE2.14 LOAD PLATES, NOTICE BOARDS AND INSTRUCTIONS

LTE2.14.010.9 LOAD PLATE

1. A load plate giving the rated load of the lift shall be fitted in each lift car in a conspicuous position;
2. For passenger lifts the rated load shall be given in kilograms and persons, each of which is regarded as weighing 75 kg.

LTE2.14.020.A NOTICES AND WARNING SIGNS

The following notice boards and warning signs shall be provided as detailed in the Project Specific Specification and Drawings:

1. In each car, the name of the lift company, telephone number, lift number, use permit, emergency instructions, inter-com symbol and user instruction shall be engraved onto stainless steel plate not less than 1.5 mm thick and fixed at the car panel by stainless steel secret-head screws as shown on the Drawings. Use permit shall be placed under clear acrylic plastic plate at least 5 mm thick and fixed rigidly by stainless steel secret-head screws at the location as shown on the Drawings;
2. In each car, the following English and Chinese characters not less than 15 mm high with graphic symbol shall be engraved onto stainless steel plate not less than 1.5 mm thick and fixed at the car panel by stainless steel secret-head screws as shown on the Drawings.

   "IN CASE OF FIRE DO NOT USE THE LIFT"

   "如遇火警 切勿使用升降機"
3. In each car, the following English and Chinese characters not less than 10 mm high and a pictograph shall be engraved onto stainless steel plate of size as shown on the Drawings, not less than 1.5 mm thick and fixed rigidly onto the car panel by stainless steel secret-head screws at the location as shown on the Drawings.

   "KEEP CLEAR OF LIFT DOORS"

   "小心升降機門"
4. The following information shall be engraved on a stainless steel plate not less than 1.5 mm thick fixed rigidly over the main entrance floor landing of each lift:
   a. Lift Number;
   b. Floors served;
   c. Name of lift company and contact telephone no in case of emergency repair and breakdown, etc..
5. In each Passenger Lift (F) car, the following additional warning notices in English and Chinese characters not less than 25 mm high shall be engraved onto a stainless steel plate not less than 1.5 mm thick and fixed at the rear panel by stainless steel secret-head screws at the locations as shown on the Drawings:
   a. "LOADING AND UNLOADING BY INDUSTRIAL POWERED TRUCK IN LIFT CAR PROHIBITED"

      "嚴禁使用機動鏟車在升降機裝卸貨物"
   b. "A SINGLE PIECE OF GOODS SHOULD NOT EXCEED xx kg"

(Note: a quarter of the rated load of the lift)

"每件貨物不准超過 xx 公斤"

6. In each freight lift car, the following additional warning notices in English and Chinese characters not less than 25 mm high shall be engraved onto a stainless steel plate not less than 1.5 mm thick and fixed at the rear panel by stainless steel secret-head screws at the locations as shown on the Drawings:

   a. "LOADING AND UNLOADING BY INDUSTRIAL POWERED TRUCK IN LIFT CAR PROHIBITED"

      "嚴禁使用機動鏟車在升降機裝卸貨物"

   b. "THIS IS A FREIGHT LIFT AND SHALL NOT BE USED AS A PASSENGER LIFT"

      "此乃載貨升降機, 不准用作運載乘客"

   c. "A SINGLE PIECE OF GOODS SHOULD NOT EXCEED xx kg"

      (Note: a quarter of the rated load of the lift)

      "每件貨物不准超過 xx 公斤"

7. In each freight lift car, an instruction plate as detailed in LTE2.11.050 shall be provided;

8. At each landing the following English and Chinese characters not less than 15 mm high for sub-clause (8)(a) and not less than 10 mm high for sub-clause (8)(b) and a pictograph shall be engraved onto a stainless steel plate not less than 1.5 mm thick and fixed by the Contractor at the location as shown on the Drawings.

   a. "IN CASE OF FIRE DO NOT USE THE LIFT"

      "如遇火警 切勿使用升降機"

   b. "KEEP CLEAR OF LIFT DOORS"

      "小心升降機門"

9. At each landing of freight lift the following warning notices in English and Chinese characters not less than 25 mm high shall be provided by the Contractor:

   a. "LOADING AND UNLOADING BY INDUSTRIAL POWERED TRUCK IN LIFT CAR PROHIBITED"

      "嚴禁使用機動鏟車在升降機裝卸貨物"

   b. "THIS IS A FREIGHT LIFT AND SHALL NOT BE USED AS A PASSENGER LIFT"

      "此乃載貨升降機, 不准用作運載乘客"

   c. "A SINGLE PIECE OF GOODS SHOULD NOT EXCEED xx kg"

      (Note: a quarter of the rated load of the lift)

      "每件貨物不准超過 xx 公斤"

10. In each car a 'DANGER, DO NOT FORCE OPEN LIFT DOORS' sign in English and Chinese characters with pictograph shall be engraved onto a stainless steel plate of not less than 1.5 mm thick and fixed rigidly by stainless steel secret-head screws at the location as shown on the Drawings. The size of the English and Chinese characters shall be as follows:

English Letters	Chinese Characters	Minimum Size

"DANGER"	危險	10 mm
"DO NOT FORCE OPEN LIFT DOORS"	切勿強行打開升降機門	10 mm

11. In each lift car, a use permit board of design and construction as shown on the drawings and with size suitable for housing the use permit in compliance with EMSD's requirements shall be fixed rigidly onto the car panel and at a height level so that the bottom of the board is at least 1 m above floor level and the top of the board is not higher than 1.8 m above floor level;

12. At each lift lobby where entry to the building can be gained, an appropriate number of International Symbol for Access for People with a Disability will be provided by the Contractor;

13. Approved electric shock treatment notice mounted in an anodised aluminium frame with transparent plastic front plate of 3 mm minimum thickness and wooden backing board of 5 mm minimum thickness shall be prominently displayed in each lift machine room;

14. The lift machinery and the lift control panels shall be properly labelled and identified with the lift number to facilitate working on the correct equipment safely;

15. Black and yellow warning stripes by spray painting shall be provided on the floor trunking in lift machine room, and the ferrules of liftwell top vent;

16. Approved notice of safe working at lift pit shall be fixed with ties, screws or other suitable fasteners to the counterweight screen located at the lift pit of each lift;

17. At the highest landing entrance and rope inspection room for each lift, a lift identification plate of not less than 1.5 mm thick stainless steel onto which the lift number is engraved shall be provided by the Contractor;

18. At the building entrance, the following English and Chinese characters in engraved wording on plate of minimum size 200 mm × 200 mm shall be provided by the Contractor:

注意

在本 (大廈 / 停車場 / 商場 / 辦事處) 設置的閉路電視系統會收錄影像作保安及管業用途，所收錄的資料將會依照個人資料 (私隱) 條例的規定處理。

ATTENTION

The CCTV System installed in this (building / carpark / shopping centre / office) will record video images for security and building management purposes. The recorded data will be processed in accordance with Personal Data (Privacy) Ordinance.

LTE2.14.030.9 EMERGENCY RELEASE EQUIPMENT AND INSTRUCTIONS

A board or suitable container for the necessary tools, together with clear instructions on the method for moving the lift car and releasing passengers in an emergency shall be positioned in the machine room in a conspicuous manner. At least one set of such equipment and instruction shall be provided in each lift machine room. For machine-room-less lift, such equipment and instruction shall be provided at a location acceptable to the Contract Manager.

LTE2.15 SAFETY GEAR AND GOVERNOR

LTE2.15.010.9 PROVISION OF SAFETY GEAR

1. Every lift shall be provided with a safety gear attached to the car frame and place beneath the car platform;
2. Where any space located below any liftway is accessible to persons, the counterweight, as well as the car, shall be provided with a safety gear if there is no solid pier below the counterweight extending down to solid ground.

LTE2.15.020.9 GENERAL REQUIREMENTS OF SAFETY GEAR

1. Safety gear shall comply with the following general requirements:
   a. It shall only be possible to release car (or counterweight) safety gears by raising the car (or counterweight);
   b. Each car or counterweight safety gear shall be operated by means of its own overspeed governor;
   c. The application of the safety gear shall not cause the car platform to slope at more than 1 in 20 to the horizontal;
   d. It shall not be possible for vibration of the car frame to cause a safety gear to be applied.
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the safety gears delivered to the site or installed.

LTE2.15.030.9 TYPE TEST OF SAFETY GEAR

The safety gear shall be type tested to the requirements of Clause 5.3 of BS EN 81-50 by an approved independent testing institution. Type test certificate to this effect shall be submitted to the CM.

LTE2.15.040.9 OVERSPEED GOVERNOR

1. The overspeed governor shall be of the centrifugal type and shall operate the safety gear in case the speed of the car reaches the tripping speed in accordance with Clause 5.6.2 of the Lift COP, Section E, Part 1;
2. The overspeed governor installed inside lift machine room shall not return, after tripping, automatically into the normal position as the car / counterweight is moved in the upward direction;
3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the overspeed governors delivered to the site or installed.

LTE2.15.050.9 ELECTRICAL CHECKING ON OPERATION OF OVERSPEED GOVERNOR

The overspeed governor shall initiate the stopping of the lift machine before the car speed, either up or down, reaches the tripping speed of the governor in accordance with Clause 5.6.2.2.1.6 of the Lift COP, Section E, Part 1.

LTE2.15.060.9 GOVERNOR ROPES

1. The governor ropes shall not be less than 6 mm in diameter and shall be tensioned by a tensioning pulley. This pulley (or its tensioning weight) shall be guided;

2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the governor ropes delivered to the site or installed.

LTE2.15.070.9 TYPE TEST OF GOVERNOR

The overspeed governor shall be type tested to the requirements of Clause 5.4 of BS EN 81-50 by an approved independent testing institution. Type test certificate to this effect shall be submitted to the CM.

LTE2.15.080.9 ASCENDING CAR OVERSPEED PROTECTION MEANS

1. Every traction drive lift shall be provided with ascending car overspeed protection means in accordance with the Lift COP. The ascending car overspeed protection means shall be type tested to the requirements of Clause 5.7 of BS EN 81-50 or other approved international standards;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the ascending car overspeed protection means delivered to the site or installed.

LTE2.15.090.9 UNINTENDED CAR MOVEMENT PROTECTION MEANS

1. Every traction drive lift shall be provided with unintended car movement protection means in accordance with the Lift COP;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the unintended car movement protection means delivered to the site or installed.

LTE2.16 OVERLOAD DEVICE

LTE2.16.010.9 PROVISION OF OVERLOAD DEVICE

Every lift shall be provided with an overload device which shall be of fail safe design, or of such a design that the device shall not be damaged by excessive overloading, and shall operate when the load in the car is ten percent or more in excess of the rated load in respect of such lift.

LTE2.16.020.9 OPERATION OF OVERLOAD DEVICE

1. The overload device, when in operation, shall:
   a. Prevent any movement of the car;
   b. Prevent the closing of any power operated door whether fitted to the car or to the landing at which the car is resting;
   c. Give audible and visible signals;
   d. The audible and visual signals shall be positioned at the same level as the car position indicator;
   e. The visual signal shall have characters that are not visible when not operating and shows amber in colour when illuminated from behind with a flashing light when in operation; and
   f. The visible signal shall be in both English and Chinese characters as follow:

      "OVERLOAD"

      "超重"
2. The lift shall resume normal operation automatically on removal of overload. The overload device shall be inoperative whilst the lift car is in motion.

LTE2.16.030.9 FLOATING PLATFORM TYPE NOT ACCEPTABLE

Overload device installed on a floating platform is not acceptable.

LTE2.17 LIFT MACHINERY FOR ELECTRIC LIFT

LTE2.17.010.9 LIFT MOTOR

1. The main driving motor shall be of quiet running type, and shall be designed to operate for an unlimited period according to the expected duty of the lift;
2. Lift motor ratings in terms of number of starts per hour shall be not less than those in the following Table:

Rated speed, v in m/s	Number of starts per hour
$v \leq 1.0$	150
$1.0 < v \leq 1.75$	180
$v > 1.75$	240

3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the lift motors delivered to the site or installed.

LTE2.17.020.9 REDUCTION GEAR

Conventional worm reduction gear shall be employed for geared lift machine. Helical or planetary reduction gear may be accepted provided that the gear system of the same speed range has proven satisfactory in-service record stipulated in LTE1.5.020.

LTE2.17.030.9 BEARINGS

Bearings for motor shall be of the sleeve ring type or ball bearing type with oil ring. Reduction gear box shall be provided with journal and thrust bearings suitable for the application.

LTE2.17.040.9 HAND WINDING FACILITIES

1. Provision shall be made for each lift whereby the lift car can be raised or lowered in an emergency by manual operation. The direction of winding corresponding to the raising and lowering of the lift car shall be clearly indicated;
2. The hand winding apparatus, when detachable and portable, shall be mounted in an accessible and conspicuous position in the machine room. If the detachable/portable apparatus is suitable for use with four or more lifts installed in the machine room, at least two sets of such apparatus shall be provided;
3. For lift where the manual effort to raise the car with its rated load exceeds 400 N, an emergency electrical operation device to permit emergency electrical operation in accordance with Clause 5.12.1.6 of the Lift COP, Section E, Part 1 shall be provided for each lift.

LTE2.17.050.9 BRAKES

Every lift machine shall be provided with a brake that is mechanically applied and electrically held off. The brake shall be capable of stopping the machine when the car is downward travelling at its rated speed with 125% rated load. It shall be fitted with an emergency release which shall remain open only while manual pressure is being applied.

LTE2.17.060.9 ELECTRIC SERVICE LIFT

Please refer to the specification requirements specified in the Project Specific Specification.

LTE2.17.080.9 REGENERATIVE POWER

1. For every lift with lift motor rating of 8kW or above, controller / inverter / converter with appropriate facilities shall be provided to condition and feed the regenerative power induced during operation of the lift back to the power line for use by other lifts or electrical installations in the building;
2. Filtering facility shall be incorporated to ensure proper regenerative power quality such that the voltage and frequency shall not exceed ±6% and ±2% respectively of the rated supply in accordance with the Supply Rules of the concerned power supply company and that the extent of harmonic distortions shall comply with the concerned power supply company's requirements;
3. The Sub-contractor shall submit to the CM a report on the quality of the regenerative power upon completion of testing and commissioning of each lift to demonstrate compliance with the requirements of the concerned power supply company.

LTE2.18 CONTROLLER

LTE2.18.010.9 CONSTRUCTION

1. Unless otherwise specified, the controller shall be mounted in a ventilated steel cubicle with hinged doors at the front, in which all contactors, solenoids, relays, electronic cards and motor starting equipment, etc. shall be fitted;
2. Panels at the rear of the cubicle shall be of removable hinged type if access for routine maintenance at the rear is required.

LTE2.18.020.9 GENERAL REQUIREMENTS

1. The controller shall comply with the general requirements as stated in the Lift COP, Section E, Part 1 and the following features shall be included:
    a. Materials used in the construction of the control equipment shall not support combustion;
    b. The components shall be designed and mounted in a manner which facilitates inspection, maintenance, adjustment and replacement. Wirings shall be terminated in such a way that the wires are not damaged. Accessible terminals suitably marked, shall be provided for all cables;
    c. Control circuits shall be supplied through a double wound isolating transformer to BS EN 61558-1, and BS EN 61558-2-23 or IEC 61558-2-23;
    d. Where rectifier is used it shall be of the full wave silicon type fed from a transformer;
    e. The control circuits shall be protected by suitably rated miniature / moulded case circuit breakers or fuses to BS EN 60269-1 or BS 88-1, and BS HD 60269-2 or BS 88-2 independent of the protection of the mains circuits;
    f. The brake solenoid and any retiring cam shall operate on direct current;
    g. Motors connected to polyphase a.c. power supplies shall incorporate means to prevent the motor from being energised in the event of phase failure and / or phase reversal;
    h. A main switch shall be provided by the Electrical Sub-contractor for each lift capable of breaking the supply to the lift on all conductors and interrupting the highest current involved in normal conditions of use in accordance with Clause 5.10.5 of the Lift COP, Section E, Part 1;
    i. Interruption of the power supply or isolation of the main switch and / or other isolation / switching devices pertaining to one of the lifts under duplex control or group control shall not affect the normal operation of the other lift(s);
    j. In the event of out of service of one of the lifts under duplex control or group control, the other lift(s) shall be able to remain in normal service while the out-of-service lift is under repair or servicing.
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the controllers delivered to the site or installed;
3. Insulation rubber mat complying with BS 921 shall be provided on the floor in front of, and also at the rear of the lift control panel and other electrical switchboards in the lift machine room, if access for routine maintenance at the rear is required, for better protection against electric shock.

LTE2.18.030.9 MICROPROCESSOR-BASED CONTROL

Microprocessor-based control shall include the following design features:

1. Interruption of the electrical supply to the lift shall not affect the system memory or software;
2. It shall be possible to change the supervisory control algorithm to meet a change in building use by re-programming the instruction memory;
3. It shall be possible to display information on the operational status of the lift and to locate fault by having means of access/test points on the controller, self-diagnosis circuits with visual indicator or equivalent means to facilitate ease of maintenance and quick repairing, and printed circuit board modules shall be used;
4. Multiplexing techniques may be employed to reduce the number of trailing cables normally required, if considered cost effective to do so.

LTE2.19 AUTOMATIC CONTROL SYSTEM

LTE2.19.010.9 DOWN COLLECTIVE CONTROL FOR SINGLE LIFT ("SIMPLEX" DOWN COLLECTIVE CONTROL)

1. All calls shall be stored in the system and answered in sequence regardless of the order in which they are registered;
2. When travelling in the "Up" direction, the car travels to the highest call, stopping at any intermediate floor for which a car call has been registered. On stopping for the highest call, preference is established for the "Down" direction;
3. When travelling downwards the car stops for all car and landing calls that have been registered. When all calls have been answered, the car remains with doors closed at the floor to which it last travelled.

LTE2.19.020.9 DOWN COLLECTIVE CONTROL FOR TWO INTER-CONNECTED LIFTS ("DUPLEX" DOWN COLLECTIVE CONTROL)

In addition to the features as required in LTE2.19.010, it shall include the following control features:

1. When both cars are away from the terminal floor and all calls have been answered, one car shall return automatically to the terminal floor and referred to as the "Next" car. The second car remains at the floor which it last deposited passengers and is referred to as the "Free" car. Both cars stand with doors closed;
2. With the cars standing with doors closed as described in sub-clause (1) above the first landing call shall be answered as follows:
    a. If a terminal floor call, by the "Next" car;
    b. If from any other floor, by the "Free" car.
        i. With the "Free" car answering calls, the "Next" car shall not start for "Down" calls behind the "Free" car until the "Free" car is descending;
        ii. Should the "Free" car return to the terminal floor and the doors close after a passenger comes in, the passenger shall be able to register a call and travel to any destination. With both cars standing at the terminal floor with doors closed, the "Next" car (i.e. the one that arrived first) shall answer the first landing call. Directional preference shall be maintained when a car stops for its last call until the doors close.

LTE2.19.025.9 DOWN COLLECTIVE CONTROL FOR MORE THAN TWO INTER-CONNECTED LIFTS

In addition to the features required in LTE2.19.010, the control shall include features similar to those in LTE2.19.020 and shall include also, but not be limited to, the following features:

1. Group supervisory control system which shall incorporate a micro-computer or other similar solid state devices which continuously monitor the transportation demand and automatically adjust the group operation to suit the prevailing traffic pattern and to optimise passenger waiting time;
2. Control system features as described below:
    a. Heavy ‘Up’ traffic

When heavy 'Up' traffic is detected, at least two lift cars shall be assigned automatically to the terminal floor. Car(s) not assigned to the terminal floor shall continue to answer demands elsewhere in the building in the normal manner;

b. Heavy 'Down' traffic

When heavy 'Down' traffic is experienced, the despatching system shall ensure that lift service is equally distributed through the building and fully loaded car(s) shall automatically bypass landing calls in order to prevent unnecessary stops;

c. Light traffic

As traffic requirements diminish, car(s) shall complete their assignments and park with closed doors wherever they happen to be;

d. Car preference

It shall be possible to withdraw any car(s) from service for maintenance purposes or for attendant control by means of a key operated switch. Under this condition, other car(s) in the bank shall continue to answer calls in the system;

e. Car separation

Out-of-order car(s) shall be automatically separated from the group, while the remaining ones shall continue to operate under group supervision.

LTE2.19.030.9 FULL COLLECTIVE CONTROL FOR SINGLE LIFT

1. All calls shall be stored in the system and answered in sequence regardless of the order in which they are registered;
2. When the car is in motion in a given direction it shall travel to the further-most call, stopping at any intermediate floor for which a car call or landing call for the corresponding direction of travel has been registered;
3. Landing calls for the direction opposite to that in which the car is travelling shall be by-passed but will remain stored in the system to be answered when the car returns in the opposite direction;
4. When the car stops for the last call in its direction of travel, car preference is established for an adjustable period;
5. When all calls have been answered the car remains with doors closed at the floor to which it last travelled.

LTE2.19.040.9 FULL COLLECTIVE CONTROL FOR TWO INTER-CONNECTED LIFTS

In addition to the features as required in LTE2.19.030, it shall include the following supervisory feature:

1. When both cars are away from the terminal floor and all calls have been answered, one car shall return automatically to the terminal floor and is referred to as the "Next" car. The second car remains at the floor to which it last travelled and is referred to as the "Free" car. Both cars stand with doors closed;
2. With the "Free" car answering calls, the "Next" car shall not start for "Up" calls or "Down" calls behind the "Free" car until the "Free" car is descending. If the "Free" car is delayed the controller shall operate to dispatch the "Next" car;
3. With both car standing at the terminal floor with doors closed the "Next" car shall answer the first landing call;
4. Should the "Free" car return to the terminal floor and the doors close after a passenger comes in, the passenger shall be able to register a call and travel to any destination; and

5. For lift serving lift tower or podium, the terminal floor as referred in sub-clauses (1) to (4) above for the purpose of lift car control shall mean the entrance / exit floor connecting to the domestic building it serves.

LTE2.19.045.9 FULL COLLECTIVE CONTROL FOR MORE THAN TWO INTER-CONNECTED LIFTS

In addition to the features required in LTE2.19.030, the control shall include features similar to those in LTE2.19.040 and shall include also, but not be limited to, the following features:

1. Group supervisory control system which shall incorporate a micro-computer or other similar solid state devices which continuously monitor the transportation demand and automatically adjust the group operation to suit the prevailing traffic pattern and to optimise passenger waiting time;
2. Control system features as described below:
   a. Heavy 'Up' traffic

      When heavy 'Up' traffic is detected, at least two lift cars shall be assigned automatically to the terminal floor. Car(s) not assigned to the terminal floor shall continue to answer demands elsewhere in the building in the normal manner;

   b. Heavy 'Down' traffic

      When heavy 'Down' traffic is experienced, the despatching system shall ensure that lift service is equally distributed through the building and fully loaded car(s) shall automatically bypass landing calls in order to prevent unnecessary stops;

   c. Light traffic

      As traffic requirements diminish, car(s) shall complete their assignments and park with closed doors wherever they happen to be;

   d. Car preference

      It shall be possible to withdraw any car(s) from service for maintenance purposes or for attendant control by means of a key operated switch. Under this condition, other car(s) in the bank shall continue to answer calls in the system;

   e. Car separation

      Out-of-order car(s) shall be automatically separated from the group, while the remaining ones shall continue to operate under group supervision.

LTE2.19.050.9 DOUBLE DUPLEX DOWN COLLECTIVE CONTROL

1. Double Duplex Down Collective Control shall be provided as shown on the Drawings for three lifts arranged in two groups serving two different floor zones (i.e. lower zone and higher zone). Two of the three lifts shall serve the high and low zones respectively while the remaining one serves both zones;
2. The Double Duplex Down Collective Control system shall be capable of achieving the following:-
   a. In case of landing call(s) registered at the lower zone, the group control system shall deploy the low-zone lift or the two-zone lift or both to answer the call(s) with due consideration of the current car locations, car calls registered and travelling directions so as to optimize the passenger waiting time and even out the lift usage;

b. In case of landing call(s) registered at the higher zone, the group control system shall deploy the high-zone lift or the two-zone lift or both to answer the call(s) with due consideration of the current car locations, car calls registered and travelling directions so as to optimize the passenger waiting time and even out the lift usage;

c. In case there are simultaneous landing calls registered at the lower zone and at the higher zone, the group control system shall deploy one or two or all of the three lifts to answer the landing calls with due consideration of the current car locations, car calls registered and travelling directions so as to optimize the passenger waiting time and even out the lift usage.

LTE2.20 LIFT POWER SYSTEM AND LEVELLING

LTE2.20.010.9 GENERAL REQUIREMENT

Lift power system shall be AC variable voltage variable frequency (ACVVVF) system using gearless drive.

LTE2.20.050.9 LEVELLING ACCURACY

Levelling accuracy of the lift system shall not exceed ± 10 mm.

LTE2.20.060.9 AUTOMATIC RE-LEVELLING

Automatic re-levelling shall be provided for lift of rated speed of 2.5 m/s and above and for lift where the lift machine is more than 60 m above the lowest landing door, to maintain the accuracy of stopping at landing within ± 10 mm such that the transient overshooting value of ± 20 mm should not be exceeded at any time including during loading and unloading of the lift car.

LTE2.20.070.9 MAXIMUM ALLOWABLE ELECTRICAL POWER, TOTAL HARMONIC DISTORTION AND TOTAL POWER FACTOR OF LIFTS

The maximum allowable electrical power, total harmonic distortion and total power factor of each lift shall comply with the requirements stipulated in the BEC.

LTE2.20.080.A MAXIMUM STARTING KVA, MAXIMUM STARTING KW AND MAXIMUM REGENERATIVE POWER OF LIFTS

The maximum starting kVA, maximum starting kW and maximum regenerative power of lifts shall comply with the table below:

Rated Load	Rated Speed (m/s)	Maximum Starting (kVA)	Maximum Starting (kW)	Maximum Regenerative Power (kW)
900kg / 1000kg	1	41	40	8
	1.75	58	44	12
	2.5	60.7	48.5	16
	3.5	76	76	20
1250kg	1.75	64	55	16
	2.5	83	67	21
	3.5	102	82	26
1600kg	1.75	72.2	71	19.3

LTE2.21 LIFT ALARM SYSTEM

LTE2.21.010.9 GENERAL REQUIREMENTS

1. The Sub-contractor shall supply and install a lift alarm system including all sensing devices, cabling, flexible conduits, alarm sounders, batteries, indication panels and accessories;

2. This system shall operate as follows:

   a. Alarm sounders shall be provided on top of the lift car, in the main entrance lift lobby, at the lift pit, in the guard counter or location(s) as shown on the Drawings, and in the lift machine room or at the maintenance access panel for machine-room-less lift. These alarm sounders shall be connected to the emergency battery normally maintained by trickle charger from A.C. source;

   b. Theses alarm sounders shall be arranged to sound as long as the alarm push button inside the car is being pressed;

   c. Alarm sounders shall be of electronic type with the following two-tone pattern:

      Low frequency: 600Hz (±15%) Duration: 600 ms (±20%)

      High frequency: 920Hz (±15%) Duration: 300 ms (±20%)

      The alarm sounders shall be impact resistant, suitable for conduit entry and with a finish colour approved by the Contract Manager. Alarm sounders for outdoor installation shall be weatherproof to IP 65;

   d. An emergency alarm push button together with an intercom shall be provided in the lift car and be connected to the guard counter or location(s) as shown on the Drawings, and the lift machine room or maintenance access panel for machine-room-less lift. Alarm sounder, indication light and intercom connected to the lift car shall be provided in the guard counter or location(s) as shown on the Drawings, and in the lift machine room or maintenance access panel for machine-room-less lift. An alarm sounder connected to the alarm push button in the lift car shall also be provided at the main entrance lift lobby and at the lift pit;

   e. The alarm sounders shall sound and the indication lights shall be lit if the alarm push button is pressed. The indication lights shall remain on until they are manually reset by activation of a reset button inside the guard counter/main entrance lift lobby or as shown on the Drawings upon releasing of trapped passengers. The hook switch of an intercom handset shall not be used as the indication lights reset button. The sound generated by the alarm sounders shall be distinguishable from that of fire alarms;

   f. An indication light for acknowledgment shall be provided in the lift car. The indication light for acknowledgment shall be in the form of a blinking light adjacent to the intercom speaker and the following notice shall be provided next to the blinking light:

      "When light blinks, it indicates your emergency call has already been received. Please be patient and wait for the rescue."

      "此燈閃亮時，表示已收到求救信息，請耐心等候救援"

      The indication light for acknowledgment shall blink after the manual activation of an acknowledgment switch located in the guard counter/main entrance lift lobby. The blinking shall continue until the acknowledgment switch is reset;

g. Separate lift alarm/indication/intercom system shall be provided for each lift. In the lift machine room, separate lift alarm/indication/intercom panels constructed of 1.5 mm thick hairline stainless steel shall be provided for each lift adjacent to each lift control panel. In the guard counter/main entrance lift lobby, a combined lift alarm/indication/intercom panel constructed of 1.5 mm thick hairline stainless steel shall be provided;

h. A pair of voltage free contacts for each lift shall be provided and terminated as shown on the Drawings for connection to the local alarm system by others. The contacts shall be normally open and shall close when the alarm push button in lift car is being pressed;

i. The lift alarm system for all lifts shall be provided as detailed in Clause 5.12.3 of the Lift COP, Section E, Part 1;

j. For each of the lifts, a lift failure indication light shall be provided in the guard counter/main entrance lift lobby as shown on the Drawings. The lift failure indication light shall be lit and the alarm sounder in the guard counter/main entrance lift lobby mentioned in LTE2.21.010 (2)(a) shall sound when the lift is caused to stop under the following fault conditions:

   i. Actuation of any safety devices, e.g. the stopping device and inspection operation switch on the car roof, but excluding the lift door safety devices;

   ii. Power supply failure for lifts; or

   iii. Malfunction of ventilation fan for the lift well, when applicable.

The alarm sounder shall continue to sound until manually muted by activation of the reset button in LTE2.21.010 (2)(i). The lift failure indication light shall remain on until the fault is cleared and the actuated safety devices resume to the normal condition.

LTE2.21.020.9 CABLING FACILITIES BY ELECTRICAL SUB-CONTRACTOR

The Electrical Sub-contractor will be responsible for the provision of the portion of concealed conduit and accessories for the lift alarm system as shown on the Drawings.

LTE2.21.030.9 FLOOD ALARM SYSTEM FOR LIFT TOWER

1. In addition to requirements of lift alarm system specified in clause LTE2.21.010, the Sub-contractor shall supply and install a flood alarm system for lift tower to detect the occurrence of flooding in lift pit and alert the management office / maintenance personnel to take remedial action;

2. The alarm sounder at the main entrance lobby of lift tower and guard counter of nearby domestic block shall sound upon actuation of water level sensor of the flood alarm system at the pre-set high level due to flooding of the lift pit. The alarm sounder at guard counter shall continue to sound until manually muted by activation of the reset button at guard counter of nearby block. The alarm sounder at the main entrance lobby of lift tower shall remain on until manually muted by activation of the reset button at local lift alarm indication panel in the lift machine room of lift tower or at the maintenance access panel for machine-room-less lift;

3. Separate flood alarm indication light for each lift pit shall be provided at master lift alarm indication panel at guard counter of the nearby domestic block/estate management office and local lift alarm indication panel in the lift machine room of lift tower or at the maintenance access panel for machine-room-less lift. The flood alarm indication light shall remain on until water level sensor resume to normal condition;

4. A pair of voltage free contacts for flood alarm of each lift pit shall be provided and terminated as shown on the Drawings for connection to the local alarm system of the nearby domestic block by others. The contacts shall be normally open and shall close when the water level sensor at lift pit is actuated.

LTE2.22 FIRE SERVICES REQUIREMENTS

LTE2.22.010.9 FIREMAN'S LIFTS

Where called for in the Project Specific Specification or on the Drawings, fireman's lift(s) shall be provided which shall satisfy the following conditions:

1. Lift well openings shall be provided with automatic self-closing fire-resisting doors;
2. It shall be of a minimum size of 1.35 m² net internal floor area of car, with a minimum rated load of 680 kg;
3. It shall be provided with a suitable control switch at the designated point of entry to enable the Fire Services Department to gain immediate control over the lift and return it to the designated point of entry, such switch shall isolate the lift from control by the public. The fireman switch shall be flush mounted on a stainless steel plate of thickness not less than 2.5 mm;
4. The speed of the lift shall be such that it shall reach the highest landing in not more than one minute;
5. It shall be suitably indicated by the words "Fireman's Lift" in English and Chinese characters;
6. All landings doors shall be automatic self-closing;
7. For every refuge floor except that provided at the main roof of a building, the lift doors of the fireman's lifts shall not be open onto the refuge floor in normal operation and shall be locked at all times until automatically released on actuation of the fireman's switch.

LTE2.23 REQUIREMENTS ON RIDING COMFORT

LTE2.23.010.9 RIDING COMFORT

1. All lift installation shall comply with the following riding comfort criteria:

Maximum Jerk (m/s^3)	Maximum Lift Car Vibration (cm/s^2)		
	X - Axis	Y - Axis	Z - Axis
2.2	25	25	25

2. The Z-axis is along the lift travel direction and the X-axis and Y-axis are on the horizontal plane;
3. Upon completion of the lift installation, the Sub-contractor shall carry out riding comfort measurement for each lift. Measurement results shall be submitted to the Contract Manager for record. The Sub-contractor shall propose and carry out remedies to the installation if the measurement result exceeds the criteria in sub-clause (1);
4. Riding comfort measurement shall be conducted with the lift car carrying rated load and travelling in both upward and downward directions;
5. Re-measurement shall be carried out by the Sub-contractor after any remedy to show compliance with the criteria in sub-clause (1).

LTE2.24 REQUIREMENTS ON HOMING OPERATION IN LIFT TOWER

LTE2.24.010.9 HOMING OPERATION IN LIFT TOWER

1. The lifts at lift tower shall home at the terminal floor;
2. For lifts at lift tower provided with flood alarm system, the lifts shall go to upper floor and the lift car doors shall be opened for passenger release upon activation of water level sensor of flood alarm system. The lifts then stop at that landing level with lift car doors closed and lift car lighting on. The door open push button inside lift car can still remain functional;
3. The lifts shall start to resume operation only until the water level sensor of flood alarm system resume to normal;
4. In case the lift(s) in lift tower also serve as fireman's lift(s), the above operation shall still be applied to the lift(s) provided that the lift(s) can resume operation upon the activation of Fireman's Switch.

LTE2.25 PARTICULAR REQUIREMENTS FOR MACHINE-ROOM-LESS LIFT

LTE2.25.010.9 STATUTORY REQUIREMENTS

1. The machine-room-less lift shall be of a type approved by the Electrical and Mechanical Services Department;
2. The passenger rescue operation for the machine-room-less lift shall be accepted by the Fire Services Department;
3. The Sub-contractor shall be responsible for preparing and arranging all necessary submissions to the relevant authorities and providing all necessary information and assistance to the Contract Manager for applying for approval and exemptions/modifications of the statutory codes and requirements, where applicable.

LTE2.25.020.9 GENERAL REQUIREMENTS

1. Maintenance, repair, major alteration, replacement and examination of the overspeed governor and machine shall be able to be carried out on the car roof safely and efficiently;
2. Tripping and re-setting of the overspeed governor shall be able to be remotely controlled outside the lift well or where required at a position approved by the Contract Manager;
3. The motor brake shall be able to be remotely released by hand outside the lift well or where required at a location approved by the Contract Manager. A constant manual effort is required to keep the brake open;
4. In any case, the over-travel of the lift car above the upper terminal landing floor level shall not exceed a dimension that will hinder the release of passengers in a safe manner;
5. Sufficient energy efficient lighting with battery back-up shall be provided for illumination of the overspeed governor, motor brake and machine in the lift well;
6. Lift motor located in lift pit is not acceptable.

LTE2.25.030.9 LIFT WELL VENTILATION

1. A ventilation system for the lift well of machine-room-less lift shall be provided as shown on the Drawings. A ventilation fan adequately sized to maintain the temperature inside the lift well below 40ºC shall be provided as shown on the Drawings. The motor of the ventilation fan shall be protected to IP55 minimum and suitable for continuous running;
2. The operation of the ventilation fan shall be controlled by both a temperature sensor installed in the lift well and a timer in the maintenance access panel. The status and fault indication of ventilation fan shall be provided at the maintenance access panel. An independent by-pass ON/OFF switch in maintenance access panel for each ventilation fan for the lift well shall be provided for maintenance purpose;
3. For ventilation system to be installed by the Sub-contractor, the Sub-contractor shall submit calculation to verify that the proposed ventilation fan can maintain the temperature inside lift well below 40ºC. The Main Contractor will provide relevant building information and heat load data of the lift well to facilitate the design calculation. The calculation together with the control arrangement of the ventilation fan shall be submitted to Contract Manager for approval;

4. For ventilation system to be installed by the Main Contractor, the Sub-contractor shall provide information for heat dissipation of the lift machine.

LTE2.25.040.9 LIFT CONTROL PANEL

1. The controller for machine-room-less lift shall be mounted in a ventilated stainless steel lift control panel, in which all contactors, solenoids, relays, electronic cards and motor starting equipment, etc. shall be fitted;

2. When the lift control panel is located outside the lift well, a maintenance access panel constructed of stainless steel frame and stainless steel sheet of minimum 1.5 mm thick shall be provided by the Sub-contractor to enclose and protect the lift control panel, the lift alarm/indication/intercom panel, the CCTV monitor, the 2-way lift well lighting switch, the emergency light switches, the lift well ventilation fan switches, timer and indication lights, flood alarm indication lights etc.. Position of the lift control panel and enclosure shall be as specified in the specification and/or on the drawings. The door(s) of the enclosure shall be hinged at the front, shall not open towards the lift control panel, shall be fitted with a lock which can be locked without a key from outside and only accessible by authorised person. It shall bear on the outside face a notice in English and Chinese in letters and characters not less than 25 mm high as follows:

UNAUTHORISED OPENING PROHIBITED
LIFT CONTROL PANEL
CLOSE AND LOCK THIS DOOR

不得打開
升降機控制箱
請關閉並緊鎖此門

3. When the lift control panel is located inside the lift well, it shall be located at a position that will enable the lift maintenance personnel to carry out inspection and maintenance work in a safe and efficient manner. All necessary working platform and access to the lift control panel shall be provided by the Sub-contractor. A thermal protection device shall be provided by the Sub-contractor to stop the lift car and return to a landing when the lift control panel has reached a pre-set temperature level. At a suitable location outside the lift well, a maintenance access panel constructed of stainless steel frame and stainless steel sheet of minimum 1.5 mm thick with hinged lockable door(s) shall be provided by the Sub-contractor to enclose and protect the lift alarm/indication/intercom panel, the CCTV monitor, the 2-way lift well lighting switch, the emergency light switches, the lift well ventilation fan switches, timer and indication lights, flood alarm indication lights etc.;

4. The door of the enclosure located outside the lift well shall be so constructed that the CCTV monitor inside the enclosure can be visible from the outside through safety glass of 6 mm minimum thickness complying to BS 952-1 and BS 952-2, BS EN 81-20 or equivalent;

5. Additional wall thickness to embed the enclosure located outside the lift well while maintaining the fire resistance period requirement for the wall will be provided by the Main Contractor as necessary.

LTE2.25.060.9 LIFTS FOR OUTDOOR APPLICATION

1. When the lift is susceptible to outdoor weather, all the lift equipment of the lift shall be suitable for outdoor use;

2. The metal work of the lift installation other than moving parts shall be adequately protected against corrosion by suitable and approved epoxy paint coating system, hot dip galvanising or factory applied finish;
3. Lift components, such as limit switches, car door and landing door locks etc., shall be protected by drip-proof enclosure or suitable watertight cover;
4. Electrical wirings and accessories shall be of water-proof type at least IP54.

   Please refer to the specification requirements specified in the Project Specific Specification.

LTE2.26 MULTITRADE INTEGRATED MECHANICAL, ELECTRICAL AND PLUMBING (MIMEP)

LTE2.26.010.N EXTENT OF APPLICATION

1. The Sub-contractor shall design, assemble, install and test the off-site prefabricated MiMEP modules, including but not limited to the following items, for on-site assembly and installation:
    a. Accessories at lift pit;
    b. Accessories at lift car top.

LTE2.26.020.N ACCESSORIES AT LIFT PIT

1. The module shall comprise electrical assembly including, but not limited to alarm, emergency stop switch, socket outlet and well lighting switch, other accessories and the mounting framework as appropriate;
2. Electrical cabling works of a completed circuit / sub-circuit within the individual MiMEP module shall be pre-installed off-site. Interconnection of cables between the MiMEP modules and other electrical installation shall be conducted on-site;
3. All components and devices shall be assembled and properly fixed to the framework. The framework shall be designed with pre-drilled holes for on-site direct fixing to building structures;
4. Provisions shall be allowed to facilitate the transportation, delivery, assembly and services connection on Site.

LTE2.26.030.N ACCESSORIES AT LIFT CAR TOP

1. The module shall comprise electrical assembly including, but not limited to alarm, emergency stop switch, socket outlet, car ceiling fan switch and car top & bottom lighting switch, other accessories and the mounting framework as appropriate;
2. Electrical cabling works of a completed circuit / sub-circuit within the individual MiMEP module shall be pre-installed off-site. Interconnection of cables between the MiMEP modules and other electrical installation shall be conducted on-site;
3. All components and devices shall be assembled and properly fixed to the framework. The framework shall be designed with pre-drilled holes for on-site direct fixing to building structures;
4. Provisions shall be allowed to facilitate the transportation, delivery, assembly and services connection on Site.

LTE3 ESCALATOR INSTALLATION

LTE3.1 STEPS 4
LTE3.1.010.9 HORIZONTAL STEPS 4
LTE3.1.020.9 INTEGRAL DIE-CAST ALUMINIUM OR STAINLESS STEEL STEP TREAD AND RISER 4
LTE3.1.030.9 ROLLERS 4
LTE3.1.040.A END TRAVELS 4
LTE3.1.050.A RUNNING CLEARANCE 4
LTE3.1.060.9 TYPE TEST 4
LTE3.1.070.9 NOMINAL WIDTH OF ESCALATOR STEPS 5

LTE3.2 STEP CHAINS 6
LTE3.2.010.9 STEP CHAINS 6
LTE3.2.020.9 MATERIALS 6
LTE3.2.030.9 QUIET OPERATION 6

LTE3.3 TRACKS 7
LTE3.3.010.9 CURVED SECTIONS 7
LTE3.3.020.9 STRAIGHT SECTIONS 7
LTE3.3.030.9 DESIGN 7

LTE3.4 LANDING OPENINGS AND LANDING PLATES 8
LTE3.4.010.9 OPENINGS 8
LTE3.4.020.9 LANDING PLATES 8

LTE3.5 COMB 9
LTE3.5.010.9 COMB 9
LTE3.5.020.9 COMB TEETH SECTION 9

LTE3.6 BALUSTRADING 10
LTE3.6.010.A BALUSTRADES 10
LTE3.6.020.9 BRUSH BRISTLE TYPE DEFLECTOR DEVICE 10
LTE3.6.030.A EXTERNAL CLADDING 10
LTE3.6.040.A OBSTRUCTION GUARD FOR ESCALATOR 11
LTE3.6.050.9 SILICONE SPRAY 11

LTE3.7 HANDRAILS 12
LTE3.7.010.9 RUBBER HANDRAIL 12
LTE3.7.020.9 SPEED 12
LTE3.7.030.9 SAFETY GUARD 12
LTE3.7.040.9 HANDRAIL GUIDES 12
LTE3.7.050.N CONCEALED TYPE SELF-CLEANING DEVICES 12

LTE3.8 TRUSS 13
LTE3.8.010.9 CONSTRUCTION 13
LTE3.8.020.9 MACHINERY PIT 13

LTE3.9 LUBRICATION 14
LTE3.9.010.9 LUBRICATION 14
LTE3.9.020.9 OIL PANS 14

LTE3.10 DRIVING MACHINERY 15

LTE3.10.010.9 INDEPENDENT DRIVING MACHINE....15
LTE3.10.020.9 REDUCTION GEAR....15
LTE3.10.030.9 MOTOR....15
LTE3.10.040.9 CAPACITY....15
LTE3.10.050.9 ESCALATOR SPEED....15
LTE3.10.060.9 BEARINGS....15

LTE3.11 BRAKING SYSTEM 16
LTE3.11.010.A OPERATIONAL BRAKE....16
LTE3.11.020.A AUXILIARY BRAKE....16
LTE3.11.030.9 HANDWINDING....16

LTE3.12 FOOTLIGHTS AND STEP LIGHTS UNDER LANDING 17
LTE3.12.010.9 FOOTLIGHTS....17
LTE3.12.020.9 STEP LIGHTS UNDER LANDINGS....17
LTE3.12.030.9 REPLACEMENT OF LAMP BULB/TUBE....17

LTE3.13 SUPPORT BEAMS 18
LTE3.13.010.9 STRUCTURAL SUPPORTS....18
LTE3.13.020.9 MOUNTING FACILITIES....18
LTE3.13.030.9 INTERMEDIATE SUPPORT FOR ESCALATOR....18

LTE3.14 SAFETY DEVICES 19
LTE3.14.010.A SAFETY DEVICES....19
LTE3.14.020.A OPERATION OF SAFETY DEVICE....20

LTE3.15 CONTROL AND INSPECTION STATION 21
LTE3.15.010.9 STATION POSITION....21
LTE3.15.020.A INSPECTION CONTROL DEVICE....21
LTE3.15.030.9 TYPE OF SWITCHES....21
LTE3.15.040.9 MARKINGS....21

LTE3.16 CONTROLLER.... 22
LTE3.16.010.9 CONTENTS....22
LTE3.16.020.9 LOCATION....22

LTE3.17 MAINTENANCE FACILITIES 23
LTE3.17.010.9 MACHINE PIT LIGHT....23
LTE3.17.020.9 SOCKET OUTLET....23
LTE3.17.030.9 NOTICE....23

LTE3.18 ALARM DEVICE 24
LTE3.18.010.9 ALARM SOUNDER....24
LTE3.18.020.9 TYPE OF ALARM SOUNDER....24

LTE3.19 REQUIREMENTS FOR WEATHER-PROOF ESCALATORS 25
LTE3.19.010.9 GENERAL....25
LTE3.19.020.9 PROTECTION....25
LTE3.19.030.9 PROTECTION AGAINST CORROSION FOR TRUSS AND METAL WORK OF ESCALATOR....25
LTE3.19.040.9 PROTECTION AGAINST CORROSION FOR MOVING PARTS....26
LTE3.19.050.9 WATER-OIL SEPARATOR....26

LTE3.19.060.9 MOTOR AND CONTROLLER 26
LTE3.19.070.9 ELECTRICAL WIRINGS AND ACCESSORIES 26
LTE3.19.080.9 DRAINAGE 26
LTE3.19.090.9 LEVEL SWITCH AT BOTTOM LANDING MACHINE PIT 26

LTE3.20 SIGNS AND PICTOGRAPHS 27
LTE3.20.010.A PICTOGRAPHS 27

LTE3.21 MAXIMUM ALLOWABLE ELECTRICAL POWER, TOTAL HARMONIC DISTORTION AND TOTAL POWER FACTOR 28
LTE3.21.010.9 MAXIMUM ALLOWABLE ELECTRICAL POWER, TOTAL HARMONIC DISTORTION AND TOTAL POWER FACTOR OF ESCALATORS AND PASSENGER CONVEYORS 28

LTE3.22 AUDIBLE DEVICE OF ESCALATOR FOR THE VISUALLY IMPAIRED 29
LTE3.22.010.9 AUDIBLE DEVICE FOR THE VISUALLY IMPAIRED 29
LTE3.22.020.9 AUDIO ALERT SYSTEM 29

LTE3.23 SERVICE-ON-DEMAND ESCALATOR CONTROL 31
LTE3.23.010.9 GENERAL REQUIREMENTS 31
LTE3.23.020.9 MOTION SENSOR AT EXIT 31
LTE3.23.030.9 VISIBLE SIGNAL SYSTEM 31

LTE3.1 STEPS

LTE3.1.010.9 HORIZONTAL STEPS

1. The surface of the steps shall be horizontal at all positions exposed to passenger;
2. Yellow demarcation on minimum three borders of each step shall be provided by durable and wear resistant material such as yellow moulded resin demarcation cleats. The width of the demarcation strips on step shall be at least 20 mm for the strips at the back and shall be at least 13 mm for the strips on the two sides.

LTE3.1.020.9 INTEGRAL DIE-CAST ALUMINIUM OR STAINLESS STEEL STEP TREAD AND RISER

1. The step treads shall be die-cast aluminium with closely spaced cleats designed to provide a secure foothold, the latter being grooved parallel to the travel of the steps to mesh with the comb at the entrance and exit. Alternative material of stainless steel of EN 10088-1 grade 1.4301 (grade 304) may be acceptable if not exposed to weather conditions;
2. The step risers shall also be die-cast aluminium integral with the step treads and shall include vertical cleats designed to pass between the cleats of the tread in the adjacent steps thus providing a combing action with minimum clearances. Alternative material of stainless steel of EN 10088-1 grade 1.4301 (grade 304) may be acceptable if not exposed to weather conditions;
3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the steps delivered to the site or installed.

LTE3.1.030.9 ROLLERS

Each step shall be supported on four synthetic or rubber tyred ball bearing rollers, grease sealed for life and so mounted that tilting and rocking of steps is prevented whilst ensuring smooth and quiet operation in service.

LTE3.1.040.A END TRAVELS

At the ends of the escalators (including public service escalators at rated speeds not exceeding 0.65m/s, as specified on the Drawings) the steps shall be guided in such a way that the front edges of the steps leaving the comb and the rear edges of the steps entering the comb are moving horizontally for a length of at least 1.20m measured from the root of the comb teeth.

For public service escalators at rated speeds above 0.65m/s, as specified on the Drawings, the steps shall travel in a substantially horizontal direction for the minimum distances in accordance with Clause 5.7.2 of the Lift COP, Section E, Part 4.

LTE3.1.050.A RUNNING CLEARANCE

All steps running clearances shall comply with the requirements as laid down in Clauses 5.3.5 and 5.5.5 of the Lift COP, Section E, Part 4.

LTE3.1.060.9 TYPE TEST

1. The steps shall be type tested in accordance with clause 5.3.3.2 and 5.3.3.3 of BS EN 115-1 by an Approved independent testing institution;
2. Type test certificate to this effect shall be submitted to the CM.

LTE3.1.070.9 NOMINAL WIDTH OF ESCALATOR STEPS

The nominal width of escalator steps shall be 1000 mm unless otherwise specified in the Project Specific Specification.

LTE3.2 STEP CHAINS

LTE3.2.010.9 STEP CHAINS

1. The steps shall be driven by at least two steel link chains of which at least one shall be located on each side of the step;
2. The step chains shall be of endless roller type and modular construction. Each module shall comprise not more than 4 rollers.

LTE3.2.020.9 MATERIALS

1. The step chains shall be made of high tensile steel links with hardened and ground pins;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the step chains and drive chains delivered to the site or installed.

LTE3.2.030.9 QUIET OPERATION

The rollers shall accurately engage with the drive sprockets to ensure smooth and quiet operation.

LTE3.3 TRACKS

LTE3.3.010.9 CURVED SECTIONS

All the curved sections of the tracks shall be manufactured in aluminium pressure die-castings or steel.

LTE3.3.020.9 STRAIGHT SECTIONS

The straight sections of the tracks shall be of steel or aluminium extrusions. These extrusions shall essentially be channels forming both running surfaces and guards over the trailing rollers.

LTE3.3.030.9 DESIGN

The entire tracking system shall be so designed that in the unlikely event of a step chain breaking, there shall be no likelihood of the steps lifting out of place.

LTE3.4 LANDING OPENINGS AND LANDING PLATES

LTE3.4.010.9 OPENINGS

Floor openings will be provided by the Main Contractor on both upper and lower landings. The Sub-contractor shall submit builder's work drawings detailing the exact dimensions and locations of the openings.

LTE3.4.020.9 LANDING PLATES

1. Removable floor landing plates to harmonise with the comb shall be provided by the Sub-contractor over the openings to give access to the machinery for maintenance purpose. These landing plates shall be of stainless steel or wear-resistant aluminium alloy and shall afford a secure foothold;
2. The Sub-contractor shall provide documentary evidence in accordance PRE.BS1.205 to verify the place of manufacture and authenticity of the landing plates delivered to the site or installed.

LTE3.5 COMB

LTE3.5.010.9 COMB

Comb shall be provided at the top and bottom landings and shall be of wear-resistant aluminium alloy or stainless steel with anti-slip pattern.

LTE3.5.020.9 COMB TEETH SECTION

1. The comb sections shall have fine pitch teeth to allow the cleats of the step tread to pass them with minimum clearance. The comb teeth sections shall be made of synthetic resin or metal or equivalent materials, and shall be adjustable vertically and horizontally, and readily replaceable. The width of each comb teeth section shall be not more than 200 mm;
2. The teeth of every comb teeth section shall be so meshed with and set into the slots of the step tread and pallets that the points of such teeth are always below the upper surface of such tread surface.

LTE3.6 BALUSTRADING

LTE3.6.010.A BALUSTRADES

1. Solid balustrades possessing sufficient mechanical strength in compliance with Clause 5.5.2.3, 5.5.2.4 and 5.5.3.3 of the Lift COP, Section E, Part 4 shall be installed on each side of the escalator and shall consist of the following components:
   a. The skirting panels shall be vertical and constructed of smooth hairline finish stainless steel with thickness of not less than 2 mm. Embossed, perforated or roughly textured materials shall not be used;
   b. The interior profile shall be of hairline finish stainless steel with thickness of not less than 2 mm. The interior profile and the balustrade interior panelling shall have an angle of inclination of at least 25° to the horizontal;
   c. Unless otherwise specified, the interior panelling shall be of hairline finish stainless steel with thickness of not less than 1.5 mm. The balustrade panel shall be of splinter free one-layer safety glass of thickness not less than 6 mm. Lighting shall be provided along and underneath the handrails except for slim type balustrade decking design and stainless steel type balustrade decking design;
   d. The balustrade decking shall be of hairline finish stainless steel. The decking is to be situated under the handrail and forms the top cover of the balustrade panelling;
   e. The newel including the handrails shall project beyond the root of the comb teeth by at least 600 mm in longitudinal direction;
   f. Stainless steel specified for skirting, interior profile, interior and exterior panelling and decking shall be stainless steel of EN 10088-1 grade 1.4301 (grade 304) or equivalent.
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the balustrades delivered to the Site or installed.

Please refer to specification requirements specified in Project Specific Specification.

LTE3.6.020.9 BRUSH BRISTLE TYPE DEFLECTOR DEVICE

Approved brush bristle type deflector devices shall be provided along the full length of the lower part of the skirting panels on each side.

LTE3.6.030.A EXTERNAL CLADDING

1. Unless otherwise specified, metal enclosure with sufficient mechanical strength in compliance with Clause 5.2 of the Lift COP, Section E, Part 4 shall be provided. The extent of metal enclosure shall cover the balustrade exterior panelling, machine pits and underside of the truss;
2. Unless otherwise specified, the Contractor will install stainless steel cladding onto the metal enclosure. The Sub-contractor shall coordinate with the Contractor and submit the method and details of fixing of stainless steel cladding onto the metal enclosure for the CM's approval. The Sub-contractor shall also allow reasonable time in his programme for the Contractor to complete the external cladding.

Please refer to the specification requirements specified in the Project Specific Specification.

LTE3.6.040.A OBSTRUCTION GUARD FOR ESCALATOR

Obstruction guard will be provided by the Contractor for adjacent building obstacles and criss-cross escalators. The Sub-contractor shall indicate on the builder's work drawings the constructions and positioning of the guards in accordance with Clause A2.4 of Annex A of the Lift COP, Section E, Part 4.

Please refer to the specification requirements specified in the Project Specific Specification.

LTE3.6.050.9 SILICONE SPRAY

Approved silicone spray or platform coating shall be applied before substantial completion. Silicone spray shall be applied during the Maintenance Period at a regular interval of not more than 2 months to the escalator balustrade where it may come into contact with feet and shoes to reduce the friction at these areas for passenger safety unless platform coating is applied.

LTE3.7 HANDRAILS

LTE3.7.010.9 RUBBER HANDRAIL

1. The handrails shall be constructed of multi-layered canvas with the exposed surface covered with smooth black abrasion resistant rubber which shall be vulcanised into an endless loop;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the handrails delivered to the site or installed.

LTE3.7.020.9 SPEED

The handrails shall move in the same direction of the steps. The speed of the handrail is permitted to deviate from the speed of the steps within the limits of 0% to +2%.

LTE3.7.030.9 SAFETY GUARD

Safety guards shall be provided where the handrails enter and leave the escalator newels. In addition to being protected by the automatic operation of the handrail entry safety guard, the point of entry of the handrail into the newel shall be so configured as to prevent the pinching of fingers, hands or other objects. Handrail entry designs which form part of the continuous profile of the balustrade decking or which are considered by the Contract Manager as vulnerable to the pinching of fingers, hands or other objects are not acceptable.

LTE3.7.040.9 HANDRAIL GUIDES

The handrail guides shall be in specially formed aluminium or steel section to allow easy movement of the handrail but properly shaped as to retain the handrail in its place.

LTE3.7.050.N CONCEALED TYPE SELF-CLEANING DEVICES

The handrails shall be equipped with automatic concealed type Ultra Violet (UV- C) light sterilizer unless otherwise specified. Test reports or other substantiation documents to verify the disinfection capability and effectiveness of the self-cleaning devices, e.g. sterilization rate or eradication rate not less than 99%, shall be submitted to the CM. The self-cleaning devices shall be compatible with the escalators and shall not interfere with the operation and maintenance of the escalator.

LTE3.8 TRUSS

LTE3.8.010.9 CONSTRUCTION

1. The lattice type structural steel truss shall be a rigid steel fabricated structure and shall be capable of carrying a full complement of passengers together with the machinery of the escalator, the balustrades and the exterior covering. The factor of safety used in the design of the truss shall not be less than 5 basing on the static load;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the trusses delivered to the site or installed.

LTE3.8.020.9 MACHINERY PIT

The upper section of the truss shall contain the drive machine and shall be fitted with a trap door.

LTE3.9 LUBRICATION

LTE3.9.010.9 LUBRICATION

Effective means for lubricating the bearings and moving parts as required shall be provided with easy access. Oil pump shall be provided for the automatic lubrication of steel chains.

LTE3.9.020.9 OIL PANS

Oil tight drip pans shall be provided for the entire length of the escalator to contain any wasted lubricant within the truss. When necessary, the oil tight drip pans shall be removable to give access to both the machinery space and the return station for maintenance.

LTE3.10 DRIVING MACHINERY

LTE3.10.010.9 INDEPENDENT DRIVING MACHINE

Each escalator shall be independently driven.

LTE3.10.020.9 REDUCTION GEAR

1. The driving machine shall be a worm reduction gear, helical reduction gear or planetary gear with a drive motor situated in the machinery pit at the upper landing. It shall be connected by chains or other proven means to the main drive shaft of the escalator;
2. The reduction gear shall be housed in a substantial cast iron housing which shall also hold the lubricant;
3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the reduction gears delivered to the site or installed.

LTE3.10.030.9 MOTOR

1. The motor shall be three-phase A.C. squirrel cage, induction motor of continuous rating, reversible type with high starting torque and low starting current and specially designed for escalator application;
2. The motor speed shall not exceed 1,500 revolutions per minute;
3. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the motors delivered to the site or installed.

LTE3.10.040.9 CAPACITY

The A.C. squirrel cage motor shall be of ample capacity, free from objectionable noise and vibrations when in operation.

LTE3.10.050.9 ESCALATOR SPEED

The escalator speed shall be continuously adjustable from a minimum value of 0.17 m/s to a maximum value of 0.5 m/s. A key switch shall be provided in or near the control panel to adjust the speed manually and on continuous basis.

LTE3.10.060.9 BEARINGS

The motor shall be fitted with grease lubricated ball bearings.

LTE3.11 BRAKING SYSTEM

LTE3.11.010.A OPERATIONAL BRAKE

1. Each escalator shall be provided with an operational brake which is mechanically applied and electrically held off type and of sufficient capacity to effectively bring the escalator to rest within the stopping distance in accordance with Clause 5.4.2.1.3.2 of the Lift COP, Section E, Part 4 when travelling at full contract speed in either direction;
2. Operational brake shall be located on the driving machine or the main drive shaft;
3. When springs are used to apply brake shoes, such springs shall be in compression and adequately supported and guarded.

LTE3.11.020.A AUXILIARY BRAKE

Auxiliary brake of mechanical (friction) type shall be provided and function in accordance with Clause 5.4.2.2 and Clauses 5.12.3.5.3 of the Lift COP, Section E, Part 4.

LTE3.11.030.9 HANDWINDING

If a handwinding device is provided, it shall be suitably marked for "UP" and "DOWN" operation in both English and Chinese characters. The handwinding device shall be used in conjunction with a brake release device for the operational brake and shall be easily accessible and safe to operate.

LTE3.12 FOOTLIGHTS AND STEP LIGHTS UNDER LANDING

LTE3.12.010.9 FOOTLIGHTS

Footlights shall be provided on either side of the interior of the skirting at both upper and lower landings and energy efficient fluorescent or LED luminaries shall be used.

LTE3.12.020.9 STEP LIGHTS UNDER LANDINGS

Energy efficient fluorescent or LED lighting shall be provided underneath landings to illuminate the clearance between steps, steps and skirting, steps and comb, at the horizontal step portion of the escalator. The colour of these lights shall be automatically switched to green at landings where passengers can gain entry, and red at landings where passengers cannot gain entry. Green and red coloured lightings shall be provided at each landing to allow change of escalator travelling direction.

LTE3.12.030.9 REPLACEMENT OF LAMP BULB/TUBE

Facility shall be incorporated for the replacement of lamp bulb or fluorescent tube.

LTE3.13 SUPPORT BEAMS

LTE3.13.010.9 STRUCTURAL SUPPORTS

Structural supporting beams will be provided by the Main Contractor at the top and bottom landings. Intermediate support will not be provided unless otherwise shown on the Drawings. The Sub-contractor shall submit for the Contract Manager's approval the exact locations and dimensions of the structural supports and the reaction forces to be imposed on the same.

LTE3.13.020.9 MOUNTING FACILITIES

All other supports and mounting facilities, e.g. mounting brackets, bearing plates, etc. required for the installation of the escalator shall be provided by the Sub-contractor.

LTE3.13.030.9 INTERMEDIATE SUPPORT FOR ESCALATOR

Please refer to the specification requirements specified in the Project Specific Specification.

LTE3.14 SAFETY DEVICES

LTE3.14.010.A SAFETY DEVICES

Safety devices shall be provided in accordance with the Lift COP, Section E, Part 4 and comprise the following minimum features:

1. A stopping device shall be provided at the driving and return stations and machinery space inside the truss where means of access is provided. The stopping device does not need to be provided in the machinery space if a main switch according to Clause 5.11.3 of the Lift COP, Section E, Part 4 is located therein and is sufficiently close to the machinery. The stopping device shall:
   a. Be of mushroom head, push to stop, pull to run type, coloured red and suitably protected against accidental operation;
   b. Be conspicuously and permanently marked "STOP" in both English and Chinese characters.
2. An emergency stopping device shall be provided in conspicuous and easily accessible position at or near to each landing of the escalator. The emergency stopping device shall be a red button suitably protected against accidental operation and conspicuously and permanently marked "STOP" in both English and Chinese characters;
3. A broken step chain safety device shall be incorporated as part of the tension carriage, and it shall operate if the bottom sprocket moves unduly in either direction in the event of either or both step chains breaking or becoming unduly lengthened due to wear of the pins, or tension in either chain dropping below a pre-determined value. The operation of this device shall remove power and applies the operational brake;
4. If the chain or belt between the driving machine and the escalator main drive shaft breaks, a broken drive chain device shall be provided which shall cause the electrical supply to motor to be disconnected and shall cause the operational brake as well as the auxiliary brake to operate;
5. Broken handrail device shall be situated inside the balustrades on either side at the lower end of the incline, and shall actuate and cause the escalator to stop if either or both handrails break;
6. A non-reversing and overspeed protective device shall be arranged to prevent a travelling escalator to slow unduly or attempts to reverse its direction of travel or to overspeed in accordance with Clauses 5.4.2.3 of the Lift COP, Section E, Part 4;
7. Comb obstruction device shall be provided on either side of each comb to stop the escalator if any object is caught between a step and the teeth of the comb;
8. Skirting switches, actuated by a passenger’s foot or other foreign object trapped between a step and the skirting, shall be provided to stop the escalator. Skirting switches shall be provided at each side of the skirting at the points of upper lower transition from incline to horizontal, and at the inclined section in accordance with Clause 5.5.3.4(e) of the Lift COP, Section E, Part 4;
9. A handrail switch shall be provided at each handrail entry guard which shall stop the escalator if foreign objects are trapped;
10. A protective device for sagging of steps shall be provided to stop the escalator when any part of the steps is sagging such that meshing of the combs is no longer ensured at the point at which the steps enter the landings;

11. Escalators connected to 3-phase A.C. power supply shall incorporate phase protective relay to prevent the units running in the event of phase failure and phase reversal;

12. Motor overload relay shall be fitted to protect the motor against overload;

13. Monitoring devices for synchronisation of handrails and steps shall be provided to detect out of synchronism of handrails and steps. In the event of out of synchronism, an alarm shall be sounded to alert the security guards in the vicinity to stop the escalator manually.

LTE3.14.020.A OPERATION OF SAFETY DEVICE

The operation of any of the safety devices mentioned in LTE3.14.010 shall cause the electrical supply to the driving motor to be disconnected and the operational brake to operate bringing the escalator to rest. All switching-off operations mentioned in sub-clauses (1) to (10) of LTE3.14.010 shall be effected by electrical safety devices in conformity with Clause 5.12.2 of the Lift COP, Section E, Part 4.

LTE3.15 CONTROL AND INSPECTION STATION

LTE3.15.010.9 STATION POSITION

A control station shall be provided at both the upper and lower landing newel, which shall contain a directional switch, an alarm and a foot light switch. The station shall be so positioned as to enable any person operating any of the switches to afford a full view of the escalator.

LTE3.15.020.A INSPECTION CONTROL DEVICE

1. Inspection control device shall be provided at the upper and lower landing by means of portable control device in accordance with Clause 5.12.3.13 of the Lift COP, Section E, Part 4;
2. When the portable control device is operated, the movement of the escalator shall be dependent on a continuous pressure simultaneously on a "Common" push button and a "Up" or "Down" push button. A stopping device of "mushroom head, push to stop, pull to run" type and coloured red shall be provided in the inspection control device. These push buttons and stopping device shall be protected against accidental operation and with the direction of movement clearly indicated.

LTE3.15.030.9 TYPE OF SWITCHES

The up and down directional starting switch and the footlight switch shall be of key-operated spring off type.

LTE3.15.040.9 MARKINGS

All switches shall be clearly marked in both English and Chinese characters.

LTE3.16 CONTROLLER

LTE3.16.010.9 CONTENTS

1. The controller shall be a self-contained unit containing all the necessary electrical switchgear, contactors, relays and electronic controller cards, etc.;
2. The Sub-contractor shall provide documentary evidence in accordance with PRE.BS1.205 to verify the place of manufacture and authenticity of the controllers delivered to the site or installed.

LTE3.16.020.9 LOCATION

The controller housed in a cabinet shall be located in the upper landing, and provision shall be made for easy access for maintenance.

LTE3.17 MAINTENANCE FACILITIES

LTE3.17.010.9 MACHINE PIT LIGHT

A permanent light, suitably guarded, shall be provided in each machine pit by the Sub-contractor, and which can be switched without passing over or reaching over any part of the machinery.

LTE3.17.020.9 SOCKET OUTLET

A 13 amp. 3 pin socket outlet of the type specified in ELE20.3.020 shall be provided in each escalator machine pit by the Sub-contractor.

LTE3.17.030.9 NOTICE

1. A permanent notice reading "Danger, unauthorised access prohibited" and the equivalent in Chinese characters shall be conspicuously fixed on each access door to machinery space. The characters shall not be less than 25 mm high;
2. The name of the manufacturer, the Sub-contractor's name and telephone number and the escalator identification number shall be displayed at the landings.

LTE3.18 ALARM DEVICE

LTE3.18.010.9 ALARM SOUNDER

An alarm sounder shall be provided in the machinery space and shall sound when any of the safety devices mentioned in LTE3.14.010 operates.

LTE3.18.020.9 TYPE OF ALARM SOUNDER

1. The alarm sounders shall be of electronic type with the following two-tone pattern:
   a. Low frequency: 600 Hz (±15%) & duration: 600 ms (±20%);
   b. High frequency: 920 Hz (±15%) & duration: 300 ms (±20%).
2. The alarm sounders shall be impact resistant, suitable for conduit entry. Alarm sounder for outdoor installation shall be weatherproof to IP 65.

LTE3.19 REQUIREMENTS FOR WEATHER-PROOF ESCALATORS

LTE3.19.010.9 GENERAL

Weather-proof escalators shall comply with the specification requirements as detailed in LTE3.19.020 to LTE3.19.090.

LTE3.19.020.9 PROTECTION

Unless otherwise specified, the escalator(s) will be protected by canopy or other similar structure constructed by the Main Contractor as shown on the Drawings.

LTE3.19.030.9 PROTECTION AGAINST CORROSION FOR TRUSS AND METAL WORK OF ESCALATOR

1. The entire truss and metal work of the escalator other than moving parts shall be adequately protected against corrosion for service in wet conditions either by epoxy paint coating system designed for marine application or by hot dip galvanising;
2. When epoxy paint coating system is employed, the surface of the complete truss and metal work shall be prepared and treated in accordance with the epoxy paint coating manufacturer's recommendation:
    a. All rust and dirt on the surface of the truss and metal work shall be removed by wire brushing, and the truss and metal work shall be thoroughly degreased by degreasing solvent prior to the application of any paint coating;
    b. The number, thickness and method of application of paint coating shall be in accordance with the epoxy paint coating manufacturer's recommendation and at least three coats of epoxy paint coating system primer shall be applied followed by at least three coats of finishing epoxy paint coating;
    c. Each coat of paint shall be thoroughly dried before application of next coat.
3. When hot dip galvanising is employed, the complete truss and metal work shall be thoroughly cleaned and degreased by degreasing solvent, and followed by hot dip galvanising to BS EN ISO 1461;
4. Information of the epoxy coating system or hot dip galvanising including details of surface preparation, method of application, number of coatings and details of paints shall be submitted for the Contract Manager's approval prior to manufacture;
5. All the cleansing, degreasing, painting and galvanising processes shall be carried out at the factory, and painting of truss and metal work at site is not permitted except for touching up of damaged coating during installation on Site:
    a. Welding carried out on site on the truss or any metal work that will damage the protective coating is not permitted unless prior approval is given by the Contract Manager;
    b. Where rust appears on the truss or metal work due to damage of protective coating, it must be thoroughly removed by wire brush, degreased and followed by the application of the same number of paint coatings as in the factory or the application of two coats of cold galvanising paints to the satisfaction of the Contract Manager.

LTE3.19.040.9 PROTECTION AGAINST CORROSION FOR MOVING PARTS

1. Moving parts of the escalator including step driving chains, sprocket gears, etc. which require greasing or oiling and any metal components which for functional reasons shall not be painted. These parts shall be constructed of non-corrosive materials such as stainless steel or heavily electroplated with non-corrosive materials such as nickel or chromium. These moving parts shall be adequately lubricated all the time by automatic oilers and suitably protected against water from entering into them;
2. All ball or roller bearings such as those installed on the step driving chain and driving mechanism shall be of sealed type.

LTE3.19.050.9 WATER-OIL SEPARATOR

Device for separation of oil and water shall be provided when water ingress into the escalator can mix with the oil in the lubrication system or the lubrication system is of re-circulating type.

LTE3.19.060.9 MOTOR AND CONTROLLER

The motor and the controller cabinet shall be at least of IP54 protection. Watertight cover shall be provided on all bearings.

LTE3.19.070.9 ELECTRICAL WIRINGS AND ACCESSORIES

All wiring subject to water ingress shall have water-proof terminations. Junction boxes, switches, sockets and alarm bells shall be water-proof type at least IP54.

LTE3.19.080.9 DRAINAGE

The Sub-contractor shall provide proper drainage facilities for the escalator. A permanent drain point will be provided by the Main Contractor at the bottom escalator pit;

An alarm giving a warning of flooding at the lowest escalator pit coupled with a timer to stop the escalator after a preset time shall be provided by the Sub-contractor.

LTE3.19.090.9 LEVEL SWITCH AT BOTTOM LANDING MACHINE PIT

A level switch shall be provided at the bottom landing machine pit to switch off the escalator in the event water collected in pit reaches a pre-determined level.

LTE3.20 SIGNS AND PICTOGRAPHS

LTE3.20.010.A PICTOGRAPHS

1. Pictographs and notices in accordance with Clause 7.2.1.2 of the Lift COP, Section E, Part 4 shall be provided in a conspicuous position at each escalator landing and at either sides of the mid-point of the inclined section of the escalator;
2. Pictographs for "Do not ride on escalator handrail" shall also be provided;
3. The minimum size of the pictographs shall be 100 mm x 100 mm;
4. Corresponding instruction for use of hand winding device and brake release device shall be available in the driving station, and the direction of travel of the escalator shall be indicated clearly.

LTE3.21 MAXIMUM ALLOWABLE ELECTRICAL POWER, TOTAL HARMONIC DISTORTION AND TOTAL POWER FACTOR

LTE3.21.010.9 MAXIMUM ALLOWABLE ELECTRICAL POWER, TOTAL HARMONIC DISTORTION AND TOTAL POWER FACTOR OF ESCALATORS AND PASSENGER CONVEYORS

The maximum allowable electrical power, total harmonic distortion and total power factor of each escalator and passenger conveyor shall comply with the requirements stipulated in the BEC.

LTE3.22 AUDIBLE DEVICE OF ESCALATOR FOR THE VISUALLY IMPAIRED

LTE3.22.010.9 AUDIBLE DEVICE FOR THE VISUALLY IMPAIRED

1. A device generating audible "ticking" signals shall be provided for each escalator to enable the visually impaired to distinguish between escalator steps moving towards and away from them. The device shall also enable the visually impaired to distinguish between adjacent escalators with steps moving in different directions;
2. The driving unit of the audible device shall be housed in a rigid enclosure and mounted inside the escalator machine pit. The speakers of the device shall be flush mounted at the skirting or balustrade interior panelling of the upper and lower landings of each escalator and at the left hand side facing the escalator;
3. The audible device shall be suitable for operation at an ambient temperature of not less than 60ºC;
4. The sound level of the audible "ticking" signal emitted by the speaker of the audible device at each landing shall be adjustable, with a maximum output of 70 dB, such that changes can be effected at no cost to the Employer to suit operational needs after completion of the Works. For outdoor escalators, automatic timer-controlled volume adjusting device shall be provided to produce two pre-set volume levels respectively for day and night operation modes;
5. Frequency of the "ticking" sound shall be adjustable from 70/minute (step moving towards the visually impaired) to 800/minute (steps moving away from the visually impaired). The frequency of the "ticking" sound shall be automatically reversed when the direction of step movement of the escalator is reversed;
6. Technical data and fixing location of the audible device shall be submitted to the Contract Manager for approval;
7. The audible device shall be disabled manually if required.

LTE3.22.020.9 AUDIO ALERT SYSTEM

1. The Contractor shall provide audio alert system for each escalator consisting of an MP3 player, an audio amplifier, loudspeakers and associated equipment for safety messages broadcasting. Each message shall be announced in the order of Cantonese, Putonghua and English;
2. The system shall consist of an MP3 player which acts as the storage of message to be broadcast and as the signal source of the system, an audio amplifier to drive loudspeaker(s) in the escalator, and a built-in monitoring loudspeaker for system testing;
3. A loudspeaker shall be installed on the right side (in direction of escalator) of the balustrade at both landings of the escalator but only the one at the "entry" landing (in accordance with the direction the escalator is running in) shall be active. For high rise escalator with emergency stop button(s) installed at the inclined section, additional loudspeaker(s) shall be provided at the location(s) where the emergency stop button(s) are installed;
4. The MP3 player shall be set to "repeat play" the pre-recorded safety message continuously with the operation direction of the escalator for 'going up', 'going down' and 'please hold the handrail';

5. A pre-recorded message to alert passengers to hold the handrail that the escalator is going to stop shall be broadcasted from all the loudspeakers when the escalator is stopping. This message shall override the safety message as mentioned in sub-clause 4 above;
6. A 24 hour on/off timer shall be provided to enable/disable the message broadcast as described in sub-clause 4 at the predetermined time automatically;
7. An override switch shall be provided inside the newel control box at the lower landing of escalator for turning off the system manually when required;
8. Message change is effected through downloading the new message to the flash memory of the MP3 player;
9. The MP3 player shall comply with the following requirements:
    a. Storage space : minimum 20 minutes of message time when encoded in Windows Media Audio (WMA) format at 80kbps or MP3s at 128kbps.
    b. Supported Formats : MP3, WMA
    c. Play Mode: repeat all
    d, Signal-to-Noise Ratio: 90 dB or higher
    e. Frequency range : 20 Hz to 20 kHz
    f. Line or headphone output: 0 dBm min.
    g. USB (1.1 or 2.0) Transfer: 2 GB memory
    h. Operating System Supported: Microsoft Windows 98/ME/2000/XP/Vista/Window 7
10. The amplifiers shall comply with the following requirements:
    a. Frequency Response: 100Hz-15kHz (-3dB)
    b. S/N ratio: >80dB
    c. Output Power: 10 Wrms min. at 8Ω
    d. Output Protection: Overload & short circuit
    e. Sensitivity: 0 dBm at rated power at 1 kHz
    f. Distortion: <1% at rated power at 1 kHz

    Volume control shall be provided to facilitate playback level adjustment.

    Built-in monitoring loudspeaker with on/off switch shall be provided for system testing.
11. The loudspeakers shall have water-proof diaphragm meeting the following requirements:
    a. Frequency Response: 125Hz-13kHz (-10dB)
    b. Impedance: 8Ω or higher
    c. SPL at 1 kHz, 1 m, 1 W: 90 dB±3 dB
    d. Power Handling: 3 W minimum
12. The audio alert system shall be disabled manually if required.

LTE3.23 SERVICE-ON-DEMAND ESCALATOR CONTROL

LTE3.23.010.9 GENERAL REQUIREMENTS

1. All Escalators shall be of service-on-demand (SOD) by means of motion sensor. The motion sensor shall be installed at least 1.3 m before the comb intersection line. The escalator shall accelerate from crawling to its rated speed automatically and shall start to accelerate before the person reaches the comb intersection line of escalator. Construction measures shall discourage circumvention of the control elements. The escalator shall start automatically from crawl speed upon detection of personnel movement within landing zone of the escalator;
2. The escalator shall be reduced to a crawl speed automatically after a preset period of time (which shall be adjustable) which shall be at least the anticipated passenger transfer time plus 10 seconds after the passenger has actuated the motion sensor at exit.

LTE3.23.020.9 MOTION SENSOR AT EXIT

Motion sensor shall also be installed at exist of the service-on-demand escalator to detect whether there is any passenger approaching the escalator in opposite direction. Upon detection of passenger approaching the escalator in opposite direction, the escalator shall immediately start up from crawl speed to rated speed and run in the predetermined direction for an adjustable period of not less than 10 seconds. Concurrently audible signal shall be provided to alert the passenger not to step onto the escalator.

LTE3.23.030.9 VISIBLE SIGNAL SYSTEM

1. A clear visible signal system shall be provided at both ends indicating to the user whether the escalator is available for use, and its direction of travel. Electronic signage display shall also be provided at each of the ingress/egress point of escalator in order to notify the users of the travel direction;
2. The indicator for the visible signal system shall be dot-matrix type tricolour (red, green and amber) LED display, minimum 128 x 16 dots, actuated by reliable solid state circuitry. The indicator shall be of robust design and impact resistance to a degree equivalent to that of polycarbonate material;
3. The indicator shall be able to display at least 32 messages. The dot -matrix display system shall be pre-programmed with the following messages/symbols to inform passengers the corresponding status of the escalator:
   a. '暫停使用 Out of Service';
   b. '例行保養,暫停使用 Routine Maintenance (Out of Service)';
   c. '維修中,暫停使用 Under Maintenance (Out of Service)';
   d. '清潔中,暫停使用 Cleaning in Progress (Out of Service)';
   e. Symbols to indicate the escalator travelling direction; and
   f. Other messages/symbols as required by the Contract Manager.

   The height of each character in the dot-matrix indicator shall be 50 mm minimum. The luminous intensity of the indicator shall be at least 3500 μcd.

4. Messages/symbols of dot-matrix indicator shall be re-programmable such that changes, if required, can be effected to suit requirements arise after completion of the Works. Two (2) times of free messages/symbols revision within the Maintenance Period for the Contract shall be deemed to be included.

5. The box for the indicators shall be galvanised steel of thickness not less than 1.5 mm thick. Sample of the floor indicator with the base box as well as the dot-matrix graphic layout and the pre-programmed messages shall be submitted for the Contract Manager's approval.

AP1.LTE APPENDIX 1 - LTE

AP1 APPENDIX LTE/I..... 2
AP1.LTE1.APPEND1.9 LIST OF TECHNICAL STANDARDS.....2
AP1.LTE2.APPEND1.9 LIST OF TECHNICAL STANDARDS.....2
AP1.LTE3.APPEND1.9 LIST OF TECHNICAL STANDARDS.....4

AP1 APPENDIX LTE/I

AP1.LTE1.APPEND1.9 LIST OF TECHNICAL STANDARDS

Standard	Year of Standards	Description	Sections	Clauses
BS 1133	N/A	Packaging code	LTE1	1.6.010
BS EN 81-20	2020	Safety rules for the construction and installation of lifts– Lifts for the transport of persons and goods	LTE1	1.8.010
BS EN 115-1	2008	Safety of escalators and moving walks. Construction and installation	LTE1	1.8.010
BS EN 50214	2006	Flat polyvinyl chloride sheathed flexible cables	LTE1	1.7.060
BS EN 55014-1	2006	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Emission	LTE1	1.7.070
EN 10088-1	2005	Stainless steels. List of stainless steels	LTE1	1.5.090
EN 12015	2004	Electromagnetic compatibility. Product family standard for lifts, escalators and moving walks. Emission	LTE1	1.7.070
EN 12016	2004	Electromagnetic compatibility. Product family standard for lifts, escalators and moving walks. Immunity	LTE1	1.7.070

AP1.LTE2.APPEND1.9 LIST OF TECHNICAL STANDARDS

Standard	Year of Standards	Description	Sections	Clauses
BS 88-1	2007	Low-voltage fuses. General requirements	LTE2	2.18.020
BS 88-2	2010	Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to J	LTE2	2.18.020
BS 921	1972	Specification. Rubber mats for electrical purposes	LTE2	2.18.020
BS 952-1	1995	Glass for glazing. Classification	LTE2	2.25.040
BS 952-2	1980	Glass for glazing. Terminology for work on glass	LTE2	2.25.040
BS 1363-1	1995	13 A plugs, socket-outlets, adaptors and connection units. Specification for rewirable and non-rewirable 13 A fused plugs	LTE2	2.8.070
BS 1363-2	1995	13 A plugs, socket-outlets, adaptors and connection units. Specification for 13 A switched and unswitched socket-outlets	LTE2	2.8.070

Standard	Year of Standards	Description	Sections	Clauses
BS 5655-7	1983	Lifts and service lifts. Specification for manual control devices, indicators and additional fittings	LTE2	2.9.100
BS 5655-9	1985	Lifts and service lifts. Specification for guide rails	LTE2	2.1.010
BS EN 81-20	2020	Safety rules for the construction and installation of lifts– Lifts for the transport of persons and goods	LTE2	2.1.010 2.25.040
BS EN 81-50	2020	Safety rules for the construction and installation of lifts – Examinations and tests	LTE2	2.2.020 2.11.160 2.15.030 2.15.070 2.15.080
BS EN 12385-4	2002	Steel wire ropes. Safety. Stranded ropes for general lifting applications	LTE2	2.11.010
BS EN 60269-1	2007	Low-voltage fuses. General requirements	LTE2	2.18.020
BS EN 61558-1	2005	Safety of power transformers, power supplies, reactors and similar products. General requirements and tests	LTE2	2.18.020
BS EN 61558-2-23	2001	Safety of power transformers, power supply units and similar. Particular requirements for transformers for construction sites	LTE2	2.18.020
BS HD 60269-2	2010	Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to J	LTE2	2.18.020
EN 12385-1	2002	Steel wire ropes. Safety. General requirements	LTE2	2.4.010
EN 12385-5	2002	Steel wire ropes. Safety. Stranded ropes for lifts	LTE2	2.4.010
IEC 61558-2-23	2000	Safety of power transformers, power supply units and similar. Particular requirements for transformers for construction sites	LTE2	2.18.020
ISO 4344	2004	Steel wire ropes for lifts --Minimum requirements	LTE2	2.4.010
ISO 7465	2007	Passenger lifts and service lifts. Guide rails for lift cars and counterweights - T-type	LTE2	2.1.010.

AP1.LTE3.APPEND1.9 LIST OF TECHNICAL STANDARDS

Standard	Year of Standards	Description	Sections	Clauses
BS EN 115-1	2008	Safety of escalators and moving walks. Construction and installation	LTE3	3.1.060
BS EN ISO 1461	2009	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods	LTE3	3.19.030
EN 10088-1	2005	Stainless steels. List of stainless steels	LTE3	3.1.020

AP2 APPENDIX FWP/II

AP2.FWP.APPEND1.A DECLARATION OF VALIDITY OF WSD SUBMISSION FORMS (FOR FIRE SERVICES AND WATER PUMP INSTALLATION)

HOUSING DEPARTMENT

DECLARATION OF VALIDITY OF WSD SUBMISSION FORMS

Contract Title	:	Ref. No.:	
		Date:	
Contract No. :			
Sub-contract :	Fire Services & Water Pump Installation		
File Reference	:		

To : Contract Manager's Representative (Attn : / PBSE/) via PBSI/

From : (State Names of Main Contractor / Nominated Sub-contractor for FS&WP Installation)

_____/_____

1. Pursuant to sub-clause (3) of Specification Clause No. FWP1.6.050, we attach for CM's processing / signing the following WSD Form(s) –

(please tick the box(s) whichever relevant)

(a)	☐	**WWO 542**		Application for Water Supply
(b)	☐	**WWO 1155**		Request for Work to be Carried out by the Water Authority
(c)	☐	**WWO 46**	☐ **Part I** ☐ **Part II** ☐ **Part IV**	Application for Constructing, Installation, Altering or Removing an Inside Service or Fire Service
(d)	☐	**WWO 1149**		List of Pipes and Fittings to be Installed

2. We confirm that the above WSD Form(s) undercover of this declaration have been checked / verified by the Licensed Plumber, the FS&WP Installation Sub-contractor and the Main Contractor. We hereby declare that -

(please tick the box(s) whichever relevant)

☐ The data entry in the Form is accurate.

☐ The pipes and fittings to be installed and any materials to be used for the construction, installation, alteration or removal of the Approved water services works for fire services and water pump installation covered by this Form, including those as listed on Form WWO 1149 and those not listed, shall be as prescribed by the Waterworks Regulations.

☐ The pipes and fittings installed and any materials used for the construction, installation, alteration or removal of the Approved water services works for fire services and water pump installation covered by this Form are as prescribed by the Waterworks Regulations.

☐ The water services works for fire services and water pump installation for the captioned Sub-contract have been completed in accordance with WSD Approved Drawings, WSD Circular Letters in force, the Specification and statutory requirements.

☐ Others, please state : _____

For and on behalf of the NSC for FS&WP Installation

_____

(Supervising Engineer)

Name : _____

Checked and acknowledged by the Main Contractor

_____

(Building Services Engineer)

Name : _____

_____

(Licensed Plumber)

Name : _____

License No. : _____

AP2.FWP.APPEND2.A DECLARATION OF THE COMPLETED WATER SERVICES WORKS FOR FIRE SERVICES AND WATER PUMP INSTALLATION

HOUSING DEPARTMENT

DECLARATION OF THE COMPLETED WATER SERVICES WORKS FOR FIRE SERVICES AND WATER PUMP INSTALLATION

Contract Title	:	Ref. No.	:
		Date :	
Contract No.	:		
Sub-contract	:	Fire Services & Water Pump Installation	
File Reference	:		

To : Contract Manager's Representative (Attn : / PBSE/) via PBSI/

From: (State Names of Main Contractor / Nominated Sub-contractor for FS&WP Installation)

_____/_____

1. Pursuant to sub-clause (4) of Specification Clause No. FWP1.6.050, we confirm that water services works for fire services and water pump installation for the captioned Contract have been completed. We hereby declare that -

   a. All pipes and fittings installed on Site have been approved by WSD and registered with WSD under Form WWO 1149;

   b. Only cadmium-free category brazing alloy and lead-free category soldering alloy are used;

   c. All pipes and fittings installed and any materials used for the constriction and installation of the water services works for fire services and water pump installation are as prescribed by the Waterworks Regulations and approved by the Water Authority.

2. The Licensed Plumber's inspection report of the completed water services works for fire services and water pump installation is submitted herewith.

For and on behalf of the NSC for FS&WP Installation

_____

(Supervising Engineer)

Name : _____

Checked and acknowledged by the Main Contractor

_____

(Building Services Engineer)

Name : _____

_____

(Licensed Plumber)

Name : _____

License No. : _____

HONG KONG HOUSING AUTHORITY

SPECIFICATION LIBRARY 2022 (BATCH 4) EDITION

Civil Engineering Works Specification

BRI BRIDGE WORKS

BRI BRIDGE WORKS 4

DESIGN 4

GENERAL 4

BRI.D010.9 DEFINITIONS 4

BRIDGE BEARINGS 4

BRI.D110.9 GENERAL 4
BRI.D120.9 SLIDING BEARINGS 4
BRI.D130.9 ELASTOMERIC BEARINGS 5
BRI.D140.9 GUIDES FOR BEARINGS 5
BRI.D150.9 FIXINGS FOR BEARINGS 5
BRI.D160.9 PROTECTIVE COATINGS 5
BRI.D170.9 MARKING 5

MOVEMENT JOINTS 5

BRI.D210.9 MOVEMENT JOINTS FORMED IN PLACE 5
BRI.D220.9 DESIGN CRITERIA FOR FABRICATED MOVEMENT JOINTS 5
BRI.D230.9 FIXINGS FOR FABRICATED MOVEMENT JOINTS 6

SUBMISSIONS 6

BRI.D310.9 BRIDGE BEARINGS 6
BRI.D320.9 MOVEMENT JOINTS 7

MATERIALS 8

WATERPROOFING 8

BRI.M010.9 PREFABRICATED SHEETING 8
BRI.M020.9 BENTONITE PANELS 8
BRI.M030.9 BITUMINOUS PAINT 8

BRIDGE BEARINGS 9

BRI.M110.9 HOLDING DOWN BOLTS 9
BRI.M120.9 CEMENT MORTAR, GROUT AND ADHESIVE 9
BRI.M130.9 DOWEL BARS 9

VEHICULAR PARAPETS 9

BRI.M210.9 GENERAL 9
BRI.M220.9 STEEL 9
BRI.M230.9 ALUMINIUM 9
BRI.M240.9 STAINLESS STEEL NUTS, BOLTS AND WASHERS 10
BRI.M250.9 HOLDING DOWN BOLTS 10
BRI.M260.9 GROUT 10

MOVEMENT JOINTS 10

BRI.M310.9 JOINT FILLER 10
BRI.M320.9 JOINT SEALANT 10
BRI.M330.9 COMPRESSION SEALS 10
BRI.M340.9 PVC CAPPING STRIP 10
BRI.M350.9 HOLDING DOWN BOLTS 10
BRI.M360.9 GROUT 11

SUBMISSIONS 11

BRI.M410.9 WATERPROOFING SYSTEMS 11
BRI.M420.9 SAMPLES FOR WATERPROOFING SYSTEMS 11
BRI.M430.9 SAMPLES FOR VEHICULAR PARAPETS 11

WORKMANSHIP 12

DELIVERY AND STORAGE 12

BRI.W010.9 DELIVERY OF BENTONITE PANELS FOR WATERPROOFING 12
BRI.W020.9 STORAGE OF WATERPROOFING MATERIALS 12

BRI.W030.9 STORAGE OF BRIDGE BEARINGS 12
BRI.W040.9 STORAGE OF VEHICULAR PARAPETS 12
BRI.W050.9 STORAGE OF FABRICATED MOVEMENT JOINTS 12

INSTALLATION OF WATERPROOFING SYSTEMS 12
BRI.W110.9 GENERAL 12
BRI.W120.9 PREPARATION 12
BRI.W130.9 PREFABRICATED SHEETING 13
BRI.W140.9 BENTONITE PANELS 13
BRI.W150.9 BITUMINOUS PAINT 14

INSTALLATION OF BRIDGE BEARINGS 14
BRI.W210.9 GENERAL 14
BRI.W220.9 PRE-ASSEMBLED BEARINGS 14
BRI.W230.9 LEVELS 14
BRI.W240.9 SETTING AND LOCKING BEARINGS 14

INSTALLATION OF VEHICULAR PARAPETS 14
BRI.W310.9 GENERAL 14
BRI.W320.9 FIXING AND GROUTING 15

INSTALLATION OF FABRICATED MOVEMENT JOINTS 15
BRI.W410.9 GENERAL 15
BRI.W420.9 PREPARATION 15
BRI.W430.9 BEDDING AND FIXING 15
BRI.W440.9 ROAD SURFACES ADJOINING JOINTS 15
BRI.W450.9 PROTECTION 15

MOVEMENT JOINTS FORMED IN PLACE 16
BRI.W510.9 FORMING JOINTS 16
BRI.W520.9 FORMING GROOVES 16
BRI.W530.9 SEALING GROOVES 16

TOLERANCES 16
BRI.W610.9 GENERAL 16

TESTING 17

TESTING BRIDGE BEARINGS GENERALLY 17
BRI.T010.9 DEFINITION OF BATCH 17
BRI.T020.9 LABORATORY 17
BRI.T030.9 NOTICE TO THE CM 17
BRI.T040.9 CHANGES TO PROCEDURES 17
BRI.T050.9 REPORTS 17

FRICTION TESTS ON BRIDGE BEARINGS 17
BRI.T110.9 SAMPLING 17
BRI.T120.9 TEST METHOD 17
BRI.T130.9 TEMPERATURE 17
BRI.T140.9 EQUIPMENT 17
BRI.T150.9 PROCEDURE 18
BRI.T160.9 CALCULATION 18
BRI.T170.9 REPORTING RESULTS 18
BRI.T180.9 COMPLIANCE CRITERIA 18

TESTING NON-ELASTOMERIC BEARINGS 19
BRI.T210.9 SAMPLING 19
BRI.T220.9 TEST METHODS 19
BRI.T230.9 COMPLIANCE CRITERIA 19

TESTING ELASTOMERIC BEARINGS 19
BRI.T310.9 SAMPLING 19
BRI.T320.9 TEST METHODS 19

BRI.T330.9 COMPLIANCE CRITERIA 19

TESTING VEHICULAR PARAPETS GENERALLY 20

BRI.T410.9 DEFINITION OF BATCH 20
BRI.T420.9 SAMPLING 20
BRI.T430.9 TEST PROCEDURE 20

TESTING PARAPET MATERIALS 20

BRI.T510.9 SAMPLING 20
BRI.T520.9 TENSILE AND IMPACT TESTING 20
BRI.T530.9 QUALITY GRADING 20

TESTING FASTENERS 20

BRI.T610.9 TENSILE TESTING 20

TESTING WELDED COMPONENTS OF VEHICULAR PARAPETS 21

BRI.T710.9 GENERAL 21
BRI.T720.9 NON-DESTRUCTIVE TESTING 21
BRI.T730.9 COMPLIANCE CRITERIA 21
BRI.T740.9 NON-COMPLIANCE 22

TESTING METAL VEHICULAR PARAPET POSTS 22

BRI.T810.9 SAMPLING 22
BRI.T820.9 TEST METHODS 22
BRI.T830.9 COMPLIANCE CRITERIA 22
BRI.T840.9 NON-COMPLIANCE 22

BRI BRIDGE WORKS

DESIGN

GENERAL

BRI.D010.9 DEFINITIONS

1. Schedule of bearings: the schedule of bearings stated in the Contract;
2. Type of bridge bearing: a term used to identify bridge bearings of exactly the same design and same capacity for all bearing loads, movements and rotations;
3. Fabricated movement joint: a manufactured assembly, including nosings, designed to carry traffic smoothly over a movement joint and to seal the joint against the ingress of water and debris;
4. Movement joint: a permanent joint or hinge throat which allows expansion, contraction or angular rotation to occur;
5. Movement joint formed in place: a movement joint formed during construction of a structure to permit adjacent structural elements to move relative to each other without damage.

BRIDGE BEARINGS

BRI.D110.9 GENERAL

1. Bridge bearings shall be designed by the Contractor;
2. The design and manufacture of bridge bearings and the materials used shall comply with BS 5400:Part 9:1983, including the guidance notes, except as stated in BRI.D120 and BRI.D130. Inspection and maintenance of bridge bearings shall be easy to carry out and the bearings shall be easily replaceable;
3. The maximum bearing stress in concrete underlying or overlying a bridge bearing under the design load at the ultimate limit state shall not exceed 40% of the specified grade strength of the concrete. Higher bearing stresses may be adopted provided that in the opinion of the CM sufficient steel reinforcement is provided to resist the resulting bursting forces and that the bearing stresses are within the limits stated in Clause 7.2.3.3 of BS 5400:Part 4:1990;
4. The deflection of bridge bearings which have a specified zero horizontal movement in a particular direction shall not exceed 1 mm in that direction under the maximum horizontal loadings.

BRI.D120.9 SLIDING BEARINGS

1. Clause 4.3.4.2 of BS 5400:Part 9: 1983:Section 9.2 shall not apply to sliding bearings;
2. Stainless steel sliding surfaces of sliding bearings which are attached to backing plates by mechanical fasteners instead of continuous welding along the edges shall be bonded to the backing over the full area and supplemented with peripheral sealing if necessary. Mechanical fixing with peripheral sealing only shall not be used.

BRI.D130.9 ELASTOMERIC BEARINGS

The requirements for use of elastomer in elastomeric bearings at sub-zero temperatures stated in Clause 3.7.1 of BS 5400:Part 9:1983:Section 9.2 shall not apply.

BRI.D140.9 GUIDES FOR BEARINGS

The clearance between guides and complementary sliding surfaces of a guide bearing shall not exceed 1 mm.

BRI.D150.9 FIXINGS FOR BEARINGS

1. Except for elastomeric bearings, bridge bearings, including bearings which are not required to provide horizontal restraint, shall be fixed to the superstructure and substructure with mechanical fixings or by other methods approved by the CM. The friction between the bearing and the superstructure or substructure may be used to resist the horizontal forces provided that a factor or safety of at least 2 is applied to the proven coefficient of friction and that the worst combination of vertical load and horizontal load is considered;
2. The ultimate capacity of the mechanical fixings for bridge bearings shall not be less than the worst combination of loading at ultimate limit state stated in the schedule of bearings.

BRI.D160.9 PROTECTIVE COATINGS

Metal components of bridge bearings shall be protected against corrosion by a protective coating complying with, and selected in accordance with, BS 5493:1977. For the purpose of selecting the coating system, the environment shall be classified as 'exterior exposed - polluted coastal' and the typical time to first maintenance shall be 'very long' (20 years or more).

BRI.D170.9 MARKING

1. Bridge bearings shall be marked by the manufacturer either with the type numbers stated in the schedule of bearings or with the manufacturer's own type or other numbers. A schedule shall be provided which relates the manufacturer's own type or other numbers to the type numbers stated in the schedule of bearings;
2. The design movement directions and magnitudes and the axes of bearing shall be marked on the upper faces of bridge bearings to facilitate checking of the installation. Movement indicators shall be provided for sliding and roller bearings to permit checking of movement of the bearings before and after installation.

MOVEMENT JOINTS

BRI.D210.9 MOVEMENT JOINTS FORMED IN PLACE

Movement joints formed in place shall comply with Worksection CON6 except as stated in this Worksection.

BRI.D220.9 DESIGN CRITERIA FOR FABRICATED MOVEMENT JOINTS

1. Fabricated movement joints shall be a proprietary type approved by the CM;
2. Fabricated movement joints shall be capable of withstanding the following loads, either separately or in combination:

a. Vertically: two 112.5 kN wheel loads, 1 m apart, each spread over a contact area giving an average pressure of 1 MPa and applied in such a manner as to produce the worst possible effect;

b. Horizontally: a traction force of 75 kN/m run of the joint applied perpendicular to the alignment of the joint, together with any forces arising from strain of the joint.

Allowance for additional loading due to impact is not necessary.

3. Fabricated movement joints shall be capable of accommodating the movements and rotations as specified in the Project Specific Specification without damaging the joint and without loading the supporting structure with forces which arise from strain of the joint exceeding 5 kN/m run of the joint;
4. Facilities shall be provided in fabricated movement joints for easy clearance of grit or silt entering slots, grooves or channels forming or associated with the joint;
5. Surfaces of fabricated movement joints which will be exposed at finished road level shall be treated to provide a resistance to skidding not less than that of the adjacent road surface;
6. Fabricated movement joints shall not impair the riding quality of the road surface for vehicular traffic and the passage of vehicular traffic shall not cause undue noise or vibration. The size of gaps, including gaps sealed with flexible material, on the riding surface of the joint shall not exceed 65 mm;
7. The passage of pedestrians and cyclists shall not be impeded or endangered by fabricated movement joints.

BRI.D230.9 FIXINGS FOR FABRICATED MOVEMENT JOINTS

1. The holding down and fixing arrangements for fabricated movement joints shall be capable of withstanding the loads stated in BRI.D220 (2). The diameter of bolts fixed as double row bolts on one side shall be at least 12 mm and the diameter of other holding down bolts and studs shall be at least 16 mm;
2. Fixings for fabricated movement joints shall be compatible with the reinforcement in the underlying concrete. Any revisions to the reinforcement required to suit the fixings shall be designed by the Contractor and submitted to the CM for Approval.

SUBMISSIONS

BRI.D310.9 BRIDGE BEARINGS

Certificates shall be submitted for each batch of bridge bearings delivered to the Site. The following particulars shall be submitted to the CM at least 28 days before Approval of the bridge bearings is required:

1. Details of type of bridge bearings, including materials, and the name and address of the manufacturer;
2. Design calculations, including:
   a. Calculations of bearing stresses above and below the bearings;
   b. Calculations for bursting or other necessary additional or revised reinforcement;
   c. Calculations to show that the bearings comply with the requirements of BS5400:Part 9:1983.
3. Shop drawings and drawings of any additional or revised reinforcement details;

4. Certificate for each type of bridge bearing showing the manufacturer's name, the date and place of manufacture and showing that the bridge bearings comply with the requirements stated in the Contract and including results of:
    a. Friction tests;
    b. Load tests;
    c. Tests on elastomers;
    d. Quick production tests;
    e. Stiffness tests.
5. Values of stiffness in compression and in shear of elastomeric bearings;
6. Details of fixings to superstructures and substructures;
7. Details of protective coatings;
8. Methods of installation;
9. Programme of manufacture, testing and delivery, including name and address of testing laboratory.

BRI.D320.9 MOVEMENT JOINTS

The following particulars shall be submitted to the CM at least 28 days before construction of the movement joints starts:

1. Details of type of movement joints and the name and address of the manufacturer;
2. Design calculations and drawings;
3. Details of fixings, including the size, length and spacing of holding down bolts and any necessary revisions to the reinforcement;
4. Details of materials for making good adjoining road surfaces and nosings, including reinforcement, jointing and curing details;
5. Programme of manufacture, testing and delivery;
6. For fabricated movement joints, a written undertaking from the supplier that he will install the proposed movement joint.

MATERIALS

WATERPROOFING

BRI.M010.9 PREFABRICATED SHEETING

1. Prefabricated sheeting for waterproofing shall be a proprietary type approved by the CM;
2. Prefabricated sheeting shall not rot or support the growth of mildew and shall be compatible with the materials with which it is in contact. Prefabricated sheeting which will be exposed to sunlight after installation shall be of a type which is unaffected by ultraviolet light;
3. Prefabricated sheeting shall have a tensile strength, pliability and puncture resistance such that the sheeting will withstand the stresses induced during handling and laying without damage. The elongation properties of prefabricated sheeting shall be such that the sheeting can accommodate the creep, shrinkage and thermal movements of concrete without distress;
4. Prefabricated bituminous sheeting shall be a self-adhesive, self-sealing type and shall have a thickness of at least 1.2 mm;
5. Prefabricated rubberised base sheeting shall be of a type which is unaffected by fuel, oils or grease;
6. Primers and mastic for prefabricated sheeting shall be a proprietary type recommended by the sheeting manufacturer and approved by the CM.

BRI.M020.9 BENTONITE PANELS

1. Bentonite panels shall consist of bentonite filler enclosed in self-degradable boards. The panels shall have a permeability of less than 1×10^{-7} mm/sec under simulated test conditions similar to those of the as-built conditions. The performance of bentonite panels shall not be affected by contaminants present in the groundwater;
2. Bentonite panels for slabs less than 200 mm thick or with soil cover of less than 450 mm shall be special panels with specific provision for swelling to prevent lifting of the slab;
3. Bentonite joint seal and bentonite granules shall be a proprietary type recommended by the bentonite panel manufacturer and approved by the CM;
4. Polyethylene sheeting for use with bentonite panels shall be a heavy duty type.

BRI.M030.9 BITUMINOUS PAINT

Bituminous paint for waterproofing shall be cut-back bitumen complying with BS 3690:Part 1:1989. The bitumen shall have a viscosity grade as determined by a standard tar viscometer within the range 25-50 seconds with a coverage of 0.5 L/m². Primers for bituminous paint shall be a proprietary type recommended by the bituminous paint manufacturer and approved by the CM.

BRIDGE BEARINGS

BRI.M110.9 HOLDING DOWN BOLTS

Holding down bolts for bridge bearings shall be of stainless steel and a proprietary type approved by the CM.

BRI.M120.9 CEMENT MORTAR, GROUT AND ADHESIVE

1. Cement mortar for bedding and construction of unreinforced plinths for bridge bearings shall be a proprietary non-shrink type approved by the CM having a grade strength of at least 50 MPa;
2. Chemical-resin mortar for the construction of plinths for bridge bearings shall be a proprietary non-shrink type approved by the CM having a grade strength of at least 50 MPa;
3. Grout for grouting base plates and holding down bolts shall be a proprietary non-shrink cementitious type approved by the CM having a grade strength of at least 50 MPa. The grout shall be flowable and shall not bleed or segregate. The suitability of the grout shall be demonstrated by site trials to the satisfaction of the CM. Chemical-resin based grout shall not be used;
4. Adhesive and chemical resin mortars for locating and bedding elastomeric bridge bearings shall be a proprietary type approved by the CM. They shall be compatible with the elastomer.

BRI.M130.9 DOWEL BARS

Dowel bars for bridge bearings shall be grade 1.4401 stainless steel complying with BS EN 10084:2008, BS EN 10085:2001, BS EN 10087:1999, BS EN 10095:1999, BS EN 10250-4:2000 and PD 970:2005.

VEHICULAR PARAPETS

BRI.M210.9 GENERAL

Vehicular parapets shall be of the types shown on the Drawings.

BRI.M220.9 STEEL

1. Steel for vehicular parapets, including weldings, shall comply with Worksection STW except clauses STW.T410 to STW.T430 and clauses STW.T450 to STW.T910. The requirements for testing of materials and welded components shall follow clauses BRI.T410 to BRI.T840;
2. Protective treatment to steel for vehicular parapets shall comply with Worksection STW and shall be applied after welding, drilling and cutting is complete.

BRI.M230.9 ALUMINIUM

1. Aluminium for vehicular parapets shall comply with the following or equivalent approved by the CM:
    a. Wrought aluminium and aluminium alloys for general engineering purposes:
        i. Plate, sheet and strip: BS EN 485:Part 1:1994, BS EN 485:Part 2:2004, BS EN 485:Part 3:2003;
        ii. Rivet, bolt and screw stock: BS 1473:1972;

iii. Bars, extruded round tubes and sections: BS EN 755:Part 1:1997, BS EN 755:Part 2:1997, BS EN 755:Part 3:1996, BS EN 755:Part 4:1996, BS EN 755:Part 5:1996.

2. Aluminium shall be anodised to Grade AA 25 in accordance with BS EN 12373:Part 1:2001 or equivalent approved by the CM;
3. Welding of aluminium for vehicular parapets shall comply with BS EN 1011:Part 4:2000 or equivalent approved by the CM.

BRI.M240.9 STAINLESS STEEL NUTS, BOLTS AND WASHERS

Stainless steel bolts, nuts and washers for vehicular parapets shall be grade A4 - 80 and shall comply with BS EN ISO 3506:Part 1:1998 and BS EN ISO 3506:Part 2:1998 or equivalent approved by the CM.

BRI.M250.9 HOLDING DOWN BOLTS

Holding down bolts for vehicular parapets shall be a proprietary type approved by the CM.

BRI.M260.9 GROUT

Grout for holding down bolts for vehicular parapets shall be based on polyester resins and shall be a proprietary type approved by the CM. Epoxy resin based grout shall not be used.

MOVEMENT JOINTS

BRI.M310.9 JOINT FILLER

Joint filler for movement joints formed in place shall be non-absorbent.

BRI.M320.9 JOINT SEALANT

1. Joint sealant for movement joints formed in place shall be a polysulphide-based sealant. Polyurethane-based sealant shall not be used unless approved by the CM;
2. Joint sealant shall be resistant to attack by petrol, diesel oil, dilute acids and alkalis, synthetic and mineral oils, hydraulic fluids and paraffin. The sealant shall have a transverse butt joint movement range for repeated cyclic movement of at least 25% of the width of the joint.

BRI.M330.9 COMPRESSION SEALS

Compression seals shall be a proprietary type approved by the CM and shall be manufactured from natural rubber, neoprene or other synthetic material. Compression seals shall have the dimensions specified by the manufacturer for each joint width.

BRI.M340.9 PVC CAPPING STRIP

PVC capping strip shall be a proprietary type approved by the CM.

BRI.M350.9 HOLDING DOWN BOLTS

Holding-down bolts for movement joints shall be a proprietary type approved by the CM.

BRI.M360.9 GROUT

Grout for holding-down bolts for movement joints shall be based on polyester resins and shall be a proprietary type approved by the CM. Epoxy-resin based grout shall not be used.

SUBMISSIONS

BRI.M410.9 WATERPROOFING SYSTEMS

Certificates shall be submitted for each batch of the material delivered to the Site. The following particulars, including certificates, shall be submitted to the CM at least 14 days before the first delivery of the material to the Site:

1. Manufacturer's literature and a certificate for prefabricated sheeting showing the manufacturer's name, the date and place of manufacture and showing that the prefabricated sheeting complies with the requirements stated in this Specification including results of tests for:
    a. Tensile strength;
    b. Pliability;
    c. Puncture resistance;
    d. Elongation.
2. Manufacturer's literature and a certificate for bentonite panels showing the manufacturer's name, the date and place of manufacture and showing that the bentonite panels comply with the requirements stated in this Specification and including results of tests for permeability;
3. Manufacturer's literature and a certificate for bituminous paint showing the manufacturer's name, the date and place of manufacturer and showing that the bituminous paint complies with the requirements stated in this Specification and including results of tests for viscosity;
4. Particulars of primers and mastic for prefabricated sheeting, bentonite joint seal and bentonite granules and primers for bituminous paint;
5. Method of laying prefabricated sheeting and bentonite panels.

BRI.M420.9 SAMPLES FOR WATERPROOFING SYSTEMS

Samples of the following proposed materials for waterproofing systems shall be submitted to the CM at the same time as particulars of the materials are submitted:

1. Prefabricated sheeting;
2. Bentonite panels.

BRI.M430.9 SAMPLES FOR VEHICULAR PARAPETS

Samples for the proposed posts and rails for vehicular parapets shall be submitted to the CM at least 14 days before installation of the parapets starts.

WORKMANSHIP

DELIVERY AND STORAGE

BRI.W010.9 DELIVERY OF BENTONITE PANELS FOR WATERPROOFING

Bentonite panels shall be delivered in original unbroken packages bearing the manufacturer's label.

BRI.W020.9 STORAGE OF WATERPROOFING MATERIALS

1. Prefabricated sheeting and bentonite panels shall be stored in accordance with the manufacturers' recommendations in a dry weather proof store with a raised floor;
2. Bituminous paint shall be stored in sealed containers marked to identify the contents and protected from exposure to conditions which may affect the bituminous paint. The bituminous paint shall be stored in accordance with the manufacturer's recommendations and shall not be used after the recommended shelf life has been exceeded.

BRI.W030.9 STORAGE OF BRIDGE BEARINGS

Bridge bearings shall be stored off a levelled, well drained and maintained hard-standing ground on level supports and in a manner which will not result in damage or deformation to the bearings or in contamination of the bearings.

BRI.W040.9 STORAGE OF VEHICULAR PARAPETS

Vehicular parapets shall be stored off a levelled, well drained and maintained hard-standing ground on level supports and in a manner which will not result in damage or deformation to the parapets or in contamination of the parapets.

BRI.W050.9 STORAGE OF FABRICATED MOVEMENT JOINTS

Fabricated movement joints shall be stored off a levelled, well drained and maintained hard-standing ground on level supports and in a manner which will not result in damage or deformation to the movement joint or in contamination of the movement joint.

INSTALLATION OF WATERPROOFING SYSTEMS

BRI.W110.9 GENERAL

Waterproofing systems shall be laid in accordance with the manufacturer's recommendations.

BRI.W120.9 PREPARATION

1. Surfaces on which waterproofing systems will be laid shall be clean, dry and free from voids, loose aggregate, sharp protrusions, projecting tying wire, release agents and other substances which are likely to damage or affect the waterproofing system;

2. Before waterproofing systems are laid on concrete surfaces the concrete surface shall have been cured for at least 7 days and shall be cleaned with a broom and sealed with one coat of primer. Primed surfaces shall not be covered until the solvent constituent has evaporated. Water shall be allowed to evaporate from primers containing bituminous emulsion before the surface is covered. Primed surfaces shall be protected from contamination.

BRI.W130.9 PREFABRICATED SHEETING

1. Prefabricated sheeting shall be laid one sheet at a time from low points and drains towards high points. The sheeting shall be firmly and tightly brought into contact with the primer or underlying sheeting;
2. Laps shall be formed at joints between individual sheets of prefabricated sheeting. Unless otherwise approved by the CM, end laps shall be at least 150 mm and side laps shall be at least 100 mm. Joints shall be arranged in such a manner that the number of layers of sheeting at any joint does not exceed three;
3. The perimeter of prefabricated sheeting laid each day shall be sealed with a trowelled bead of mastic;
4. A double layer of prefabricated sheeting shall be laid around pipes, posts or other components which pass through the sheeting and the edges shall be sealed with a trowelled bead of mastic.

BRI.W140.9 BENTONITE PANELS

1. Bentonite panels shall not be laid in water or during wet weather;
2. Immediately before bentonite panels are laid on a surface, joints and cracks in the surface shall be sealed with bentonite joint seal;
3. Polyethylene sheeting shall be laid below and above bentonite panels to prevent prehydration. Laps of at least 100 mm shall be formed at joints in the sheeting;
4. Laps shall be formed at the edges of bentonite panels or the edges shall be closely butted together and the seam filled with loose bentonite granules;
5. Bentonite panels shall not be fixed to the underlying surface unless permitted by the CM, if permitted, the method of fixing shall be by 25 mm masonry washerhead nails or by other methods agreed by the CM;
6. Bentonite panels shall be laid continuously around wall bases and corners. Flat panels shall not be folded or bent if the panels will be damaged or bentonite filler will be lost;
7. Bentonite which is exposed at the edges of bentonite panels cut to fit around pipes, posts or other components which pass through the panel shall be taped or sealed by other methods agreed by the CM to prevent loss of the bentonite filler. The joint between panels and the pipe, post or components shall be sealed with a continuous bentonite seal;
8. Exposed bentonite panels shall be protected from moisture by polyethylene sheeting unless panels with a water repellent coating are used. The sheeting shall be removed before fill materials is deposited. As soon as practicable after each course of panels has been laid, fill material shall be deposited and compacted up to a level which is within 50 mm of the top edge of the panel;
9. Damaged or expanded bentonite panels shall be replaced before being covered by the permanent work.

BRI.W150.9 BITUMINOUS PAINT

Surfaces to which bituminous paint will be applied shall be treated with a primer before the paint is applied if recommended by the paint manufacturer. Bituminous paint shall be applied in two coats; the first coat shall be allowed to dry before the second coat is applied.

INSTALLATION OF BRIDGE BEARINGS

BRI.W210.9 GENERAL

Bridge bearings shall be installed as recommended in BS 5400:Part 9:1983 and as in this sub-section.

BRI.W220.9 PRE-ASSEMBLED BEARINGS

Bridge bearings which have been pre-assembled shall not be dismantled unless approved by the CM.

BRI.W230.9 LEVELS

The levels of substructures shown on the drawings, on which bridge bearings will be installed shall be adjusted to suit the thickness of the bearing so that the superstructure will be at the specified level after completion.

BRI.W240.9 SETTING AND LOCKING BEARINGS

1. Bridge bearings, other than elastomeric bridge bearings, shall be set level on substructures using only a thin layer of cementitious mortar, unless the CM permits the bearings to be set on plinths. If setting on plinths is permitted, the plinths shall be constructed of cementitious mortar or grout, unless otherwise approved by the CM, and the thickness of such plinths shall be at least 25 mm and shall not exceed 40 mm. If approved by the CM, the plinths may not be constructed of chemical resin mortar, having a thickness of at least 5 mm and not exceeding 10 mm;
2. Elastomeric bearings shall be set directly on the substructure. A thin layer of cementitious mortar may be used to level the surface if the substructure is concrete. Elastomeric bearings shall not be set in position by grouting between the substructure and the underside of the bearing;
3. The top surface of bridge bearings which will support precast concrete or other prefabricated beams shall be covered with a thin layer of cementitious mortar immediately before the beam is placed. The beam shall be temporarily supported on folding wedges or by other methods agreed by the CM until the mortar has achieved sufficient strength to transmit the weight of the beam to the bearings; the temporary supports shall then be removed;
4. Temporary locking devices for bridge bearings shall be removed before post-tensioned superstructures are stressed. Temporary locking devices for other types of superstructures shall be removed at times agreed by the CM.

INSTALLATION OF VEHICULAR PARAPETS

BRI.W310.9 GENERAL

Vehicular parapets shall be installed to a smooth alignment and with the posts vertical.

BRI.W320.9 FIXING AND GROUTING

Grouting shall be carried out by setting the vehicular parapets in position and grouting the gap between the vehicular parapets and the structure. Vehicular parapets shall be held in position until connections and fixings are complete and until the fixings have gained sufficient strength.

INSTALLATION OF FABRICATED MOVEMENT JOINTS

BRI.W410.9 GENERAL

Fabricated movement joints shall be installed in accordance with the manufacturer's recommendations. The installation shall be carried out by the supplier of the movement joint.

BRI.W420.9 PREPARATION

The vertical faces of recesses in bridge decks for fabricated movement joints shall be formed by saw-cutting. Holding-down bolts shall be cast into the concrete for direct mounting of the joints unless the CM permits the bolts to be grouted. If grouting is permitted, the grouting shall be carried out by setting the movement joint in position and grouting the gap between the movement joint and the structure. Rebates and pockets for subsequent trimming to line and level or for holding-down bolts shall not be used unless permitted by the CM.

BRI.W430.9 BEDDING AND FIXING

1. The bedding to fabricated movement joints shall be formed such that there shall be no gaps between the joints and the bedding;
2. Relative movement between components and supports of a fabricated movement joint shall be prevented during installation of the joint and during placing and hardening of concrete and mortar under the components. Joint components shall be free to move longitudinally relative to each other;
3. When one side of a fabricated movement joint is being set, the other side shall be free from longitudinal restraint. Strongbacks or templates used to locate the side of a joint shall not be fixed to both sides at any one time.

BRI.W440.9 ROAD SURFACES ADJOINING JOINTS

1. The gap between fabricated movement joints and the adjoining road surface or nosing shall be made good after installation of the joint with material which has properties as similar as practicable to those of the material in the adjoining road surface;
2. Bituminous road surfaces shall be made good with a bituminous mixture or elastomeric concrete. Concrete road surfaces shall be made good with a cementitious matrix reinforced with metal or glass fibres or with elastomeric or polymer concrete. Epoxy resin mortar shall not be used;
3. Elastomeric and polymer concrete shall be prepared, laid and cured in accordance with the manufacturer's recommendations.

BRI.W450.9 PROTECTION

1. The permission of the CM shall be obtained before constructional plant or other vehicles cross a fabricated movement joint or the adjacent road surface;

2. Constructional plant or other vehicles shall not cross fabricated movement joints or adjacent road surfaces until installation of the joint is complete unless permitted by the CM. If permitted, ramps shall be provided to allow the vehicles to cross without loads being applied to the joint.

MOVEMENT JOINTS FORMED IN PLACE

BRI.W510.9 FORMING JOINTS

Gaps forming part of movement joints formed in place shall be filled with joint filler fixed in position with adhesive. The edge of the joint filler shall be covered with bond breaker tape or a PVC capping strip.

BRI.W520.9 FORMING GROOVES

Grooves for joint sealant and compression seals for movement joints formed in place shall be formed by saw cutting.

BRI.W530.9 SEALING GROOVES

Grooves for movement joints formed in place shall be sealed with joint sealant or with a compression seal.

TOLERANCES

BRI.W610.9 GENERAL

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

TESTING

TESTING BRIDGE BEARINGS GENERALLY

BRI.T010.9 DEFINITION OF BATCH

A batch of bridge bearings is any quantity of bridge bearings of the same type fabricated by the same manufacturer and which for the purpose of testing elastomeric bearings contains the same type of elastomer.

BRI.T020.9 LABORATORY

Bridge bearings shall be tested by the Contractor at a laboratory approved by the CM.

BRI.T030.9 NOTICE TO THE CM

The Contractor shall inform the CM of the date and place of testing at least 28 days before testing starts.

BRI.T040.9 CHANGES TO PROCEDURES

The specified procedure for testing bridge bearings shall not be changed unless permitted by the CM.

BRI.T050.9 REPORTS

The reports of tests on bridge bearings shall include load/deflection graphs and shall be submitted to the CM for Approval at least 28 days before installation of the bridge bearings starts.

FRICTION TESTS ON BRIDGE BEARINGS

BRI.T110.9 SAMPLING

One sample of bridge bearing shall be provided from each batch of sliding bearings and from each batch of other types of bridge bearings which contain sliding parts.

BRI.T120.9 TEST METHOD

The friction test shall be carried out on each sample of bridge bearing to determine the coefficient of friction, flatness, bonding properties and resistance to mechanical damage. The method of testing shall be in accordance with this sub-section.

BRI.T130.9 TEMPERATURE

The friction test shall be carried out at room temperature.

BRI.T140.9 EQUIPMENT

The following equipment is required:

1. Compression testing rig;
2. Test loads;
3. Equipment for measuring the loads applied, readable and accurate to within 2% of the measured load;

4. Equipment for measuring movement, readable and accurate to 0.01 mm;
5. Lubricant of the same type as will be used in service.

BRI.T150.9 PROCEDURE

The procedure shall be as follows:

1. The PTFE surface of the bearing shall be lubricated with the lubricant;
2. Two sets of sliding surfaces shall be mounted back to back between the platens of the compression testing rig with the stainless steel sliding surfaces in the centre. A vertical load equal to the permanent load stated in the schedule of bearings shall be applied for 1 hour;
3. A horizontal load shall then be applied steadily and without shock to the pair of stainless steel sliding surfaces and shall be increased at a rate of 0.2% of the vertical load per minute until movement occurs between the sliding surfaces. The maximum horizontal load sufficient to cause movement of at least 25 mm between the stainless steel and PTFE sliding surfaces at a rate not exceeding 50 mm/min shall be recorded;
4. The loads shall be removed;
5. The sliding surfaces shall be removed from the rig and inspected.

BRI.T160.9 CALCULATION

The coefficient of friction shall be calculated from the equation:

$$\text{Coefficient of friction} = \frac{\text{maximum horizontal force}}{2 \times \text{vertical load}}$$

BRI.T170.9 REPORTING RESULTS

The following shall be reported:

1. Name of bearing manufacturer;
2. Details of bearing and sliding surfaces;
3. The vertical load applied;
4. The maximum horizontal force applied;
5. The total movement and rate of movement at the maximum horizontal force applied;
6. The coefficient of friction to two significant figures;
7. Details of any damage to the sliding surfaces;
8. That the test method used was in accordance with this Specification.

BRI.T180.9 COMPLIANCE CRITERIA

The results of friction tests for bridge bearings shall comply with the following requirements:

1. The coefficient of friction in any test position shall not exceed 0.04;
2. The flatness of the stainless steel shall be within the specified limits after testing;
3. The bond to the backing plate shall be unaffected by the friction test;
4. The PTFE shall be free from mechanical damage after testing.

TESTING NON-ELASTOMERIC BEARINGS

BRI.T210.9 SAMPLING

One sample of bridge bearing shall be provided from each batch of bridge bearings other than elastomeric bearings.

BRI.T220.9 TEST METHODS

1. Carry out vertical load tests and horizontal load tests on each sample of bridge bearing. The test loads shall be the serviceability limit stated loads;
2. Carry out additional tests with test loads up to the ultimate limit state loads, if stated in the Project Specific Specification;
3. The method of testing shall be in accordance with Clause 7.2(b)(1) of the guidance notes to BS 5400:Part 9:1983:Section 9.2.

BRI.T230.9 COMPLIANCE CRITERIA

The results of tests on bridge bearings other than elastomeric bearings shall comply with the requirements stated in Clause (b)(1) of the guidance notes to BS 5400:Part 9:1983:Section 9.2.

TESTING ELASTOMERIC BEARINGS

BRI.T310.9 SAMPLING

1. Except as stated in sub-clause (2), one sample of elastomeric bearing shall be provided from each batch of elastomeric bearings for testing by the "Quick Production Test";
2. Samples shall not be provided for the "Quick Production Test" if in the opinion of the CM there is sufficient evidence that tests have been carried out within the previous 18 months on identical materials and that the results of the tests comply with the specified requirements for the test;
3. Two samples of elastomeric bearings shall be provided from each batch of ten or part thereof of elastomeric bearings to determine the stiffness in compression and stiffness in shear.

BRI.T320.9 TEST METHODS

1. Each sample of elastomeric bearing shall be tested to determine the physical and weathering properties of the elastomer and the bond of the elastomer to metal. The method of testing shall be the "Quick Production Test" in accordance with the guidance notes to BS 5400:Part 9:1983:Section 9.2;
2. One sample of elastomeric bearing provided as BRI.T310 (3) shall be tested to determine the stiffness in compression and the other sample shall be tested to determine that stiffness in shear. The method of testing to determine the stiffness in compression shall be in accordance with Clause 7.2(b)(2) of the guidance notes to BS 5400:Part 9:1983: Section 9.2. The method of testing to determine the stiffness in shear shall be in accordance with BS 5400:Part 9:1983:Section 9.2, Appendix A.

BRI.T330.9 COMPLIANCE CRITERIA

The results of tests on elastomeric bearings shall comply with the following requirements:

1. There shall be no evidence of surface flaws in the bearings during or after the test;
2. There shall be no irregularities in the deflected shape of laminated bearings during or after the test;
3. The stiffness in compression shall be within 20% of the value quoted by the manufacturer and approved by the CM;
4. The stiffness in shear shall be within 20% of the value quoted by the manufacturer and approved by the CM.

TESTING VEHICULAR PARAPETS GENERALLY

BRI.T410.9 DEFINITION OF BATCH

A batch of vehicular parapets is the amount of parapet materials which is completed or delivered to the Site at any one time. Submit to the CM a list of the parts of vehicular parapets included in each batch at least 7 days before testing starts.

BRI.T420.9 SAMPLING

Select samples from positions which in the opinion of the CM are representative of the batch as a whole. CM shall inform the Contractor of the samples selected for testing at least 3 days before testing starts.

BRI.T430.9 TEST PROCEDURE

1. Carry out the relevant tests stated in BRI.T510 to BRI.T840 on each batch of vehicular parapets;
2. Inform the CM at least 7 days before tests are carried out.

TESTING PARAPET MATERIALS

BRI.T510.9 SAMPLING

The frequency of tests and results of material test shall conform to BS 6779:Part 1:1998, Table 3 for steel parapets and Table 4 for aluminium parapets.

BRI.T520.9 TENSILE AND IMPACT TESTING

Carry out the tensile test and Charpy impact test of materials for vehicular parapets in accordance with BS EN 10002:Part 1:2001 and BS EN 10045:Part 1:1990 respectively or equivalent approved by the CM.

BRI.T530.9 QUALITY GRADING

Carry out quality grading of vehicular parapet materials which have not been tested for quality grades by the manufacturer in accordance with BS 5400: Part 6:1980 as appropriate.

TESTING FASTENERS

BRI.T610.9 TENSILE TESTING

Carry out the tensile test of stainless steel fasteners for vehicular parapets in accordance with BS EN ISO 3506:Part 1:1998 and BS EN ISO 3506: Part 2:1998.

TESTING WELDED COMPONENTS OF VEHICULAR PARAPETS

BRI.T710.9 GENERAL

1. Carry out inspection and testing of welds for components of vehicular parapets on each batch after cleaning and before application of hot dip galvanising and other protective treatment. Carry out de-burring, dressing, grinding, machining and peening after the visual inspection for cracks, surface pores and joint fit-up and before other inspections and tests are carried out;
2. Visual examination and testing shall be carried out by a testing consultant approved by the CM.

BRI.T720.9 NON-DESTRUCTIVE TESTING

Inspect all welds visually and examine 10 % of welds for vehicular parapets visually in accordance with the techniques in BS EN 970:1997 or equivalent approved by the CM. Carry out non-destructive testing on a proportion of welds after visual inspection.

1. Non-destructive testing of welds for components of vehicular parapets shall comply with the following:
    a. For the components of vehicular parapets which are butt welded or fillet welded with nominal leg length greater than 12 mm, 10% of welds for each type of components shall be examined by ultrasonic testing in accordance with BS EN 1714:1998 or equivalent approved by the CM;
    b. 10% of the welds other than that mentioned in sub-clause (a) shall be tested as follows:
        i. Magnetic particle flaw detection to joints in steel parapet in accordance with BS EN ISO 9934:Part 1:2001 or equivalent approved by the CM; or
        ii. Liquid penetrant method to welds in aluminium parapet in accordance with BS EN 571: Part 1:1997 or equivalent approved by the CM.
2. Inspect welds for vehicular parapets which have been fabricated and tested by non-destructive testing in the fabricator's works visually for cracks when the vehicular parapets are delivered to the Site. If welding quality of the vehicular parapets is in doubt, test 5% of the welds by magnetic particle flaw detection in accordance with BS EN ISO 9934:Part 1:2001 or equivalent approved by the CM. Make good the surface protection of vehicular parapets to the satisfaction of the CM after the tests.

BRI.T730.9 COMPLIANCE CRITERIA

1. Welds shall be inspected, examined and tested for compliance with BS 6779:Part 1:1998, Clauses 9.4.3.1.2 to 9.4.3.1.4;
2. For the butt welds to be tested, the individual pores shall be less than 2.5 mm diameter and the localized pores shall be less than 3% by the area;
3. The width of defect of buried slag shall be less than 1.5 mm;
4. Linear groups of inclusions are acceptable provided that adjacent groups shall be separated by a distance of at least 4 times and 6 times the length of longest defect for parent metal thickness less than 20 mm and larger than 20 mm respectively.

BRI.T740.9 NON-COMPLIANCE

1. If result of any test on weld does not comply with the requirements stated in BRI.T730, carry out the test on additional samples from the batch. The number of additional tests shall be twice the number of original tests;
2. The batch is considered as not complying with the compliance criteria if the result of any additional test does not comply with the compliance criteria;
3. If the batch is not complying with the compliance criteria, the Contractor may propose to carry out 100% testing on the batch at his own costs and no extension of time shall be entertained;
4. If the result of every additional test complies with the compliance criteria, only those parts of the samples from which the testing samples selected have failed in the original tests shall be considered as not complying with the compliance criteria.

TESTING METAL VEHICULAR PARAPET POSTS

BRI.T810.9 SAMPLING

The frequency of destructive testing shall be as stated in the following table:

No.of posts per batch	No. of posts to be tested per batch
<150	1 (The CM may waive this testing requirements if satisfactory tests within 3 months are provided)
150-300	1
>300	1 for each 300 posts or remaining part thereof

BRI.T820.9 TEST METHODS

Carry out destructive static testing of metal vehicular parapet posts in accordance with the procedures stated in Annex E of BS 6779:Part 1:1998.

BRI.T830.9 COMPLIANCE CRITERIA

The results of test on post shall comply with the following criteria:

1. The post shall sustain a moment of 1.05 times its theoretical moment of resistance (product of nominal yield stress and plastic modulus) at its critical section without failure;
2. The material thickness, effective weld throat sizes and external dimensions of the post shall be within the tolerances.

BRI.T840.9 NON-COMPLIANCE

1. In the event that any of the compliance criteria as stated in BRI.T830 are not met, select further two posts from the same batch of posts and test;
2. If any further test fails to meet the compliance criteria, the whole batch shall be rejected.

BSW WORK FOR ELECTRICAL AND MECHANICAL INSTALLATIONS

BSW WORK FOR ELECTRICAL AND MECHANICAL INSTALLATIONS

BSW WORK FOR ELECTRICAL AND MECHANICAL INSTALLATIONS 3

MATERIALS 3

GENERAL 3

BSW.M010.9 APPLICATION OF OTHER WORKSECTIONS 3

BSW.M020.9 DEFINITIONS 3

CONDUITS, DUCTS AND ANCILLARY MATERIALS 3

BSW.M110.9 ELECTRICAL CONDUITS AND FITTINGS 3

BSW.M120.9 CABLE DUCTS AND FITTINGS 3

BSW.M130.9 PAINT FOR CONDUIT AND DUCT SYSTEMS 4

BSW.M140.9 FIRE BARRIERS 4

BSW.M150.9 CEMENT GROUT 4

WORKMANSHIP 5

STORAGE OF MATERIALS 5

BSW.W010.9 CONDUIT AND CABLE DUCT SYSTEMS 5

HOLES AND RECESSES 5

BSW.W110.9 GENERAL 5

BSW.W120.9 TEMPORARY COVERS 5

BSW.W130.9 MAKING GOOD 5

FIRE BARRIERS 5

BSW.W210.9 LOCATION 5

CONCEALED ELECTRICAL CONDUIT SYSTEMS 5

BSW.W310.9 CONSTRUCTION 5

BSW.W320.9 INSTALLATION 6

BSW.W330.9 TERMINATIONS 6

BSW.W340.9 PROTECTION 7

BSW.W350.9 CLEANING SYSTEMS 7

CABLE DUCT SYSTEMS 7

BSW.W410.9 INSTALLATION 7

BSW.W420.9 PROTECTION 7

BSW.W430.9 CLEANING 8

EXCAVATION AND FILLING FOR EARTHING SYSTEMS 8

BSW.W510.9 EXCAVATION 8

BSW.W520.9 BACKFILLING 8

GROUTING 8

BSW.W610.9 GENERAL REQUIREMENTS 8

COMPLETION AND PROTECTION 9

BSW.W710.9 COMPLETION 9

BSW.W720.9 PROTECTION 9

TOLERANCES 9

BSW.W810.9 GENERAL 9

INSPECTION 9

BSW.W910.9 GENERAL 9

TESTING 11

EARTHING CONTINUITY 11

BSW.T010.9 TIMING 11

BSW.T020.9 TEST METHODS 11

BSW.T030.9 COMPLIANCE CRITERIA 11

LOAD TESTS ON BEAMS AND JOISTS 11
BSW.T110.9 GENERAL 11
BSW.T120.9 COMPLIANCE CRITERIA 11

BSW WORK FOR ELECTRICAL AND MECHANICAL INSTALLATIONS

MATERIALS

GENERAL

BSW.M010.9 APPLICATION OF OTHER WORKSECTIONS

The following works and materials shall comply with the Worksections stated, unless otherwise stated in this Worksection:

1. Earthworks shall comply with Worksection EAR1;
2. Materials for grout shall comply with Worksection GRO.

BSW.M020.9 DEFINITIONS

Concealed electrical conduit system is an electrical conduit system, including all bends, couplers, bushes, saddles, boxes, covers, plugs, draw wires and other conduit fittings, which is cast into concrete or fixed in chases in brickwork with a minimum cover of 20 mm or which is laid directly in the ground.

CONDUITS, DUCTS AND ANCILLARY MATERIALS

BSW.M110.9 ELECTRICAL CONDUITS AND FITTINGS

1. Electrical conduits and fittings shall comply with BS 4568:Parts 1 and 2:1970 and shall have Class 4 heavy protection inside and outside. Conduits shall be heavy gauge with screw-end construction in steel and shall have an external diameter of at least 20 mm. Conduits shall be longitudinally welded;
2. Metal boxes for enclosing electrical accessories shall comply with BS 4662:1970 and shall have heavy protection inside and outside. The boxes shall be of preferred sizes and shall be 35 mm or 47 mm deep as appropriate. Circular ceiling boxes of deep pattern shall comply with BS 4568:Part 2:1970 and shall have Class 4 heavy protection inside and outside. The boxes shall be at least 60 mm deep internally;
3. Circular boxes, dome covers and hook covers shall be cast iron. Bushes and plugs shall be brass.

BSW.M120.9 CABLE DUCTS AND FITTINGS

1. UPVC cable ducts for installation above ground or for casting into concrete shall be Class 0 UPVC pipes complying with BS 3506:1969. Cable ducts for installation below ground shall be Class B UPVC pipes complying with BS 3506:1969;
2. Joints and fittings for use with UPVC cable ducts shall comply with BS 4346:Part 1:1969 and BS 4346:Part 2:1970. Solvent cement for UPVC pipes and fittings shall comply with BS 4346:Part 3:1982;

3. Steel cable ducts shall be steel tubes complying with BS 1387:1985, medium series, screwed and socketed tubes and shall have screwed sockets suitable for screwing to BS 21:1985, Table 2 pipe threads. The tubes, sockets, clamps and saddles for ducts shall be galvanized in accordance with BS EN ISO 1461:1999 complying with STW.M410.

BSW.M130.9 PAINT FOR CONDUIT AND DUCT SYSTEMS

1. Bituminous paint for steel conduits and steel cable ducts shall comply with BS 3416:1991, Type 1;
2. Anti-rust paint for concealed electrical conduits systems shall be a proprietary type approved by the CM;
3. Zinc chromate primer for cable duct systems shall comply with BS 4652:1971;
4. Galvanizing paint for cable duct systems shall be a proprietary type approved by the CM.

BSW.M140.9 FIRE BARRIERS

Internal fire barriers shall be a type offering adequate fire resistance for the application. The material shall be approved by the CM in compliance with Fire Services Department requirements and shall be resistant to fire, smoke, gas and water.

BSW.M150.9 CEMENT GROUT

The different types of cement grout for electrical and mechanical installations shall consist of Portland cement, sand and PFA in the proportions by mass stated in the following table, together with the minimum amount of water necessary to achieve a consistency suitable for completely filling the voids. The mix shall contain a non-shrink admixture:

Mix proportions of cement grout			
Type	Mix proportions by mass		
	Cement	Sand	PFA
G1	1	-	-
G2	1	3	-
G3	1	10	-
G4	1	-	7

WORKMANSHIP

STORAGE OF MATERIALS

BSW.W010.9 CONDUIT AND CABLE DUCT SYSTEMS

Materials for concealed electrical conduit systems and for cable duct systems shall be stored in accordance with the manufacturer's recommendations in a dry weatherproof store.

HOLES AND RECESSES

BSW.W110.9 GENERAL

Holes and recesses shall be left in structures for electrical and mechanical installations. If instructed by the CM, holes and recesses shall be cut in structures for electrical and mechanical installations.

BSW.W120.9 TEMPORARY COVERS

Holes and recesses in internal floors, stairways and platforms shall be protected with temporary covers or by other methods agreed by the CM until the electrical and mechanical installation starts. Holes and recesses in roofs, external walls and external floors shall be sealed with watertight temporary covers until the electrical and mechanical installation starts.

BSW.W130.9 MAKING GOOD

Holes in structures shall be filled and made good after electrical and mechanical installations are complete. Holes left in structural elements designated as fire barriers shall be sealed to at least the same degree of fire resistance as the structural element.

FIRE BARRIERS

BSW.W210.9 LOCATION

Internal fire barriers shall be constructed in service channels, service shafts and service ducts for electrical and mechanical installations at the following locations:

1. At points of intersection with structural elements designated as fire barriers;
2. At 5 m centres in vertical and inclined shafts, and at intersections with floor slabs;
3. At termination points and open ends.

CONCEALED ELECTRICAL CONDUIT SYSTEMS

BSW.W310.9 CONSTRUCTION

Concealed electrical conduit systems which are shown diagrammatically in the Contract shall be constructed as follows:

1. Concealed electrical conduit systems shall be mechanically and electrically continuous and shall be effectively earthed;

2. Principal conduit runs shall be either vertical or horizontal. Tee pieces and elbows, including those with provision for inspection, shall not be used unless approved by the CM;
3. Joints shall be made using coupler units into which the ends of the conduits shall be inserted and tightened. Running couplings shall not be used unless permitted by the CM. If permitted, the couplings shall be made by screwing each of the conduits half way into the coupler with a hexagonal lock nut against each end of the coupler;
4. Adaptable boxes shall be provided at:
   a. Every second bend;
   b. After a bend and a straight run of 10 m or less;
   c. Every 15 m in straight runs.
5. Adaptable boxes for conduits installed in floor screeds shall have lids set flush with the adjacent floor. The boxes shall be covered with the same material as the remainder of the floor and shall remain accessible at all times;
6. The clearance between conduits entering adaptable boxes and between adjacent or parallel conduits shall be at least the nominal maximum coarse aggregate size of the concrete plus 5 mm.

BSW.W320.9 INSTALLATION

1. Concealed electrical conduit systems shall be arranged and installed in accordance with best trade practice and in such a manner that all cables can be drawn with ease and without damage;
2. Bends in concealed electrical conduit systems shall be formed by using proprietary bending equipment of a type agreed by the CM. Connections and other work shall be carried out using purpose made equipment;
3. Conduits shall not be bent by more than 90° and the internal radius at bends shall be at least 2.5 times the external diameter of the conduit. Conduits shall not be flattened at bends;
4. Burrs and sharp edges shall be removed from the ends of conduits before installation;
5. Concealed electrical conduit systems which are to be cast into concrete shall be fastened to the reinforcement with tying wire of the same type used for the reinforcement. The conduit systems shall not be positioned between the reinforcement and the outside face of the concrete unless permitted by the CM;
6. Conduit boxes shall be of a compatible size and shall have a single extension ring of the required depth if the plaster finish exceeds 13 mm thick. Multiple extension rings shall not be used.

BSW.W330.9 TERMINATIONS

Screw fitting couplers shall be provided at each end of conduits which terminate in distribution boards, busbar chambers, motor starters, cable ducts, boxes or similar termination points. The item at which the conduit terminates shall be drilled with an unthreaded clearance hole to receive a brass male bush. The bush shall be screwed into the coupler from the inside of the item in such a manner that the surface of the item is gripped between the coupler and the bush. The threads shall be at least half the length of the coupler.

BSW.W340.9 PROTECTION

1. Concealed electrical conduit systems shall have special arrangements designed by the Contractor to permit movement of conduits to take place on each side of movement joints in structures. A separate circuit protective conductor shall be installed to maintain effective electrical continuity across the joint. The protective conductor shall have a cross-sectional area rated to suit the largest live conductor to be drawn into the conduit;
2. Steel conduit systems laid in contact with or adjacent to other metal work shall have efficient and permanent metallic connection made between the conduit and the metal work;
3. Underground steel conduits and conduits in contact with soil shall be painted with two coats of bituminous paint before installation;
4. Exposed threads and damage to protective coatings of conduit systems shall be painted with two coats of anti-rust paint;
5. Conduits shall be laid in such a manner that accumulation of condensed moisture in the conduit system is prevented. Measures shall be taken to prevent water from entering the system;
6. Water, moisture and deleterious material shall be prevented from entering permanent and temporary terminations in concealed electrical conduit systems, including conduit boxes, by using conduit stopping plugs of a type approved by the CM. Paper or rags shall not be used.

BSW.W350.9 CLEANING SYSTEMS

After installation, concealed electrical conduit systems shall be swabbed out with draw-in tapes and absorbent cloth of a type agreed by the CM. All obstructions shall be removed and draw wires shall be installed. After cleaning, exposed conduit ends shall be sealed as BSW.W340 (6).

CABLE DUCT SYSTEMS

BSW.W410.9 INSTALLATION

1. Changes in direction in cable duct systems shall be constructed in such a manner that the cables in the duct will have radii of curvature of at least 800 mm. Ducts entering draw-in pits shall be on the same horizontal plane as the draw-in pit;
2. UPVC cable ducts shall be jointed in accordance with the manufacturer's recommendations;
3. Steel cable ducts shall be jointed using screwed galvanized sockets and spun yarn or by an equivalent method approved by the CM such that the jointed pipes abut. The threads shall be painted with two coats of bituminous paint. Internal rags and burrs shall be removed to provide a smooth bore through joints in the cable duct system;
4. Surface mounted cable ducts shall be secured by galvanized steel clamps or saddles at spacings not exceeding 3 m.

BSW.W420.9 PROTECTION

1. After jointing, exposed bare metal in cable duct systems shall be cleaned and painted with two coats of zinc chromate primer and two coats of galvanizing paint;
2. Surface mounted galvanized steel cable ducts shall be cleaned and painted after fittings and jointings have been completed.

BSW.W430.9 CLEANING

After jointing, cable duct systems shall be cleaned internally by scrubbing with a cylindrical brush of a type agreed by the CM. The ends of ducts, including ends of ducts in draw-in pits and spare ducts, shall be fitted with tapered hardwood plugs to prevent water, moisture and deleterious material from entering the system and a 6 mm diameter nylon draw line shall be installed. The plugs shall be centrally drilled for the draw line and the draw line shall be secured by a knot tied on the outer face of the plug to leave at least 1500 mm of surplus line at each plug.

EXCAVATION AND FILLING FOR EARTHING SYSTEMS

BSW.W510.9 EXCAVATION

Pits and trenches for electrical earthing systems shall be excavated at positions and at the times instructed by the CM.

BSW.W520.9 BACKFILLING

After the electrical earthing systems have been installed fill material shall be deposited and compacted in the pits and trenches to a depth of 300 mm above the electrical earthing system. Fill material shall be sand or fine fill material which has been selected from the excavated material, and which is free from stones retained on a 20 mm BS test sieve. Fill material shall be compacted by handrammers in a manner approved by the CM.

GROUTING

BSW.W610.9 GENERAL REQUIREMENTS

Grouting to structural steelwork, machine bases, crane rails, electrical and mechanical equipment and other electrical and mechanical installations shall comply with the following;

1. Grouting shall be carried out at the times instructed by the CM and shall be completed within 7 days of the instruction unless otherwise permitted by the CM;
2. The permission of the CM shall be obtained before items or equipment are grouted. The Contractor shall inform the CM 3 days, or such shorter period agreed by the CM, before grouting starts and shall allow the CM sufficient time to inspect the work which is to be grouted;
3. Concrete surfaces shall be scabbled to remove laitance and loose material and to expose the aggregate before the item or equipment is installed in position;
4. The voids to be grouted shall be cleaned and thoroughly wetted immediately before grouting. Excess water shall be removed by using a compressed air jet or by other methods agreed by the CM;
5. Grout shall be mixed and placed by methods agreed by the CM;
6. If grouting is to be carried out in two operations, holding down bolts shall be grouted into preformed pockets and sufficient time shall be allowed for the grout to cure and for the bolts to be tensioned before the remaining voids are grouted;
7. Exposed grout surfaces shall have a uniform, dense and smooth surface free from trowel marks and which is produced by steel trowelling the surface under firm pressure. The exposed surfaces shall be cured by either:

a. Using a liquid curing compound applied to the surface by a low-pressure spray until a continuous visible covering is achieved; or

b. Covering the surface with hessian or sacking. The hessian or sacking shall be lapped and securely held in position and shall be kept damp for at least 4 days.

COMPLETION AND PROTECTION

BSW.W710.9 COMPLETION

Work shall be completed to the following conditions before structures are made available to others for electrical and mechanical installations:

1. The structures shall be clean, dry and free from dust. Work which in the opinion of the CM will produce large quantities of dust shall be complete;
2. Holes and recesses, concealed electrical conduit systems and cable duct systems required for the installation shall be complete. Concrete surfaces on which items and equipment are to be installed shall be scabbled;
3. Plinths, trenches, louvres, openings and similar work shall be complete and shall have hardened sufficiently to allow the installation to proceed;
4. Floors and slabs shall be complete to the specified finishes except that floor tiles shall not be laid until after the installation is complete;
5. Plant rooms shall be complete, including fixtures and fittings, to a secure and weatherproof condition. Two sets of door keys for the plant room shall be provided for the CM;
6. Paintwork and similar finishes in plant rooms shall be complete to undercoat level. Final coats shall not be applied until after the installation is complete;
7. Temporary power supplies and connections required for the installation shall be complete. The supply shall be metered and shall be 346V, 3 phase supply of 20A maximum rating. Temporary power supplies shall be provided for the periods stated in the Project Specific Specification.

BSW.W720.9 PROTECTION

1. Structures in which electrical and mechanical installations are being carried out shall be maintained in a clean, dry condition, free from dust, during the installation;
2. The dust level in plant rooms shall be kept to a minimum by using industrial dust extractors of a type agreed by the CM during and after the installation. Temporary screens shall be installed to separate dust-affected areas from the installations or temporary covers shall be installed around the installation.

TOLERANCES

BSW.W810.9 GENERAL

Refer to Appendix H "Schedule of Tolerances" to this Specification.

INSPECTION

BSW.W910.9 GENERAL

1. The Contractor shall allow the CM to inspect the following work for electrical and mechanical installations:

a. Completed concealed electrical conduit systems, cable duct systems, electrical earthing systems and items and equipment which are to be grouted or covered up;

b. Items and equipment which are to be tested;

c. structures which are to be made available for electrical and mechanical installations.

2. The Contractor shall inform the CM three days, or such shorter period agreed by the CM, before work is covered up, tested or made available.

TESTING

EARTHING CONTINUITY

BSW.T010.9 TIMING

Concealed electrical conduit systems shall be tested to determine the earthing continuity. The system shall be tested:

1. Before the system is cast in concrete or covered up;
2. After the system is cast in concrete or covered up;
3. After electrical wiring which is installed by the Contractor is complete.

BSW.T020.9 TEST METHODS

Unless otherwise approved by the CM the method of testing shall be in accordance with Appendix 15 to the IEE Wiring Regulations, 15th Edition, 1981 issued by the Institution of Electrical Engineers.

BSW.T030.9 COMPLIANCE CRITERIA

The results of tests for earthing continuity shall comply with the IEE Wiring Regulations, 15th Edition, 1981 issued by the Institution of Electrical Engineers.

LOAD TESTS ON BEAMS AND JOISTS

BSW.T110.9 GENERAL

1. Load tests shall be carried out on lifting beams, rolled steel joists and lifting hooks which are installed by the Contractor;
2. Testing shall be carried out by an independent testing consultant approved by the CM and by using methods approved by the CM;
3. A certificate showing the results of the load tests and signed by the testing agent shall be submitted to the CM within 14 days of the test.

BSW.T120.9 COMPLIANCE CRITERIA

The results of tests on lifting beams, rolled steel joists and lifting hooks shall comply with the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations, 1978 issued by the Labour Department.

CLE SITE CLEARANCE

CLE SITE CLEARANCE 2

MATERIALS 2

MATERIALS ARISING FROM SITE CLEARANCES 2

CLE.M010.9 MATERIALS ARISING FROM SITE CLEARANCES REQUIRED BY THE AUTHORITY 2

WORKMANSHIP 3

DEMOLITION 3

CLE.W010.9 EXTENT 3
CLE.W020.9 SURVEY 3
CLE.W030.9 METHOD 3
CLE.W040.9 PROTECTION 3
CLE.W050.9 SALVAGED MATERIALS 3

SITE CLEARANCE 3

CLE.W110.9 STORAGE OF AND DAMAGE TO MATERIALS FOR RE-USE 3
CLE.W120.9 DISCONNECTION OF UTILITIES 4
CLE.W130.9 UNDERGROUND STRUCTURES AND CHAMBER 4
CLE.W140.9 ABANDONED PIPES AND MANHOLE 4
CLE.W150.9 EARTHWORKS AND BLASTING 4
CLE.W160.9 EXISTING TREES 4
CLE.W170.9 DISPOSAL 4
CLE.W180.9 REINSTATEMENT 4

CLE SITE CLEARANCE

MATERIALS

MATERIALS ARISING FROM SITE CLEARANCES

CLE.M010.9 MATERIALS ARISING FROM SITE CLEARANCES REQUIRED BY THE AUTHORITY

Take up, take down, transport to store, as applicable, the items resulting from the site clearance that are required by the Authority as specified in the Project Specific Specification.

WORKMANSHIP

DEMOLITION

CLE.W010.9 EXTENT

1. The Contractor shall demolish, break up and remove walls and superficial obstructions down to ground level on the Site in the way of or otherwise affected by the Works and ensuring compliance with the requirements of CLE.W130 and CLE.W160. He shall clear each part of the site at times and to the extent required or approved by the CM;
2. Where the Contractor is required to demolish buildings and structures, he shall demolish down to ground level only those parts which are scheduled for removal on the Drawings or which he is directed to remove by the CM.

CLE.W020.9 SURVEY

Structures which are to be demolished shall be surveyed by the Contractor, and the result given to the CM for information, before demolition starts.

CLE.W030.9 METHOD

Particulars of the proposed methods of carrying out demolition work shall be submitted to the CM for information at least 14 days before the demolition starts.

CLE.W040.9 PROTECTION

1. Areas adjacent to demolition work shall be protected from damage resulting from the demolition;
2. During demolition the Contractor shall take every precaution to protect the roadway, embankment and all other existing works from damage and to ensure the safety of his workmen and the general public;
3. Any damage beyond that so required shall be made good by the Contractor at his own expense.

CLE.W050.9 SALVAGED MATERIALS

The maximum quantity of material shall be salvaged and all material for re-use shall be cleaned and stacked on the Site, and the debris removed to an Approved dump.

SITE CLEARANCE

CLE.W110.9 STORAGE OF AND DAMAGE TO MATERIALS FOR RE-USE

1. Items which are to be re-used or taken to store shall be dismantled and removed by a suitable method so as to avoid damage or minimise the damage if this is unavoidable. The items shall be cleaned before re-use or taking to store;
2. Items which are to be re-used in the Works shall be kept in stores provided by the Contractor;
3. Items which are to be taken to the Authority's store shall be delivered by the Contractor. See CLE.M010;

4. Materials or equipment which are to be re-used or taken to store and which are damaged due to the Contractor's negligence shall be repaired by the Contractor by a method agreed by the CM. Materials or equipment which are lost or which in the opinion of the CM are not capable of being repaired satisfactorily shall be replaced by the Contractor.

CLE.W120.9 DISCONNECTION OF UTILITIES

The Contractor shall make all arrangements with and obtain the necessary approvals from the relevant authorities for disconnecting utilities inside and outside the Site. The ends of disconnected utilities shall be made good and sealed; the positions of the ends shall be marked with marker posts or by other methods agreed by the CM.

CLE.W130.9 UNDERGROUND STRUCTURES AND CHAMBER

Disused underground structures and chambers shall be filled and compacted as directed by the CM.

CLE.W140.9 ABANDONED PIPES AND MANHOLE

Comply with the requirements of Worksection DRA as appropriate.

CLE.W150.9 EARTHWORKS AND BLASTING

Comply with the requirements of Worksection EAR as appropriate.

CLE.W160.9 EXISTING TREES

1. The roots of trees and shrubs which have been cut down shall be grubbed up. Branches shall not be removed from trees which are to be retained unless permitted by the CM, if permitted, the branches shall be removed in accordance with BS 3998:1989 and the cut surfaces shall be treated with a wound sealant approved by the CM;
2. Where shown on the Drawings or directed by the CM trees shall be uprooted or cut down as near to ground level as possible. All felled timber shall be removed from the Site;
3. Holes left by stumps and roots shall be filled with suitable material and compacted as specified.

CLE.W170.9 DISPOSAL

Except for items which are to be re-used or taken to store; demolished items, trees, shrubs, vegetation, boulders, debris, rubbish and other items arising from site clearance shall be disposed of by the Contractor and become the property of the Contractor when they are removed from the Site.

CLE.W180.9 REINSTATEMENT

Unless otherwise permitted by the CM, areas affected by site clearance shall be reinstated as follows:

1. Fine fill material shall be deposited and compacted in voids which are left in the ground;
2. Holes which are left in structures and pavements shall be made good using materials similar to that in the adjoining area;
3. The ends of fences, walls structures, utilities and other items shall be made good in such a manner that the affected part will not corrode or deteriorate, and will remain stable;

4. Straining posts shall be fixed at the end of strained fences which have been cut and the fences shall be restrained.

FEN FENCING

FEN FENCING 2

MATERIALS 2

GENERAL 2

FEN.M010.9 OTHER RELATED SPECIFICATION WORKSECTIONS 2
FEN.M020.9 DETAILS OF FENCING 2
FEN.M030.9 SAMPLES 2

FENCING MATERIALS 2

FEN.M110.9 WIRE 2
FEN.M120.9 CHAIN LINK FENCING 3
FEN.M130.9 PLYWOOD FOR HOARDINGS 3
FEN.M140.9 TIMBER 3
FEN.M150.9 STEEL 3
FEN.M160.9 FIXINGS 3
FEN.M170.9 CONCRETE POSTS 4
FEN.M180.9 GATES 4

POST FOUNDATION CONCRETE 4

FEN.M210.9 CONCRETE 4

WORKMANSHIP 5

GENERAL 5

FEN.W010.9 STORAGE AND PROTECTION 5

FABRICATION OF FENCING 5

FEN.W110.9 FABRICATING STEELWORK 5
FEN.W120.9 GALVANIZING STEEL 5
FEN.W130.9 WELDING STEEL 5

ERECTING FENCING 6

FEN.W210.9 LOCATION 6
FEN.W220.9 ALIGNMENT 6
FEN.W230.9 LOCATION OF POSTS 6
FEN.W240.9 ERECTING FENCING POSTS AND STRUTS 6
FEN.W250.9 FIXING FENCING WIRE 6
FEN.W260.9 FIXING TIMBER FENCING 7
FEN.W270.9 FIXING GATES 7
FEN.W280.9 TOLERANCES 7

FEN FENCING

MATERIALS

GENERAL

FEN.M010.9 OTHER RELATED SPECIFICATION WORKSECTIONS

The appropriate materials and workmanship requirements specified in the following Worksections apply to this Worksection unless otherwise stated herein:

1. Handrailing shall comply with Worksection MEW;
2. Earthworks shall comply with Worksection EAR1;
3. Pedestrian guardrailing shall comply with Worksection MEW;
4. Formwork and finishes to concrete shall comply with Worksection FOR;
5. Reinforcement shall comply with Worksection CON3;
6. Concrete shall comply with Worksection CON1;
7. Steelwork, including protective treatment, shall comply with Worksection STW;
8. Vehicular parapets shall comply with Worksection BRI.

FEN.M020.9 DETAILS OF FENCING

1. The following particulars of the proposed fencing shall be submitted to the CM:
   a. Drawings showing the fabrication details of gates; and,
   b. Details of the source, type and properties of the proposed materials.
2. The particulars of the proposed fencing shall be submitted to the CM at least 14 days before the fencing is erected.

FEN.M030.9 SAMPLES

The following samples of the proposed materials shall be submitted to the CM at the same time as the details of the proposed fencing are submitted:

1. Each type of wire and fitting;
2. Chain link;
3. Plywood;
4. Precast concrete, steel and timber posts;
5. Fixings.

FENCING MATERIALS

FEN.M110.9 WIRE

1. Wire for fencing shall be galvanized mild steel complying with BS 4102:1990;
2. Barbed wire shall consist of two line wires and point wire formed in accordance with BS 4102:1990, Clause 4.1;

3. Galvanized coatings to steel wire shall comply with BS EN 10244-2:2001.

FEN.M120.9 CHAIN LINK FENCING

Chain link fence shall comply with BS 1722:Part 1:1986 unless otherwise stated in this Worksection.

FEN.M130.9 PLYWOOD FOR HOARDINGS

Plywood for hoardings shall comply with BS 6566:1985 and shall have a Grade 2 veneer. The bonding adhesive between veneers shall be phenol formaldehyde resin adhesive classified as weather-proof and boil-proof in accordance with BS 1203:1979.

FEN.M140.9 TIMBER

1. Timber for fencing shall be of mature growth and shall be seasoned and free from large, loose or dead knots, wood wasp holes, infestation, splits and other defects which will reduce the strength or produce blemishes. The moisture content in timber at the time of fabrication shall not exceed 20%;
2. Hardwood shall be 'San Cheung' (Kapore) and shall have a density of at least 720 kg/m³ at 15% moisture content;
3. Softwood shall be cedar, spruce or China fir;
4. Timber which is not to be painted shall be preserved with coal tar creosote. The creosote shall comply with BS 144 and shall be applied by pressure impregnation in accordance with BS 144.

FEN.M150.9 STEEL

Steel for fencing shall comply with the following:

1. Hot rolled sections: BS 4:Part 1:1980;
2. Hot rolled structural steel sections:
    a. Equal and unequal angles: BS 4848:Part 4:1972;
    b. Hollow sections: BS 4848:Part 2:1991.
3. Weldable structural steel: BS 4360:1986.

FEN.M160.9 FIXINGS

1. Bolts, nuts and washers for fencing shall comply with the following:
    a. ISO metric black hexagon bolts, screws and nuts: BS 4190:1967;
    b. ISO metric black cup and countersunk head, bolts and screws with hexagon nuts: BS 4933:1973;
    c. Metal washers for general engineering purposes: BS 4320:1968;
2. The length of bolts shall be such that the threaded portion of each bolt projects through the nut by at least one thread and by not more than four threads;
3. Fittings, including eye bolt strainers, cleats, winding brackets, stretcher bars, extension arms, hook bolts and base plates shall be galvanized mild steel;
4. Bolts, nuts, washers and fittings for fixing to concrete and timber shall be galvanized. Bolts, nuts, washers and fittings for fixing to steel shall have the same protective treatment as the steel;
5. Staples shall be D-section galvanized wire.

FEN.M170.9 CONCRETE POSTS

1. Concrete posts and struts for fencing shall be precast using Grade 30/10 concrete as Worksection CON1. The finish to formed surfaces shall be Class F4 and the finish to unformed surfaces shall be Class U5 as Worksection FOR. The tops of posts and all arrises shall be rounded or chamfered;
2. Reinforcement for concrete posts and struts shall be Grade 250 plain round steel bars as Worksection CON3.

FEN.M180.9 GATES

1. Steel gates shall be of welded construction. The frame shall be square with the corners mitred or saddled;
2. Chain link infilling in gates shall be of the same type and size as in the adjoining fence and shall be attached to the framework by stretcher bars.

POST FOUNDATION CONCRETE

FEN.M210.9 CONCRETE

Grade 30/20 concrete as Worksection CON1.

WORKMANSHIP

GENERAL

FEN.W010.9 STORAGE AND PROTECTION

1. Plywood and timber posts, rails and struts for fencing shall be stored on level supports in a dry weatherproof store;
2. Gates and concrete and steel posts and struts for fencing shall be stored off the ground on level supports and in a manner which will not result in damage or deformation to the materials or in contamination of the materials;
3. Fencing shall be protected from damage and damaged fencing shall not be used in the permanent work unless permitted by the CM.

FABRICATION OF FENCING

FEN.W110.9 FABRICATING STEELWORK

Steelwork for fencing shall be fabricated in accordance with BS 5950:Part 2:1992.

FEN.W120.9 GALVANIZING STEEL

1. Steel which is to be galvanized shall be hot-dip galvanized in accordance with BS EN ISO 1461:1999 to a minimum coating thickness of 70 µm;
2. Unless Approved, all components are to be galvanized after welding, drilling and cutting are complete;
3. All hot dip galvanizing is to be carried out by galvanizers with ISO 9001 certification. Submit the name of galvanizer for Approval;
4. Submit original invoice/delivery note and galvanizing certification for each delivery. These documents shall include the following information:
    a. Project title/number;
    b. Name of galvanizer;
    c. Types and dimensions of articles;
    d. Quantities.
5. Attach a durable identification tape to each batch of galvanized articles indicating the project title, galvanizing certification number and name of galvanizer.

FEN.W130.9 WELDING STEEL

1. Welds to steel for fencing shall be full depth fillet welds. Weld surfaces shall be clean and flush before application of the protective coating;
2. Steel shall not be welded after galvanizing unless permitted by the CM, if permitted, the welded areas shall be free from scale and slag and shall be treated with an alternative galvanizing or zinc coating system approved by the CM.

ERECTING FENCING

FEN.W210.9 LOCATION

Erect fencing to lines and levels shown on the Drawings.

FEN.W220.9 ALIGNMENT

Fencing shall be erected to a smooth alignment with no abrupt irregularities. The ground shall be trimmed or filled in such a manner that the bottom of the fence will approximately follow the level of the ground. The distance between the bottom of chain link mesh and hoardings and the ground shall not exceed 100 mm.

FEN.W230.9 LOCATION OF POSTS

1. Straining posts for fencing shall be provided at all ends and corners, at changes in direction, at abrupt changes in level, at gate posts and at intervals not exceeding 30 m along straight lengths of fencing. Struts shall be fitted to straining posts in the direction of each wire secured to the post;
2. Intermediate posts shall be provided at intervals not exceeding 3.5 m.

FEN.W240.9 ERECTING FENCING POSTS AND STRUTS

1. Posts and struts for fencing shall be set in excavations for foundations and the excavations shall be filled with concrete as FEN.M210 up to 50 mm below ground level;
2. Struts shall be fitted into slots in timber posts and concrete posts; struts shall be bolted to steel posts;
3. The ground surface around posts shall be made good with the same material as in the adjoining area.

FEN.W250.9 FIXING FENCING WIRE

1. Line wire, chain link mesh and barbed wire for fencing shall be strained tightly between straining posts. Winding brackets shall be used for straining between steel posts and winding brackets or eye bolt strainers shall be used for straining between concrete and timber posts. The tension in the wire on each side of straining posts shall be equal. Wire shall not be strained until at least 14 days after concrete has been placed in the foundation;
2. Chain link mesh shall be secured at each straining post by a stretcher bar and shall be tied to the line wire by tying wire at 150 mm intervals;
3. Each line wire and each line of barbed wire shall be secured to each intermediate post by one of the following methods as stated in the following table:
    a. A hairpin staple shall be passed through a hole in the post and secured to the wire by three complete turns on each side of the post;
    b. A stirrup shall be passed through a hole in the post and the ends bent over twice;
    c. The wire shall be threaded through a hole in the post;
    d. The wire shall be stapled to the post;
    e. A hook bolt shall be passed through a hole in the post and secured with a nut and washer.

Method of securing wire to intermediate posts			
Type of fence	Type of wire	Type of post	Method of securing wire
Strained wire	Line wire	Concrete	1, 2 or. 3
		Steel	1, 2 or 3
		Timber	1, 3 or 4
	Barbed wire	Concrete	1 or 2
		Steel	1
		Timber	1 or 4
Chain wire	Line wire Mesh wire	Concrete	1, 2 or 5
		Steel	1 or 3
		Timber	4
	Barbed wire	Concrete	1, 2 or 5
		Steel	1
		Timber	4

FEN.W260.9 FIXING TIMBER FENCING

The ends of timber rails for fencing shall be closely butted together and the rails shall be securely nailed to each post. The ends of plywood sheets in hoardings shall be closely butted together and the sheets shall be securely nailed to each post and to the horizontal rails.

FEN.W270.9 FIXING GATES

1. Gates shall be installed after the fence wire is in place and strained, so as to eliminate the possibility of the gates being pulled out of alignment;
2. Gates shall be hung truly plumb to ensure they will open and close easily.

FEN.W280.9 TOLERANCES

Refer to Appendix H "Schedule of Tolerances" to this Specification.

FOR FORMWORK

FOR FORMWORK 4

DESIGN 4

GENERAL 4

FOR.D010.9 STANDARD 4
FOR.D020.9 DEFINITIONS 4
FOR.D030.9 BRIDGE CONSTRUCTION 4
FOR.D040.9 SUBMISSIONS 5

DESIGNED PARAMETERS 5

FOR.D110.9 GENERAL 5
FOR.D120.9 LOADINGS 5
FOR.D130.9 INCLINED SURFACES 5
FOR.D140.9 DISMANTLING AND REMOVAL 5
FOR.D150.9 PANEL JOINTS 5
FOR.D160.9 TIE HOLES 5
FOR.D170.9 EXTERNAL ANGLES 6
FOR.D180.9 CURVED SURFACES 6

FALSEWORK SPANNING PUBLIC HIGHWAYS 6

FOR.D210.9 DESIGN RESPONSIBILITY 6
FOR.D220.9 GENERAL DESIGN REQUIREMENTS 6
FOR.D230.9 APPROVALS 6
FOR.D240.9 SUBMISSIONS 6

MATERIALS 7

SHEATHING MATERIALS 7

FOR.M010.9 GENERAL 7
FOR.M020.9 PLYWOOD 7
FOR.M030.9 FACES FOR CLASS F4 AND F5 FINISHES 7

RELEASE AGENTS 7

FOR.M110.9 GENERAL 7
FOR.M120.9 POTABLE AND FRESH WATER RETAINING STRUCTURES 7
FOR.M130.9 STEEL FORMWORK 7
FOR.M140.9 CLASS F4 AND F5 FINISHES 7

ANCILLARY MATERIALS 8

FOR.M210.9 FORMWORK TIES 8
FOR.M220.9 COVER SPACERS 8
FOR.M230.9 CEMENT MORTAR FOR REMEDIAL WORK 8
FOR.M240.9 SURFACE RETARDERS 8
FOR.M250.9 ABRASIVES 8
FOR.M260.9 SPATTERDASH 8

SUBMISSIONS 9

FOR.M310.9 SCHEDULE OF SUBMISSIONS 9
FOR.M320.9 TIMING OF SUBMISSIONS 10

WORKMANSHIP 11

STORAGE OF MATERIALS 11

FOR.W010.9 FORMWORK GENERALLY 11
FOR.W020.9 CLASS F4 AND F5 11
FOR.W030.9 RELEASE AGENTS AND SURFACE RETARDERS 11

CONSTRUCTING AND ERECTING FORMWORK GENERALLY 11

FOR.W110.9 GENERAL 11
FOR.W120.9 REUSE OF FORMWORK 11
FOR.W130.9 JOINTS AND GAPS 11

FOR.W140.9 CUTTING FORMWORK 11
FOR.W150.9 FORMERS ETC 12
FOR.W160.9 BUILT-IN COMPONENTS, VOID FORMERS AND BOX-OUTS 12
FOR.W170.9 FORMWORK TIES AND COMPONENTS 12
FOR.W180.9 TEMPORARY OPENINGS 12

CLASS F4 AND F5 FINISHES 12
FOR.W210.9 GENERAL 12
FOR.W220.9 JOINTS 12
FOR.W230.9 PROTECTION 12

APPLYING RELEASE AGENTS 12
FOR.W310.9 USE OF RELEASE AGENTS 12
FOR.W320.9 PREPARATION 13
FOR.W330.9 APPLICATION 13
FOR.W340.9 CLASS F4 AND F5 FINISHES 13

INSPECTION 13
FOR.W410.9 GENERAL 13
FOR.W420.9 CLASS F4 AND F5 FINISHES 13

REMOVAL OF FALSEWORK AND FORMWORK 13
FOR.W510.9 MINIMUM TIMES BEFORE REMOVAL 13
FOR.W520.9 WATER RETAINING STRUCTURES 14
FOR.W530.9 CONCRETE IN FLEXURE 14
FOR.W540.9 REMOVING FORMWORK 14
FOR.W550.9 CLASS F5 FINISHES 14
FOR.W560.9 FORMWORK FOR REUSE 14

MAINTENANCE OF FORMWORK 14
FOR.W570.9 DAMAGED AND DETERIORATED FORMWORK 14
FOR.W580.9 RE-USE OF TIMBER FORMWORK 15
FOR.W590.9 RUBBER SEALS 15

CLASSIFICATION OF FINISHES 15
FOR.W610.9 FORMED FINISHES 15
FOR.W620.9 UNFORMED FINISHES 15
FOR.W630.9 TREATED FINISHES 16
FOR.W640.9 APPLICATION OF FINISHES 17

UNFORMED FINISHES 17
FOR.W710.9 GENERAL 17
FOR.W720.9 CLASS U4 FINISH 18
FOR.W730.9 FLOATING AND TROWELLING 18
FOR.W740.9 CONCRETE CARRIAGEWAYS 18

TREATED FINISHES 18
FOR.W810.9 GENERAL 18
FOR.W820.9 CLASS T1 FINISH 18
FOR.W830.9 CLASS T2 AND T3 FINISHES 18
FOR.W840.9 CLASS T4 FINISH 19
FOR.W850.9 CLASS T5 AND T6 FINISHES 19

INSPECTION AND COMPLIANCE OF FINISHES 19
FOR.W910.9 INSPECTION 19
FOR.W920.9 COMPLIANCE STANDARD 19

REMEDIAL AND REPAIR WORK 19
FOR.W1010.9 GENERAL 19
FOR.W1020.9 BLOWHOLES 20
FOR.W1030.9 FORMWORK TIE HOLES 20
FOR.W1040.9 APPLYING SPATTERDASH 20

FOR.W1050.9 CRACK REPAIR 20

PROTECTION OF FINISHES 20

FOR.W1110.9 GENERAL 20
FOR.W1120.9 CLASS F4, F5, U5 AND T FINISHES 20
FOR.W1130.9 CLASS F5 FINISH 20

TRIAL PANELS 21

FOR.W1210.9 GENERAL 21
FOR.W1220.9 NON-COMPLIANCE OF TRIAL PANELS 21
FOR.W1230.9 COMMENCEMENT OF FORMWORK AND CONCRETING 21
FOR.W1240.9 CHANGES IN MATERIALS AND METHODS 21

FOR FORMWORK

DESIGN

GENERAL

FOR.D010.9 STANDARD

Comply with the requirements of BS 5975:1982 regarding design, construction and dismantling of falsework and formwork.

FOR.D020.9 DEFINITIONS

In this Specification, the following definitions apply:

1. Class: a term used to identify the different types and standards of formed, unformed and treated finishes;
2. Falsework: a temporary structure used to support formwork and a permanent structure until the permanent structure is self-supporting;
3. Formed finish: the finish of the concrete surface produced by the use of formwork;
4. Formwork: the mould against which concrete is cast and which gives the shape and finish to the concrete surface;
5. Permanent formwork: formwork designed to remain in position as part of the permanent work;
6. Profiled formwork: formwork designed to produce a ribbed or patterned finish on the concrete surface;
7. Sealed plywood: plywood which has been sealed with a factory-applied film of phenolic resin or plastic material;
8. Spatterdash: a mixture of cement, coarse sand, granite fines and water, used as a rendering on concrete surfaces;
9. Treated finish: the finish of the concrete surface produced by a treatment applied to a formed or unformed finish;
10. Unformed finish: the finish of the concrete surface produced without formwork and by working the concrete surface before the concrete has hardened.

FOR.D030.9 BRIDGE CONSTRUCTION

1. Appoint a Registered Structural Engineer to design and control the temporary works for the construction of the bridge;
2. The submission shall include drawings and supporting calculations and shall be submitted to the CM not less than 4 weeks before the Contractor proposes to put such work in hand. Do not commence the proposed work without the prior consent of the CM. Such consent shall, however, in no way relieve the Contractor of any of his responsibilities for the design of the falsework;
3. Monitor falsework levels and make any necessary adjustments for settlement or other deflection or movements.

FOR.D040.9 SUBMISSIONS

See FOR.M310.

DESIGNED PARAMETERS

FOR.D110.9 GENERAL

Falsework and formwork shall be designed and constructed to maintain the position and shape of the formwork such that the hardened concrete surface complies with the characteristics of finish and other requirements of this Specification. Allowance shall be made for cambers.

FOR.D120.9 LOADINGS

Design and construct falsework and formwork to withstand any combination of the following loadings and to maintain the position and shape of the formwork to achieve the required shape and finish of the hardened concrete:

1. Total weight of formwork, falsework and wet concrete;
2. Construction loads including dynamic effects of placing, compacting and construction traffic;
3. Wind loads in accordance with the Code of Practice on Wind Effects in Hong Kong 2004 issued by the Buildings Department;
4. Any other relevant loading described in BS 5975:1982.

FOR.D130.9 INCLINED SURFACES

Formwork shall be used to form the top surface of concrete inclined at a slope exceeding 15° to the horizontal unless it can be demonstrated that the specified finish will be produced without the use of formwork. Formwork to top surfaces shall be anchored to prevent flotation.

FOR.D140.9 DISMANTLING AND REMOVAL

Falsework and formwork shall be capable of being dismantled and removed without shock, disturbance, damage or loading to the concrete and in such a manner that the specified requirements for removing or leaving in position side formwork, soffit formwork and props will be achieved without disturbing other formwork or props.

FOR.D150.9 PANEL JOINTS

Formwork panels for Class F2, F3, F4 and F5 finishes shall be the same size and shall form a regular pattern approved by the CM. The lines of joints between panels shall be straight and continuous, horizontal and vertical, or inclined to suit the pattern of profiled formwork, and shall be coincident with construction joints and other joints and with recesses in the concrete surface. The number of make-up pieces shall be kept to a minimum.

FOR.D160.9 TIE HOLES

Holes left by formwork ties and components in concrete surfaces with Class F2, F3, F4 and F5 finishes shall be in line horizontally and vertically and shall form a regular pattern approved by the CM. Unless otherwise permitted by the CM, holes in profiled formwork shall be located in such a manner that the holes are completely within recesses in the concrete surface.

FOR.D170.9 EXTERNAL ANGLES

Unless otherwise stated in the Contract or permitted by the CM, chamfers shall be provided for all external angles of 90° or less in concrete surfaces with Class F2, F3, F4 and F5 finishes shall not be made up of a series of flats unless permitted by the CM.

FOR.D180.9 CURVED SURFACES

Formwork for curved concrete surfaces with Class F2, F3, F4 and F5 finishes shall not be made up of a series of flats unless permitted by the CM.

FALSEWORK SPANNING PUBLIC HIGHWAYS

FOR.D210.9 DESIGN RESPONSIBILITY

Employ a Registered Structural Engineer to take responsibility for the design and construction of all temporary works and falsework spanning public highways. No consent or dissent of the CM will relieve the Contractor of his sole responsibility for the falsework design, construction and obtaining Approval.

FOR.D220.9 GENERAL DESIGN REQUIREMENTS

Ensure the falsework system does not interfere with normal traffic flow and does not reduce the width of the traffic lanes. Design clearances to falsework spanning a public highway in accordance with Section 35 of the Transport Planning and Design Manual Volume 2 - Highway Design Characteristics.

FOR.D230.9 APPROVALS

1. Take responsibility for obtaining all necessary approvals of any proposed falsework design and construction, through the Authority, from the Highways Department, the Commissioner of Police and the Commissioner for Transport;
2. Do not commence any temporary works, including falsework spanning a public Highway, unless the falsework design and construction method has been approved by the Highways Department, Commissioner of Police and Commissioner for Transport.

FOR.D240.9 SUBMISSIONS

Submit proposals for falsework spanning a public highway to the CM in the form of proper, numbered, fully dimensioned drawings accompanied by full structural calculations endorsed by the Contractor's Registered Structural Engineer. Make any amendments required by the CM and submit copies to the CM in order to obtain all necessary approvals from the Highways Department, Commissioner of Police and Commissioner for Transport.

MATERIALS

SHEATHING MATERIALS

FOR.M010.9 GENERAL

Formwork shall be timber, metal, plastic or other material which will produce the specified finish. Materials used as formers for profiled formwork, chamfers, splays, rebates and other features shall be such that they produce the same finish as the main formwork. Tropical hardwood is strictly prohibited for use in the formwork and falsework.

FOR.M020.9 PLYWOOD

Plywood for formwork shall have a close, uniform grain and the edges shall be sealed with barrier paint, polyurethane varnish or other impermeable material.

FOR.M030.9 FACES FOR CLASS F4 AND F5 FINISHES

The faces of formwork for Class F4 and F5 finishes shall have a uniform texture and a matt, not a shiny or polished, surface. The edges of the formwork shall be straight and square.

RELEASE AGENTS

FOR.M110.9 GENERAL

Release agents shall be:

1. A proprietary type approved by the CM. Release agents containing mineral oils shall not be used. Barrier paint, polyurethane varnish, wax or other materials shall not be used instead of a release agent;
2. A type which will not stain or colour the concrete and which will not affect the bond between the concrete and subsequent coverings. Release agents other than those which incorporate a surface retarder to produce a Class T1 finish shall be a type which will not affect the hardening of the concrete.

FOR.M120.9 POTABLE AND FRESH WATER RETAINING STRUCTURES

Release agents used on formwork for water retaining structures for potable and fresh water shall be non-toxic and shall not impart a taste to the water.

FOR.M130.9 STEEL FORMWORK

Release agents used on steel formwork shall contain a rust-inhibiting agent.

FOR.M140.9 CLASS F4 AND F5 FINISHES

1. Release agents used on formwork for Class F4 and F5 finishes shall be a chemical release agent;
2. On areas of formwork which in the opinion of the CM are likely to be affected by pedestrian traffic, rain or dust, release agents for Class F4 and F5 finishes shall be a type which evaporates to leave a dry film on the formwork, unless protection from such effects is provided;

3. Each type of release agent used on formwork for Class F4 and F5 finishes shall be obtained from one manufacturer and different types of release agent shall not be used on formwork for the same element.

ANCILLARY MATERIALS

FOR.M210.9 FORMWORK TIES

1. Formwork ties and components shall be a type such that any removable part can be removed without damaging the concrete; any part left in the concrete shall be at least 40 mm or the specified nominal cover to the reinforcement, whichever is greater, from the concrete surface;
2. Unless otherwise permitted by the CM, formwork ties and components used with profiled formwork shall be a type such that holes left by the ties and components are small enough to be located completely within the recesses in the concrete surface;
3. Formwork ties for use in water-retaining structures and waterproof structures shall incorporate a diaphragm welded to the mid-point of the tie, designed to prevent water from passing along the tie. Ties shall be degreased before being placed and shall not touch or foul the reinforcement.

FOR.M220.9 COVER SPACERS

See Worksection CON3.

FOR.M230.9 CEMENT MORTAR FOR REMEDIAL WORK

Materials for cement mortar shall comply with Worksection CON1 and:

1. Cement mortar for filling blowholes shall consist of cement and fine aggregate together with the minimum amount of water necessary to achieve a consistency suitable for completely filling the blowholes;
2. Cement mortar for filling holes left by formwork ties and components shall consist of 1 part of cement to 3 parts of fine aggregate, together with the minimum amount of water necessary to achieve a consistency suitable for compacting the mortar into the holes; the mix shall contain a non-shrink admixture;
3. Cement mortar for filling blowholes and holes left by formwork ties and components in concrete surfaces with Class F4 and F5 finishes shall be the same colour as the hardened concrete; light-coloured sand or white cement may be used for this purpose.

FOR.M240.9 SURFACE RETARDERS

Surface retarders shall be a proprietary type approved by the CM and shall be a type which will not stain or colour the concrete.

FOR.M250.9 ABRASIVES

Abrasives for blasting shall be grit or other materials approved by the CM and shall not contain any iron, clay or other materials which will stain or colour the concrete.

FOR.M260.9 SPATTERDASH

Spatterdash shall consist of cement and coarse sand or granite fines in the proportion 1:2 by volume mixed with the minimum amount of water necessary to achieve the consistency of a thick slurry.

SUBMISSIONS

FOR.M310.9 SCHEDULE OF SUBMISSIONS

1. General

   a. Particulars and samples of the proposed materials and methods of construction for Class F4, F5, U5 and T finishes shall be submitted to the CM as marked 'x' in the following table:

Particulars to be submitted	Formed finishes	Unformed finishes	Treated finishes
Formwork drawings:			
Panel Construction:	x	-	x
Layout and pattern of panels, joints and formwork ties:	x	-	x
Method statement:	-	x	x
Samples: Formwork:	x	-	-
Formwork ties:	x	-	x
Cover spacers:	x	-	x
Brand name and Manufacturer's literature:			
Release agent:	x	-	x
Curing compound:	x	x	x
Surface retarder:	-	-	x
Programme:Removing formwork:	x	-	-
Applying treated finishes:	-	-	x
Details: Sources of formwork, Formwork ties and cover Spacers:	x	-	x
Curing:	x	x	x
Filling blowholes:	x	-	-
Filling formwork tie holes:	x	-	x
Protecting finishes:	x	x	x

   b. The same particulars shall be submitted for other Classes of finish if required by the CM;

   c. Where the sheathing is timber plywood, submit for approval, details of the method of identifying and recording the number of uses to which the sheathing will be subjected to. Upon approval, provide all labour and equipment and carry out marking and recording to the satisfaction of the CM.

2. Bridge construction

   Submit the following details of formwork and falsework to the CM:

   a. Details of the system, including drawings and calculations;

   b. Details of holding down and stabilising the system including horizontal ties;

   c. Method statement for construction of the bridge;

d. Proposal for curing and protecting the concrete; and

e. Method statement for placing and compacting the concrete.

FOR.M320.9 TIMING OF SUBMISSIONS

1. General

   The particulars and samples for formed finishes shall be submitted at least 14 days before the relevant formwork, including formwork for trial panels, is fabricated. The particulars and samples for unformed and treated finishes shall be submitted at least 14 days before the relevant element, including trial panels, is concreted.

2. Bridge Construction

   Refer to Project Specific Specification.

WORKMANSHIP

STORAGE OF MATERIALS

FOR.W010.9 FORMWORK GENERALLY

Formwork shall be stored off the ground on level supports and in a manner which will not result in damage or deformation to the formwork or in contamination of the formwork.

FOR.W020.9 CLASS F4 AND F5

Formwork for Class F4 and F5 finishes shall be covered and protected from exposure to conditions which may affect the formwork.

FOR.W030.9 RELEASE AGENTS AND SURFACE RETARDERS

Release agents and surface retarders shall be stored in sealed containers marked to identify the contents and protected from exposure to conditions which may affect the material. The materials shall be stored in accordance with the manufacturers' recommendations and shall not be used after the recommended shelf life has been exceeded.

CONSTRUCTING AND ERECTING FORMWORK GENERALLY

FOR.W110.9 GENERAL

Formwork shall not have any splits, cracks or other defects. The faces and edges of formwork shall be clean and formwork faces shall be free of projecting nails.

FOR.W120.9 REUSE OF FORMWORK

Formwork which has been previously used shall be repaired and the edges resealed before it is erected. Formwork which in the opinion of the CM has deteriorated to an extent such that it will not produce the specified finish shall not be used for that Class or a higher Class of finish.

FOR.W130.9 JOINTS AND GAPS

Formwork shall be firmly supported and individual panels shall be rigid. Joints between formwork panels, stop ends and adjoining concrete shall be tight and shall not permit grout loss. Gaps shall be sealed with gaskets, filler, sealant or tape before the application of release agents.

FOR.W140.9 CUTTING FORMWORK

Formwork shall be cut in such a manner that reinforcement and built-in components passing through the formwork are maintained in position; the joints shall be tight and shall not permit grout loss.

FOR.W150.9 FORMERS ETC

Formers for profiled formwork, chamfers, splays, rebates and other features shall be rigidly and evenly fixed to the formwork along the complete length and shall not permit grout loss.

FOR.W160.9 BUILT-IN COMPONENTS, VOID FORMERS AND BOX-OUTS

Built-in components, void formers and box-outs shall be fixed in position before concreting. Unless permitted by the CM, void formers and box-outs shall not be used instead of built-in components. Polystyrene shall not be used for void formers and box-outs unless permitted by the CM.

FOR.W170.9 FORMWORK TIES AND COMPONENTS

Formwork ties and components shall be fixed in such a manner that they do not touch reinforcement or built-in components. Formwork ties and components shall fit rigidly against formwork faces and shall not permit grout loss.

FOR.W180.9 TEMPORARY OPENINGS

If required for cleaning or inspection, temporary openings shall be provided in the formwork.

CLASS F4 AND F5 FINISHES

FOR.W210.9 GENERAL

Each type of formwork for Class F4 and F5 finishes shall obtained from one source and different types of formwork shall not be mixed unless permitted by the CM. Damaged formwork shall not be used unless permitted by the CM. Parts of steel formwork which will be in contact with concrete shall be free from rust.

FOR.W220.9 JOINTS

For concrete surfaces with Class F4 and F5 finishes, joints between formwork panels shall be sealed with foamed rubber strips. The foamed rubber strips shall be sufficiently compressible to form a grout-tight joint. The width of the resulting gap between the panels shall not be greater than 1 mm and the sealing strips shall not protrude proud of the surface of the formwork panels. Alternatively, subject to the approval of the CM, joints between formwork panels may be sealed with an Approved filler provided the butting edges of the panels are smooth and the resulting gap between the panels is not wider than 1 mm. Joints between formwork panels shall not be sealed by tape fixed to the formwork faces.

FOR.W230.9 PROTECTION

Formwork for Class F4 and F5 finishes shall be protected from spillages, rust marks and stains.

APPLYING RELEASE AGENTS

FOR.W310.9 USE OF RELEASE AGENTS

A release agent shall be used on all formwork other than permanent formwork and formwork on which a surface retarder is used to produce a Class T1 finish.

FOR.W320.9 PREPARATION

Formwork faces shall be cleaned before release agents are applied. Concrete, reinforcement and built-in components shall not be contaminated by release agents.

FOR.W330.9 APPLICATION

The release agent shall be applied by the method and at the rate of application recommended by the manufacturer or as demonstrated to be satisfactory by use in the trial panel.

FOR.W340.9 CLASS F4 AND F5 FINISHES

Release agents shall be applied to formwork for Class F4 and F5 finishes after the formwork has been erected and before the reinforcement is fixed or, if this is not practicable, immediately before the formwork is erected. The release agent covering shall be complete and uniform.

INSPECTION

FOR.W410.9 GENERAL

The Contractor shall allow the CM to inspect the complete formwork and reinforcement, including trial panels, before carrying out any work, including fixing reinforcement adjacent to formwork and erecting formwork adjacent to reinforcement, which will make access to erecting formwork adjacent to reinforcement, which will make access to the formwork faces or reinforcement difficult. The Contractor shall inform the CM 24 hours, or such shorter period agreed by the CM, before carrying out such work.

FOR.W420.9 CLASS F4 AND F5 FINISHES

The Contractor shall allow the CM to inspect formwork for Class F4 and F5 finishes before it is erected and shall inform the CM 24 hours, or such shorter period agreed by the CM, before erecting the formwork.

REMOVAL OF FALSEWORK AND FORMWORK

FOR.W510.9 MINIMUM TIMES BEFORE REMOVAL

Except as stated in FOR.W530, falsework and formwork shall not be loosened or removed before the minimum times stated in the following table:

Type of falsework or formwork	Class F1, F2, F3 and F4 finishes		Class F5 finish
	Concrete without PFA	Concrete with PFA	Concrete with or without PFA
Vertical (non-profiled) (profiled)	12 hours 7 days	15 hours 7 days	48 hours 7 days
Inclined to top surfaces	12 hours	15 hours	48 hours
Soffits of slabs (props left in)	4 days	4 days	10 days
Soffits of beams (props left in)	7 days	7 days	14 days
Props to slabs	10 days	10 days	10 days
Props to beams	14 days	14 days	14 days

Props to cantilevers	28 days	28 days	28 days

The times stated are for a minimum ambient temperature of 15°C, for elements without superimposed loads and for concrete containing PC, PFAC or both PC and PFA not exceeding the PC replacement level as specified in the Contract. If other conditions apply, particulars of proposed changes to the minimum times shall be submitted to the CM for approval.

FOR.W520.9 WATER RETAINING STRUCTURES

For the purpose of determining the minimum times for loosening or removing falsework and formwork, copings at the tope of columns in water retaining structures shall be classified as slabs and roof slabs in water retaining structures shall be classified as beams.

FOR.W530.9 CONCRETE IN FLEXURE

Falsework and formwork supporting concrete in flexure may be loosened or removed when the strength of the concrete in that element is 10 MPa or twice the stress to which it will be subjected, whichever is greater, provided that deflection which in the opinion of the CM is unacceptable will not result and that superimposed loads will not be applied. The strength of the concrete shall be determined from tests on test cubes which have been made with concrete from the same pour and which have been cured by the same method and under similar conditions as the concrete in the element.

FOR.W540.9 REMOVING FORMWORK

1. Formwork shall be removed without hammering or levering to the concrete and in such a manner that there is no shock, disturbance, damage or loading to the concrete. Side formwork shall be removed without disturbing soffit formwork and soffit formwork shall be removed without disturbing props except as provided for in sub-clause (2);
2. Individual props may be removed to allow the removal of soffit formwork provided that the formwork has been designed accordingly and that each prop is replaced as soon as the formwork has been removed.

FOR.W550.9 CLASS F5 FINISHES

Falsework and formwork for Class F5 finishes shall be loosened and removed in a continuous operation and in accordance with a consistent programme agreed by the CM. All formwork shall be loosened before individual panels are removed and all formwork shall be removed and all formwork shall be removed within the programmed period. Individual panels or make-up pieces shall not be left in position.

FOR.W560.9 FORMWORK FOR REUSE

After removal, formwork which is intended for re-use shall be cleaned and stored as FOR.W010 and FOR.W020.

MAINTENANCE OF FORMWORK

FOR.W570.9 DAMAGED AND DETERIORATED FORMWORK

Do not re-use formwork where strength and composition have so far deteriorated due to repeated use that, in the opinion of the CM, it will no longer adequately perform its function in accordance with the Specification but remove it from Site.

FOR.W580.9 RE-USE OF TIMBER FORMWORK

Do not subject plywood sheathing to formwork to more than nine uses, irrespective of the use of one or both faces of such sheathing.

FOR.W590.9 RUBBER SEALS

Properly maintain the rubber hose seals and replace when required or as Instructed but in no case subject seals to more than nine uses.

CLASSIFICATION OF FINISHES

FOR.W610.9 FORMED FINISHES

1. The characteristics of each class of formed finish shall be as stated in the following table:

Classification of Formed Finishes

Class of finish	Type of formwork normally used	Characteristics of finish			
		Formwork pattern	Abrupt irregularities permitted	Gradual irregularities permitted	Specific requirements
F1	Sawn timber	Not required	< 10 mm	< 15 mm in 2 m	No specific requirements
F2	Plywood	Pattern of formwork joints and tie holes as stated in Clauses. FOR.D150 and FOR.D160	< 5 mm	< 10 mm in 2 m	Even surface; no grout runs
F3			< 3 mm	< 5 mm in 2 m	Even surface; no grout runs
F4	Sealed plywood				Uniform, dense and smooth surface; no grout runs; no grain; pattern; no crazing; no major; blemishes
F5			< 2 mm	< 3 mm in 2 m	Uniform, dense and smooth surface; no grout runs; no grain pattern; no crazing; no blemishes; no staining or discolouration

2. Formwork of the type stated in the table in sub-clause (1), will normally produce a concrete surface which complies with the characteristics of finish stated but other types of formwork may be used to produce the specified finish.

FOR.W620.9 UNFORMED FINISHES

The characteristics of each class of unformed finish shall be as stated in the following table:

Classification of Unformed Finishes				
Class of finish	Method of producing finish	Characteristics of finish		
		Abrupt irregularities permitted	Gradual irregularities permitted	Specific requirements
U1	Levelling the surface of the compacted concrete with a screed board	Screed marks < 5 mm	< 10 mm in 2 m	No specific requirements
U2	Forming a Class U1 finish and tamping the surface	Tamp marks < 3 mm	Not applicable	Ridged surface
U3	Forming a Class U1 finish and wood floating or power floating the surface	Float marks < 3 mm	< 10 mm in 2 m	Uniform, dense and smooth surface
U4	Forming a Class U3 finish and brushing the surface with a stiff brush	Brush marks < 3 mm	< 10 mm in 2 m	Rough texture
U5	Forming a Class U3 finish and steel trowelling the surface under firm pressure or power floating the surface	Nil	< 5 mm in 2 m	Uniform, dense and smooth surface, free from trowel marks No staining or discolouration

FOR.W630.9 TREATED FINISHES

The characteristics of each class of treated finish shall be as stated in the following table:

Classification of Treated Finishes			
Class of finish	Type of finish	Method of producing finish	Characteristics of finish
T1	Exposed aggregate	Washing and brushing the concrete surface	Cement matrix removed and coarse aggregate exposed to a depth not exceeding one-third of the nominal maximum coarse aggregate size
T2	Point tooled	Point tooling the concrete surface	Cement matrix and aggregate surface removed sufficiently to expose the aggregate with a minimum penetration
T3	Bush hammered	Bush hammering the concrete surface	into the matrix between aggregates
T4	Broken rib	Hammering or chiselling the edges and faces of the concrete surface	Fragments of concrete ribs removed
T5	Light blasting	Blasting the concrete surface by abrasives	Cement matrix removed and coarse aggregate exposed to a minimum depth
T6	Heavy blasting	and compressed air or by water jetting	Cement matrix removed and coarse aggregate exposed to a depth not exceeding one-third of the nominal maximum coarse aggregate size

FOR.W640.9 APPLICATION OF FINISHES

The Class of formed and unformed finish required for different concrete surfaces shall be as stated in the following table unless otherwise stated in the Drawings. The high Class of finish shall start at least 150 mm below the finish ground level for concrete surfaces which are partly buried:

Description of surface			Class of finish	
			Formed	Unformed
Surfaces to be covered	-	screeded	-	U2
	-	rendered, plastered	F2	-
	-	tiles	F2	U3
	-	painted	F4	U5
Surface for treated finishes			F3	U3
Surfaces for pedestrian traffic			-	U4
Construction joints (for Class T1 finish)			F2	U3
Movement joints			F3	U3
Benching, screeds			F3	U5
Blinding, foundations, pile caps			F1	U1
Piers, blocks, pipe surrounds	-	below FGL	F1	U1
	-	above FGL	F2	U3
Manholes, chambers	-	external below FGL	F1	U1
	-	external above FGL	F2	U3
	-	internal	F2	U3
Culverts, channels	-	external below FGL	F1	U1
	-	external above FGL	F2	U3
	-	internal	F4	U5
Water retaining structures	-	external below FGL	F2	U3
	-	external above FGL	F4	U5
	-	internal	F4	U5
Buildings	-	external below FGL	F1	U1
	-	external above FGL	F2	U3
	-	internal	F4	U5
Bridges, retaining walls, walls	-	below FGL	F1	U1
	-	above FGL, not exposed to direct public view	F4	U5
	-	above FGL, exposed to direct public view	F5	U5
	-	internal, not exposed to direct public view	F2	U1

UNFORMED FINISHES

FOR.W710.9 GENERAL

Unformed finishes shall be produced by the methods stated in the table in FOR.W620.

FOR.W720.9 CLASS U4 FINISH

Brushing to produce a Class U4 finish shall be carried out in straight lines in a direction agreed by the CM; brushing shall be carried out when the concrete has hardened sufficiently for the float marks to be removed and for the ridges to be formed without displacing the aggregate.

FOR.W730.9 FLOATING AND TROWELLING

Floating and trowelling shall not be carried out until the concrete has hardened sufficiently to allow the specified finish to be produced with the minimum amount of floating and trowelling such that excess laitance is not produced.

FOR.W740.9 CONCRETE CARRIAGEWAYS

Surface finish to concrete carriageways shall comply with Worksection EXT2.

TREATED FINISHES

FOR.W810.9 GENERAL

1. Treated finishes shall be produced by constructing a concrete surface with a Class F3 or U3 finish as appropriate and applying the treatment to the surface by the methods stated in the table in FOR.W630;
2. The treatment shall be applied in a continuous operation in accordance with a consistent programme agreed by the CM.

FOR.W820.9 CLASS T1 FINISH

1. Washing and brushing to produce a Class T1 finish shall not be carried out until the concrete has hardened sufficiently for the cement matrix to be removed without disturbing the coarse aggregate. After washing and brushing have been completed and the concrete surface has hardened, the surface shall be cleaned;
2. The cement matrix shall not be removed or the aggregate exposed by mechanical methods unless permitted by the CM;
3. Class T1 finishes may be produced by using a surface retarder applied to the formwork or to the concrete surface. The surface retarder applied to the formwork or to the concrete surface. The surface retarder shall be applied by the method and at the rate of application recommended by the manufacturer, or as demonstrated to be satisfactory by use on the trial panel;
4. Plywood to which a surface retarder is to be applied shall be sealed with barrier paint, polyurethane varnish or other impermeable material agreed by the CM. The formwork shall be removed in small sections and the coarse aggregate exposed by washing and brushing the concrete surface;
5. Unless permitted by the CM, formwork to which a surface retarder has been applied shall not be re-used unless a surface retarder is to be used again on the formwork. Formwork to which a surface retarder has been applied and which is to be re-used shall be cleaned before the retarder is applied.

FOR.W830.9 CLASS T2 AND T3 FINISHES

Point tooling to produce Class T2 finishes and bush hammering to produce Class T3 finishes shall be carried out evenly in small areas and not in distinct lines. Tooling and hammering shall not start until at least 7 days after concreting.

FOR.W840.9 CLASS T4 FINISH

Hammering or chiselling to produce a Class T4 finish shall be applied from only one direction, and only either hammering or chiselling shall be applied on any one face. Hammering and chiselling shall not start until at least 14 days after concreting.

FOR.W850.9 CLASS T5 AND T6 FINISHES

Blasting to produce Class T5 and T6 finishes shall not be carried out until the concrete has hardened sufficiently for the cement matrix to be removed without disturbing the coarse aggregate. Adjacent surfaces shall be protected from blasting and dust shall be controlled by screens and by water-spraying.

INSPECTION AND COMPLIANCE OF FINISHES

FOR.W910.9 INSPECTION

1. Before any subsequent work is carried out on a concrete surface, the surface shall be inspected by the CM to determine if the specified finish has been produced. Formed finishes shall be inspected as soon as the formwork has been removed;
2. Blowholes or holes left by formwork ties and components shall not be filled and spatterdash or other coverings shall not be applied before the inspection; any such filling or covering carried out before the inspection may be rejected.

FOR.W920.9 COMPLIANCE STANDARD

1. Concrete surfaces shall have the characteristics stated in tables in FOR.W610 and FOR.W620 for the different Classes of formed and unformed finish before any subsequent work is carried out on the concrete surface and shall have the characteristics stated in the table in FOR.W630 for the different Classes of treated finish;
2. The CM shall determine if the specified finish has been produced and may use the trial panels as a means of comparison;
3. Abrupt irregularities shall be measured by direct measurement. Gradual irregularities shall be measured using a 2 m long straight edge on surfaces intended to be flat and by a method agreed by the CM on other surfaces.

REMEDIAL AND REPAIR WORK

FOR.W1010.9 GENERAL

1. Remedial or repair work shall not be carried out on concrete surfaces unless permitted by the CM; any such work carried out without permission may be rejected;
2. Filling of blowholes and holes left by formwork ties and components shall be carried out as soon as practicable after the CM has inspected the finish and with the minimum interruption to curing.

FOR.W1020.9 BLOWHOLES

Blowholes exceeding 3 mm in size in water retaining structures and watertight structures, and blowholes exceeding 10 mm in size in other structures shall be filled with cement mortar. The size of blowholes shall be the maximum dimension measured across the hole on the concrete surface. If the number and size of blowholes in concrete surfaces with Class F3, F4 and F5 finishes is in the opinion of the CM greater than in the trial panel the blowholes shall be filled, unless in the opinion of the CM filling is not required.

FOR.W1030.9 FORMWORK TIE HOLES

Holes left by formwork ties and components shall be cleaned and filled by ramming cement mortar into the holes in layers. Holes in concrete surfaces with a Class F5 finish shall be filled to a level slightly below the concrete surface; the holes shall not be overfilled and rubbed down.

FOR.W1040.9 APPLYING SPATTERDASH

1. Spatterdash shall be thrown with a hand trowel onto the surface to a thickness not exceeding 6 mm and shall cover at least 60% of the area which is to be plastered or rendered. Spatterdash shall be wetted one hour after application and shall be allowed to cure and harden before under coats are applied;
2. Spatterdash shall be applied as soon as practicable after the CM has inspected the finish and after the concrete surface has been cleaned and wetted.

FOR.W1050.9 CRACK REPAIR

See Worksection CON1.

PROTECTION OF FINISHES

FOR.W1110.9 GENERAL

Materials, constructional plant or other vehicles shall not use or be placed on or against concrete surfaces unless permitted by the CM.

FOR.W1120.9 CLASS F4, F5, U5 AND T FINISHES

Concrete surfaces with Class F4, F5, U5 and T finishes shall be:

1. Protected from running water, spillages, rust-marks and stains by covering the surface with polyethylene sheeting or timber or by other methods agreed by the CM. Protection from rust-marks caused by reinforcement bars shall be by polyethylene sleeves tied to the bars or by coating the bars with cement slurry; the bars shall not be coated with oil or grease;
2. Protected from damage by securing timber battens to the surface, by erecting barriers or fences or by other methods agreed by the CM.

FOR.W1130.9 CLASS F5 FINISH

Concrete surfaces with a Class 5 finish shall be protected from exposure to extreme variations in weather conditions for at least 14 days after the formwork has been removed.

TRIAL PANELS

FOR.W1210.9 GENERAL

1. A trial panel shall be constructed for each Class F4, F5, U5 and T finish to demonstrate that the proposed materials, mix design, methods of production and methods of construction, including curing and removal of formwork, will produce the specified finish;
2. Trial panels for Class F4 and F5 finishes shall be constructed before the relevant formwork for the permanent work is erected, and trial panels for Class U5 and T finishes shall be constructed before the relevant permanent work is concreted. The trial panels shall be constructed at least 4 weeks before the relevant permanent work is carried out;
3. The Contractor shall inform the CM at least 24 hours, or such shorter period agreed by the CM, before constructing trial panels;
4. Trial panels shall be constructed using the materials, mix design, methods of production and methods of construction, including curing and removal of formwork, submitted to the CM;
5. Trial panels shall be horizontal, vertical or inclined as appropriate and shall be constructed at locations agreed by the CM. Unless otherwise stated in the Contract, each trial panel shall be not less than 2 m by 2 m by 300 mm thick, and shall contain reinforcement representative of the most congested reinforcement which will be used in the permanent work. Trial panels shall incorporate formwork ties and components, horizontal joints, vertical joints, chamfers, splays, rebates and other features representative of those which will be used in the permanent work;
6. Trial panels shall be protected from damage and shall be left in position until the CM instructs their removal.

FOR.W1220.9 NON-COMPLIANCE OF TRIAL PANELS

If in the opinion of the CM the specified finish has not been produced in the trial panel, particulars of proposed changes to the materials, mix design, methods of production or methods of construction shall be submitted to the CM, further trial panels shall be constructed until the specified finish is produced in the trial panel. Further trial mixes shall be made unless in the opinion of the CM non-compliance of the trial panel was not due to the concrete mix.

FOR.W1230.9 COMMENCEMENT OF FORMWORK AND CONCRETING

Formwork for Class F4 and F5 finishes shall not be erected and elements with Class U5 and T finishes shall not be concreted until in the opinion of the CM the specified finish has been produced in the trial panel.

FOR.W1240.9 CHANGES IN MATERIALS AND METHODS

Unless permitted by the CM, the materials, mix design, methods of production or methods of construction, including curing and removal of formwork, used to produce the specified finish in trial panels shall not be changed.

MAR MARINE WORKS

MAR MARINE WORKS 4

MATERIALS 4

GENERAL 4

MAR.M010.9 APPLICATION OF OTHER WORKSECTIONS 4
MAR.M020.9 DEFINITIONS 4

FILL MATERIAL 4

MAR.M110.9 PARTICLE SIZE DISTRIBUTION 4
MAR.M120.9 UNDERWATER FILL MATERIAL (TYPE 1) 5
MAR.M130.9 UNDERWATER FILL MATERIAL (TYPE 2) 5
MAR.M140.9 ROCK FILL MATERIAL (GRADE 75) 5
MAR.M150.9 ROCK FILL MATERIAL (GRADE 700) 5
MAR.M160.9 SUBMISSIONS 5
MAR.M170.9 IMPORTATION OF SAND 5

ROCK ARMOUR 7

MAR.M210.9 MAXIMUM AND MINIMUM MASSES 7
MAR.M220.9 PROPERTIES 8
MAR.M230.9 SUBMISSIONS 8

STONES 8

MAR.M310.9 FACING STONES 8
MAR.M320.9 BERMSTONES 8
MAR.M330.9 LEVELLING STONES 9

FENDERING SYSTEMS 9

MAR.M410.9 TIMBER SPECIES AND PROPERTIES 9
MAR.M420.9 TREATMENT OF TIMBER 9
MAR.M430.9 RUBBER FOR FENDERS 9
MAR.M440.9 SUBMISSIONS FOR FENDERING MATERIALS 10

IRON AND STEEL FITTINGS 10

MAR.M510.9 CAST IRON 10
MAR.M520.9 BOLTS AND NUTS 11
MAR.M530.9 WASHERS 11
MAR.M540.9 MILD STEEL CHAIN 11
MAR.M550.9 STAINLESS STEEL FITTINGS 11

SUBMARINE OUTFALLS 11

MAR.M610.9 PRECAST CONCRETE PIPES 11
MAR.M620.9 CLAMPS AND BOLTS 11
MAR.M630.9 GASKETS 11
MAR.M640.9 EPOXY RESIN 11
MAR.M650.9 MARKER BUOYS 11
MAR.M660.9 SUBMISSIONS 12

ANCILLARY MATERIALS 12

MAR.M710.9 JOINT FILLER FOR SLIP JOINTS 12
MAR.M720.9 PRIMING PAINT 12
MAR.M730.9 BITUMINOUS PAINT 12
MAR.M740.9 CREOSOTE 12

WORKMANSHIP 13

SUBMISSIONS PRIOR TO COMMENCEMENT OF WORK 13

MAR.W010.9 MARINE WORKS GENERALLY 13
MAR.W020.9 DREDGING 13
MAR.W030.9 DEPOSITION OF FILL MATERIAL 13
MAR.W040.9 LIFTING SEAWALL BLOCKS, COPING AND WAVE DEFLECTORS 13

HANDLING AND STORAGE OF MATERIALS 14
MAR.W110.9 STORAGE OF FILL AND DREDGED MATERIAL 14
MAR.W120.9 FILL MATERIAL 14
MAR.W130.9 PRECAST CONCRETE COMPONENTS 14
MAR.W140.9 TIMBER FOR FENDERING 14
MAR.W150.9 RUBBER FOR FENDERING 14
EXECUTION OF MARINE WORKS GENERALLY 14
MAR.W210.9 NOTIFICATION 14
MAR.W220.9 MARKING 15
MAR.W230.9 MARINE TRAFFIC AND WATERFRONT OPERATIONS 15
MAR.W240.9 TEMPORARY TIDE GAUGES 15
MAR.W250.9 WORK BOATS 15
MAR.W260.9 REMOVAL OF FLOATING DEBRIS 15
MAR.W270.9 SURVEYS 15
MAR.W280.9 UNSUITABLE OR DETERIORATED FILL MATERIAL 16
MAR.W290.9 CONCRETING IN TIDAL LOCATIONS 16
DREDGING 16
MAR.W310.9 MARINE PLANT AND EQUIPMENT 16
MAR.W320.9 AVOIDANCE OF POLLUTION DURING DREDGING, TRANSPORTING AND DUMPING OF MARINE MUD 17
MAR.W330.9 PROTECTION OF WATER QUALITY AT WATER INTAKES 18
MAR.W340.9 SILT CURTAINS 18
MAR.W350.9 REFUSE CONTAINMENT BOOMS AND FLOATING REFUSE 19
MAR.W360.9 CM'S PERMISSION 19
MAR.W370.9 PROCEDURE AND SEQUENCE 19
MAR.W380.9 SAMPLING OF DREDGED MATERIAL 19
MAR.W390.9 DISPOSAL 19
DEPOSITION OF FILL MATERIAL BELOW +2.5MPD 19
MAR.W410.9 CM'S PERMISSION 19
MAR.W420.9 DEPOSITING FILL MATERIAL 20
MAR.W430.9 DEPOSITING FILL MATERIAL IN DREDGED TRENCHES 20
MAR.W440.9 DEPOSITING ROCK FILL MATERIAL ADJACENT TO STRUCTURES AND UTILITIES 20
DEPOSITION OF ROCK ARMOUR 20
MAR.W510.9 GENERAL 20
MAR.W520.9 BREAKWATERS, REVETMENTS ETC 20
MAR.W530.9 DEPOSITING ROCK ARMOUR ON GEOTEXTILE 20
LEVELLING AND COMPACTION OF FILL MATERIAL 21
MAR.W610.9 UNDERWATER FOUNDATIONS 21
CONSTRUCTION OF MARINE STRUCTURES GENERALLY 21
MAR.W710.9 CONSTRUCTING SEAWALL BLOCKS, COPINGS AND WAVE DEFLECTORS 21
MAR.W720.9 SETTING SEAWALL BLOCKS 21
MAR.W730.9 FACING STONES 21
MAR.W740.9 SLIP JOINTS IN SEAWALLS 21
MAR.W750.9 FILLING CHANNELS IN SEAWALL BLOCKS 22
MAR.W760.9 CONCRETE COPINGS TO SEAWALLS 22
MAR.W770.9 BERMSTONES 22
MAR.W780.9 BAGGED CONCRETE 22
MAR.W790.9 TIMBERWORK FOR FENDERING 22
MAR.W800.9 PAINTING TIMBER FENDERING 22
MAR.W810.9 INSTALLING RUBBER FENDERS 23

CONSTRUCTION OF SUBMARINE OUTFALLS 23
MAR.W910.9 LAYING OUTFALL PIPES 23
MAR.W920.9 MARKER BLOCKS 23
MAR.W930.9 DIFFUSER PIPES 23
MAR.W940.9 DIFFUSER CAPS 23
TOLERANCES 24
MAR.W1010.9 GENERAL 24
TESTING 25
TRIALS FOR SUBMARINE OUTFALLS 25
MAR.T010.9 GENERAL 25
MAR.T020.9 TRIAL RESULTS 25
MAR.T030.9 COMMENCEMENT OF PIPELAYING 25
DREDGED MATERIAL 25
MAR.T110.9 SAMPLING 25
MAR.T120.9 TEST METHOD 25
FILL MATERIAL 25
MAR.T210.9 DEFINITION OF "BATCH" 25
MAR.T220.9 SAMPLING 26
MAR.T230.9 TEST METHODS 26
MAR.T240.9 NON-COMPLIANCE 26
ROCK ARMOUR 26
MAR.T310.9 DEFINITION OF "BATCH" 26
MAR.T320.9 SAMPLING ROCK FOR ROCK ARMOUR 26
MAR.T330.9 TEST METHODS FOR ROCK FOR ROCK ARMOUR 26
MAR.T340.9 SAMPLING ROCK ARMOUR 27
MAR.T350.9 TESTING ROCK ARMOUR 27
MAR.T360.9 NON-COMPLIANCE OF ROCK FOR ROCK ARMOUR 27
MAR.T370.9 NON-COMPLIANCE OF ROCK ARMOUR 27
TIMBER FOR FENDERING SYSTEMS 27
MAR.T410.9 DEFINITION OF "BATCH" 27
MAR.T420.9 SAMPLING 28
MAR.T430.9 TEST METHODS 28
MAR.T440.9 COMPLIANCE CRITERIA 28
MAR.T450.9 NON-COMPLIANCE 28
RUBBER FENDERS 28
MAR.T510.9 DEFINITION OF "BATCH" 28
MAR.T520.9 SAMPLING 28
MAR.T530.9 TEST METHOD 29
MAR.T540.9 COMPLIANCE CRITERIA 29
MAR.T550.9 NON-COMPLIANCE 29
SUBMARINE OUTFALLS 29
MAR.T610.9 TEST METHODS 29
MAR.T620.9 COMPLIANCE CRITERIA 30
MAR.T630.9 NON-COMPLIANCE 30

MAR MARINE WORKS

MATERIALS

GENERAL

MAR.M010.9 APPLICATION OF OTHER WORKSECTIONS

The works and materials specified below shall comply with the Worksections stated, unless otherwise stated in this Worksection:

1. Pipes and fittings, including gaskets, internal linings, external coatings and anticorrosion tape, for submarine outfalls shall comply with Worksection DRA2;
2. Fill material for marine works shall comply with Worksection EAR;
3. Formwork and finishes to concrete shall comply with Worksection FOR;
4. Steel reinforcement shall comply with Worksection CON3;
5. Concrete shall comply with Appendix B entitled "Recommended Specification for Concrete in Marine Environment" of the Port Works Design Manual to address the corrosion of reinforced concrete for marine structures and also shall comply with Worksection CON1 in general.

MAR.M020.9 DEFINITIONS

1. Reclamation: the formation of land over an area of foreshore, sea bed, tidal inlet or river, including the adjoining areas, by the deposition of fill material to the limits shown in the Drawings;
2. Marine structures: seawalls, revetments, breakwaters, jetties, quay walls, dolphins, docks, slipways, beacons, lighthouses, landing steps for berthing of vessels and other similar structures;
3. Final surface of any work: the surface to which the work is to be finished.

FILL MATERIAL

MAR.M110.9 PARTICLE SIZE DISTRIBUTION

The different types of fill material for marine works shall either be Type 1, Type 2, rock or public fill as specified in the Contract and shall have the particle size distributions within the ranges stated in the table in clause EAR1.M220 and in the following table unless otherwise stated in the Contract:

Particle size distributions of fill material					
Type of fill material	Percentage by mass passing				
	Size		BS test sieve size		
	700 mm	200 mm	75 mm	20 mm	63 microns
Underwater fill material (Type 1)	-	-	100	-	0-30
Underwater fill material (Type 2)	-	-	100	-	0-25

Rock fill material (Grade 75)	-	-	100	0	-
Rock fill material (Grade 700)	100	0-10	0-5	0	-

MAR.M120.9 UNDERWATER FILL MATERIAL (TYPE 1)

Underwater fill material (Type 1) shall consist of natural material extracted from the sea bed or a river bed.

MAR.M130.9 UNDERWATER FILL MATERIAL (TYPE 2)

Underwater fill material (Type 2) shall consist of material which has a coefficient of uniformity exceeding 5 and a plasticity index not exceeding 12.

MAR.M140.9 ROCK FILL MATERIAL (GRADE 75)

Rock fill material (Grade 75) shall consist of pieces of hard, durable rock which are free from cracks, veins, discolouration and other evidence of decomposition.

MAR.M150.9 ROCK FILL MATERIAL (GRADE 700)

Rock fill material (Grade 700) shall consist of pieces of rock which are free from cracks, veins and similar defects and of which in the opinion of the CM not more than 30% by mass shall be discoloured or show other evidence of decomposition.

MAR.M160.9 SUBMISSIONS

Submit details of the sources and properties of fill material specified in this sub-section to the CM, at least 14 days before deposition of the fill material starts.

MAR.M170.9 IMPORTATION OF SAND

1. Where the Contractor intends to import sand as defined in the Contract from the People's Republic of China (PRC) by barges, he shall submit to the CM for Approval a proposal containing the information as referred to in sub-clause (2) below for the delivery of sand from any source in PRC waters to the Site at least 28 days prior to its delivery. Within a reasonable time of being required to do so, provide to the CM such further particulars as may be required by the CM to enable the CM to make a proper decision on the proposal. Approval by the CM shall not relieve the Contractor of any obligation or liability under the Contract;
2. The proposal shall contain the following information:
    a. The source of the sand, grading curves and test results for contamination of heavy metals or any other test required by the CM or as are necessary to confirm compliance with the Specification;
    b. The name and licence number of each barge to be engaged in transporting the sand, and the company name, address, telephone and fax number and contact person of their appointed Hong Kong shipping agent;
    c. Details of all permits and authorizations, original versions of which the relevant PRC and Hong Kong authorities require to be carried on each barge. The original versions of the documents normally required shall include but not be limited to the following:

        PRC Authorities

        Certificate of ship Nationality

        Certificate of Survey

Certificate of Navigation (Government of the Hong Kong Special Administrative Region, Government of the Macau Special Administrative Region and PRC)

Route Approval

Clearance Certificate

Pass for entering HK and Macau

Custom Supervision Book of Small Craft (Government of the Hong Kong Special Administrative Region, Government of the Macau Special Administrative Region and PRC)

Master and Chief Engineer Certificates

Seamans' ID Cards/Record Books

Permit for Sand Exportation

Hong Kong Authorities

Arrival Report (Marine Department)

Arrival Clearance, Vessel and Crew (Immigration Department)

Cargo Manifest (Customs & Excise Department)

Sand Permit (Civil Engineering Development Department)

Departure Clearance (Marine Department)

Departure Clearance (Immigration Department)

3. All sand imported from PRC for incorporation into the Works shall be obtained from the source approved under the above sub-clause (1);

4. On each occasion sand is delivered by barge to the Site, produce to the satisfaction of the CM documentary evidence that the sand is from the source approved under the above sub-clause (1);

5. Requirement for proof of third party insurance cover:

   Vessels transporting sand from China will be required to have third party risk insurance valid for Hong Kong waters and to carry a certified true copy of the third party insurance certificate on board the vessel.

6. Requirement for route approval:

   To minimise the adverse effects on marine traffic, the Contractor intending to import sand material from China in barges will be required before the sand importation starts, to apply to the Director of Marine to obtain Approval for the transportation routes to be used. Guidance on the approval procedures is given below:

   a. Sand imported from China should be transported to the Hong Kong destination site by the shortest and most direct route possible;

   b. Routes which are under heavy marine traffic usage include Ma Wan and Kap Shui Mun Channels, the Central Harbour, the East Lamma Channel, the Adamasta Channel and Lei Yue Mun. It is intended that these routes will not generally be available to an unlimited number of barges transporting sand. However, if sand barges must traverse these busy waters the number of such vessels allowed to do so will be strictly limited;

   c. To minimise the volume of individual vessels used, the Contractor is encouraged to use large rather than small vessels;

d. The Contractor intending to import sand from China in barges must apply to the Director of Marine for Approval of the transportation routes as soon as possible and certainly before any sand importation starts;

e. When making an application the following information will be required:

i. The site of the reclamation and Contract name and number;

ii. The total quantity of sand to be transported and the planned daily/monthly tonnage amounts to be transported;

iii. The proposed route;

iv. The number of vessels to be used plus their tonnage capacities and identities;

v. The frequency of vessel trips;

vi. The name and address of the Hong Kong agent;

vii. Details of third party risk insurance coverage for the vessels.

f. The Director of Marine will establish a working committee to advise him on individual applications for route approval. The committee membership will include concerned government departments, the Hong Kong Pilot's Association and selected port user groups. In considering applications for route approval, the Director of Marine will take into account the location of the reclamation and existing traffic levels;

g. Once route approval has been given, the marine traffic effects of the sand transportation will be monitored. The information gained from monitoring marine traffic, including marine traffic unrelated to a particular project, will be used by the Director of Marine to verify that the traffic level generated by that particular project is acceptable, needs adjusting downwards or could be set at higher levels;

h. Approved applications will stipulate a requirement for the applicant to forward to the Director of Marine on a monthly basis the following information:

i. The site of the reclamation and Contract name and number;

ii. The monthly amount in tonnage of sand transported;

iii. The number of vessels used plus their tonnage capacities and identities;

iv. The frequency of vessel trips;

v. The route used.

ROCK ARMOUR

MAR.M210.9 MAXIMUM AND MINIMUM MASSES

1. The different types of rock armour shall have the maximum and minimum masses as stated in the following table:

Mass of rock armour		
Type of fill material	Mass of individual piece of rock (kg)	
	Maximum	Minimum
Rock armour (Type 1)	1500	750
Rock armour (Type 2)	2000	1000

Rock armour (Type 3)	2500	1500
Rock armour (Type 4)	3000	2000
Rock armour (Type 5)	4000	2500
Rock armour (Type 6)	5000	3000
Rock armour (Type 7)	6500	4000

2. At least 50% in number of the individual pieces shall have a mass exceeding the mean of the specified maximum and minimum masses.

MAR.M220.9 PROPERTIES

Rock armour shall consist of rock having the properties stated in the following table:

Properties of rock for rock armour	
Property	Value
Specific gravity	≥2.6
Water absorption	≤3%
Aggregate impact value (in dry condition)	≤30%
Ten percent fines value (in dry condition)	≥100 kN
Soundness	loss in mass after five cycles not exceeding 12% for sodium sulphate and 18%for magnesium sulphate
Aggregate abrasion value	≤15%

and shall comply with the following requirements:

1. The maximum size of rock shall not be greater than twice the minimum dimension;
2. Each piece of rock shall be free from cracks, veins and similar defects;
3. In the opinion of the CM not more than 20% in number of the individual pieces shall be discoloured or show other evidence of decomposition.

MAR.M230.9 SUBMISSIONS

Submit details of the sources and properties of rock armour specified in this sub-section to the CM, at least 14 days before placing of the rock armour starts.

STONES

MAR.M310.9 FACING STONES

1. Facing stones to seawalls and pitched slopes shall consist of pieces of hard, durable fresh granite, free from cracks, veins, and similar defects. Facing stones shall be uniform in size, shape and colour, roughly squared and hammer dressed such that they will fit together without the use of quarry spalls or surface pinning;
2. Facing stones for vertical concrete seawalls shall be at least 300 mm wide on the face, at least 300 mm from back to front and shall be of a height which will allow the stones to be laid in 300 mm to 400 mm courses.

MAR.M320.9 BERMSTONES

1. Bermstones for seawalls and revetments shall consist of pieces of sound fresh rock, free from cracks, veins and similar defects;

2. Bermstones for vertical seawalls shall be at least 1000 kg in mass and when placed in position shall be roughly rectangular on plan and between 450 mm and 750 mm thick.

MAR.M330.9 LEVELLING STONES

Stones for levelling founding layers for marine structures shall be rock fill material (Grade 75) as stated in MAR.M140.

FENDERING SYSTEMS

MAR.M410.9 TIMBER SPECIES AND PROPERTIES

Timber for fendering systems shall be Selangan Batu species, also known as Yacal and Balau, or a similar species of hardwood visually stress graded to the HS (Hardwood Structural) grade of BS 5756:1980. The species shall comply with the strength requirements for strength class SC8 or SC9 as stated in BS 5628:Part 2:1985, shall be resistant to mechanical wearing and marine borer attack, and shall comply with the requirements stated in the following table:

Properties of timber for fendering systems	
Property	Minimum value
Oven dry density	655 kg/m³
Static bending at rupture	56 MPa
Modulus of elasticity under bending	8700 MPa
Hardness (Janka indentation test)	3200 N
Compressive stress parallel to grain at maximum load	29 MPa
Shear stress parallel to grain at maximum load	6.5 MPa

MAR.M420.9 TREATMENT OF TIMBER

Kempas, Kapur and other hardwoods which are less resistant in a marine environment shall be pressure treated with creosote in accordance with BS 144 and BS 5589:1989 or with copper, chrome and arsenic (CCA) salts in accordance with BS 4072:1987. The minimum net retention for pressure creosoting shall be 130 kg/m³ and the minimum net dry salt retention for treatment with CCA shall be 30 kg/m³.

MAR.M430.9 RUBBER FOR FENDERS

Rubber for fenders shall be natural or synthetic rubber, resistant to ageing, weathering and wearing, homogeneous and free from defective impurities, pores or cracks, and shall have the properties stated in the following table:

Properties of rubber for fenders		
Property	Value	Test method and condition Part No. of BS 903
Density	1100 kg/m³ to 1300 kg/m³	Part A1:1980
Hardness (International rubber hardness degrees)	≤72	Part A26:1969 Method N
Tensile strength	≥16 N/mm²	Part A2:1989
Elongation change	≥350%	Part A2:1989

After accelerated air ageing test: Hardness (increase in IRHD) Reduction in tensile strength Reduction in elongation	 ≤8° ≤20% ≤20%	Part A19:1986 Method A at 70°C × 96 hours
Oil resistance (measured by volume change percentage): Industrial gasoline Heavy oil	 ± 60% ± 20%	Part A16:1987 at 23°C × 22 hours
Compression set	≤30%	Part A6:1969 Method A at 70°C × 22hours using Type 2 test pieces
Ozone resistance	No crack visible	Part A43:1990 at 40°C × 100 hours
Tear resistance	≥60 kN/m	Part A3:1982 Method C at 23°C
Abrasion resistance (volume loss at 3000 revolutions)	≤1500 mm³	Part A9:1988 Method C

MAR.M440.9 SUBMISSIONS FOR FENDERING MATERIALS

1. For timber:
    a. The following particulars shall be submitted to the CM at least 30 days before the first delivery of the timber to the Site:
        i. Species and grade of timber;
        ii. Name and address of timber supplier;
        iii. Method of pressure treatment and amount of net retention;
    b. Each batch of the timber delivered to the Site shall be accompanied by a certificate issued by a forestry authority approved by the CM or a bill of lading certifying the country of origin, method of pressure treatment, and grade and species of timber;
2. For rubber:
    a. The following particulars shall be submitted to the CM for approval of the source and type of rubber fenders at least 30 days before the first delivery of the rubber fenders to the Site:
        i. Manufacturer's literature, including a list of physical properties of the rubber for the fenders;
        ii. A report on compression load tests and characteristic load-deflection and energy deflection curves;
    b. A certificate showing the manufacturer's name, the date and place of manufacture and showing that the rubber fenders, including the rubber used in manufacturing the fenders, comply with the requirements stated in the Contract, shall be submitted for each batch of rubber fenders delivered to the Site.

IRON AND STEEL FITTINGS

MAR.M510.9 CAST IRON

Cast iron for bollards, pumphouse screens and screen guides shall be Grade 150 or 180 complying with BS 1452:1990.

MAR.M520.9 BOLTS AND NUTS

1. Mild steel bolts and nuts shall comply with BS 3692:1967;
2. Stainless steel bolts and nuts shall comply with Grade A4 and property class 80 of BS 6105:1981.

MAR.M530.9 WASHERS

1. Mild steel washers shall comply with BS 4320:1968;
2. Stainless steel washers shall be grade 316 austenitic steel complying with BS 1449:Part 2:1983. The dimensions and tolerances of stainless steel washers shall comply with BS 4320:1968.

MAR.M540.9 MILD STEEL CHAIN

Mild steel chain shall be grade 30 steel complying with BS 6405:1984.

MAR.M550.9 STAINLESS STEEL FITTINGS

Stainless steel for chains, railings, cat ladders, pumphouse screens and screen guides, mooring eyes and other marine fittings shall be grade 316 austenitic steel complying with the following:

1. General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels: BS 970:Part 1:1983;
2. Specification for stainless and heat-resisting steel plate, sheet and strip: BS 1449:Part 2:1983.

SUBMARINE OUTFALLS

MAR.M610.9 PRECAST CONCRETE PIPES

Precast concrete pipes for submarine outfalls shall comply with BS 5911:Part 100:1988 and shall have gasket type flexible rebated joints with clamps and bolts.

MAR.M620.9 CLAMPS AND BOLTS

The clamps and bolts shall be cast steel complying with BS 3100:1976 and shall be painted with two coats of coal tar epoxy of a type approved by the CM to a dry film thickness of 300 microns.

MAR.M630.9 GASKETS

Gaskets for joints in precast concrete pipes shall be type D (drainage) rubber gaskets complying with BS 2494:1990. The rubber gaskets shall be moulded jointless in ring moulds and shall not contain any reclaimed rubber.

MAR.M640.9 EPOXY RESIN

Epoxy resin for joints between precast concrete pipes shall be a type approved by the CM.

MAR.M650.9 MARKER BUOYS

Marker buoys shall be a hard plastic type approved by the CM.

MAR.M660.9 SUBMISSIONS

1. The following particulars of the proposed materials and methods of construction for submarine outfalls shall be submitted to the CM:
    a. Methods of lifting, laying, jointing and testing pipes;
    b. Manufacturer's literature;
    c. A certificate for pipes and pipe joints showing the manufacturer's name, the date and place of manufacture and showing that the pipes comply with the requirements stated in this Specification and including the results of load tests.
2. The particulars shall be submitted to the CM at least 14 days before the first delivery of the material to the Site. Certificates shall be submitted for each batch of the material delivered to the Site.

ANCILLARY MATERIALS

MAR.M710.9 JOINT FILLER FOR SLIP JOINTS

1. Joint filler for slip joints in seawalls shall consist of three plies of Type 1B fine granule surfaced bitumen felt of 1.4kg/m² nominal mass in accordance with BS 747:1994;
2. Adhesive for use with joint filler shall be a proprietary type recommended by the joint filler manufacturer and approved by the CM;
3. The following particulars shall be submitted to the CM at least 14 days before the first delivery of the material to the Site:
    a. Details of joint filler, including manufacturer's literature;
    b. Method of fixing and application of the materials.

MAR.M720.9 PRIMING PAINT

1. Priming coat for temporary tide gauges shall be lead based priming paint complying with BS 2523:1966. Undercoat and finishing coat for temporary tide gauges shall be micaceous iron oxide paint complying with BS 3981:1976;
2. Primer for steel fittings for fendering systems shall be lead based primer complying with BS 2523:1966.

MAR.M730.9 BITUMINOUS PAINT

Bituminous paint for fendering systems shall comply with BS 3416:1991.

MAR.M740.9 CREOSOTE

Creosote for pressure treatment of timber shall be Type 2 coal tar creosote as stated in BS 144:Part 1:1990.

WORKMANSHIP

SUBMISSIONS PRIOR TO COMMENCEMENT OF WORK

MAR.W010.9 MARINE WORKS GENERALLY

The following particulars shall be submitted to the CM at least 14 days before marine works start:

1. Any conditions or restrictions imposed by the Director of Marine and other authorities, including copies of applications, licences, permits, and correspondence;
2. Details of methods for controlling marine traffic.

MAR.W020.9 DREDGING

The following particulars shall be submitted to the CM at least 14 days before dredging starts:

1. Type and capacity of dredgers;
2. Methods of anchorage and positioning of dredgers;
3. Sequence and rate of working;
4. Arrangements for the transportation and disposal of dredged material.

MAR.W030.9 DEPOSITION OF FILL MATERIAL

1. The following particulars of the proposed materials and methods of deposition of fill material shall be submitted to the CM:
    a. Details of Constructional Plant and transport;
    b. Methods of deposition and compaction of fill material;
    c. Methods of controlling the moisture content of fill material;
    d. Sequence and rate of working;
2. The following particulars shall also be submitted if the proposed method involves deposition of fill material by hydraulic method:
    a. Layout plan showing the pumpline alignments and positions of the discharge points;
    b. Calculations of the rate and duration of discharge;
    c. Details of containment bunds and tailwater drainage systems;
3. The particulars shall be submitted to the CM at least 14 days before deposition of fill material starts.

MAR.W040.9 LIFTING SEAWALL BLOCKS, COPING AND WAVE DEFLECTORS

Particulars of the proposed methods and devices to be used for lifting precast concrete seawall blocks, seawall copings and wave deflectors shall be submitted to the CM at least 14 days before lifting starts.

HANDLING AND STORAGE OF MATERIALS

MAR.W110.9 STORAGE OF FILL AND DREDGED MATERIAL

Fill material and dredged material shall not be stockpiled on the foreshore, seabed or river bed within the Site unless permitted by the CM.

MAR.W120.9 FILL MATERIAL

1. Fill material shall not be handled or stored in a manner which will result in segregation, deterioration, erosion or instability of the material;
2. Different types of fill material shall be kept separate from each other.

MAR.W130.9 PRECAST CONCRETE COMPONENTS

1. Precast concrete seawall blocks, copings and wave deflectors shall be stored in such a manner that identification markings can be easily seen;
2. Precast concrete seawall blocks, copings and wave deflectors shall be stored on level supports and in a manner which will not result in damage or deformation to the units or in contamination of the units. The units shall be protected from damage and damaged units shall not be used in the permanent work unless permitted by the CM.

MAR.W140.9 TIMBER FOR FENDERING

1. Timber for fendering systems shall be stored off the ground on level supports and shall be protected from exposure to conditions which cause reduction in the moisture content in the material;
2. Timber which is treated with preservatives shall not be stored on or adjacent to concrete surfaces which form part of the permanent work;
3. Safety precautions as recommended by the timber treatment company shall be observed in the handling of treated timber. Treated wood offcuts shall be buried in a suitable location, or burnt in an open area and the ashes buried;
4. Safety precautions as recommended by the supplier of wood preservatives shall be observed in the handling of the wood preservatives.

MAR.W150.9 RUBBER FOR FENDERING

1. Rubber fenders and fittings shall be left in their original packing until required for placing. All rubber surfaces shall be protected against damage;
2. Rubber fenders shall be handled with nylon slings of a size agreed by the CM or by other methods agreed by the CM.

EXECUTION OF MARINE WORKS GENERALLY

MAR.W210.9 NOTIFICATION

Before commencing marine works, provide the CM with evidence that the Director of Marine has been notified of the proposed works in accordance with Section 70 of the Shipping and Port Control Regulations, Chapter 313.

MAR.W220.9 MARKING

Marine works and any part of the Site in which marine works are carried out shall be marked with flags, marker buoys and lights in accordance with the International Association of Lighthouse Authorities Maritime Buoyage System (current edition as adopted by Marine Department) for Region A and in a manner agreed by the CM. Red flags shall be at least 0.7 m square and marker buoys shall be a type, size and colour Approved by the CM. Lights shall be either fixed red lights or quick flashing yellow lights visible all round the horizon at a distance of 2 km.

MAR.W230.9 MARINE TRAFFIC AND WATERFRONT OPERATIONS

1. Marine traffic and the operation of public and private concerns in areas adjacent to the Site shall not be obstructed by the activities of the Contractor;
2. Make all arrangements with and obtain the necessary approvals from the Director of Marine and any other relevant authority for temporary marine traffic arrangements and control.

MAR.W240.9 TEMPORARY TIDE GAUGES

1. Temporary tide gauges shall be mounted vertically and firmly on rigid supports at locations agreed by the CM and shall be calibrated, levelled and fixed to give tidal readings within an accuracy of 20 mm;
2. Temporary tide gauges shall be made of 50 mm thick hardwood and shall be at least 250 mm by 3200 mm in size. The gauges shall be painted on the marked faces with alternate 100 mm stripes in red and white and shall be marked and numbered in black at 0.5 m intervals over the tidal range from 0.0 m to +3.0 m C.D. The painting applied shall consist of one primary coat, one undercoat and one finishing coat.

MAR.W250.9 WORK BOATS

1. Work boats shall be motorised boats equipped with a rain shelter and capable of carrying at least six passengers;
2. Work boats shall be licensed under the Merchant Shipping (Launches and Ferry Vessels) Regulations, Chapter 281 and shall be manned and maintained in good seaworthy condition;
3. Work boats shall be kept available for use by the CM for supervision, inspection and measurement during normal working hours and at other times when the Contractor is working.

MAR.W260.9 REMOVAL OF FLOATING DEBRIS

Floating debris within the Site arising from any source shall be collected and disposed of by the Contractor at regular intervals agreed by the CM. Floating debris shall be prevented from dispersing outside the Site.

MAR.W270.9 SURVEYS

1. Surveys for dredging and deposition of fill material shall be carried out using echo sounders of 200 kHz to 220 kHz frequency or by other methods agreed by the CM;
2. The initial survey for dredging shall be carried out within 30 days before dredging starts;
3. The final survey for dredging shall be carried out within 30 days after dredging has been completed;

4. The initial survey for deposition of fill material shall be taken as being the same as the final survey for dredging, or the final survey for the underlying layer of fill material as appropriate, except as stated in sub-clause (5) below;
5. If the final survey for dredging or the final survey for the underlying layer of fill material was carried out more than 30 days before deposition of the next layer of fill material starts, the initial survey for deposition of fill material shall be carried out within 30 days before deposition of the layer of fill material starts;
6. The final survey for deposition of fill material for the first layers, intermediate layers, and final layers of underwater foundations shall be carried out within 30 days after deposition of fill material has been completed. The final survey for final layers other than those of underwater foundations shall be carried out at least 30 days and not more than 90 days after deposition of fill material has been completed.

MAR.W280.9 UNSUITABLE OR DETERIORATED FILL MATERIAL

1. Fill material which has been used or is required for use in the permanent work and which is allowed to become unsuitable such that in the opinion of the CM it no longer complies with the specified requirements for that type of material shall be replaced or dealt with by methods agreed by the CM;
2. The material which is to be replaced shall be disposed of by the Contractor.

MAR.W290.9 CONCRETING IN TIDAL LOCATIONS

Concreting in locations affected by tides shall be carried out in dry conditions unless otherwise permitted by the CM. After concreting is complete, the top of the concrete shall be covered with polyethylene sheets fixed to the formwork.

DREDGING

MAR.W310.9 MARINE PLANT AND EQUIPMENT

1. Two weeks before commencement of any marine works, submit to the CM for approval the proposed methods of working and the marine plant and equipment to be used;
2. The marine plant and equipment to be used on the Works shall meet the requirement in MAR.W320 and shall be operated to achieve the water quality requirements. Provide all necessary facilities to the CM for inspecting or checking such plant and equipment and shall not use such plant and equipment for the execution of the Works without the agreement of the CM. When instructed by CM, carry out trials of any plant and equipment to prove their suitability;
3. After commencement of the Works, if the plant and equipment or work methods are in the opinion of the CM causing unacceptable adverse impacts which can be checked against the Technical Memorandum on Effluent Standards issued under the Water Pollution Control Ordinance, initiate immediately remedial measures so as to halt such deterioration when notified by the CM in writing. If the Contractor fails to initiate remedial measures, the CM may stop the Works. Where such remedial measures include the use of additional or alternative plant and equipment, do not use such plant and equipment on the Works until agreed by the CM. Where remedial measures include maintenance or modification of previously approved plant and equipment, do not use such plant and equipment on the Works until such maintenance or modification is completed and the adequacy of the maintenance or modification is demonstrated to the satisfaction of the CM;

4. Comply with the conditions of dumping permits obtained from the Director of Environmental Protection. Display the permits prominently displayed in the Chinese and English language on site and also on the dredgers and barges.

MAR.W320.9 AVOIDANCE OF POLLUTION DURING DREDGING, TRANSPORTING AND DUMPING OF MARINE MUD

1. Include pollution avoidance measures but not be limited to the following:-
   a. Design and maintain all equipment to minimise the risk of silt and other contaminants being released into the water column or deposited in locations other than designated location;
   b. Design and maintain mechanical grabs to avoid spillage and seal tightly grabs while being lifted;
   c. Where trailing suction hopper dredgers for dredging of marine mud are in use, do not permit overflow from the dredger and the operation of lean mixture overboard systems permitted unless expressly approved by the CM in consultation with the Director of Environmental Protection;
   d. Use cutterheads of suction dredgers suitable for the material being excavated and design cutterheads to minimise overbreak and sedimentation around the cutter;
   e. All vessels shall be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;
   f. Repair all pipe leakages promptly and do not operate plant with leaking pipes;
   g. Before moving the vessels which are used for transporting dredged materials, clean excess material from the decks and exposed fittings of vessels and never dump the excess materials into the sea except at the approved locations;
   h. Maintain adequate freeboard on barges to ensure that decks are not washed by wave action;
   i. Monitor all vessels transporting material to ensure that no dumping outside the Approved location takes place. Keep and produce logs and other records to demonstrate compliance and that journey times are consistent with designated locations and submit copies of such records to the CM;
   j. Fit all bottom dumping vessels with tight fitting seals to their bottom openings to prevent leakage of material;
   k. Control loading of barges and hoppers to prevent splashing of dredged material to the surrounding water, and do not fill vessels to a level which will cause overflowing of material or polluted water during loading or transportation; and
   l. The CM may monitor any or all vessels transporting material to check that no dumping outside the Approved location nor loss of material during transportation takes place. Provide all reasonable assistance to the CM for this purpose.
2. Obtain all necessary dumping permits and dispose the dredged marine mud at a disposal site as designated in the dumping permit.
3. When dredging, transporting and disposing of contaminated marine mud, implement adequate measures for the avoidance of pollution which shall include but not be limited to the following:
   a. Engage a suitable grab dredger with closed watertight grab to undertake dredging of contaminated marine mud;

b. Use split barge of not less than 750 m³ capacity, well maintained and capable of rapid opening and discharge at the disposal site to transport contaminated marine mud;

c. Place the material into the disposal pit by bottom dumping;

d. Ensure discharge from split barges only within a radius of 100 metres of centre of the area allocated for the disposal of contaminated marine mud;

e. Discharge rapidly and then close immediately the hoppers, do not wash out material adhering to the sides of the hopper and keep the hopper closed until the barge next returns to the disposal site; and

f. Anchor the dumping vessel throughout the dumping operation.

4. Ensure that all marine mud is disposed of at the Approved locations. Ensure accurate positioning of vessels before discharge and submit proposals for accurate position control at disposal sites to the CM for approval before commencing dredging and dumping;

5. Ensure that all unsuitable material is disposed of at the Approved landfill or other designated location;

6. Employ vessels equipped with automatic self-monitoring devices as specified by the Director of Environmental Protection for disposal operation, co-operate with and facilitate the Director of Environmental Protection to inspect the device and retrieve the record stored in the device on a regular basis;

7. Provide experienced full time personnel on board all dumping vessels to ensure that appropriate methods to minimise pollution are implemented.

MAR.W330.9 PROTECTION OF WATER QUALITY AT WATER INTAKES

When dredging mud or placing fill in the vicinity of water intakes, protect the water intake by surrounding it with a suitable silt screen to prevent excessive suspended solids from entering the intake. Design the silt screen to ensure that the concentration of suspended solids entering the intake meets intake user requirements.

MAR.W340.9 SILT CURTAINS

1. If silt curtains shall be used to contain sediment losses during dredging and placing fill, design, install and maintain the silt curtains to minimise the impacts on the water quality and the protection of water quality at water intakes as described in MAR.W330. Submit the design and specification of silt curtains to the CM for approval.

2. Form silt curtains from tough, abrasion resistant, permeable membranes, suitable for the purpose, supported on floating booms in such a way as to ensure that the sediment plume shall be restricted to within the limit of the works area;

3. Form and install the silt curtain in such a way that tidal rise and fall are accommodated, with the silt curtains always extend from the surface to the bottom of the water column. The removal and reinstallation of such curtains during typhoon conditions shall be as agreed with the Director of Marine.

4. Regularly inspect the silt curtains and check that they are moored and marked to avoid danger to marine traffic. Repair any damage to the silt curtain promptly and stop the works until the repair is effected to the satisfaction of the CM.

MAR.W350.9 REFUSE CONTAINMENT BOOMS AND FLOATING REFUSE

1. Provide and install refuse containment booms before commencing public dumping to confine the floating debris arising within the site as a result of public dumping. Submit details of the refuse containment booms to the CM for approval before their use on site;
2. Remove refuses, timber debris, or oil contamination contained in public dump materials. Segregate all inert construction waste material suitable for reclamations. Dispose of all non-inert construction waste material at a public landfill;
3. Plastic buoys for the refuse booms will be provided by the Employer. Collect the plastic buoys from the Civil Engineering Development Department Technical Services Division's Store at North Point, clean and return after use;
4. Provide adequate sinker blocks and lit marker buoys to ensure that the booms are visible above the water line and securely anchored. The lights on the marker buoys shall be quick flashing yellow light visible all round the horizon at a distance of at least 2 km. Submit details to the CM for approval. The maximum spacing between the flashing yellow light shall be 30 metres. Properly maintain and operate the booms to the satisfaction of the CM throughout the progress of public dumping of the Site and replace the same if necessary when they are under repair or beyond repair;
5. Deploy sufficient sampans and labour for collecting floating refuse and preventing floating refuse within the Site from drifting into public waters. The frequency of collecting floating refuse shall be as agreed by the CM. Dispose of floating refuse collected off Site.
6. Make due allowance in programming the public dumping for the provision, installation, operation and maintenance of the refuse booms and the regular collection of the floating refuse throughout the progress of the reclamation work.

MAR.W360.9 CM'S PERMISSION

The permission of the CM shall be obtained before dredging starts in any area.

MAR.W370.9 PROCEDURE AND SEQUENCE

Dredging shall be carried out in such a manner and sequence that semi-fluid or disturbed seabed or foundation material will not accumulate in dredged areas.

MAR.W380.9 SAMPLING OF DREDGED MATERIAL

During dredging, samples shall be taken from the dredged materials for inspection and determination of the sand content. Notify the CM if there is any sudden or significant change in the properties of dredged material.

MAR.W390.9 DISPOSAL

Dredged material shall be disposed of by the Contractor in the dumping ground stated in the Contract.

DEPOSITION OF FILL MATERIAL BELOW +2.5mPD

MAR.W410.9 CM'S PERMISSION

The permission of the CM shall be obtained before deposition of the fill material starts in any area.

MAR.W420.9 DEPOSITING FILL MATERIAL

1. Fill material shall be deposited in a manner and sequence such that minimum lateral displacement of the underlying material will be induced and such that slopes are stable at all times;
2. The methods and Constructional Plant used for deposition of fill material shall be such that segregation of the material does not result. Fill material shall not be deposited by end-tipping unless permitted by the CM;
3. Fill material for blanketing layers and drainage layers shall be deposited uniformly by a method agreed by the CM.

MAR.W430.9 DEPOSITING FILL MATERIAL IN DREDGED TRENCHES

1. The first layer of fill material in dredged trenches for seawalls, revetments and breakwaters shall be deposited as soon as practicable after the dredged profile has been agreed by the CM. The dredged trench shall be substantially free from silt and debris before deposition of fill material starts;
2. Subsequent layers of fill material shall be deposited as soon as practicable after the profile of the underlying layer of fill material has been agreed by the CM.

MAR.W440.9 DEPOSITING ROCK FILL MATERIAL ADJACENT TO STRUCTURES AND UTILITIES

1. Rock fill material deposited adjacent to or above structures, piles or pedestals shall be hand packed or placed by a method approved by the CM;
2. Rock fill material deposited around utilities, including pipes for submarine outfalls, shall be hand packed or placed by a method Approved by the CM and shall be brought up to the specified level equally on both sides;
3. Rock fill material deposited directly on geotextile shall be deposited in such a manner that the geotextile is not ruptured.

DEPOSITION OF ROCK ARMOUR

MAR.W510.9 GENERAL

Each piece of rock armour shall be placed individually and shall not be deposited by tipping, dumping or dropping.

MAR.W520.9 BREAKWATERS, REVETMENTS ETC

Rock armour for breakwaters, revetments and similar structures shall be deposited by working from the bottom to the top of a section in such a manner and sequence that the individual rock pieces interlock and do not segregate. The interstices shall be kept free from small fragments of rock.

MAR.W530.9 DEPOSITING ROCK ARMOUR ON GEOTEXTILE

Rock armour deposited directly on geotextile shall be deposited in such a manner that the geotextile is not ruptured.

LEVELLING AND COMPACTION OF FILL MATERIAL

MAR.W610.9 UNDERWATER FOUNDATIONS

The top surface of rock fill material in foundations for structures or pipes shall be thoroughly tamped with a concrete block weighing at least 10 t dropped through a height of at least 300 mm or by other methods agreed by the CM. The voids at the top of the foundation shall be filled with rock fill material (Grade 75).

CONSTRUCTION OF MARINE STRUCTURES GENERALLY

MAR.W710.9 CONSTRUCTING SEAWALL BLOCKS, COPINGS AND WAVE DEFLECTORS

1. Formwork or moulds for precast concrete seawall blocks, copings and wave deflectors shall not be loosened or removed in less than 12 hours after completion of concreting;
2. Precast concrete seawall blocks, copings and wave deflectors shall be marked with the date of casting, identification reference and orientation in the structure. The letters and figures used for marking shall be at least 75 mm high and shall be sufficiently durable to be legible until the unit is placed in the final position;
3. Key holes in precast concrete seawall blocks, copings and wave deflectors shall be kept free from soil, aggregates, concrete and other materials before and after the blocks are set in position.

MAR.W720.9 SETTING SEAWALL BLOCKS

1. Seawalls constructed with precast concrete seawall blocks shall be constructed in layers between slip joints. The blocks shall be set in close contact with each other. Packing pieces shall not be used unless permitted by the CM;
2. The permission of the CM shall be obtained before the next layer is placed on each completed layer of blocks.

MAR.W730.9 FACING STONES

1. Facing stones to seawalls and revetments shall be built up one course at a time. The stones shall be thoroughly washed and cleaned with fresh water before placing and shall be set in 1:3 cement mortar. In vertical concrete seawalls there shall be at least one header stone to each square metre of facework. Header stones shall be staggered in alternate courses;
2. Concrete backing behind facing stones shall be placed as soon as each course of facing stones has been completed.

MAR.W740.9 SLIP JOINTS IN SEAWALLS

1. Slip joints in seawalls shall be straight and vertical and shall be perpendicular to the face of the seawall. The joints shall extend through the seawall from the coping down to the foundation;
2. Joint filler shall be cut to size before fixing and shall be securely fixed in position to the existing surface with adhesive. Concrete to the adjacent section of seawall shall be placed directly against the joint filler.

MAR.W750.9 FILLING CHANNELS IN SEAWALL BLOCKS

The channels in precast concrete seawall blocks and backing to seawalls shall be filled with rock pieces of sizes between 20 mm to 40 mm.

MAR.W760.9 CONCRETE COPINGS TO SEAWALLS

Concrete copings to seawalls shall be constructed in lengths of at least 5 m and not more than 10 m.

MAR.W770.9 BERMSTONES

1. Bermstones shall be placed as soon as practicable after toe blocks have been set in position or fill material has been deposited at the toe of marine structures;
2. Bermstones shall be set in close contact with each other and with the structure. The longitudinal axis of bermstones shall be perpendicular to the alignment of the structure on plan.

MAR.W780.9 BAGGED CONCRETE

1. Bagged concrete shall consist of hessian or canvas bags filled to approximately 70% full with Grade 30/10 concrete;
2. The bags shall be filled and the open ends tied or sewn up immediately before placing;
3. The bags shall be placed in brick bond fashion and flattened into position. The open ends of the bags shall be directed away from the outside surface and the spaces between bags and between layers of bags shall be kept as small as practicable. Bags shall not be disturbed after placing.

MAR.W790.9 TIMBERWORK FOR FENDERING

1. The finished surfaces of timber for fendering systems shall be free from irregularities. The timber shall not be cut by force splitting;
2. Timber which is to be pressure treated with preservatives shall be machined to the specified dimensions, sizes and shapes before treatment;
3. Drilling of holes and cutting of notches and recesses in timber shall be completed before painting and installation starts;
4. Pieces of timber shall not be jointed to form a member for the fendering system unless otherwise shown on the Drawings;
5. Unless otherwise permitted by the CM, pressure treated timber shall not be cut or drilled for holes after the treatment process. If cutting or drilling is permitted, surfaces exposed by cutting or drilling shall be field-treated as stated in sub-clauses (6) and (7);
6. Exposed surfaces of timber treated with creosote shall be field-treated by brushing, spraying or dipping with hot creosote;
7. Exposed surfaces of timber treated with CCA salts shall be field-treated by brushing or dipping with either a 100 g/L solution of the wood preservative or a solution suitable for after-fabrication treatment as recommended in BS 4072:1987.

MAR.W800.9 PAINTING TIMBER FENDERING

1. Timber members in fendering systems shall be painted with two coats of bituminous paint before installation;

2. Steel fittings for fendering systems, other than the threaded portions of bolts, nuts and other fittings, shall be painted with one coat of primer and two coats of bituminous paint before installation. The minimum thickness of each coat shall be 300 microns;
3. Bolt heads, shanks and nuts on the outer face of timber fendering systems shall be recessed into notches at a distance of 25 mm below the surface of the fenders. The notches shall be filled flush with the surface with a sealant composed of one part bitumen and two parts cement.

MAR.W810.9 INSTALLING RUBBER FENDERS

Timber or steel base templates shall be used to position anchor bolts for rubber fenders.

CONSTRUCTION OF SUBMARINE OUTFALLS

MAR.W910.9 LAYING OUTFALL PIPES

1. Pipes for submarine outfalls shall be marked with fluorescent paint such that the sequence of laying will be seen on underwater photographs. The letters and numbers used for marking shall be at least 100 mm high and shall be painted in orange on a white background;
2. Before submarine outfall pipes are laid, a guide rail of mild steel channel or other material agreed by the CM, painted with fluorescent paint, shall be laid on the levelling stones to provide a visible aid for laying pipes;
3. During construction of submarine outfalls, the open ends of the outfall pipes and riser pipes shall be temporarily capped by a method agreed by the CM to prevent the entry of silt or fill material.

MAR.W920.9 MARKER BLOCKS

1. Concrete marker blocks for submarine outfalls shall be placed on top of the fill material along the alignment of the pipeline as soon as deposition of fill material has been completed;
2. Concrete marker blocks shall be marked with fluorescent paint. The letters and numbers used for marking shall be at least 100 mm high and shall be painted in orange on a white background;
3. Concrete marker blocks shall be linked by coloured nylon ropes of at least 25 mm diameter.

MAR.W930.9 DIFFUSER PIPES

Epoxy resin joints between riser pipes and diffuser pipes shall be made in dry conditions.

MAR.W940.9 DIFFUSER CAPS

1. Diffuser caps shall be placed on top of the open ends of riser pipes and precast end plates shall be placed on the open end of the outfall within 7 days after the pipeline has been tested;
2. Marker buoys shall be tied to the diffuser caps with 1 m long nylon ropes of 6 mm diameter.

TOLERANCES

MAR.W1010.9 GENERAL

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

TESTING

TRIALS FOR SUBMARINE OUTFALLS

MAR.T010.9 GENERAL

1. A trial shall be carried out to demonstrate that the proposed methods of lifting, laying and jointing pipes for submarine outfalls, including jointing of riser pipes to the diffuser pipes, comply with the specified requirements. The trial shall include a demonstration by a method agreed by the CM that the joints between the riser pipes and the diffuser pipes are sufficiently strong to withstand the forces which will be applied during construction of the submarine outfall;
2. The trial shall be carried out at least 14 days before pipelaying starts.

MAR.T020.9 TRIAL RESULTS

If in the opinion of the CM the proposed methods of lifting, laying and jointing the pipes as demonstrated by the outfall trial do not comply with the specified requirements, particulars of proposed changes shall be submitted to the CM. Further trials shall be carried out until in the opinion of the CM the methods are satisfactory.

MAR.T030.9 COMMENCEMENT OF PIPELAYING

Pipelaying for submarine outfalls shall not start until in the opinion of the CM the methods of lifting, laying and jointing pipes as demonstrated by the submarine outfall trial are satisfactory.

DREDGED MATERIAL

MAR.T110.9 SAMPLING

1. Areas being dredged shall be divided into a grid at 15 m intervals. One sample of dredged material shall be provided from each point on the grid at 2 m depth intervals. Additional samples shall be provided from positions instructed by the CM if there appears to be any change in the quality of the dredged material;
2. The mass of each sample shall be at least 1 kg. The method of sampling shall be as agreed by the CM.

MAR.T120.9 TEST METHOD

Each sample of dredged material shall be tested for sand content to the satisfaction of the CM. The test shall be carried out by an independent laboratory appointed by the Contractor and approved by the CM. The method of testing for sand content shall be as agreed by the CM.

FILL MATERIAL

MAR.T210.9 DEFINITION OF "BATCH"

A batch of fill material for marine works is any quantity of fill material for marine works of the same type and which in the opinion of the CM has similar properties throughout.

MAR.T220.9 SAMPLING

1. One sample of each type of fill material for marine works shall be provided at the same time as particulars of the material are submitted to the CM. Unless otherwise agreed by the CM, one sample of each type of fill material for marine works shall be provided from each batch;
2. The size of samples and the method of sampling shall be in accordance with the Testing section of Worksection EAR.

MAR.T230.9 TEST METHODS

1. Each sample of fill material shall be tested to determine the particle size distribution, plasticity index and coefficient of uniformity;
2. The method of testing shall be in accordance with the following:
   a. Particle size distribution: as Worksection EAR;
   b. Plasticity index: as Test Method 6.1 of Geospec 3;
   c. Coefficient of uniformity: as Worksection EAR.

MAR.T240.9 NON-COMPLIANCE

1. If the result of any test for particle size distribution, plasticity index or coefficient of uniformity of fill material for marine works does not comply with the specified requirements for the property, two additional samples shall be provided from the same batch and additional tests for the property shall be carried out;
2. The batch shall be considered as not complying with the specified requirements for the property if the result of any additional test does not comply with such requirements.

ROCK ARMOUR

MAR.T310.9 DEFINITION OF "BATCH"

A batch of rock armour is any quantity of rock armour of the same type and which in the opinion of the CM has similar properties throughout.

MAR.T320.9 SAMPLING ROCK FOR ROCK ARMOUR

1. One sample of each proposed type of rock for rock armour shall be provided at the same time as particulars of the material are submitted to the CM;
2. If instructed by the CM, a representative example of each type of rock for rock armour, broken down into appropriate sizes, shall be provided for testing.

MAR.T330.9 TEST METHODS FOR ROCK FOR ROCK ARMOUR

1. Each sample of rock for rock armour shall be tested to determine the specific gravity, water absorption, aggregate impact value, ten percent fines value, aggregate abrasion value and soundness;
2. The method of testing shall be in accordance with the following:
   a. Relative density: BS 812:Part 2:1975;
   b. Water absorption: BS 812:Part 2:1975;
   c. Aggregate impact value: BS 812:Part 1121990;
   d. Ten percent fines value: BS 812:Part 111:1990;

e. Aggregate abrasion value: BS 812:Part 113:1990;

f. Soundness: BS 6349:Part 1:1984, Appendix B.

MAR.T340.9 SAMPLING ROCK ARMOUR

1. One sample piece of each type of rock armour shall be provided for the dropping test from each 100 pieces or part thereof of that type delivered to the Site;
2. One sample piece of each type of rock armour of the specified minimum size and one piece of the specified maximum size shall be provided for checking the sizes of material;
3. The sample pieces of the specified minimum and maximum sizes shall be mounted on individual plinths at locations agreed by the CM. The design and detail of the plinths shall be prepared by the Contractor and agreed by the CM.

MAR.T350.9 TESTING ROCK ARMOUR

1. Each sample piece of rock armour shall be tested by the dropping test to determine the resistance to fracture;
2. The dropping test shall be carried out with the largest cross-section of the specimen horizontal. The specimen shall be dropped from a vertical height, to the underside of the specimen, of 1.5 m onto a steel plate. The steel plate shall be at least 20 mm thick and shall be firmly bedded on a level concrete base.

MAR.T360.9 NON-COMPLIANCE OF ROCK FOR ROCK ARMOUR

1. If the result of any test for specific gravity, water absorption, aggregate impact value, ten percent fines value, aggregate abrasion value or soundness of rock for rock armour does not comply with the specified requirements for the property, two additional samples shall be provided from the same batch and additional tests for the property shall be carried out;
2. The batch shall be considered as not complying with specified requirements for the property if the result of any additional test does not comply with such requirements.

MAR.T370.9 NON-COMPLIANCE OF ROCK ARMOUR

1. If a sample piece of rock armour fractures as a result of the dropping test, nine additional sample pieces of rock armour from the same group of 100 pieces or part thereof shall be tested. If any of these sample pieces fracture as a result of the dropping test, every piece of rock armour in the same group shall be tested. Only those pieces of rock armour passing the dropping test shall be used;
2. A specimen is deemed to fracture if:
   a. Cracking occurs after dropping;
   b. The difference in masses of the original specimen and the largest single piece after dropping exceeds 1% of the mass of the original specimen.

TIMBER FOR FENDERING SYSTEMS

MAR.T410.9 DEFINITION OF "BATCH"

A batch of timber for fendering systems is any quantity of timber for fendering systems of the same grade and species and from the same source, covered by the same test certificates and bills of lading.

MAR.T420.9 SAMPLING

One sample of timber for fendering systems shall be provided at the same time as particulars of the material are submitted to the CM. Unless otherwise permitted by the CM, six samples shall be provided from each batch of timber for fendering systems delivered to the Site.

MAR.T430.9 TEST METHODS

1. For fendering systems delivered to the Site, the samples shall be provided in pairs taken from three separate balks of timber. Each sample shall be 1000 mm × 50 mm × 50 mm and shall be cut with the longest dimension parallel to the grain and the two shorter dimensions tangential and radial to the growth rings;
2. Each sample of timber for fendering systems shall be tested to determine the oven dry density, static bending at rupture, modulus of elasticity under bending, hardness, compressive stress parallel to grain at maximum load and shear stress parallel to grain at maximum load;
3. The method of testing, including the Janka indentation test for hardness, shall be in accordance with BS 373:1957 except that the specimens shall be tested at a moisture content of at least 25%.

MAR.T440.9 COMPLIANCE CRITERIA

The results of Janka indentation tests and tests for maximum shear parallel to grain of timber for fendering systems shall comply with the following requirements:

1. Each of the results of Janka indentation tests on the end face, radial face and tangential face shall comply with the requirements stated in the table in MAR.M410;
2. Each of the results of tests for shear parallel to grain on the radial face and tangential face shall comply with the requirements stated in the table in MAR.M410.

MAR.T450.9 NON-COMPLIANCE

1. If the result of any test for oven dry density, static bending at rupture, modulus of elasticity under bending, hardness, compressive stress parallel to grain at maximum load or shear stress parallel to grain at maximum load, of timber for fendering systems does not comply with the specified requirements for the property, three additional pairs of samples shall be provided from the same batch and additional tests for the property shall be carried out;
2. The batch shall be considered as not complying with the specified requirements for the property if the result of any additional test does not comply with the specified requirements for the property.

RUBBER FENDERS

MAR.T510.9 DEFINITION OF "BATCH"

A batch of rubber fenders is any quantity of rubber fenders of the same type and from the same source, covered by the same test certificates.

MAR.T520.9 SAMPLING

Unless otherwise permitted by the CM, one sample shall be provided from each 50 rubber fenders or part thereof delivered to the Site.

MAR.T530.9 TEST METHOD

1. Each sample of rubber fenders shall be compression load tested either at a laboratory approved by the CM or at the manufacturer's workshop in the presence of the representative of a Government body or other organization approved by the CM;
2. Each sample of rubber fenders shall be subjected to three complete load cycles at a rate of 200 mm ± 20 mm per minute to 50% deflection. The results of the test shall be shown on a load-deflection curve and on an energy-deflection curve.

MAR.T540.9 COMPLIANCE CRITERIA

The result of compression load tests on rubber fenders shall comply with the following requirements:

1. The sample shall not show any visible sign of cracks or permanent deformation in shape;
2. The height of each sample one minute after releasing the third compression load shall be at least 95% of the original height;
3. The recovery in height shall be as stated in sub-clause (2) for the repeated compression test;
4. For each loading cycle, the deflection as measured from the load-deflection curve and the energy-deflection curve shall not deviate by more than 10% from the deflection at the same load on the characteristic curves provided by the manufacturer.

MAR.T550.9 NON-COMPLIANCE

1. If the result of any compression load test on rubber fenders does not comply with the specified requirements stated in MAR.T540, two additional samples shall be provided from the same batch and additional tests for the property shall be carried out;
2. The batch shall be considered as not complying with specified requirements for the property if the result of any additional test does not comply with such requirements.

SUBMARINE OUTFALLS

MAR.T610.9 TEST METHODS

1. Submarine outfalls shall be tested to determine if there is any blockage or leakage;
2. Precast end plates and diffuser caps shall be removed before the outfall is tested;
3. The outfall shall be cleaned by high velocity water jets or by other electromechanical methods agreed by the CM. Riser pipes and diffuser pipes shall be cleaned by high capacity grit suction pumps or by other methods agreed by the CM;
4. The outfall shall be tested for blockages by pulling a mandrel approved by the CM through the outfall between manholes and between manholes and the end of the outfall. The mandrel shall be 750 mm long and 12 mm less in diameter than the nominal diameter of the pipe;
5. Riser pipes and diffuser pipes shall be tested for blockages and leakage by pumping dyed water through the outfall and inspecting the discharge plume at each riser pipe. Precast end plates shall be replaced before the test is carried out.

MAR.T620.9 COMPLIANCE CRITERIA

There shall be no blockage or leakage in submarine outfalls, including riser pipes and diffuser pipes.

MAR.T630.9 NON-COMPLIANCE

If the result of any test for blockage or leakage does not comply with the specified requirements for the test, the blockage shall be removed, or the leakage shall be repaired, by methods approved by the CM, or the outfall or diffuser pipes shall be repaired or replaced by methods approved by the CM. The submarine outfall shall be retested for blockage or leakage.

MEW METALWORK

MEW METALWORK 3

MATERIALS 3

GENERAL REQUIREMENTS FOR GUARD RAILING 3

MEW.M010.9 ALTERNATIVE DESIGN FOR PEDESTRIAN GUARD RAILING 3
MEW.M020.9 SUBMISSION OF GUARD RAILING DETAILS 3
MEW.M030.9 SAMPLES OF GUARD RAILING 3

GENERAL REQUIREMENTS FOR METAL HANDRAILING, STAIRS, LADDERS AND FLOORING 3

MEW.M110.9 CONTRACTOR'S DESIGN 3
MEW.M120.9 SUBMISSION OF PARTICULARS 3
MEW.M130.9 SAMPLES 4

STEEL AND ALUMINIUM FOR PEDESTRIAN GUARD RAILING 4

MEW.M210.9 HOT FINISHED SEAMLESS STEEL TUBES 4
MEW.M220.9 STEEL TUBES AND TUBULARS SUITABLE FOR SCREWING TO BS 21 PIPE THREADS 4
MEW.M230.9 HOT ROLLED STEEL SECTIONS 4
MEW.M240.9 HOT ROLLED STRUCTURAL STEEL SECTIONS (EQUAL AND UNEQUAL ANGLES) 4
MEW.M250.9 WELDABLE STRUCTURAL STEELS 4
MEW.M260.9 STAINLESS STEEL 4
MEW.M270.9 STAINLESS STEEL TUBES 5
MEW.M280.9 ALUMINIUM ALLOY 5
MEW.M290.9 WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS SUITABLE FOR GENERAL ENGINEERING PURPOSES 5

STEEL AND ALUMINIUM FOR HANDRAILING, LADDERS, STAIRS AND FLOORING 5

MEW.M310.9 STEEL 5
MEW.M320.9 STAINLESS STEEL 5
MEW.M330.9 ALUMINIUM 5

FIXINGS AND MESH INFILL FOR PEDESTRIAN GUARD RAILING 6

MEW.M410.9 TYPE 6
MEW.M420.9 ISO METRIC BLACK HEXAGON BOLTS, SCREWS AND NUTS 6
MEW.M430.9 ISO METRIC BLACK CUP AND COUNTERSUNK HEAD BOLTS AND SCREWS WITH HEXAGONAL NUTS 6
MEW.M440.9 METAL WASHERS 6
MEW.M450.9 RIVETS 6
MEW.M460.9 RIVET, BOLT AND SCREW STOCK 6
MEW.M470.9 BOLT LENGTH 6
MEW.M480.9 RAG, INDENTED, EXPANSION AND RESIN BONDED BOLTS 6
MEW.M490.9 MESH INFILL PANELS 6

FIXINGS AND BEDDING MORTAR FOR HANDRAILING, LADDERS, STAIRS AND FLOORING 6

MEW.M510.9 FIXINGS 6
MEW.M520.9 CEMENT MORTAR 7

WORKMANSHIP 8

FABRICATION, PROTECTION AND INSTALLATION OF PEDESTRIAN GUARD RAILING 8

MEW.W010.9 STORAGE AND PROTECTION 8
MEW.W020.9 WELDING 8
MEW.W030.9 GALVANIZING 8
MEW.W040.9 INSTALLATION 8

FABRICATION OF HANDRAILING, LADDERS, STAIRS AND FLOORING 9
MEW.W110.9 FABRICATION OF STEELWORK 9
MEW.W120.9 GALVANIZING STEEL 9
MEW.W130.9 WELDING STEEL 9
MEW.W140.9 FABRICATION OF HANDRAILING 9
MEW.W150.9 FABRICATION OF LADDERS 9
MEW.W160.9 FABRICATION OF STAIRS 10
MEW.W170.9 FABRICATION OF FLOORING 10
MEW.W180.9 FABRICATION OF TOE PLATES 10
MEW.W190.9 FABRICATION OF SAFETY CHAINS 10
STORAGE, PROTECTION AND INSTALLATION OF HANDRAILING, LADDERS, STAIRS AND FLOORING 10
MEW.W210.9 STORAGE AND PROTECTION 10
MEW.W220.9 INSTALLATION OF HANDRAILING, LADDERS AND STAIRS 10
MEW.W230.9 INSTALLATION OF FLOORING 11
MEW.W240.9 TOLERANCES 11

MEW METALWORK

MATERIALS

GENERAL REQUIREMENTS FOR GUARD RAILING

MEW.M010.9 ALTERNATIVE DESIGN FOR PEDESTRIAN GUARD RAILING

The Contractor may offer an alternative design for the pedestrian guard railing or that which is to be erected as temporary works and shown on the drawings or detailed in this Specification. Such design must be in accordance with BS 3049:1976, Table 1, Class C.

MEW.M020.9 SUBMISSION OF GUARD RAILING DETAILS

Submit the following details to the CM at least 28 days prior to fabrication:

1. A certificate from the manufacturer stating their name, date and place of manufacture and a statement confirming that the materials comply with the requirements of this Specification; and
2. Details of alternative design proposals as MEW.M010 where applicable.

MEW.M030.9 SAMPLES OF GUARD RAILING

Submit with the other details required at MEW.M020 samples of the following for Approval of source and type:

1. Each type of pedestrian guard railing to be used;
2. Mesh infill;
3. Each type of bolt, nut and washer to be used in the fabrication.

GENERAL REQUIREMENTS FOR METAL HANDRAILING, STAIRS, LADDERS AND FLOORING

MEW.M110.9 CONTRACTOR'S DESIGN

Handrailing, ladders, stairs and flooring which are to be designed by the Contractor shall comply with the following requirements:

1. Handrailing shall be capable of withstanding a horizontal loading of 740 N/m. The deflection of handrailing shall not exceed 1 in 200 at mid-span;
2. Stairs shall be designed for a live loading of 5 kPa;
3. Flooring shall be designed for a live loading of 5 kPa. The deflection of flooring shall not exceed 1/200 of the span.

MEW.M120.9 SUBMISSION OF PARTICULARS

The following particulars of the proposed handrailing, ladders, stairs and flooring shall be submitted to the CM at least 14 days before fabrication starts:

1. Details of manufacturer's name and place of manufacture;
2. A certificate showing that the materials comply with the requirements stated in the Contract;

3. Drawings showing layout and details of handrailing, including positions of the different types of standards;
4. Drawings showing details of ladders, stairs, toe plates and safety chains;
5. Drawing showing layout and details of flooring, including positions and size of panels and supports;
6. Details of methods of fixing and of rag, indented, expansion and resin bonded bolts, including manufacturer's literature; and
7. Design details as MEW.M110.

MEW.M130.9 SAMPLES

The following samples of the proposed handrailing, ladders, stairs and flooring shall be submitted to the CM at least 14 days before the relevant work starts as Instructed:

1. Handrails;
2. Standards;
3. Ladders, including rungs;
4. Toe plates;
5. Flooring and curbs
6. Safety chains; and
7. Rag, indented, expansion and resin bonded bolts.

STEEL AND ALUMINIUM FOR PEDESTRIAN GUARD RAILING

MEW.M210.9 HOT FINISHED SEAMLESS STEEL TUBES

Complying with BS 6323:Part 3:1982.

MEW.M220.9 STEEL TUBES AND TUBULARS SUITABLE FOR SCREWING TO BS 21 PIPE THREADS

Complying with BS 1387:1985.

MEW.M230.9 HOT ROLLED STEEL SECTIONS

Complying with BS 4:Part 1:1980.

MEW.M240.9 HOT ROLLED STRUCTURAL STEEL SECTIONS (EQUAL AND UNEQUAL ANGLES)

Complying with BS 4848:Part 4:1972.

MEW.M250.9 WELDABLE STRUCTURAL STEELS

Complying with BS 4360:1986.

MEW.M260.9 STAINLESS STEEL

Complying with BS EN 10088-2:2005, Grade 1.4401.

MEW.M270.9 STAINLESS STEEL TUBES

To BS 6362:1990 Grade 316 S 31, and a type suitable for threading in accordance with BS 21:1985.

MEW.M280.9 ALUMINIUM ALLOY

1. Grade: EN AW-6082 in the T6, T651 or T62 tempers;
2. Anodized to grade AA25 in accordance with BS EN 12373:Part 1:2001.

MEW.M290.9 WROUGHT ALUMINIUM AND ALUMINIUM ALLOYS SUITABLE FOR GENERAL ENGINEERING PURPOSES

1. Plate, sheet and strip: complying with BS EN 485:Part 1:1994, BS EN 485:Part 2:2004, BS EN 485:Part 3:2003 and BS EN 485:Part 4:1994;
2. Drawn tube: complying with BS EN 754:Part 1:1997, BS EN 754:Part 2:1997, BS EN 754:Part 3:1996, BS EN 754:Part 4:1996, BS EN 754:Part 5:1996, BS EN 754:Part 6:1996, BS EN 754:Part 7:1998 and BS EN 754:Part 8:1998;
3. Bars, extruded round tubes and sections: complying with BS EN 755:Part 1:1997, BS EN 755:Part 2:1997, BS EN 755:Part 3:1996, BS EN 755:Part 4:1996, BS EN 755:Part 5:1996, BS EN 755:Part 6:1996, BS EN 755:Part 7:1998, BS EN 755:Part 8:1998 and BS EN 755:Part 9:2001.

STEEL AND ALUMINIUM FOR HANDRAILING, LADDERS, STAIRS AND FLOORING

MEW.M310.9 STEEL

Steel for handrailing, ladders, stairs and flooring shall comply with the following:

1. Steel tubes and tubulars suitable for screwing: BS 21:1985 pipe with threads: complying with BS 1387:1985;
2. Hot rolled sections: BS 4:Part 1:1980;
3. Hot rolled structural steel sections:
    a. Equal and unequal angles: BS 4848:Part 4:1972;
    b. Hollow sections: BS 4848: Part 2:1991;
    c. Weldable structural steels: BS 4360:1986.

MEW.M320.9 STAINLESS STEEL

Stainless steel for handrailing, ladders, stairs and flooring shall be Grade 1.4301 complying with BS EN 10029:1991, BS EN 10048:1997, BS EN 10051:1991 + A1:1997, BS EN 10095:1999 and BS EN ISO 9445:2006. Stainless steel tubes shall be longitudinally welded tubes complying with BS EN 10296-2:2005. Tubes for handrails shall be polished.

MEW.M330.9 ALUMINIUM

1. Aluminium for handrailing, ladders, stairs and flooring shall be type H 30 TF and shall comply with the following:

    Wrought aluminium and aluminium alloys for general engineering purposes:

    a. Plate, sheet and strip: to BS 1470:1987;
    b. Drawn tube: to BS 1471:1972;

c. Bars, extruded round tubes and sections: to BS 1474:1987.

2. Aluminium shall be anodised to Grade AA 25 in accordance with BS 1615:1987.

FIXINGS AND MESH INFILL FOR PEDESTRIAN GUARD RAILING

MEW.M410.9 TYPE

1. Use only galvanized bolts, nuts, screws and rivets with galvanized pedestrian guard railing;
2. Insulate aluminium fixings from ferrous materials with an Approved type non-conductive insulator at least 2 mm thick.

MEW.M420.9 ISO METRIC BLACK HEXAGON BOLTS, SCREWS AND NUTS

Complying with BS 4190:2001.

MEW.M430.9 ISO METRIC BLACK CUP AND COUNTERSUNK HEAD BOLTS AND SCREWS WITH HEXAGONAL NUTS

Complying with BS 4933:1973.

MEW.M440.9 METAL WASHERS

Complying with BS 4320:1968.

MEW.M450.9 RIVETS

Complying with BS 4620:1970 (1988).

MEW.M460.9 RIVET, BOLT AND SCREW STOCK

Wrought aluminium and aluminium alloys complying with BS 1473:1972.

MEW.M470.9 BOLT LENGTH

The threaded portion of bolt to project through the nut by a minimum of one thread and maximum of four threads.

MEW.M480.9 RAG, INDENTED, EXPANSION AND RESIN BONDED BOLTS

An Approved proprietary type capable of withstanding the design loading.

MEW.M490.9 MESH INFILL PANELS

To BS 4483:1998 and free from surface defects, surface irregularities and mesh misalignment.

FIXINGS AND BEDDING MORTAR FOR HANDRAILING, LADDERS, STAIRS AND FLOORING

MEW.M510.9 FIXINGS

1. Bolts, nuts, screws, washers and rivets shall comply with the following:
   a. ISO metric black hexagon bolts, screws and nuts to BS 4190:2001;

b. ISO metric black cup and countersunk headbolts and screws with hexagon nuts to BS 4933:1973;

c. Metal washers for general engineering purposes to BS 4320:1968;

d. Rivets for general engineering purposes to BS 4620:1970 (1988);

e. Wrought aluminium and aluminium alloys for general engineering purposes: rivet, bolt and screw stock to BS 1473:1972;

f. Stainless steel fasteners to BS EN ISO 3506-1&2:2009.

2. The length of bolts shall be such that the threaded portion of each bolt projects through the nut by at least one thread and by not more than four threads;

3. Rag, indented bolts, expansion bolts and resin bonded bolts shall be a proprietary type approved by the CM and shall be capable of withstanding the design working load;

4. Galvanized bolts, nuts, screws, washers and rivets shall be used with galvanized handrailing, ladders, stairs and flooring and aluminium bolts, nuts, screws, washers and rivets shall be used with aluminium handrailing, ladders, stairs and flooring; stainless steel bolts, nuts, screws, washers and rivets shall be used with other types of handrailing, ladders stairs and flooring. Bolts, nuts screws and washers shall be insulated from aluminium by non-metallic washers and sleeves.

MEW.M520.9 CEMENT MORTAR

1. Mortar for grouting fixing bolts shall consist of 1 part of cement to 3 parts of sand together with the minimum amount of water necessary to achieve a consistency suitable for completely filling the bolt holes. The mix shall contain a non-shrink admixture;

2. Resin grout shall be an Approved proprietary type and shall contain a non-shrink admixture;

3. Mortar for building in curbs for metal flooring shall consist of 1 part of cement to 3 parts of sand together with the minimum amount of water necessary to achieve a consistency suitable for the work. The mix shall contain a non-shrink admixture.

WORKMANSHIP

FABRICATION, PROTECTION AND INSTALLATION OF PEDESTRIAN GUARD RAILING

MEW.W010.9 STORAGE AND PROTECTION

1. Store and protect guard railing off the ground on level supports in a manner that will not result in damage, deformation or contamination;
2. Do not use any damaged guard railing in the permanent works unless permitted by CM.

MEW.W020.9 WELDING

1. Unless otherwise permitted by the CM, do not make welded joints after galvanizing. Where permitted, ensure welded areas are free from scale and slag and treated with an alternative zinc-coating system;
2. Type of weld: fillet;
3. Ensure welded surfaces are clean and flush, prior to application of the protective coating.

MEW.W030.9 GALVANIZING

1. Hot dip galvanize all steel components forming pedestrian guard railing in accordance with BS EN ISO 1461:1999 with a minimum coating thickness of 70 µm;
2. Unless Approved, all components are to be galvanized after welding, drilling and cutting operations are complete;
3. All hot dip galvanizing is to be carried out by galvanizers with ISO 9001 certification. Submit the name of galvanizer for Approval;
4. Submit original invoice/delivery note and galvanizing certification for each delivery. These documents shall include the following information:
    a. Project title/number;
    b. Name of galvanizer;
    c. Types and dimensions of articles;
    d. Quantities.
5. Attach a durable identification tape to each batch of galvanized articles indicating the project title, galvanizing certification number and name of galvanizer.

MEW.W040.9 INSTALLATION

1. Install guard railing to a smooth alignment within 10 mm of the line, position and height shown on the drawings;
2. Use guard railing curved in the workshop for radii of less than 45 m. Do not use straight lengths in this application;
3. Fix guard railing to concrete using rag, indented, expansion or resin bonded bolts. Fix bolts into pockets and fill with cement mortar or resin grout;
4. Bolt fix guard railing to metalwork.

FABRICATION OF HANDRAILING, LADDERS, STAIRS AND FLOORING

MEW.W110.9 FABRICATION OF STEELWORK

Steelwork for handrailing, ladders, stairs and flooring shall be fabricated in accordance with BS 5950:Part 2:1992.

MEW.W120.9 GALVANIZING STEEL

1. Steel which is to be galvanized shall be hot-dip galvanized in accordance with BS EN ISO 1461:1999 with a minimum coating thickness of 70 µm;
2. Unless Approved, all components are to be galvanized after welding, drilling and cutting operations are complete;
3. All hot dip galvanizing is to be carried out by galvanizers with ISO 9001 certification. Submit the name of galvanizer for Approval;
4. Submit original invoice/delivery note and galvanizing certification for each delivery. These documents shall include the following information:
    a. Project title/number;
    b. Name of galvanizer;
    c. Types and dimensions of articles;
    d. Quantities.
5. Attach a durable identification tape to each batch of galvanized articles indicating the project title, galvanizing certification number and name of galvanizer.

MEW.W130.9 WELDING STEEL

1. Welds to steel for handrailing, ladders, stairs and flooring shall be full depth fillet welds. The welded surface shall be clean and flush before application of the protective coating;
2. Steel shall not be welded after galvanizing unless permitted by the CM, if permitted, the welded areas shall be free from scale and slag and shall be treated with an appropriate coating system approved by the CM which is compatible with the protective system of the parent material.

MEW.W140.9 FABRICATION OF HANDRAILING

Handrailing shall be discontinued at movement joints in structures. The spaces between standards shall be regular and shall not exceed 1.6 m. Curved handrailing shall not be made up of a series of straights.

MEW.W150.9 FABRICATION OF LADDERS

1. Ladders shall comply with BS 4211:1987;
2. Steel ladders shall be hot-dip galvanized;
3. Aluminium ladders shall be Grade 6082 aluminium;
4. Rungs, extended stringers, safety cages and brackets shall be welded to the stringers of ladders;
5. Rungs on aluminium ladders shall have longitudinal grooves and pressed aluminium alloy caps shall be fixed to open ends.

MEW.W160.9 FABRICATION OF STAIRS

Stairs shall comply with BS 5395:Part 1:1977 (1984).

MEW.W170.9 FABRICATION OF FLOORING

1. The shape of each panel of flooring shall be such that the panel can be easily moved. The mass of each panel shall not exceed 40 kg. Where intermediate supports are provided to support flooring they shall be capable of being removed to provide the specified clear opening;
2. Curbs shall be provided in concrete surfaces for flooring;
3. Cut-outs in flooring shall be neatly shaped and shall be provided with toe-plates. Cut-outs in open mesh flooring shall be trimmed with edge bars welded to the bearing bars. The clearance between the edge of cut-outs and the components passing through the cut-out shall not exceed 30 mm;
4. The bearing bars in open mesh flooring shall be welded to the nosing bars. The transverse bars shall be riveted or welded to the bearing bars. Panels of open mesh flooring shall be secured with adjustable fixing clips;
5. Chequer plate flooring shall have a non-slip pattern of a type approved by the CM and shall be provided with lifting holes. The flooring shall be secured to curbs by countersunk screws.

MEW.W180.9 FABRICATION OF TOE PLATES

Toe-plates shall be fixed to handrail standards by brackets and shall be bolted or welded to stairs and flooring.

MEW.W190.9 FABRICATION OF SAFETY CHAINS

1. Safety chains shall comply with BS 4942:1981 and shall be capable of withstanding a breaking force of 30 kN and a proof force of 15 kN;
2. Steel safety chains shall be 8 mm nominal size, Grade M4 non-calibrated chain Type 1 and shall be hot dip galvanized;
3. The links of stainless steel safety chains shall be welded and shall have an internal length exceeding 45 mm and an internal width of between 12 mm and 18 mm. Fins caused by welding shall be removed;
4. Hooks on chains shall be fitted with a sprung securing device.

STORAGE, PROTECTION AND INSTALLATION OF HANDRAILING, LADDERS, STAIRS AND FLOORING

MEW.W210.9 STORAGE AND PROTECTION

Handrailing and flooring shall be stored on level supports in a dry weatherproof store and in a manner which will not result in damage or deformation to the materials or in contamination of the materials. Handrailing, ladders, stairs and flooring shall be protected from damage and damaged handrailing, ladders, stairs and flooring shall not be used in the permanent work unless permitted by the CM.

MEW.W220.9 INSTALLATION OF HANDRAILING, LADDERS AND STAIRS

1. Handrailing shall be installed to a smooth alignment;

2. Handrail standards, flanges, ladders and stairs shall be bolted to metalwork and shall be fixed to concrete using rag, indented, expansion or resin bonded bolts. The bolts shall be fitted into pockets left in the concrete and the pockets shall be filled with cement mortar or resin grout.

MEW.W230.9 INSTALLATION OF FLOORING

1. Flooring and curbs shall be flush with the adjoining surfaces;
2. Curbs shall be fitted into rebates left in the concrete and the rebates shall be filled with cement mortar;
3. Flooring shall be closely butted and the gap between panels and curbs, adjacent panels and other surfaces shall not exceed 10 mm.

MEW.W240.9 TOLERANCES

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

MRY MASONRY WALLING

MRY MASONRY WALLING 2

MATERIALS 2

GENERAL 2

MRY.M010.9 STONE FOR MASONRY 2
MRY.M020.9 CEMENT MORTAR 2

SUBMISSIONS 2

MRY.M110.9 SAMPLES OF MATERIALS 2

WORKMANSHIP 3

GENERAL 3

MRY.W010.9 TRIAL PANNELS 3
MRY.W020.9 NON-COMPLIANCE OF MASONRY 3
MRY.W030.9 COMMENCEMENT OF MASONRY 3
MRY.W040.9 CHANGES IN MATERIALS 3

HANDLING AND STORAGE OF MATERIALS 3

MRY.W110.9 HANDLING AND STORAGE OF STONE 3

RUBBLE STONE WALLING 4

MRY.W210.9 PREPARATION OF STONE 4
MRY.W220.9 LAYING AND JOINTING 4
MRY.W230.9 POINTING 4

ASHLAR STONE WALLING 5

MRY.W310.9 PREPARATION OF STONE 5
MRY.W320.9 LAYING AND JOINTING 5
MRY.W330.9 POINTING 5

PROTECTION OF MASONRY 5

MRY.W410.9 GENERAL 5

WALL TIES FOR MASONRY 5

MRY.W510.9 GENERAL 5

TOLERANCES 5

MRY.W610.9 GENERAL 5

MRY MASONRY WALLING

MATERIALS

GENERAL

MRY.M010.9 STONE FOR MASONRY

Local granite free from defects which will adversely affect the strength or appearance of the masonry.

MRY.M020.9 CEMENT MORTAR

Consisting of:

1. 1 part PC (complying with CON1);
2. 3 parts of fine aggregate (clean, hard, durable crushed rock having the particle size distribution given below:

BS test sieve size	Percentage by mass passing
5.00 mm	100
2.36 mm	90-100
1.18 mm	70-100
600 μm	40-80
300 μm	5-40
150 μm	0-10

3. The minimum of water to achieve a consistency suited to the required work.

SUBMISSIONS

MRY.M110.9 SAMPLES OF MATERIALS

Submit to the CM samples of each type of stone for masonry for approval of source and type at least 14 days before the masonry work starts.

WORKMANSHIP

GENERAL

MRY.W010.9 TRIAL PANNELS

Construct a trial panel for each type of masonry:

1. To demonstrate that the proposed materials will produce brickwork or blockwork which complies with the specified requirements;
2. At least 14 days before the relevant work starts;
3. Using the materials submitted to the Engineer;
4. Inform the Engineer 24 hours, or such shorter period agreed by the CM, before constructing trial panels;
5. Each trial panel shall be 1 m x 1 m and shall be constructed at a location agreed by the CM;
6. Trial panels shall be used as a means of comparison against which the CM shall determine the compliance or otherwise of the masonry in the permanent work. Trial panels shall be protected from damage and shall be left in position until the CM instructs their removal.

MRY.W020.9 NON-COMPLIANCE OF MASONRY

If in the opinion of the CM the brickwork or blockwork in the trial panel does not comply with the specified requirements for masonry, particulars of proposed changes to the materials and methods of construction shall be submitted to the CM; further trial panels shall be constructed until the trial panel complies with the specified requirements.

MRY.W030.9 COMMENCEMENT OF MASONRY

Masonry shall not commence until in the opinion of the CM trial panel complies with the specified requirements.

MRY.W040.9 CHANGES IN MATERIALS

Unless permitted by the CM, the materials used to produce a trial panel which complies with the specified requirements shall not be changed.

HANDLING AND STORAGE OF MATERIALS

MRY.W110.9 HANDLING AND STORAGE OF STONE

Transport stone for ashlar stone walling with the minimum amount of handling and stack in the vehicle using packing pieces to prevent damage. Store the stone in stacks on battens and protected from exposure to rain.

RUBBLE STONE WALLING

MRY.W210.9 PREPARATION OF STONE

1. Roughly cut stones for random rubble walling in irregular shapes between 75 mm and 300 mm high, at least 75 mm deep and between 75 mm and 600 mm long on bed. The length or depth on bed of each stone shall be greater than the height;
2. Trim stones for squared rubble walling roughly square to between 75 mm and 300 mm high, varying in 75 mm stages. Each stone shall be between 100 mm and 150 mm deep and between 100 mm and 600 mm long on bed. The length or depth on bed of each stone shall be greater than the height;
3. Trim the stones roughly square for square coursed rubble walling as stated in Clause MRY.W210 (2) to suit courses of regular height varying from 150 mm to 250 mm.

MRY.W220.9 LAYING AND JOINTING

1. Lay dry the stones in rubble stone walling in a full even bed of cement mortar; all joints shall be filled and shall be between 5 mm and 15 mm wide;
2. Bond together the stones of random shapes and sizes in random rubble walling over each face of the wall. Select the stones and rough dress them to keep joint widths to a minimum. Provided at least one bonding stone of minimum size 450 mm x 150 mm, carried through the full thickness of the wall per square metre. Provide not more than 3 stones adjacent to a vertical joint;
3. Bond roughly squared stones of random sizes together in square rubble walling with continuous straight horizontal joints. Keep the number of vertical joints to a minimum;
4. Lay roughly squared stones in square coursed walling as stated in clause MRY.W220 (3) but bring up courses at centres not exceeding 750 mm to line up with quoin and jamb stones;
5. Construct squared rubble walling exceeding 300 mm thick and faced one side in accordance with the following requirements:
    a. Provide roughly squared stone at least 300 mm thick with a backing of random rubble;
    b. Regularly space at least two bonding stones per square metre and carry them through the full thickness of the wall or at least 450 mm into the backing, whichever is less.
6. Construct squared rubble walling exceeding 300 mm thick and faced both sides in accordance with the following requirements:
    a. Provide roughly squared stone at least 150 mm thick with a core of random rubble;
    b. Provided bonding stones as stated in clause MRY.W220 (5) but carry them through the full thickness of the wall or 450 mm into the core.

MRY.W230.9 POINTING

Raked out joints in rubble stone walling to a depth of 15 mm as the work proceeds. Pointed the joints in cement mortar on completion with a flush, weathered or recessed joint as required.

ASHLAR STONE WALLING

MRY.W310.9 PREPARATION OF STONE

Dress the exposed faces and joint faces of each stone for ashlar stone walling square and true, free from hollows or rough areas. Finish exposed faces to a finely squared dressed surface. Stones shall be at least 300 mm high. Clearly mark each stone to indicate its position in the finished work.

MRY.W320.9 LAYING AND JOINTING

Lay stones in ashlar stone walling on a full, even bed of mortar. Form all joints 5 mm wide and fill all joints and shall be 5 mm wide. Lay stones to bond together throughout the wall, and to the backing, using projecting bonding stones.

MRY.W330.9 POINTING

Rake joints in ashlar stone walling to a depth of 15 mm as the work proceeds and point the joints with a flush joint on completion using cement mortar.

PROTECTION OF MASONRY

MRY.W410.9 GENERAL

Protect newly erected masonry from exposure to conditions which may adversely affect the masonry. Cover arrises, projections and similar features with protective sheeting lapped and securely held in position. Keep facework clean at all times.

WALL TIES FOR MASONRY

MRY.W510.9 GENERAL

1. Fix wall ties in masonry which is to face an existing or newly constructed wall at a rate of 5 per m². Fix the ties 100 mm into the wall and 75 mm into the masonry.
2. Fix wall ties between the ends of walls and concrete or brickwork at centres of at least 450 mm vertically. Project the ties 250 mm into the masonry.

TOLERANCES

MRY.W610.9 GENERAL

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

PSC PRESTRESSING CONCRETE

PSC PRESTRESSING CONCRETE 3

MATERIALS 3

GENERAL 3

PSC.M010.9 APPLICATION OF OTHER WORKSECTIONS 3
PSC.M020.9 DEFINITIONS 3

PRESTRESSING TENDONS 3

PSC.M110.9 WIRE 3
PSC.M120.9 BARS 3

COMPONENTS 3

PSC.M210.9 GENERAL 3
PSC.M220.A ANCHORAGES 3
PSC.M230.A SHEATHS AND DEVIATOR PIPES 4
PSC.M240.9 DUCTS 4
PSC.M250.9 TAPS AND VENTS FOR GROUT 4
PSC.M260.9 GROUT 4

SUBMISSIONS 5

PSC.M310.9 PRESTRESSING SYSTEMS 5
PSC.M320.9 TENDONS 5
PSC.M330.A GROUT MIX AND GROUTING PROCEDURE 6
PSC.M340.9 SAMPLES 6

WORKMANSHIP 7

HANDLING AND STORAGE OF MATERIALS 7

PSC.W010.9 HANDLING TENDONS 7
PSC.W020.9 HANDLING COMPONENTS 7
PSC.W030.9 STORAGE 7

INSTALLING PRESTRESSING SYSTEMS GENERALLY 7

PSC.W110.9 SURFACE CONDITION OF TENDONS AND COMPONENTS 7
PSC.W120.9 SAFETY 7
PSC.W130.9 LOCATION OF TENDONS AND COMPONENTS 8
PSC.W140.9 TOLERANCES 8
PSC.W150.9 INSPECTION 8

INSTALLATION OF PRESTRESSING TENDONS 8

PSC.W210.9 GENERAL 8
PSC.W220.9 WIRES 8
PSC.W230.9 ALLOY BARS 8
PSC.W240.9 DAMAGED TENDONS 8
PSC.W250.9 CUTTING 8
PSC.W260.9 JOINTS 8

COMPONENTS 9

PSC.W310.9 USE OF COMPONENTS GENERALLY 9
PSC.W320.9 INSTALLING SHEATHS 9
PSC.W330.A GROUT VENTS AND TAPS 9

TENSIONING TENDONS 9

PSC.W410.9 GENERAL 9
PSC.W420.9 PRETENSIONING 10
PSC.W430.9 POST-TENSIONING 11
PSC.W440.9 PROTECTION OF EXTERNAL TENDONS AND COMPONENTS 11
PSC.W450.9 RECORDS 11

GROUTING 12

PSC.W510.A GENERAL 12

PSC.W520.9 EQUIPMENT 12
PSC.W530.9 INJECTION GENERALLY 13
PSC.W540.A TIMING 13
PSC.W550.9 PREPARATION 13
PSC.W560.9 PROCEDURE 13
PSC.W570.9 BLOCKAGE OR BREAKDOWN 13
PSC.W580.9 PROTECTION 14
PSC.W590.A INSPECTION 14
PSC.W600.9 RECORDS 14

TESTING 16

TRIAL MIXES FOR GROUT 16
PSC.T010.9 GENERAL 16
PSC.T020.9 SAMPLING 16
PSC.T030.9 TESTING PROCEDURE 16
PSC.T040.9 NON-COMPLIANCE 16
PSC.T050.9 USE OF NON-COMPLYING MIXES IN OTHER TRIALS 16

GROUTING TRIALS 17
PSC.T110.9 GENERAL 17
PSC.T120.9 PROCEDURE 17
PSC.T130.9 COMPLIANCE CRITERIA 17
PSC.T140.9 NON-COMPLIANCE 17

APPROVED GROUT MIXES 17
PSC.T210.9 DEFINITION 17
PSC.T220.9 COMMENCEMENT OF GROUTING 18
PSC.T230.9 DEVIATION FROM APPROVED MIX 18

TESTING PRESTRESSED UNITS 18
PSC.T310.9 GENERAL 18

TESTING PRESTRESSING TENDONS 18
PSC.T410.9 DEFINITION OF "BATCH" 18
PSC.T420.9 SAMPLING 18
PSC.T430.9 SPECIMENS 18
PSC.T440.9 PROCEDURES 18
PSC.T450.9 COMPLIANCE CRITERIA 19
PSC.T460.9 NON-COMPLIANCE CRITERIA 19

DUCT FRICTION 19
PSC.T510.9 GENERAL 19
PSC.T520.9 PROCEDURE 19
PSC.T530.9 COMPLIANCE CRITERIA 20
PSC.T540.9 REPORTING OF TEST RESULTS 20

TESTING GROUT GENERALLY 20
PSC.T610.9 DEFINITION OF "BATCH" 20

TESTING GROUT FOR BLEEDING AND FREE EXPANSION 20
PSC.T710.9 SAMPLING 20
PSC.T720.9 PROCEDURE 20
PSC.T730.9 NON-COMPLIANCE 21

TESTING GROUT FOR CRUSHING STRENGTH 21
PSC.T810.9 SAMPLING 21
PSC.T820.9 PROCEDURE 21
PSC.T830.9 NON-COMPLIANCE 21

PSC PRESTRESSING CONCRETE

MATERIALS

GENERAL

PSC.M010.9 APPLICATION OF OTHER WORKSECTIONS

Materials for grout for prestressing systems shall comply with Worksection CON1 except as stated in this Worksection.

PSC.M020.9 DEFINITIONS

1. Duct: a void formed in the concrete to accommodate a prestressing tendon;
2. Prestressing components: the components used in a prestressing system, including anchorages, grips, tendon deflectors, couplers, wedges, swages, nuts and other devices used to grip the prestressing tendon;
3. Prestressing tendon:
    a. An individual steel wire, wire strand or alloy steel bar in a duct; or
    b. An individual steel wire, wire strand or alloy steel bar not in a duct; or
    c. A group of steel wires or wire strands in a duct; used in a prestressing system.
4. Sheath: a tube or lining which is used to form a duct and which is left in place.

PRESTRESSING TENDONS

PSC.M110.9 WIRE

1. High tensile steel wire and strand shall comply with BS 5896:1980, supplied in coils sufficiently large in diameter to ensure that the steel wire and wire strand will pay off straight;
2. Grease for unbonded strand shall contain a corrosive inhibitor.

PSC.M120.9 BARS

Hot rolled and processed high tensile alloy steel bars shall comply with BS 4486:1980. All alloy steel bars must be straight.

COMPONENTS

PSC.M210.9 GENERAL

Prestressing components shall be proprietary type approved by the CM.

PSC.M220.A ANCHORAGES

1. Prestressing anchorages shall comply with BS 4447:1973 and shall allow a minimum of 25 mm cover to cropped ends of prestressing tendons;

2. Anchorages shall be fabricated with inspection holes allowing a probe or inspection by borescope of the upper part of the duct behind the anchor heads. The holes shall also facilitate the post-grouting inspection. Alternatively, the anchorages shall be equipped with a device which permits the inspection personnel to monitor and verify the complete filling of grout in the anchorage.

PSC.M230.A SHEATHS AND DEVIATOR PIPES

1. Sheaths shall be an Approved proprietary type and shall be steel or other material approved by the CM. Sheaths shall be rigid and strong enough to retain their shape during fixing and concreting and to withstand forces from the prestressing tendons without damage;
2. For the sheath made of steel, the sheath shall be hot-dip galvanized to BS EN ISO 1461:1999;
3. For the sheath made of material other than steel, the sheath shall be non-metallic type;
4. Sheaths for external prestressing shall be continuous between anchorages and shall be airtight and watertight under the working conditions;
5. Results of tests on duct friction during tendon stressing shall be provided to the CM. It shall be demonstrated that at least 2 mm thickness of sheath will remain on completion of the stressing operation;
6. If the deviator pipes for external prestressing sheaths are made of steel, the deviator pipes shall be hot-dip galvanized to BS EN ISO 1461:1999. Additional protection in the form of Paint System "II" to Clause 16.4 of the Structures Design Manual for Highways and Railways shall be applied to all surfaces of the deviator pipes.

PSC.M240.9 DUCTS

The design of ducts shall allow for the grout to be injected from either end. There shall be no sudden change in the diameter of the duct.

PSC.M250.9 TAPS AND VENTS FOR GROUT

1. Taps for grout vents in ducts shall be a proprietary type, approved by the CM, and shall allow closure of the vents without loss of pressure in the duct. Vents to be used as grout entry points shall be threaded or fitted with screw connectors or other similar devices for connection to grout pumps;
2. All vents and vent connections shall have an internal diameter no less than 25 mm and shall be clearly identified by labelling.

PSC.M260.9 GROUT

1. Grout for prestressing systems shall consist of Portland cement and water. Sand, PFA and admixtures shall not be used unless permitted by the CM;
2. Grout shall have a minimum crushing strength of 25 MPa at 7 days;
3. The amount of bleeding of grout shall not exceed 2% in the first 3 hours and shall not exceed 4% in total. The water shall be reabsorbed by the grout during the 24 hours after mixing;
4. Free expansion of grout shall not exceed 10% at the ambient temperature;
5. The maximum total chloride content of grout, expressed as a percentage relationship between the chloride ion and the cementitious content by mass in the grout, shall not exceed 0.1%;
6. The maximum water/cement ratio of the grout shall be 0.40;

7. Where admixture is permitted by the CM, grout shall be non-shrink mix and comply with the following requirements:
    a. The free expansion of the grout shall be within a range from 0% to +5%;
    b. The admixtures shall not contain chlorides, thiocyanides, nitrates, formats, sulphates or other ingredients which may cause the grout to promote corrosion of the prestressing steel by rusting, pitting or stress corrosion;
    c. The admixture shall not segregate and shall be uniform in colour;
    d. The admixture shall comply with BS EN 934:2009 Part 2 or Part 4 but full account shall be taken of their effects on the finished product;
    e. The dosage shall be within the range recommended by the supplier and shall not exceed 5% of the weight of the cement.

SUBMISSIONS

PSC.M310.9 PRESTRESSING SYSTEMS

The following particulars shall be submitted to the CM for approval at least 8 weeks before the Approval is required:

1. Details of the prestressing system, including prestressing tendons, prestressing components, sheaths and tensioning apparatus;
2. Sequence of prestressing and ends of prestressing tendons from which prestress will be applied if not stated in the Contract;
3. Calculated values of:
    a. Each type of loss of prestress. Calculations for loss of prestress due to creep shall be based on the information stated in the Specification and Drawings;
    b. Prestressing tendon forces;
    c. Extensions of prestressing tendons and details of the method of measuring the extensions.
4. A certificate showing that the tensioning apparatus has been tested and calibrated by an agent approved by the CM within a period of two years before the apparatus is to be used;
5. Any alterations to the reinforcement or additional reinforcement required to allow for primary bursting effects;
6. Details of corrosion protection required for the prestressing system, including the type of grease for unbonded strand and type of corrosion inhibitor to be adopted;
7. Details of the format of tensioning schedules and of reports of tensioning operations, grouting operations and testing of duct friction.

PSC.M320.9 TENDONS

A certificate shall be submitted to the CM for each batch of prestressing tendons delivered to the Site and at least 28 days before installation of the prestressing tendons starts, showing the manufacturer's name, the date and place of manufacture and showing that the prestressing tendons comply with the requirements stated in the Contract and including details of:

1. Cast analysis;
2. Diameter, cross-sectional area and unit mass;

3. Results of tests for mechanical properties, including the characteristic breaking load, characteristic 0.1% load, elongation at maximum load, relaxation and modulus of elasticity;
4. Results of tests for ductility of prestressing wires.

PSC.M330.A GROUT MIX AND GROUTING PROCEDURE

The following particulars of proposed grout mix and grouting procedure shall be submitted to the CM at least 7 days before trial mixes for grout are made:

1. Water:cement ratio by mass;
2. Admixture: a certificate not older than 6 months showing the manufacturer's name, the date and place of manufacture and that the admixture complies with the requirements stated in the Contract and BS EN 934:Part 2 or Part 4 as appropriate including the manufacturer's test results;
3. Details of mixing and grouting equipment;
4. Method of quality control during grout injection;
5. Details of grouting trials.

PSC.M340.9 SAMPLES

Samples of the following proposed items shall be submitted to the CM at the same time as particulars of the prestressing systems are submitted:

1. Prestressing tendons;
2. Prestressing components;
3. Sheaths;
4. Grout vents and taps.

WORKMANSHIP

HANDLING AND STORAGE OF MATERIALS

PSC.W010.9 HANDLING TENDONS

Prestressing tendons shall not be subjected to rough handling, shock loading or dropping from a height.

PSC.W020.9 HANDLING COMPONENTS

Prestressing components shall be handled in accordance with the manufacturer's recommendations.

PSC.W030.9 STORAGE

1. Each prestressing tendon shall be tagged with a number to identify the coil or bundle number of the prestressing tendon used;
2. Prestressing tendons and sheaths shall be stored off the ground on level supports and in a manner which will not result in damage or deformation to the materials or in contamination of the materials;
3. Different types and sizes of prestressing tendons, prestressing components and sheaths shall be stored separately;
4. Prestressing tendons, prestressing components and sheaths shall not be stored on or adjacent to concrete surfaces which form part of the permanent work;
5. Prestressing tendons, prestressing components and sheaths shall be protected from exposure to conditions which may affect the material.

INSTALLING PRESTRESSING SYSTEMS GENERALLY

PSC.W110.9 SURFACE CONDITION OF TENDONS AND COMPONENTS

1. Prestressing tendons, prestressing components and sheaths shall be clean at the time of installation and shall be free from loose mill scale, loose rust, pitting, grease or any substance which in the opinion of the CM is likely to reduce the bond or affect the prestressing tendons, prestressing components, sheaths, concrete or grout chemically. The prestressing tendons, prestressing components and sheaths shall be maintained in this condition until concrete or grout is placed around them;
2. If the surface condition of the prestressing tendons, prestressing components or sheaths deteriorates such that it does not comply with the requirements stated in sub-clause (1), the prestressing tendons, prestressing components, or sheaths shall be cleaned or dealt with by other methods agreed by the CM.

PSC.W120.9 SAFETY

Prestressing operations shall be carried out in such a manner that persons and property are not endangered by any sudden release of the energy stored in a stressed prestressing tendon.

PSC.W130.9 LOCATION OF TENDONS AND COMPONENTS

Prestressing tendons, prestressing components and sheaths shall be accurately located and maintained in the correct position during all operations. Supports shall be placed at a maximum spacing of 600 mm.

PSC.W140.9 TOLERANCES

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

PSC.W150.9 INSPECTION

The Contractor shall allow the CM to inspect the completed prestressing system before carrying out any work, including concreting and grouting, which will make access to the prestressing system difficult. The Contractor shall inform the CM 24 hours, or such shorter period agreed by the CM, before carrying out such work.

INSTALLATION OF PRESTRESSING TENDONS

PSC.W210.9 GENERAL

Prestressing tendons from each batch shall not be installed until testing of the batch has been completed.

PSC.W220.9 WIRES

1. Steel wires, wire strands and alloy steel bars which will be tensioned in one operation shall be taken from the same batch;
2. Individual steel wires and wire strands in the same duct shall not be twisted together. Strands which have become unravelled shall not be used.

PSC.W230.9 ALLOY BARS

Unless permitted by the CM, alloy steel bars which have become bent shall not be straightened. Small adjustments for straightness may be made provided that the straightening is carried out at the ambient temperature by non-mechanical methods and provided that no force is applied on the threaded portion. Bars which have become bent in the threaded portion shall not be used.

PSC.W240.9 DAMAGED TENDONS

Prestressing tendons which have been damaged mechanically or by work-hardening or heating shall not be used. After manufacture, prestressing tendons shall not be welded and heat treatment, work-hardening, galvanizing and other metallic coatings shall not be applied.

PSC.W250.9 CUTTING

Prestressing tendons shall be cut using either a high speed abrasive cutting wheel or a friction saw or by other methods agreed by the CM. Flame cutting shall not be used.

PSC.W260.9 JOINTS

Joints in prestressing tendons shall be made using couplers fixed in accordance with the manufacturer's recommendations.

COMPONENTS

PSC.W310.9 USE OF COMPONENTS GENERALLY

Prestressing components shall be used in accordance with the manufacturer's recommendations.

PSC.W320.9 INSTALLING SHEATHS

1. At the time of tensioning, sheaths shall be free from dents or other irregularities which may affect tensioning;
2. Joints in sheaths shall be formed using sleeve connectors and adequately sealed by tape against ingress of concrete, grout and any other materials into the ducts. Joints in adjacent sheaths shall be staggered by at least 300 mm. Use of joints shall be kept to a minimum where practicable.

PSC.W330.A GROUT VENTS AND TAPS

1. Grout vents and taps shall be provided at the following positions:
    a. All crests of the prestressing tendon profile and 400 mm on each side of each crest;
    b. All low points of the prestressing profile;
    c. All anchorages and couplers for joints in prestressing tendons;
    d. Intervals not exceeding 15 m;
    e. Beyond each intermediate crest in the direction of grout flow at the point where the duct is one half diameter lower than the crest (but not further than 1 m), and elsewhere as required by the CM;
    f. Deviators for external prestressing tendons;
    g. For external tendons, in case the vents cannot be placed because of encroachment upon the diaphragm / deviator block, vents should be installed on both sides of the diaphragm / deviator block. For anchorage locations, vents should be provided at the other side of the diaphragm.
2. Vents shall not be placed at positions where they will be blocked by the prestressing tendons after tensioning;
3. Vents at high points shall be extended to a minimum of 500 mm above the highest point of the duct profile.

TENSIONING TENDONS

PSC.W410.9 GENERAL

1. Apparatus for tensioning of prestressing tendons shall be a type such that a controlled total force is imposed gradually and such that excessive secondary stresses are not induced in the prestressing tendons and prestressing components or in the structure or element to which prestress is being applied;
2. Prestressing tendons shall be securely attached to jacks and tensioning apparatus;
3. Steel wires or wire strands which are tensioned simultaneously shall be approximately the same length between anchorage points;

4. The force in the prestressing tendons during tensioning shall be measured by direct reading load cells or obtained indirectly from pressure gauges fitted in the hydraulic system. Load measuring devices shall be accurate to within 2%;
5. The extension of prestressing tendons and any movement of prestressing tendons in the gripping devices shall be measured during tensioning. The elongation of prestressing tendons shall be measured to an accuracy of 2% or 2 mm, whichever is the more accurate;
6. Tensioning apparatus and load measuring devices shall be calibrated before tensioning starts and at regular intervals agreed by the CM. The calibration certificate shall be obtained from an approved testing laboratory once every 6 months;
7. The force in the prestressing tendons shall not be transferred to the concrete until the concrete has reached the specified transfer strength;
8. The capacity of pressure gauges, when used together with the load cell as a load indicator, shall be sufficient in capacity such that the working pressure lies within the central half of the range of the gauges;
9. The time of transfer will be determined by successful testing of a batch of minimum 3 test cubes. If the test result of any individual cube in the initial batch indicates that the concrete has not attained the required strength, a further batch of cubes shall be tested at a later stage. This process shall be repeated until a batch of cubes successfully passes the strength test.

PSC.W420.9 PRETENSIONING

1. The stress in prestressing tendons shall be fully maintained during the period between pretensioning and transfer of stress. Transfer of stress shall take place gradually to minimise shock or damage to the transmission length and shall be carried out in conjunction with the release of any hold-down and hold-up forces in tendon deflectors;
2. In the long-line method of pretensioning, locator plates shall be distributed throughout the length of the bed to ensure that the steel wires or wire strands are maintained in the correct positions during concreting. Units which are made in line shall be free to slide in the direction of their length to permit transfer of the prestressing force to the concrete along the whole line;
3. Moulds used in the individual mould system of pretensioning shall be sufficiently rigid to provide the reaction to the prestressing force without excessive distortion;
4. Tendon deflectors in contact with pretensioned prestressing tendons of single steel wire or wire strand shall have a radius of at least five times the prestressing tendon diameter for steel wire and at least ten times the prestressing tendon diameter for wire strand. The total angle of deflection shall not exceed 15°. If a system is used such that friction develops between prestressing tendons and tendon deflectors, the friction force shall be determined by a test procedure agreed by the CM and any necessary allowance shall be made;
5. The tendon shall be covered with sleeves of PVC or other approved material where these materials are specified as debonded from the concrete. Tape ends of the sleeves to the tendon shall prevent the ingress of grout;
6. When the temperature of the pretensioning steel is below 10o C at the time of tensioning, steel elongation computations shall allow for the increase in temperature of the steel between the time of tensioning and the time when the concrete takes its initial set;
7. The tendons shall be trimmed to flush with the face of the concrete with the specified protection applied to their ends;

8. The precast prestressed members shall be indelibly marked to show the specific information related to its manufacturer.

PSC.W430.9 POST-TENSIONING

1. A tensioning schedule shall be submitted to the CM for Approval at least 48 hours before each post-tensioning operation starts. The schedule shall include the proposed sequence of tensioning the prestressing tendons, the required prestressing loads and the calculated extensions of the prestressing tendons;
2. Spacers used with post-tensioned steel wire or wire strand which are not tensioned simultaneously shall be sufficiently rigid to ensure that they will not be displaced during successive tensioning operations;
3. If both ends of the prestressing tendon are free to move, a demonstration shall be carried out before post-tensioning starts to show that all prestressing tendons are free to move in the ducts;
4. Post-tensioning shall be carried out in such a manner that the stress in the prestressing tendons increases at a gradual and steady rate. The sequence of tensioning prestressing tendons and the ends of prestressing tendons from which prestress will be applied shall be as stated in the Contract or as approved by the CM;
5. For each element of a structure being stressed, post-tensioning of the prestressing tendons shall be carried out until the required prestress to that element has been reached. Tensioning of each prestressing tendon shall be carried out continuously until the required tendon loads or extensions have been reached. If tensioning is stopped for more than 2 days, particulars of any proposals for remedial or other work shall be submitted to the CM for Approval and tensioning shall not recommence until the Approved work has been carried out;
6. Measurements of extensions shall not commence until any slack in the prestressing tendon has been taken up. If the design permits, the draw-in of prestressing tendons at the non-jacking end shall also be measured. The tensioning shall be applied in increments of load and the extensions shall be measured at each increment. The average measured extension of the prestressing tendons shall be within 5% of the calculated extension and the measured extension of individual prestressing tendons shall be within 10% of the calculated extension;
7. If the tendon deflector in contact with a post-tensioned prestressing tendon has a radius of less than 50 times the diameter of the prestressing tendon or if the total angle of deflection exceeds 15°, the loss of strength of the prestressing tendon shall be determined by a test procedure agreed by the CM and any necessary allowance shall be made;
8. Post-tensioned prestressing tendons shall be cut at a distance from the anchorage of at least one diameter or 10 mm, whichever is greater. Unless otherwise permitted by the CM the tendons shall not be cut until at least 1 day after stressing, if the tendon is to be cut before grouting, or alternatively, at least 3 days after grouting.

PSC.W440.9 PROTECTION OF EXTERNAL TENDONS AND COMPONENTS

External prestressing tendons and anchorages shall be protected in their permanent positions from mechanical damage or corrosion until the permanent protection is applied.

PSC.W450.9 RECORDS

Records of tensioning operations shall be kept by the Contractor on the Site and a report shall be submitted to the CM within 24 hours of each tensioning operation. The report shall contain the following details:

1. Location of tensioning operations;
2. Coil, heat and bundle numbers of strand used;
3. Date and time of starting and completing tensioning operations;
4. Weather conditions;
5. Technical personnel supervising or carrying out tensioning operations;
6. Prestressing tendon reference numbers;
7. Tensioning apparatus identification;
8. Measured extensions;
9. Pressure gauge or load cell readings;
10. Amount of draw-in.

GROUTING

PSC.W510.A GENERAL

1. Grouting of prestressing tendons shall be effective such that the duct and anchorage are completely filled, and the prestressing tendon is completely surrounded, with grout. Vacuum-assisted grouting shall be adopted. For vacuum-assisted grouting, a negative pressure of no less than 0.75 bar shall be maintained within the tendon duct for at least one minute before the injection of grout and throughout the whole grouting operation;
2. For external prestressing tendons, to inspect the quality of grout at ducts, hammer sounding or other equivalent inspection methods shall be conducted at all grouted tendons. The Contractor shall submit for approval by the CM a detailed method statement for hammer sounding (or other equivalent inspection methods), outlining the operation and type of apparatus to be used. In the case of suspected void within the grouted ducts, drilling of holes on sheathing and remedial measures shall be conducted. The Contractor shall submit for approval by the CM a detailed method statement for the drilling and remedial works;
3. The quality of grouting at anchorages and deviators shall also be inspected. Such inspection can be conducted in form of visual inspections of the grouting condition at grout vents and inspection holes. If suspected abnormalities are found, further verification by drilling through the grout vents or pre-installed inspection holes and borescope inspections shall be carried out. The Contractor shall submit for approval by the CM a detailed method statement for the drilling and remedial works;
4. The inspection of the quality of grout detailed in sub-clauses 2 and 3 shall be conducted by an experienced person from an organization independent of the Contractor and prestressing works contractor, and shall possess at least three years of experience in the inspection of grouting quality at ducts;
5. Records on the inspection on quality of grouting, inspection of grouting condition at ducts, anchorages and deviators, and the subsequent remedial and reinstatement works, shall be submitted to the CM.

PSC.W520.9 EQUIPMENT

1. Grout for prestressing tendons shall be mixed by a machine capable of producing a homogeneous colloidal grout and of keeping the grout in slow continuous agitation after mixing and until the grouting operation starts;

2. Grouting equipment shall be capable of continuous operation with little variation of pressure and shall include a system of recirculating the grout when grouting is not in progress;
3. Grout pumps shall be fitted with a safety valve to prevent pressure from rising above 2 MPa at any point within the grouting system including the sheaths. The connection of the pump to the duct shall be by a screw connector or other positive method. Baffles to the pump shall be fitted with 1.18 mm sieve strainers. Suction circuits shall be airtight;
4. Grouting equipment shall be thoroughly washed through with clean water after every series of grouting operations and at the end of use each day.

PSC.W530.9 INJECTION GENERALLY

The permission of the CM shall be obtained before prestressing tendons are grouted. If grouting is not started within 24 hours of permission having been given, the permission shall again be obtained from the CM.

PSC.W540.A TIMING

Grouting of prestressing tendons shall be carried out as soon as practicable, and not more than 5 days, after tensioning of the prestressing tendons. In case grouting cannot be carried out within 5 days after tensioning of the prestressing tendons, temporary corrosion protection measures should be implemented. The Contractor shall submit proposal of corrosion protection measures to the CM for approval before commencement of tendon prestressing works.

PSC.W550.9 PREPARATION

1. A check shall be made to ensure that the ducts, vents, inlets and outlets are capable of accepting injection of grout. This shall be done by blowing through the system with dry, oil-free air and testing each vent in turn;
2. All ducts shall be kept free of standing water at all times and shall be thoroughly clean and dry before grouting;
3. All anchorages shall be sealed by caps and fitted with grouting connections and vents. Sealing of anchorages shall be protected against damage at all times.

PSC.W560.9 PROCEDURE

1. Grout shall be used within 30 minutes of mixing unless a retarder is incorporated in the grout. If a retarder is used, the time shall be determined by a test procedure agreed by the CM;
2. The grout pressure applied shall be as low as practicable and shall not exceed 1 MPa. Grout shall be injected from the lower ends of ducts. Grout injection shall be continuous and steady and shall be at a rate which will avoid grout segregation and trapping air in the duct. Grout shall be allowed to flow from each of the grout vents until its consistency is equivalent to that of the grout injected. After the last grout vent has been closed, the pressure shall be maintained at 0.5 MPa for 5 minutes. The injection vent shall then be closed under pressure.

PSC.W570.9 BLOCKAGE OR BREAKDOWN

If there is any blockage or breakdown or if the grout injection is interrupted, the duct shall immediately be thoroughly washed with clean water and blown dry with oil-free compressed air. Regrouting shall start as soon as practicable.

PSC.W580.9 PROTECTION

Grouted ducts shall not be subject to shock or vibration within 24 hours of grouting.

PSC.W590.A INSPECTION

1. The level of grout in grout vents shall be inspected and made good as agreed by the CM. Making good shall not be carried out until at least 2 days after grouting;
2. In addition to the grouting trials stated in sub-clause (1) of PSC.T110, the Contractor shall select and propose for the CM's approval an external prestressing tendon to be completed first, and demonstrate to the CM that the workmanship and quality of the grouting works for the tendon is satisfactory. Hammer sounding or other equivalent inspection methods shall be conducted in accordance with PSC.W510 to inspect the quality of grouting. The Contractor shall not commence the grouting works for the remaining external tendons without the prior agreement of the CM;
3. If the Contractor fails to demonstrate that the workmanship and quality of the grouting works for the tendon is satisfactory, or if in the opinion of the CM any aspect of the grouting procedure as demonstrated by the Contractor is unsatisfactory, remedial measures and/or particulars of proposed changes to the method of grouting shall be submitted by the Contractor to the CM. Further grouting of external tendons shall not be carried out until in the opinion of the CM that the remedial measures and/or every aspect of the grouting procedure is satisfactory;
4. The Contractor shall employ on the Site in connection with execution of grouting works for prestressing systems an experienced site personnel who is required to supervise, witness and take record of the whole grouting process of each tendon. The site personnel shall record the sequence of work and check against the prescribed method statement. Any anomaly shall be recorded and investigated. The record shall be countersigned by a supervising engineer and submitted to the CM within 3 days of each grouting operation;
5. The supervising engineer shall be a holder of a recognized degree in civil / structural engineering with 5 years of relevant experience in tendon prestressing works;
6. The following particulars of the proposed supervising engineer for grouting works shall be submitted to the CM:
    a. Name;
    b. Copy of Hong Kong Identity Card;
    c. Details of qualifications, including copies of certificates;
    d. Details of previous experience.
7. The particulars shall be submitted to the CM for approval at least 8 weeks before the approval is required.

PSC.W600.9 RECORDS

Records of grouting operations for prestressing systems shall be kept by the Contractor on Site and a report shall be submitted to the CM within 3 days of each grouting operation. The report shall contain the following details:

1. Location of grouting operations;
2. Date and time of starting and completing grouting operations;
3. Weather conditions;
4. Technical personnel supervising or carrying out grouting operations;

5. Prestressing tendon reference numbers;
6. Grout mix, including any admixtures;
7. Grout injection pressure;
8. Volume of grout used;
9. Details of any interruptions and topping up.

TESTING

TRIAL MIXES FOR GROUT

PSC.T010.9 GENERAL

1. A trial mix for grout for prestressing systems shall be made to demonstrate that the proposed materials, grout mix and methods of production will produce grout which complies with the specified requirements;
2. The trial mixes shall be completed at least 35 days before the grout mix is used in the permanent work;
3. The Contractor shall inform the CM at least 24 hours, or such shorter period as may be agreed by the CM, before making trial mixes;
4. Trial mixes shall be made using the materials, grout mix and methods of production submitted to the CM.

PSC.T020.9 SAMPLING

1. One sample of grout shall be provided from the trial mix to determine the amount of bleeding and free expansion of the grout. The method of sampling shall be as stated in PSC.T710 (2);
2. One sample of grout shall be provided from the trial mix to determine the crushing strength of the grout. The method of sampling shall be as stated in PSC.T810 (2).

PSC.T030.9 TESTING PROCEDURE

1. Each sample of grout taken as stated in PSC.T020 (1) shall be tested to determine the amount of bleeding and free expansion. The method of testing shall be as stated in PSC.T720;
2. Each sample of grout taken as stated in PSC.T020 (2) shall be tested to determine the crushing strength. The method of testing shall be as stated in PSC.T820.

PSC.T040.9 NON-COMPLIANCE

If the result of any test for amount of bleeding, free expansion or crushing strength of trial mixes does not comply with the specified requirements for the property, particulars of proposed changes to the materials, grout mix or methods of production shall be submitted to the CM. Further trial mixes shall be made until the result of every test complies with the specified requirements for the property.

PSC.T050.9 USE OF NON-COMPLYING MIXES IN OTHER TRIALS

If grouting trials are carried out using the non-complying trial mix, further grouting trials shall be carried out unless in the opinion of the CM the changes to the materials, grout mix or methods of production will not affect the results of the previous grouting trials.

GROUTING TRIALS

PSC.T110.9 GENERAL

1. Grouting trials for grout for prestressing systems shall be carried out to demonstrate that the proposed materials, grout mix, methods of production and methods of construction will produce a grouted duct which complies with the specified requirements. The number and details of grouting trials shall be as stated in the Contract;
2. Grouting trials shall be completed at least 21 days before installation of the prestressing components in the permanent works;
3. The Contractor shall inform the CM 24 hours, or such shorter period agreed by the CM, before carrying out grouting trials;
4. Grouting trials shall be carried out using the materials, grout mix, methods of production and methods of construction submitted to the CM;
5. The profile of ducts and the method of support for grouting trials shall be as agreed by the CM. Vents shall be provided in ducts and tendons shall be pulled tight;
6. Grouting trials which do not form part of the permanent work shall be removed;
7. The grouting trial shall incorporate all relevant parts and components as if these relevant parts and components will be used in the actual prestressing system.

PSC.T120.9 PROCEDURE

Three sections selected by the CM shall be cut from the grouted duct and inspected not less than 2 hours after the grout used in the grouting trial has achieved its final set. Each cut section shall be 300 mm long. The external sheath of the cut sections shall be removed for inspection of the cut sections.

PSC.T130.9 COMPLIANCE CRITERIA

The sections of grouted duct cut in grouting trials shall be completely filled, and the prestressing tendon shall be completely surrounded with grout.

PSC.T140.9 NON-COMPLIANCE

If the result of any test on sections of grouted duct in grouting trials does not comply with the specified requirements for the test, or if in the opinion of the CM any aspect of the grouting procedure as demonstrated by the grouting trial is unsatisfactory, particulars of proposed changes to the materials, grout mix, methods of production or methods of construction shall be submitted to the CM. Further grouting trials shall be carried out until the result of every test on sections of grouted duct complies with the specified requirements for the test and until in the opinion of the CM every aspect of the grouting procedure is satisfactory. Further trial mixes for grout shall be made unless, in the opinion of the CM, non-compliance of the grouting trial was not due to the grout mix.

APPROVED GROUT MIXES

PSC.T210.9 DEFINITION

A grout mix which complies with the specified requirements for trial mixes for grout and for grouting trials shall become an Approved grout mix.

PSC.T220.9 COMMENCEMENT OF GROUTING

Grouting shall not proceed until the grout mix has been approved by the CM.

PSC.T230.9 DEVIATION FROM APPROVED MIX

The materials, grout mix, methods of production or methods of construction used to produce an Approved grout mix shall not be changed, unless permitted by the CM.

TESTING PRESTRESSED UNITS

PSC.T310.9 GENERAL

Comply with Worksection CON1.

TESTING PRESTRESSING TENDONS

PSC.T410.9 DEFINITION OF "BATCH"

A batch of prestressing tendons is any quantity of prestressing tendons of the same type, size and grade, manufactured by the same manufacturer, covered by the same certificates and delivered to the Site at any one time.

PSC.T420.9 SAMPLING

Samples of prestressing tendons shall be provided from each batch of prestressing tendons delivered to the Site and at least 28 days before installation of the prestressing tendons starts. The number of samples to be provided from each batch shall be as stated in the following table:

Rate of sampling prestressing tendons		
Description	Size of batch	No. of samples per batch
Steel wire	0 - 50 tonnes	1
	Exceeding 50 tonnes	1 for each of 50 tonnes or part thereof
Wire strand and alloy Steel bar	0 - 100 tonnes	1
	Exceeding 100 tonnes	1 for each 100 tonnes or part thereof

PSC.T430.9 SPECIMENS

1. The number of specimens in each sample shall be 15;
2. Each specimen shall be 1.5 metres long and straight;
3. Each specimen shall be taken from different coils or bars in the batch. The ends of specimens shall be cut square without unravelling of wires before delivery to the laboratory.

PSC.T440.9 PROCEDURES

1. Each specimen of prestressing tendon shall be tested to determine the characteristic breaking load, characteristic 0.1% proof load, elongation at maximum load, diameter, cross-sectional area, unit mass and modulus of elasticity. Each specimen of prestressing wire shall also be tested to determine the ductility;

2. Except that tests shall be carried out on specimens having a temperature of between 5°C and 30°C, the method of testing shall be in accordance with the following:
    a. High tensile steel wire and strand for the prestressing of concrete to BS 5896:1980;
    b. Hot rolled and hot rolled and processed high tensile alloy steel bars for the prestressing of concrete to BS 4486:1980.

PSC.T450.9 COMPLIANCE CRITERIA

1. The standard deviations of the results of tests for characteristic breaking load and characteristic 0.1% proof load, expressed as equivalent stress values, of prestressing tendons shall not exceed the following:
    a. Tensile strength: 55 MPa;
    b. 0.1% proof stress: 60 MPa.
2. The statistical interpretation of the test results shall be in accordance with BS 2846:Part 3:1975, Table 3 and BS 2846:Part 4:1976, Table E, both for a one-sided tolerance interval of 0.95 and for a confidence level of 0.95.

PSC.T460.9 NON-COMPLIANCE CRITERIA

1. If the result of any test for elongation at maximum load, diameter, cross-sectional area, unit mass, modulus of elasticity or ductility of prestressing tendons does not comply with the specified requirements for the property, one additional sample shall be provided from the same batch and additional tests for the property shall be carried out;
2. The number of specimens in the additional sample shall be 15;
3. The batch shall be considered as not complying with the specified requirements for the property if the result of any additional test does not comply with the specified requirements for the property.

DUCT FRICTION

PSC.T510.9 GENERAL

The number and details of tests to determine the duct friction in prestressing systems shall be as follows:

PSC.T520.9 PROCEDURE

1. Prestressing tendons shall be tensioned from one end and the tendon forces shall be measured at both the jacking and non-jacking ends;
2. The tendon force at the non-jacking end shall be measured by a load-measuring device of a type approved by the CM. A direct reading load cell or a dummy jack is considered to be suitable as a load-measuring device. The load-measuring device shall be sufficiently rigid to ensure that the movement of the prestressing tendon at the non-jacking end under the specified tendon force is not excessive. The deflection of the load-measuring device shall be measured to an accuracy of 0.5 mm. A load-measuring device with a deflection exceeding 10 mm under the maximum load shall not be used;

3. The prestressing tendon shall be tensioned to the specified tendon force in equal increments and the tendon extensions at the jacking end and the tendon force and tendon movement at the non-jacking end shall be measured to within 5 mm. The number of load increments shall be suited to the tensioning operation but shall be at least five.

PSC.T530.9 COMPLIANCE CRITERIA

The force at the non-jacking end of the prestressing tendon determined in the duct friction test shall be within +10% and -5% of the calculated value.

PSC.T540.9 REPORTING OF TEST RESULTS

Reports of duct friction tests shall be submitted to the CM within 3 days of each test. The report shall contain the following details:

1. Details stated in the Preliminaries;
2. Prestressing tendon reference numbers;
3. Graph showing tendon forces at jacking end against tendon forces at non-jacking end;
4. Comparison between the calculated tendon forces at the non-jacking end and the measured values.

TESTING GROUT GENERALLY

PSC.T610.9 DEFINITION OF "BATCH"

A batch of grout for prestressing systems is any quantity of grout produced in one cycle of operations of a mixer.

TESTING GROUT FOR BLEEDING AND FREE EXPANSION

PSC.T710.9 SAMPLING

1. For each grout mix one sample of grout shall be provided from each 25 batches of grout, or from the amount of grout produced in a day, whichever is the lesser, to determine the amount of bleeding and free expansion of the grout;
2. Samples shall be provided and testing commenced within 1 hour after the grout has been mixed. Samples shall be protected from rain before the tests for amount of bleeding and free expansion are carried out.

PSC.T720.9 PROCEDURE

1. Each sample of grout taken as stated in PSC.T710 shall be divided into three specimens. Each specimen shall be tested to determine the amount of bleeding and free expansion;
2. A portion of each specimen shall be placed in a covered cylinder with a diameter of 100 ± 10 mm, to a depth of 100 ±5 mm and the amount of bleeding and free expansion measured by a scale fixed to the outside of the cylinder.

PSC.T730.9 NON-COMPLIANCE

If the result of any test for amount of bleeding or free expansion of grout for prestressing systems does not comply with the specified requirements for the property, particulars of proposed changes to the materials, grout mix or methods of production shall be submitted to the CM. Further trial mixes shall be made and further grouting trials shall be carried out unless otherwise permitted by the CM.

TESTING GROUT FOR CRUSHING STRENGTH

PSC.T810.9 SAMPLING

1. For each grout mix one sample of grout shall be provided from each 25 batches of grout, or from the amount of grout produced in a day, whichever is the lesser, to determine the crushing strength of the grout;
2. Samples shall be provided not more than 1 hour after the grout has been mixed and shall be protected from rain before test cubes are made.

PSC.T820.9 PROCEDURE

1. Two 100 mm test cubes shall be made from each sample of grout. Each pair of test cubes shall be tested to determine the crushing strength at 7 days;
2. The method of making, curing and testing the test cubes, and the calculations of the test results, shall be as stated in Worksection CON1, except that compaction of the grout is not required.

PSC.T830.9 NON-COMPLIANCE

If the result of any test for crushing strength of grout for prestressing systems does not comply with the specified requirements for crushing strength, particulars of proposed changes to the materials, grout mix or methods of production shall be submitted to the CM. Further trial mixes shall be made and further grouting trials shall be carried out unless otherwise permitted by the CM.

STW STEELWORK

STW STEELWORK 5

MATERIALS 5

STANDARDS 5

STW.M010.9 GENERAL STEELWORK 5
STW.M020.9 STEELWORK FOR BRIDGEWORKS 5
STW.M030.9 PROTECTION OF STEELWORK 6

STEEL 6

STW.M110.9 STRUCTURAL STEEL GENERALLY 6
STW.M120.9 HOT ROLLED SECTIONS 6
STW.M130.9 RIVETS 6
STW.M140.9 SHEAR CONNECTORS 6
STW.M150.9 CASTINGS AND CAST STEEL PINS 6
STW.M160.9 FORGINGS AND FORGED STEEL PINS 6
STW.M170.9 STAINLESS STEEL 6
STW.M180.9 ROLLED STEEL PINS 6

CAST IRON 7

STW.M210.9 GREY IRON 7
STW.M220.9 MALLEABLE CAST IRON 7
STW.M230.9 SPHEROIDAL OR NODULAR CAST IRON 7

CONNECTIONS 7

STW.M310.9 BOLTS, SCREWS AND NUTS 7
STW.M320.9 STAINLESS STEEL BOLTS AND NUTS 7
STW.M330.9 WASHERS 7
STW.M340.9 WELDING CONSUMABLES 8

METAL COATINGS TO STEELWORK 8

STW.M410.9 GALVANIZING 8
STW.M420.9 SHERARDIZING 9
STW.M430.9 SPRAYED ZINC AND ALUMINIUM 9
STW.M440.9 ELECTROPLATED ZINC AND CADMIUM 9
STW.M450.9 THREADED COMPONENTS 9

PAINT 9

STW.M510.9 GENERAL 9
STW.M520.9 STANDARD 9
STW.M530.9 LEAD BASED PAINTS 9

ANCILLARY MATERIALS 10

STW.M610.9 GROUT FOR COLUMN BASES 10
STW.M620.9 LUBRICANT 10

SUBMISSIONS 10

STW.M710.9 STEEL 10
STW.M715.9 WELDING CONSUMABLES 10
STW.M720.9 DRAWINGS 10
STW.M730.9 DELIVERY 11
STW.M740.9 ERECTION 11
STW.M750.9 WELDER CERTIFICATES 11
STW.M760.9 WELDING PROCEDURES 12
STW.M770.9 STUD WELDING, FLAME CUTTING AND SHEARING 12
STW.M780.9 PREPARATION FOR GALVANIZING 12
STW.M790.9 NON-DESTRUCTIVE TESTING 12
STW.M800.9 INSPECTING AUTHORITY 12
STW.M810.9 TESTING CONSULTANT 12
STW.M820.9 PAINTS 12

SAMPLES **13**
STW.M910.9 STEEL 13
STW.M920.9 PAINTING SYSTEM 13
STW.M930.9 FIXINGS 13

WORKMANSHIP **14**

HANDLING, STORAGE AND TRANSPORT **14**
STW.W010.9 HANDLING STEELWORK 14
STW.W020.9 PACKING OF SMALL COMPONENTS 14
STW.W030.9 STORAGE OF STEELWORK 14
STW.W035.9 STORAGE OF ELECTRODES 15
STW.W040.9 STORAGE OF PAINT 15

FABRICATION GENERALLY **15**
STW.W110.9 STANDARDS 15
STW.W120.9 ALLOWANCES FOR DEFORMATION 15
STW.W130.9 COMPATIBILITY OF DIMENSIONS 15

FABRICATION - WELDING, HEATING AND CUTTING **15**
STW.W210.9 GENERAL 15
STW.W220.9 WELDERS 16
STW.W230.9 BUTT WELDS 16
STW.W240.9 STAINLESS STEEL 16
STW.W250.9 TEMPORARY WELDS 16

FABRICATION - BOLTED CONNECTIONS **16**
STW.W310.9 LENGTH OF BOLTS 16
STW.W320.9 LENGTH OF THREADS 16
STW.W330.9 NUTS 16
STW.W340.9 WASHERS 16
STW.W350.9 TIGHTENING BOLTS 17
STW.W360.9 TIGHTENING HSFG BOLTS 17

FABRICATION - APPROVAL AND DEFECTS **18**
STW.W410.9 DEFECTIVE STEELWORK 18
STW.W420.9 APPROVAL 18

PREPARATION OF STEELWORK TO RECEIVE COATINGS **18**
STW.W510.9 CLEANING STEELWORK AND COATED SURFACES 18
STW.W520.9 PREPARATION OF STEEL SURFACES 19
STW.W530.9 METAL COATINGS 19
STW.W540.9 BLAST CLEANING 19
STW.W550.9 ACID PICKLING 20
STW.W560.9 MECHANICAL CLEANING 20
STW.W570.9 FLAME CLEANING 20
STW.W580.9 BOLTS, NUTS AND WASHERS 20
STW.W590.9 APPROVAL 20

PAINTING SYSTEMS **20**
STW.W610.9 SYSTEM A 20
STW.W620.9 SYSTEM B 20
STW.W630.9 SYSTEM C 21
STW.W640.9 SYSTEM D 21
STW.W650.9 SYSTEM E 21

APPLYING PAINT TO STEELWORK **21**
STW.W710.9 GENERAL 21
STW.W720.9 AMBIENT CONDITIONS 22
STW.W730.9 TIME LIMITS ON PAINTING 22
STW.W740.9 STRIPE COATS 22

STW.W750.9 FINISH THICKNESS 23
STW.W760.9 FINISH QUALITY 23
STW.W770.9 ETCH AND BLAST PRIMERS 23
STW.W780.9 REPAIRS TO DAMAGED PAINT 23

PROTECTION OF JOINTS AND SURFACES 23
STW.W810.9 SHOP BOLTED JOINTS 23
STW.W820.9 SITE BOLTED JOINTS 23
STW.W830.9 HSFG BOLTED JOINTS 23
STW.W840.9 WELDED JOINTS 24
STW.W850.9 JOINTS MADE AFTER COMPLETION OF COATING 24
STW.W855.9 REINSTATEMENT OF ZINC COATING WITH POST-GALVANIZING WELDING 24
STW.W860.9 SEALING JOINTS 25
STW.W870.9 HOLLOW SECTIONS 25
STW.W880.9 BRIDGE BEARING SURFACES 25
STW.W890.9 UNCOATED SURFACES 25

ERECTION OF STEELWORK 25
STW.W910.9 FOUNDATION BOLTS 25
STW.W920.9 SUPPORTING DEVICES 25
STW.W930.9 TEMPORARY SUPPORTS AND FASTENINGS 26
STW.W940.9 ALIGNMENT 26
STW.W950.9 COLUMN BASES 26

TOLERANCES 26
STW.W1010.9 GENERAL 26

OFF-SITE FABRICATION 26
STW.W1110.9 SUBMISSIONS 26
STW.W1120.9 QUALITY ASSURANCE (QA) SCHEME 27
STW.W1130.9 REGISTERED STRUCTURAL ENGINEER 27

TESTING 28

PROCEDURE TRIALS FOR WELDING, FLAME CUTTING AND SHEARING 28
STW.T010.9 GENERAL 28
STW.T020.9 PROCEDURE TRIALS 28
STW.T030.9 TRIAL RESULTS 28
STW.T040.9 APPROVED PROCEDURES 29
STW.T050.9 CHANGES TO APPROVED PROCEDURES 29
STW.T060.9 RECORDS 29

PAINTING TRIALS 29
STW.T110.9 GENERAL 29
STW.T120.9 TRIAL RESULTS 29
STW.T130.9 COMMENCEMENT OF PAINTING 29
STW.T140.9 CHANGES TO MATERIALS AND METHODS OF APPLICATION 30

TESTING GENERALLY 30
STW.T210.9 TESTING CONSULTANT 30

OFF-SITE TESTING 30
STW.T310.9 GENERAL 30
STW.T320.9 STRUCTURAL STEEL 30
STW.T330.9 BOLTS, NUTS AND WASHERS 30

TESTING STEELWORK GENERALLY 30
STW.T410.9 STEELWORK BATCHES 30
STW.T420.9 SAMPLING 30
STW.T430.9 TEST PROCEDURES 30
STW.T440.9 TEST REPORTS 31

STW.T450.9 NON-COMPLIANCE OF STEELWORK....31

TESTING STEEL....31

STW.T510.9 SAMPLING....31
STW.T520.9 TENSILE AND IMPACT TESTING....31
STW.T530.9 QUALITY GRADING....31

TESTING WELDING CONSUMABLES....32

STW.T550.9 BATCH OF WELDING CONSUMABLES....32
STW.T560.9 TESTING OF WELDING CONSUMABLES....32
STW.T570.9 ACCEPTANCE CRITERIA - WELDING CONSUMABLES....32
STW.T580.9 FAILURE OF TESTS....32
STW.T590.9 STANDARD FOR REJECTION....33

TESTING WELDS....33

STW.T610.9 GENERAL....33
STW.T620.9 DESTRUCTIVE TESTING....33
STW.T630.9 NON-DESTRUCTIVE TESTING....33
STW.T640.9 INSPECTION OF WELDS....34

TESTING STUD SHEAR CONNECTORS AND RIVETS....34

STW.T710.9 GENERAL....34
STW.T720.9 WELDED STUD SHEAR CONNECTORS....34
STW.T730.9 RIVETS....34

TESTING FABRICATION TOLERANCES....34

STW.T810.9 GENERAL....34
STW.T820.9 PROCEDURE....35

TESTING REPAIRS....35

STW.T910.9 GENERAL....35

APPENDIX STW/I....36

STW.APPEND1.9 CALCULATION OF NUMBER OF FURTHER INSPECTIONS / TESTS....36

STW STEELWORK

MATERIALS

STANDARDS

STW.M010.9 GENERAL STEELWORK

Steelwork shall comply with BS 5950:Part 2:1992.

STW.M020.9 STEELWORK FOR BRIDGEWORKS

Comply with BS 5400:Part 6:1980, except in respect of the following amendments:

1. Content pages: delete '6.3.1 General';
2. Page 2, Clause 3.1.4.1, lines 5, 8 and 14: delete 'C of DD21' and insert 'L1 of BS 5996:1980';
3. Page 2, Clause 3.1.4.1, line 10 and Clause 3.1.4.2, line 3: delete 'DD21' and insert BS 5996:1980';
4. Page 3, Clause 4.2.1, line 1: delete '4.4.2' and insert '4.2.2';
5. Page 3, Clause 4.3.3(e), line 1: delete line 1 of text and insert 'the hardness of the edge is reduced to less than 350 HV 30 of BS 427:1990 by a suitable heat treatment';
6. Page 4, Clause 4.7.1, paragraph 2, line 4: delete '23 of BS 5135:1984' and insert '20 of BS 5135:1984';
7. Page 5, Clause 4.14: delete and insert: 'The Contractor shall determine the dead load camber of beams required to comply with the requirements of STW.W120. The camber of plate girders shall be formed by either of the two following alternatives, whichever is stated in the Contract:

   Type A cambering

   - Camber introduced by welding the flanges pressed against a web plate cut to a smooth cambered profile;

     or

   Type B cambering

   - Camber introduced by connecting straight sections of girder with the change of slope at their junctions;

   Type A

   - Camber shall be used if the alternative to be used is not stated in the Contract;

     with

   Type B

   - cambering the junction shall not be positioned at bolted connections'.
8. Page 6, Clause 5.2.2, line 2: delete 'DD21' and insert 'BS 5996:1980;
9. Page 7, Clause 5.5.2, paragraph 3, line 3: delete 'grider; and insert 'girder';
10. Page 9, Clause 6.3.1: delete Clause 6.3.1;
11. Page 15, Table 5, column 3, Member component 4: delete 'G=0' and insert 'G=D'.

STW.M030.9 PROTECTION OF STEELWORK

Protection of steelwork against corrosion shall comply with BS 5493:1977.

STEEL

STW.M110.9 STRUCTURAL STEEL GENERALLY

Structural steel shall comply with BS 4360:1986, including Clause B7 at Appendix B, and with BS 5950:Part 2:1992, Section 2.1 or BS 5400:Part 6:1980, Section 3.1 as appropriate.

STW.M120.9 HOT ROLLED SECTIONS

Hot rolled sections complying with BS 4:Part 1:1980, BS 4848:Part 2:1991, BS 4848:Part 4:1972 (1986) or BS 4848:Part 5:1980 shall not be replaced with sections complying with other standards unless approved by the CM. If approved, the sections shall have equivalent properties, and the dimensional tolerances shall comply with the relevant British Standard.

STW.M130.9 RIVETS

Steel rivet bars for the manufacture of steel rivets shall comply with BS 5400:Part 6:1980, Appendix A.

STW.M140.9 SHEAR CONNECTORS

Steel for headed stud type shear connectors shall have a yield stress of at least 385 N/mm² and a tensile strength of at least 495 N/mm². Steel for other types of shear connectors shall comply with BS 4360:1986.

STW.M150.9 CASTINGS AND CAST STEEL PINS

Carbon manganese steel castings shall comply with BS EN 10293:2005.

STW.M160.9 FORGINGS AND FORGED STEEL PINS

Steel forgings and forged steel pins shall comply with BS 29:1976.

STW.M170.9 STAINLESS STEEL

1. Wrought stainless steel shall comply with BS EN 10084:2008, BS EN 10085: 2001, BS EN 10087:1999, BS EN 10095:1999, BS EN 10250-1:2000 and PD 970:2005, grade 1.4401;
2. Flat rolled stainless steel shall comply with BS EN 10029:1991, BS EN 10048:1997, BS EN 10051:1991 + A1:1997, BS EN 10095:1999 and BS EN ISO 9445:2006, grade 1.4401 in the softened condition;
3. Stainless steel tubes shall comply with BS EN 10296-1:2003 and BS EN 10296-2:2005.

STW.M180.9 ROLLED STEEL PINS

Rolled steel pins, including those made from slabs, shall comply with BS 970:Part 1:1996 or BS 4360:1986, grades 43, 50 or 55.

CAST IRON

STW.M210.9 GREY IRON

Grey cast iron shall comply with BS 1452:1990, grade 10.

STW.M220.9 MALLEABLE CAST IRON

Malleable cast iron shall comply with BS 6681:1986.

STW.M230.9 SPHEROIDAL OR NODULAR CAST IRON

Spheroidal or nodular cast iron shall comply with BS 2789:1985.

CONNECTIONS

STW.M310.9 BOLTS, SCREWS AND NUTS

Bolts, screws and nuts shall comply with the British Standards and strength grades stated in the following table unless other strength grades or British Standards are stated on the Drawings or elsewhere in this Worksection:

British Standards and strength grades for bolts, screws and nuts			
Type of bolts, screws and nuts	British Standard	Strength grade of bolt	Strength grade of nut
High strength friction grip bolts and nuts	BS 4395: Part 1 : 1969	General grade	As specified in BS 4395:Part 1:1969
Precision bolts, screws and nuts	BS 3692: 1967	4.6	4.0
Cup head and counter-sunk head bolts, screws and nuts	BS 4933: 1973	4.6	4.0
Black bolts, screws and nuts	BS 4190: 2001	4.6	4.0
Other types of bolts, screws and nuts	BS 4190: 2001	4.6	4.0
Hexagon socket screws	BS 4168: Part 1 : 1981	12.9	12.0

STW.M320.9 STAINLESS STEEL BOLTS AND NUTS

Stainless steel bolts and nuts shall comply with BS EN ISO 3506-1&2:2009, steel grade A4 and property class 80. Stainless steel washers shall comply with BS EN 10029:1991, BS EN 10048:1997, BS EN 10051:1991 + A1:1997, BS EN 10095:1999 and BS EN ISO 9445:2006, grade 1.4401 in the softened condition. The dimensions and tolerances of bolts and nuts shall comply with BS 3692:1967. The dimensions and tolerances of tapered washers shall comply with BS 3410:1961 and the dimensions and tolerances of flat washers shall comply with BS 4320:1968, Form C.

STW.M330.9 WASHERS

1. Washers for high strength friction grip bolts and nuts shall comply with the following:

a. High strength friction grip bolts and associated nuts and washers for structural engineering:

i. General grade: BS 4395:Part 1:1969;

ii. Higher grade bolts and nuts and general grade washers: BS 4395:Part 2:1969;

iii. Higher grade bolts (waisted shank), nuts and general grade washers: BS 4395:Part 3:1973.

2. Plain washers for other bolts, screws and nuts shall comply with BS 4320:1968; tapered washers for other bolts, screws and nuts shall comply with BS 3410:1961.

STW.M340.9 WELDING CONSUMABLES

1. Welding consumables used in metal-arc welding of grades of steel complying with BS 4360:1986 shall comply with BS 5135:1984. Welding consumables used in the fusion of steel castings shall comply with BS 4570:1985. Welding consumables used in metal-arc welding of austenitic stainless steels shall comply with BS 4677:1984;
2. Welding consumables and the procedures used shall be such that the mechanical properties of the deposited weld metal shall not be less than the respective minimum values of the parent metal being welded;
3. Welding consumables used with grades of steel other than those complying with BS 4360:1986 shall be such that the performance requirements stated in BS 5400:Part 6:1980, Table 1 or BS 5950:Part 2:1992, Table 1 as appropriate are achieved.

METAL COATINGS TO STEELWORK

STW.M410.9 GALVANIZING

1. Unless otherwise specified, galvanized coatings to be applied by hot-dip galvanizing to be in accordance with BS EN ISO 1461:1999. The coating thickness to comply with the following Table:-

Article Thickness	Minimum Mean Coating Thickness
≥ 6 mm	85 μm
3 mm to < 6 mm	70 μm
1.5 mm to < 3 mm	55 μm
< 1.5 mm	45 μm

2. Unless Approved, all components are to be galvanized after fabrication and welding;
3. All hot dip galvanizing, including the galvanizing work specified in other Worksections, is to be carried out by galvanizers with ISO 9001 certification. Submit the name of galvanizer for Approval;
4. Submit original invoice/delivery note and galvanizing certification for each delivery. These documents shall include the following information:

a. Project title/number;

b. Name of galvanizer;

c. Types and dimensions of articles;

d. Quantities.

5. Attach a durable identification tape to each batch of galvanized articles indicating the project title, galvanizing certification number and name of galvanizer.

STW.M420.9 SHERARDIZING

Sherardized zinc coatings shall comply with BS 4921:1988, Table 1, Class 1.

STW.M430.9 SPRAYED ZINC AND ALUMINIUM

Sprayed zinc and aluminium coatings shall comply with BS 2569:Part 1:1964. The nominal coating thickness shall be 100 microns. Sprayed metal shall be pre-treated with product CP1 and sealed product CP3C in accordance with BS 5493:1977.

STW.M440.9 ELECTROPLATED ZINC AND CADMIUM

Electroplated zinc and cadmium coatings on threaded components with a diameter not exceeding 36 mm shall comply with BS 3382:Parts 1 and 2:1961. The coating thickness shall be at least 5 microns.

STW.M450.9 THREADED COMPONENTS

Allowance for the thickness of the metal coating shall be made in the sizes of the threads of metal coated threaded components. Nuts shall not be tapped oversize by more than 0.4 mm. Metal coated HSFG bolts and nuts shall not be tapped oversize unless Approved.

PAINT

STW.M510.9 GENERAL

Paint shall be supplied in sealed containers of not more than 5 litres capacity. Each container shall be marked on the side to show the following:

1. The name of the manufacturer;
2. The paint manufacturer's reference number;
3. Intended purposes, type of pigment and binder;
4. Batch number, date of manufacture, expiry date and pot life; and
5. Colour, gloss, drying times and flash point.

STW.M520.9 STANDARD

1. Paint for steelwork shall comply with BS 5493:1977, Section 2, Table 4;
2. Organic zinc-rich paint shall comply with BS 4652:1971;
3. The Volatile Organic Compound (VOC) content of all paint applied on surfaces of steelwork shall comply with the VOC limits stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation.

STW.M530.9 LEAD BASED PAINTS

Shall not be used for finishing coats.

ANCILLARY MATERIALS

STW.M610.9 GROUT FOR COLUMN BASES

1. Grout for bedding steel bases and for filling bolt pockets and pocket bases shall be based on PC and shall have the same grade strength as the surrounding foundation concrete. The grout shall contain a non-metallic expanding admixture and shall have a total chloride content of not more than 0.1% by mass of cement;
2. Grout for bedding steel bases and for filling bolt pockets shall be a proprietary type approved by the CM and shall be suitable for filling the space by pouring under a suitable head. The proportions of the grout shall be in accordance with the manufacturer's recommendations;
3. A dry packed mortar may be used for bedding steel bases which exceed 75 mm thick. The mortar shall consist of 1 part by weight of cement of 2 parts by weight of fine aggregate together with the minimum amount of water necessary to achieve a consistency suitable for thorough ramming against supports such that the space is completely filled;
4. Grout for filling pocket bases shall be a mix Approved by the CM with a nominal maximum aggregate size of 10 mm.

STW.M620.9 LUBRICANT

Lubricant for lubricating nut threads of HSFG bolts shall be a wax based type Approved by the CM. Machine oil and other free flowing lubricants shall not be used.

SUBMISSIONS

STW.M710.9 STEEL

1. The manufacturer's certificates for steel shall be submitted to the CM in accordance with BS 4360:1986, Clause 12 and Appendix B6;
2. The certificates shall be submitted to the CM not more than 2 days after the steel has been delivered to the place of fabrication.

STW.M715.9 WELDING CONSUMABLES

The manufacturer's certificates for each batch of electrodes / rods / coils of wire shall be submitted to the CM.

STW.M720.9 DRAWINGS

1. Two sets of drawings of the steelwork shall be submitted to the CM. The drawings shall show details of the following:
    a. Steelwork and welds, including any stud welds, marked with the relevant welding procedures;
    b. Joints or non-standard welds proposed by the Contractor;
    c. Locations and methods of removal of any temporary welded attachments proposed by the Contractor;
    d. Edges of steelwork complying with BS 5400:Part 6:1980 to be formed by flame cutting or shearing procedures complying with BS 5400:Part 6:1980, Clause 4.3.3 (a), (d) and (e) with the edges marked with the procedures to be used;

e. Parts of steelwork complying with BS 5400:Part 6:1980 to be worked by hot processes complying with BS 5400:Part 6:1980, Clause 4.8, 4.9 or 4.10 with the parts marked with the processes to be used;

2. The drawings shall be submitted to the CM for Approval at least 6 weeks before fabrication of the steelwork starts. Drawings shall not be Approved until all procedures and details shown on the drawings have been approved by the CM;

3. A print and a diazo film of the Approved drawings shall be submitted to the CM at least 7 days before fabrication of the steelwork starts.

STW.M730.9 DELIVERY

1. The following particulars of steelwork fabricated off the Site shall be submitted to the CM:

   a. Expected and actual arrival dates;

   b. Name of carrier;

   c. Duplicate copies of bill of lading and packing list for steelwork transported by sea;

   d. Duplicate copies of delivery note and a list showing the marking and weight of each component for steelwork transported by land;

2. The particulars of expected arrival date and name of carrier shall be submitted to the CM at least 14 days before the due date; other particulars shall be submitted to the CM within 3 days after delivery of the steelwork to the Site.

STW.M740.9 ERECTION

1. The following particulars of the proposed method of erecting steelwork shall be submitted to the CM:

   a. Sequence and method of erection of steelwork;

   b. Method of lifting and handling the components;

   c. Method of preventing damage to protective coatings on steelwork during handling;

   d. Procedure for aligning, levelling and plumbing steelwork, including temporary supports and methods of making beddings for column bases;

   e. Sequence of casting concrete bonded to the steelwork;

2. The particulars shall be submitted to the CM at least 6 weeks before erection of the steelwork starts.

STW.M750.9 WELDER CERTIFICATES

1. Certificates endorsed by inspecting authority Approved by the CM shall be submitted to the CM to show that each welder has been Approved in accordance with BS 4570:1985, BS EN 287:Part 1:1992 or BS 4872:Part 1:1982 as appropriate. The extent of approval of the welder shall be appropriate to the categories of welds which he will carry out;

2. The welder certificates shall be submitted at least 4 weeks before fabrication of the steelwork starts.

STW.M760.9 WELDING PROCEDURES

The particulars of the proposed welding procedures as specified in Project Specific Specification shall be submitted to the CM at the same time as welder certificates are submitted.

STW.M770.9 STUD WELDING, FLAME CUTTING AND SHEARING

1. The following particulars of the proposed stud welding, flame cutting and shearing procedures for steelwork complying with BS 5400:Part 6:1980 shall be submitted to the CM:
    a. Procedures for stud welding, flame cutting and shearing processes complying BS 5400:Part 6:1980, Clause 4.3.3 (a), (d) or (c);
    b. Documentation endorsed by an inspecting authority Approved by the CM to show that the stud welding, flame cutting or shearing procedure has complied with the procedure trial requirements stated in STW.T020 (4) in previous tests; report of procedure trials as stated in STW.T060 (2) if procedure trials are required under STW.T010 (1).
2. The particulars shall be submitted to the CM at least 6 weeks before fabrication of the steelwork starts.

STW.M780.9 PREPARATION FOR GALVANIZING

Particulars of the method of plugging vent holes required for hot-dip galvanizing hollow or box sections shall be submitted to the CM at least 3 weeks before fabrication of the steelwork starts.

STW.M790.9 NON-DESTRUCTIVE TESTING

Particulars of the proposed method for carrying out non-destructive testing on welds shall be submitted to the CM at least 4 weeks before the tests start.

STW.M800.9 INSPECTING AUTHORITY

The name of the proposed inspecting authority endorsing welder certificates and records of approval tests for welding procedures shall be submitted to the CM. The name shall be submitted at least 3 weeks before approval tests start or, if approval tests are not required, at the same time as the welder certificates are submitted.

STW.M810.9 TESTING CONSULTANT

The name of the proposed testing consultant stated in STW.T210 shall be submitted to the CM at least 3 weeks before the testing consultant commences work.

STW.M820.9 PAINTS

The following particulars of the proposed paints and associated products shall be submitted to the CM at least 6 weeks before painting starts:

1. Name of manufacturer;
2. Duplicate copies of the manufacturer's data sheets including temperature, humidity and other conditions at the workshop or on the Site under which the paint is to be applied; and
3. Manufacturer's product specifications, product range and technical information.

SAMPLES

STW.M910.9 STEEL

A sample of blast cleaned steel plate shall be submitted to the CM for Approval at least 14 days before blast cleaning starts. The sample shall be 150 mm x 150 mm x 6 mm and shall be enclosed in a sealed, colourless, transparent wrapping. The grade of steel and the method of blasting shall be representative of those which will be used in the permanent work.

STW.M920.9 PAINTING SYSTEM

Two samples of painted tin plates for each painting system shall be submitted to the CM at least 14 days before painting starts. Each plate shall be 150 mm x 75 mm x 1 mm and shall have smooth edges and 10 mm corner radii. The plates shall be brush cleaned and painted on one face with the painting system in such a manner that each coat is stepped back from the underlying coat in equal strips. The degree of gloss of the finishing coat shall be as agreed by the CM.

STW.M930.9 FIXINGS

Samples of each type of nut, bolt, washer, stud and rivet shall be provided within 3 days after the material is delivered to the Site.

WORKMANSHIP

HANDLING, STORAGE AND TRANSPORT

STW.W010.9 HANDLING STEELWORK

1. Steelwork shall not be subject to rough handling, shock loading or dropping from a height;
2. During handling and transport of coated steelwork, the steelwork shall be separated from wires and lashings by rubber padding in such a manner that the coatings are not damaged or discoloured. Free ends shall be stiffened, measures shall be taken to prevent permanent distortion and machined surfaces and faying surfaces shall be protected;
3. Steelwork shall not be lifted from the painting bed until the last applied coating is sufficiently dry or cured for handling.

STW.W020.9 PACKING OF SMALL COMPONENTS

Rivets, bolts, nuts, washers, screws and small plates and articles shall be packed in containers marked to identify the contents.

STW.W030.9 STORAGE OF STEELWORK

1. Steelwork shall be stored off the ground on level supports in well drained areas in a manner which will not result in damage or deformation to the steelwork or coatings or in contamination of the steelwork or coatings. Packings shall be placed between steelwork which is stacked;
2. Covered places in which steelwork is stacked shall be ventilated;
3. Different types and sizes of steelwork shall be stored separately;
4. Steelwork shall not be stored on or adjacent to concrete surfaces which form part of the permanent work;
5. Steelwork shall be protected from exposure to conditions which may affect the steelwork or coatings;
6. Wet paint films, steelwork surfaces which are to be primed or overcoated and joint surfaces which are to be assembled shall be protected from exposure to conditions which may affect the film or surface. Undercoats which contain anatase titanium dioxide shall be protected from exposure to direct sunlight;
7. Except as stated in sub-clauses (8) and (9) steelwork shall be stored in an enclosed workshop and protected from conditions which may affect the steelwork after the steelwork has been cleaned as stated in STW.W510 until the following times:
    a. When the second undercoat to painted steelwork has hard dried;
    b. When the coating process to galvanized, electroplated or metal sprayed steelwork has been completed;
    c. When the sealer to metal sprayed and sealed steelwork has been completely absorbed;
    d. When the first undercoat to metal sprayed and painted steelwork has hard dried.
8. Primed steelwork surfaces may be exposed outside the enclosed workshop for a period not exceeding two weeks;

9. Micaceous iron oxide undercoats to steelwork may be exposed outside the enclosed workshop for a minimum period necessary to move the steelwork from one part of the workshop to the other; the undercoated surfaces shall be covered when the steelwork is being moved.

STW.W035.9 STORAGE OF ELECTRODES

Keep electrodes in unbroken packets in accordance with BS EN 1011-1:2009. Any drying or baking of consumables before issue shall be carried out in accordance with the manufacturer's recommendations.

STW.W040.9 STORAGE OF PAINT

Paint and associated materials shall be stored in sealed containers marked as stated in STW.M510 and protected from exposure to conditions which may affect the materials. The materials shall be stored in accordance with the manufacturers' recommendations and shall not be used after the recommended expiry date has been exceeded. The materials shall be stored in a locked store.

FABRICATION GENERALLY

STW.W110.9 STANDARDS

1. Comply with BS 5950:Part 2:1992, Sections 3 and 4 for general steelwork except where stated in this Worksection;
2. Comply with BS 5400:Part 6:1980, Clauses 4.1 to 4.16 for bridgeworks.

STW.W120.9 ALLOWANCES FOR DEFORMATION

Allowances shall be made for the deformation due to permanent loads and the process and sequence of fabrication, erection and construction such that steelwork is completed to within the specified tolerances.

STW.W130.9 COMPATIBILITY OF DIMENSIONS

The compatibility of the dimensions and setting-out data of steelwork shall be verified by the Contractor before the materials for steelwork are ordered.

FABRICATION - WELDING, HEATING AND CUTTING

STW.W210.9 GENERAL

1. Welding, heating or thermal cutting processes which give off toxic or irritant gases shall not be used unless permitted by the CM; if permitted, precautions, including the provision of exhaust ventilation, breathing apparatus and display of warning signs, shall be taken to enable the work to be carried out in safe conditions. Welding, heating or thermal cutting shall not be carried out within 2 m of lead-based, cadmium or carbonaceous coatings;
2. Pre-setting, pre-bending, skip welding, back-step techniques and other measures shall be taken as necessary to counteract shrinkage or distortion due to welding, gouging, thermal cutting or heat treatment.

STW.W220.9 WELDERS

Welding shall be carried out by welders who possess a valid welding certificate for the appropriate category of welding. A welder shall cease to carry out welding if any of the circumstances stated in BS 4570:1985, Clause 21.1 or BS 4872:Part 1:1982, Clause 6 as appropriate occurs, or the requirements stated in BS EN 287:Part 1:1992, Clause 10.1 are not satisfied.

STW.W230.9 BUTT WELDS

1. Butt welds shall be complete penetration butt welds made between fusion faces;
2. Butt welds in each component part shall be completed before the final assembly of built-up assemblies.

STW.W240.9 STAINLESS STEEL

Welding of austenitic stainless steel shall be carried out in accordance with BS 4677:1984.

STW.W250.9 TEMPORARY WELDS

1. Temporary welded attachments shall not be used unless permitted by the CM;
2. Temporary welded attachments, when permitted by the CM to be used, shall be removed by cutting with a flame torch 3 mm above the surface of the steel member when not required any longer. The excess metal protruding above the parent plate surface shall be removed by grinding and finished flush.

FABRICATION - BOLTED CONNECTIONS

STW.W310.9 LENGTH OF BOLTS

1. The length of HSFG bolts shall comply with BS 4604:Part 1:1970 or BS 4604:Part 2:1970 as appropriate;
2. The length of bolts complying with BS 3692:1967, BS 4190:2001 and BS 4933:1973 shall be such that the end of the bolt will project above the nut by at least one thread, but by not more than one nominal bolt diameter, after tightening.

STW.W320.9 LENGTH OF THREADS

The length of threads on bolts shall be determined in accordance with BS 3692:1967, BS 4190:2001, BS 4395:Part 1:1969, BS 4395 Part 2:1969, BS 4395 Part 3:1973 or BS 4933:1973 as appropriate. If additional locknuts or other nuts are specified, the thread length shall be increased by one nominal bolt diameter for each additional nut.

STW.W330.9 NUTS

Nuts shall not be used with bolts or screws which comply with a different Standard.

STW.W340.9 WASHERS

Washers for HSFG bolts shall be provided in accordance with BS 4604:Part 1:1970 or BS 4604:Part 2:1970 as appropriate. Washers shall be provided for bolts complying with BS 3692:1967, BS 4190:2001 and BS 4933:1973 under the nut or bolt head, whichever is rotated during tightening, if the parts to be connected are to be coated with protective coatings before assembly. Washers shall be provided under the nuts and heads of bolts in oversized and slotted holes.

STW.W350.9 TIGHTENING BOLTS

Bolts shall be tightened in such a manner that the contact surfaces of permanent bolted joints are drawn into close contact.

STW.W360.9 TIGHTENING HSFG BOLTS

1. The degree of preliminary tightening of bolts and nuts complying with BS 4395:Part 1:1969 which are tightened by the part turn method shall be torque controlled. The tightening equipment for preliminary tightening shall be calibrated with a bolt load meter. The value of bedding torque for the preliminary tightening shall be within 10% of the values stated in the following table:

Bedding Torque for HSFG Bolts	
Nominal diameter of bolt (mm)	Bedding torque (N.m)
16	80
20	160
22	210
24	270
27	340
30	460

2. Bolts and nuts at each joint with bolts and washers with load indicating devices shall be initially tightened to bring the faying surfaces into close contact over the full area. The range of the average gap after initial tightening shall be as agreed by the CM. The bolts and nuts shall be re-tightened to close the average gap back to the agreed range. After all bolts and nuts at the joint have been initially tightened, the bolts and nuts shall be finally tightened to attain the shank tension stated in BS 4604:Part 1:1970 or BS 4604:Part 2:1970 as appropriate. The range of average gap corresponding to the required shank tension shall be established for each batch as defined in BS 4395:Part 1:1969, BS 4395:Part 2:1969 or BS 4395:Part 3:1973 as appropriate by testing at least three bolt, nut and washer assemblies in a bolt load meter and shall be as agreed by the CM. The average gap after final tightening shall be within the established range;

3. The threads of nuts for HSFG bolts which are to be tightened by the part turn method or the load indicating method shall not be lubricated unless Approved by the CM. If the use of lubricant is Approved in the part turn method, the bedding torque shall be established by a bolt load meter and shall be as agreed by the CM. The lubricant shall be applied at the place of manufacture and shall only be applied to the nut threads. The bearing surfaces of the nuts and the faying surfaces shall not be contaminated with the lubricant;

4. The bolt load meter for measuring bolt shank tension in the part turn, torque control or load indicating methods of tightening shall be calibrated by a laboratory approved by the CM before tightening of bolts and nuts starts and at regular intervals agreed by the CM. During re-calibration, a replacement calibrated bolt load meter shall be provided on the Site. Calibration results shall be submitted to the CM at least one week before the bolt load meter is used.

FABRICATION - APPROVAL AND DEFECTS

STW.W410.9 DEFECTIVE STEELWORK

Defective components for steelwork shall not be used in the permanent work unless repair of the defects is permitted by the CM. If permitted, defective components shall be repaired by methods agreed by the CM.

STW.W420.9 APPROVAL

Until the steelwork, including any repaired areas, complies with the specified test and inspection requirements and has been approved by the CM, fabricated steelwork shall not be:

1. Covered with protective coatings, concrete or other materials;
2. Erected; or
3. Despatched from the place of fabrication if fabricated off the Site.

PREPARATION OF STEELWORK TO RECEIVE COATINGS

STW.W510.9 CLEANING STEELWORK AND COATED SURFACES

1. Soil, concrete and other adherent matter shall be removed immediately from steelwork or coated surfaces and the surfaces shall be made good by methods agreed by the CM;
2. Dust, soot, grit, detritus, metallic or other loose particles shall be removed by vacuuming after steelwork surfaces have been blast cleaned or before coated surfaces are washed or steam cleaned;
3. Oil and grease shall be removed by emulsion cleaners, by steam cleaning or by high pressure water jets before removing rust and mill scale or overcoating. Oil and grease shall not be removed by turpentine or other solvents. If steam cleaning is used, steam cleaning shall be carried out after the greasy deposits have been removed by scraping and a detergent shall be added to the feed water of the steam generator;
4. Salts, chemicals, corrosion or paint degradation products, including rust-spotting on blast cleaned surfaces and zinc salts on zinc coatings or zinc-rich paints, shall be removed by washing with detergent solution before coating steelwork surfaces or overcoating;
5. The final shop coats on external surfaces shall be thoroughly washed with a detergent solution at the Site before being overcoated;
6. Unless otherwise permitted by the CM finished coated surfaces shall be cleaned as stated in sub-clauses (2), (3), and (4) not more than 14 days before handover of the steelwork;
7. Cleaning agents to be used shall be as agreed by the CM. Surfaces which have been cleaned using cleaning agents shall be rinsed with fresh water to remove all traces of the cleaning agent;
8. Cleaning tools shall be a type which will not result in damage to the surfaces being cleaned. Wire brushes and brooms shall not be used for cleaning coated surfaces.

STW.W520.9 PREPARATION OF STEEL SURFACES

1. Bare metal surfaces of steelwork which are to be painted or metal coated shall be treated before rust and mill scale are removed in accordance with the following requirements:
   a. Burrs, arrises and serrations shall be smoothed by grinding or filing;
   b. Weld spatter, weld slag and raised metal laminations shall be removed by grinding or chipping and the surface shall be made good.
2. Rust and mill scale shall be removed from steelwork which is to be metal coated in factories by a pickling process which is compatible with the metal coating process;
3. Rust and mill scale shall be removed from steelwork which is to be metal sprayed by blast cleaning carried out in accordance with BS 2569:Part 1:1964, Clause 3;
4. Rust and mill scale shall be removed from steelwork which is to be painted by blast cleaning as stated in STW.W540 unless the use of acid-pickling, mechanical cleaning or flame cleaning as stated in STW.W550 to STW.W570 has been approved by the CM;
5. Excess acid or other chemicals used in the pickling process shall be removed from steelwork which has been prepared by pickling before the application of the metal coating. Pickling shall not be carried out for longer than is necessary to remove the rust and mill scale.

STW.W530.9 METAL COATINGS

1. Metal coatings which will be overcoated with paint shall not be passivated;
2. Damaged areas of metal coatings shall be rubbed down to remove excessive roughness, cleaned and made good with a compatible coating of a type approved by the CM;
3. Metal coatings required on part of a component shall be completed before the rest of the component is painted.

STW.W540.9 BLAST CLEANING

1. Carry out blast cleaning of steelwork to second quality of surface finish in accordance with Sa 2½ in Swedish Standard SIS 05 59 00:1988 using chilled iron abrasive;
2. Grade chilled iron grit in accordance with BS 2451:1963. The maximum size of grit shall be G17 for use in automatic impeller type equipment and shall be G12 for manual or compressed air equipment. The difference in level between a peak and the adjacent trough of the blasted surface profile shall not exceed 0.1 mm;
3. Do not use non-metallic abrasives with a maximum particle size not exceeding 1 mm other than with portable equipment;
4. Abrasives shall not contain materials which may contaminate the steel surfaces. Do not use sand containing salt or excessive amounts of silts. Remove contaminants from recovered abrasives before re-use;
5. Carry out blast cleaning in a fully enclosed space separated from the place of painting. The enclosed space shall be fitted with dust extractors and filters to prevent the dispersal of dust outside the enclosed space.

STW.W550.9 ACID PICKLING

Acid-pickling of steelwork shall be carried out by the Footner process in accordance with BS 5493:1977, Clause 14.3.2. The first priming coat of paint shall be applied as soon as the steel has dried and is still warm.

STW.W560.9 MECHANICAL CLEANING

Mechanical cleaning of steelwork shall be carried out using carborundum grinding discs or other power-driven tools followed by steel wire brushing and dusting to remove all loosened material which is not firmly bonded to the metal surface. Excessive burnishing of the metal through prolonged application of rotary wire brushes shall not be carried out. Visible peaks and ridges shall be removed. Pneumatic chipping hammers shall not be used.

STW.W570.9 FLAME CLEANING

1. Flame cleaning shall be carried out without distorting the steelwork and without adversely affecting the properties of the steel. The temperature of the steel surface being flame cleaned shall not exceed 200°C;
2. Loose materials shall be removed from the flame-cleaned surface by wire brushing followed by blowing dry air or vacuuming. The priming coat shall be applied when the surface temperature of the steel is between 35°C and 40°C. Surfaces with temperatures of less than 35°C shall be reheated;
3. Flame cleaning of steelwork shall not be carried out at the following locations:
    a. Within 2 m of HSFG bolts, cold worked high tensile steel and surfaces already coated with paint or cadmium, lead-based or carbonaceous materials;
    b. On sections thinner than 0.5 mm.

STW.W580.9 BOLTS, NUTS AND WASHERS

Bolts, nuts and washers for steelwork shall be kept free from dirt and deleterious material. Oil and grease on bolts, nuts and washers other than Approved lubricants for nuts of HSFG bolts, shall be removed before assembling and coating the exposed parts of assembled bolts, nuts and washers.

STW.W590.9 APPROVAL

Surfaces shall not be coated until the cleaning and preparation of the surfaces have been approved by the CM.

PAINTING SYSTEMS

STW.W610.9 SYSTEM A

Here shown or scheduled on the Drawings, apply the following paint system:

1. Primer: 1 coat of high build zinc phosphate paint;
2. Undercoat: 2 coats of oil based with micaceous iron oxide phenolic paint;
3. Finish: 1 coat of alkyd resin paint;
4. Minimum total DFT: 250 microns.

STW.W620.9 SYSTEM B

Where shown or scheduled on the Drawings, apply the following paint system:

1. Primer: 1 coat of epoxy resin with aluminium mastic paint;
2. Undercoat: 1 coat of epoxy resin paint;
3. Finish: 1 coat of epoxy resin paint;
4. Minimum total DFT: 280 microns.

STW.W630.9 SYSTEM C

Where shown or scheduled on the Drawings, apply the following paint system:

1. Primer: 1 coat of inorganic zinc silicate paint DFT 75 microns;
2. Undercoat: 2 coats of high build micaceous iron oxide epoxy paint;
3. Finish: 1 coat of high build amine adduct cure epoxy paint;
4. Minimum total DFT: 320 microns.

STW.W640.9 SYSTEM D

Where shown or scheduled on the Drawings, apply the following paint system:

1. Primer: 1 coat of two pack wash primer DFT 5 microns;
2. Undercoat: 1 coat of epoxy resin paint;
3. Finish: 1 coat of epoxy resin paint or 2 coats of polyurethane paint;
4. Minimum total DFT: 180 microns.

STW.W650.9 SYSTEM E

Where shown or scheduled on the Drawings, apply the following paint system:

1. Inhibitor: rustoleum or other rust inhibitor paint Approved by the CM;
2. Primer: zinc phosphate, for hot-dip galvanized or GI surface, 'T' wash as specified in BS 5493:1977, Section 2, Clause 11.3.2;
3. Undercoat: 2 coats of micaceous iron oxide paint;
4. Finish: 1 coat of oil based paint or 1 coat of micaceous iron oxide paint;
5. DFT of each coat: as recommended by the manufacturer.

APPLYING PAINT TO STEELWORK

STW.W710.9 GENERAL

1. The different types of paints within each painting system shall be compatible with each other and shall be manufactured by the same manufacturer. Successive coats in a painting system including stripe coats, shall be in contrasting colours to aid identification;
2. Surfaces which are to be painted shall be dry immediately before paint is applied;
3. Paint shall be taken from the paint store ready for application. Thinning, if necessary, shall be carried out in the paint store in the presence of the CM and using the type of thinner in the ratio stated in the manufacturer's data sheets;
4. Paint shall be applied by brush, by air pressure spray or by airless spray. Sealer and primers shall be applied by continuous spraying;

5. Each coat in the paintwork system shall be sufficiently dry or cured before the next coat is applied. The time between the application of successive coats shall be within the limits recommended by the manufacturer and the limits stated in STW.W730;
6. Paints having a pot life specified by the manufacturer, including two pack paints and moisture cured paints, shall be discarded on expiry of the pot life or at the end of each working day, whichever comes first. Other paints in opened containers shall be kept in sealed containers with not more than 10% ullage in store after each day's work and shall not be thinned or mixed with fresh paint when re-issued for another day's work.

STW.W720.9 AMBIENT CONDITIONS

1. Paint shall not be applied to steelwork under the following conditions:
   a. When the ambient temperature falls below 4°C or the relative humidity rises above 90%;
   b. For outdoor work, during periods of inclement weather including fog, frost, mist and rain or when condensation has occurred or is likely to occur on the metal;
   c. When the surface temperature of the metal to be painted in less than 3°C above the dew point of the ambient air;
   d. When the amount of dust in the air or on the surface to be painted is in the opinion of the CM excessive;
2. Two pack paints of the epoxide resin type shall not be applied and cured when the temperature is below that recommended by the paint manufacturer.

STW.W730.9 TIME LIMITS ON PAINTING

1. Blast cleaned steel shall be primed or metal coated within 4 hours after blast cleaning;
2. Primed steel surfaces shall be overcoated within 8 weeks after priming;
3. Second undercoats shall be applied within 72 hours after application of the first undercoat;
4. Sealer or etch primer to sprayed metal shall be applied within 4 hours after spraying. The etch primed surfaces shall be overcoated within 72 hours after priming;
5. Etch primer to galvanized steelwork shall be applied within 14 days after delivery of the steelwork to the Site. The etch primed surfaces shall be overcoated within 48 hours after priming;
6. Overcoats to two pack paints of the epoxide of polyurethane type shall be applied within 48 hours after application of the two pack paint. If it is not possible to overcoat within 48 hours, the two pack paint shall be abraded to produce a roughened surface and shall be given a flash coat of primer of a type approved by the CM. The primer shall be allowed to dry for at least 4 hours before application of the next coat of the system.

STW.W740.9 STRIPE COATS

Immediately after the first undercoat of the painting system to steelwork has dried, a stripe coat of undercoat paint shall be applied by brush to edges, corners, crevices, exposed parts of bolts, nuts, rivets and welds. Another stripe coat of finishing paint shall be applied in the same manner after the last undercoat has dried.

STW.W750.9 FINISH THICKNESS

1. The dry film thickness of the paint coats to steelwork shall be measured using a magnetic dry film thickness gauge or other apparatus Approved by the CM. The total dry film thickness shall be measured at spacings of approximately 1.0 m. If the measured dry film thickness is less than 75% of the specified nominal dry film thicknesses or if more than 10% of the measured dry film thickness are less than 95% of the specified nominal dry film thickness, repair work shall be carried out as stated in STW.W780;
2. Wet film thickness gauges shall not be used as a means of determining whether the dry film thickness of the painting system complies with this Specification.

STW.W760.9 FINISH QUALITY

1. Each coat of paint shall be free from embedded foreign matter, mechanical damage and surface defects, including bittiness, blistering, brush marks, bubbling, cissing, cracking, cratering, dry spray, floating, pinholing, rivelling, runs, sagging, spotting and spray mottle as stated in BS 2015:1992. The finished paintwork system shall have an even and uniform appearance;
2. Each coat of paint shall adhere firmly to the substrate without blistering, chipping, flaking or peeling.

STW.W770.9 ETCH AND BLAST PRIMERS

Etch primers and blast primers shall not be applied on phosphated steel and shall not be overcoated with zinc-rich primers.

STW.W780.9 REPAIRS TO DAMAGED PAINT

1. Areas of paint to steelwork which have been damaged shall be cleaned to bare metal or to the metal coating; the edges of the undamaged paint shall be bevelled;
2. The full specified painting system shall be restored in such a manner that each new paint coat overlaps the existing paint by at least 50 mm all round the affected part.

PROTECTION OF JOINTS AND SURFACES

STW.W810.9 SHOP BOLTED JOINTS

Blast primer for painted steelwork or sprayed metal plus sealer for metal sprayed steelwork shall be applied to the joint and parent material of shop-bolted joints other than HSFG bolted joints. Joints for painted steelwork shall be assembled after the first undercoat of the painting system has been applied to the contact surfaces and while the undercoat is still wet.

STW.W820.9 SITE BOLTED JOINTS

Surfaces of the parent and joint material of site-bolted joints other than HSFG bolted joints shall be coated with the same protective system as the parent material.

STW.W830.9 HSFG BOLTED JOINTS

1. The faying surfaces of HSFG bolted joints in steelwork which is metal sprayed overall and sealed or metal sprayed and painted overall shall be coated with the sprayed metal. The sealer on the parent material shall extend for a distance of between 10 mm and 20 mm inside the perimeter of the faying surfaces. Free surfaces and edges of the joint material shall be coated with the same sealer;

2. The joint material and the faying surfaces on the parent material of steelwork which is metal sprayed only at joints and painted overall shall be metal sprayed. The sprayed metal on the parent material shall extend for a distance of between 10 mm and 20 mm outside the perimeter of the faying surfaces. The primer on the parent material shall extend for a distance of between 10 mm and 20 mm inside the perimeter of the faying surfaces. Sprayed metal on the free surfaces and edges of the joint material shall be coated with a sealer which is compatible with the painting system;
3. The primer on the parent material of steelwork which is painted overall and undercoat at faying surfaces of HSFG bolted joints shall extend for a distance of between 10 mm and 20 mm inside the perimeter of the faying surfaces.

STW.W840.9 WELDED JOINTS

Welds and steelwork surfaces which have been affected by welding shall be coated with the same protective system as the parent material.

STW.W850.9 JOINTS MADE AFTER COMPLETION OF COATING

1. Hot-dip galvanizing and electroplating to steelwork shall not be carried out until all welds for the steelwork which is to be galvanized or electroplated have been completed;
2. Except as stated in sub-clause (4), sprayed metal on the parent material shall be kept at least 15 mm, but not more than 300 mm, clear of areas which are to be welded. The restricted area shall be masked during metal spraying;
3. Except as stated in sub-clause (4), successive coats of paint on the parent material shall be stepped back at 30 mm intervals commencing at 100 mm from welded joints and at 10 mm from the perimeter of HSFG bolted joints;
4. If the parent metal in the Approved welding procedure is coated with the pre-fabrication primer or sprayed metal such coatings are permitted to cover the area to be welded. After welding the pre-fabrication primer or sprayed metal adjacent to the weld shall be made good;
5. The parent material, joint material, exposed part of bolts, nuts and washers, welds and weld affected areas shall be cleaned, prepared and brought up to the same protective system as the adjoining surfaces not more than 14 days after the joints have been made.

STW.W855.9 REINSTATEMENT OF ZINC COATING WITH POST-GALVANIZING WELDING

1. Where post-galvanizing welding is necessary and permitted by the CM, the zinc coating shall be ground off the mating surfaces directly before welding. Immediately after welding, the surface of the weld area shall be prepared by removal of slag with the chipping hammer followed by vigorous wire brushing. The zinc coating shall then be reinstated within 4 hours of welding by either:
    a. Application of the two coats of an organic zinc rich paint (zinc content at least 95%) to an overall dry film thickness greater than 100 μm in accordance with BS EN ISO 12944 (1998); or
    b. Pre-heating the surface of the weld area to 315°C and application of proprietary metallic repair stick or powder to a thickness greater than 100 μm.
2. If reinstatement of the zinc coating takes place after 4 hours of welding, the weld areas shall be vacuum-grit blasted in accordance with BS EN ISO 8501 "first quality" and hot-zinc spray coated in accordance with BS EN ISO 2063 (2005) to a minimum coating thickness of 100 μm;

3. After reinstatement of the zinc coating, the specified paint system shall be applied to the repaired area in accordance with STW.W610 to STW.W780 in such a manner that each new paint coat overlaps the existing paint by at least 50 mm all round the affected part.

STW.W860.9 SEALING JOINTS

1. The different parts of joints in steelwork shall be dry immediately before the joints are assembled;
2. Gaps around the perimeter of bolted joints and load indicator gaps of HSFG bolts in steelwork painted overall shall be sealed by brush application of the same painting system as the parent material; gaps shall be plugged if necessary with soft solder wire without flux core as a backing before sealing with paint.

STW.W870.9 HOLLOW SECTIONS

The ends of hollow steel section shall be sealed by welding mild steel plates over the open ends; the plates shall be at least 5 mm thick. Immediately before hollow steel sections are sealed, bags of anhydrous silica gel shall be inserted in each void at the rate of 0.25 kg/m^3 of void.

STW.W880.9 BRIDGE BEARING SURFACES

Dirt, oil, grease, rust and mill scale shall be removed from the metal bearing surfaces for bridge bearings. The surfaces shall be masked with tape or other methods agreed by the CM and shall not be primed or painted until the bonding agent has been applied.

STW.W890.9 UNCOATED SURFACES

The coated surfaces of steelwork coated over part of the surface shall be protected from rust which may form on the uncoated surfaces. Temporary coatings which may affect the bond between concrete and uncoated surfaces against which the concrete is to be placed shall be removed and the uncoated surfaces shall be cleaned before the concrete is placed. The full coating system shall extend 25 mm, or 75 mm for steel piles, into areas against which concrete is to be placed.

ERECTION OF STEELWORK

STW.W910.9 FOUNDATION BOLTS

1. Foundation bolts for steelwork shall be held firmly in the set position during fixing. Measures shall be taken to ensure that the full movement tolerances are achieved and the bolts are not displaced during concreting. Bolts and nuts, including the threads, shall be protected against damage, corrosion and contamination;
2. Bolt pockets shall be kept dry and clean. Tubes which are cast in concrete for grouting bolt pockets shall be securely fixed and sealed to prevent ingress of grout during concreting;
3. Bolts in bolt pockets shall be installed in such a manner that the bolt can be moved inside the pocket as designed without hindrance.

STW.W920.9 SUPPORTING DEVICES

The material, size, position and cover of packs, shims and other supporting devices for steelwork which are to be embedded shall be as approved by the CM.

STW.W930.9 TEMPORARY SUPPORTS AND FASTENINGS

1. Steelwork shall be secured in position by temporary supports and fastenings until sufficient permanent connections are complete to withstand the loadings liable to be encountered during erection. The temporary supports and fastenings shall be capable of withstanding loadings which may be encountered during erection and shall not damage the steelwork or the protective coatings;
2. Riveted and bolted connections shall be aligned using drifts complying with BS 5400:Part 6:1980, Clause 4.12 and shall be temporarily fastened using service bolts.

STW.W940.9 ALIGNMENT

1. Steelwork shall be erected in such a manner that the alignment and levels of the steelwork comply with the tolerances stated in TOL.STW.040. Allowance shall be made for the effects of temperature on the steelwork;
2. Measures shall be taken to ensure that the steelwork will remain stable before temporary supports and fastenings are slackened or removed for lining, levelling, plumbing or other purposes. The temporary supports and fastenings shall be re-tightened or replaced as soon as the adjustments are complete and at the end of each continuous period of working;
3. Permanent connections shall be made as soon as a sufficient portion of the steelwork has been lined, levelled and plumbed. Temporary supports and fastenings shall be replaced by permanent connections progressively and in such a manner that the part connected are securely restrained in the aligned position at all times;
4. Permanent connections for each portion of steelwork shall be completed not more than 14 days after the portion has been erected.

STW.W950.9 COLUMN BASES

1. Column bases for each portion of steelwork shall not be bedded or grouted until the portion has been lined, levelled, plumbed and permanently connected. Spaces below the steel shall be dry, clean and free from rust immediately before bedding or grouting;
2. Proprietary types of grout shall be used in accordance with the manufacturer's recommendations;
3. Temporary timber wedges holding steel columns in position shall not project into pockets bases by more than one-third of the embedded length of the steel column. The pocket shall be initially concreted up to the underside of the wedges and the steel column shall be left undisturbed until 48 hours after concreting; the wedges shall then be removed and the remainder of the pocket shall be concreted.

TOLERANCES

STW.W1010.9 GENERAL

Refer to Appendix H 'Schedule of Tolerances' to this Specification.

OFF-SITE FABRICATION

STW.W1110.9 SUBMISSIONS

Where structural steelwork is to be fabricated off-site, submit the following items for Approval within a period from the notified date for commencement of the Works as specified in the Project Specific Specification:

1. The name, fabrication yard address with street maps and job reference of the fabricator and the following:
    a. A quality assurance (QA) scheme and testing regime on fabrication of the structural steelwork with the items as stipulated in STW.W1120; and
    b. A fabrication and delivery schedule.
2. A RSE appointed by the Contractor who shall carry out the duties as stipulated in STW.W1130;
3. A laboratory for carrying out the tests and issuing test certificates in the QA scheme, which shall be accredited either by Hong Kong Accreditation Scheme (HKAS) under the Hong Kong Laboratory Accreditation Scheme (HOKLAS), or an equivalent organization which has signed a mutual recognition agreement with HOKLAS.

STW.W1120.9 QUALITY ASSURANCE (QA) SCHEME

Ensure that the steelwork is fabricated under a quality assurance scheme which covers the following items and is certified under ISO 9001:

1. Organisation chart of the fabrication yard with the qualification and experience of key technical personnel clearly stated;
2. Responsibility of the management in respect of the fabrication process;
3. Material purchasing and delivery procedures;
4. Material / product identification, traceability process and control;
5. Fabrication and inspection process;
6. Designated welders who shall be tested to and comply with the requirements of this Specification;
7. Quality control testing regime including welding procedural test and chemical analysis for welding consumables used for temporary or permanent structural steelworks on Site of steel grade as stated in STW.M110 and shown in the working drawings;
8. Control on non-compliant materials and works;
9. Transportation and storage process.

STW.W1130.9 REGISTERED STRUCTURAL ENGINEER

1. Appoint a Registered Structural Engineer (RSE) registered under Buildings Department for ensuring and certifying that the fabrication works are in compliance with the drawings and Specification;
2. The duties and roles of the RSE include but not limited to:
    a. Pay regular site visits to off-site fabrication yard for proper control of the works and submit reports after each visit;
    b. Carry out inspection on all activities which, in his professional judgement, are critical and require close supervision.
3. The frequency of RSE's visits shall be a minimum of two visits per month.

TESTING

PROCEDURE TRIALS FOR WELDING, FLAME CUTTING AND SHEARING

STW.T010.9 GENERAL

1. If in the opinion of the CM the proposed welding procedure submitted as stated in STW.M760 or the proposed stud welding, flame cutting or shearing procedure for steelwork complying with BS 5400:Part 6:1980 submitted as stated in STW.M770 has not complied with the procedure trial requirements for the procedure stated in the Contract in previous tests, a procedure trial shall be carried out as stated in STW.T020;
2. Procedure trials for welding, flame cutting and shearing shall be carried out in the presence of an inspecting authority approved by the CM.

STW.T020.9 PROCEDURE TRIALS

1. Procedure trials for welding for structural steel shall comply with BS 5400:Part 6:1980, Clauses 4.7.3, 5.4.1.1 and 5.4.1.2;
2. Procedure trials for welding for steel castings shall comply with BS 5400:Part 6:1980, Clauses 4.7.3 and 5.4.2;
3. Procedure trials for welding of studs shall comply with BS 5400:Part 6:1980, Clauses 4.7.4 and 5.4.4;
4. Procedure trials for flame cutting and shearing shall comply with BS 5400:Part 6:1980, Clauses 4.7.3 and 5.4.3;
5. Welds for grade A steels complying with BS 4360:1986 are not required to comply with the requirements for Charpy V-notch impact tests. The temperature of -20°C stated in BS 5400:Part 6:1980, Clause 5.4.1.2(a)(3) shall be amended to 0°C;
6. If in a welding procedure one or more of the parts to be welded is coated with a prefabrication primer or metal coating before welding, the same primer or coating shall be applied to the same before the procedure trial for the welding procedure is carried out;
7. The thickness of the sample of material to be used in procedure trials for flame cutting shall be:
    a. 20 mm for material not exceeding 20 mm thick;
    b. 40 mm for material exceeding 20 mm and not exceeding 40 mm thick;
    c. T mm for material exceeding (T-10) mm and not exceeding T mm thick, where T is any multiple of 10 from 50 up.

STW.T030.9 TRIAL RESULTS

If a procedure trial for welding, flame cutting or shearing does not comply with the specified requirements for the procedure trial, the cause of failure shall be established by the Contractor and particulars of proposed changes shall be submitted to the CM. Further procedure trials shall be carried out to establish the amended procedure unless otherwise permitted by the CM.

STW.T040.9 APPROVED PROCEDURES

1. A welding flame cutting or shearing procedure which complies with the specified requirements for the procedure trial shall become an Approved procedure;
2. If a procedure trial is not required, the procedure for welding, flame cutting or shearing submitted as stated in STW.M760 and STW.M770 shall become an Approved procedure;
3. Welding, flame cutting or shearing shall not commence until the procedure has been approved by the CM.

STW.T050.9 CHANGES TO APPROVED PROCEDURES

Unless permitted by the CM, Approved procedures for welding, flame cutting or shearing shall not be changed. Further procedure trials shall be carried out to demonstrate proposed changes to the procedure unless otherwise permitted by the CM.

STW.T060.9 RECORDS

1. A record of the Approval test for welding procedures shall be submitted to the CM for approval at least 3 weeks before fabrication of the steelwork starts. The record shall be in the form stated in BS 4870:Part 1:1981, Appendix B or BS 4570:1985, Appendix A as appropriate and shall be endorsed by the inspecting authority approved by the CM;
2. Reports of procedure trials for stud welding, flaming cutting and shearing shall be submitted to the CM at least 3 weeks before fabrication of the steelwork starts.

PAINTING TRIALS

STW.T110.9 GENERAL

1. A painting trial shall be carried out for each painting system which will be applied to areas exceeding 100 m² to demonstrate that the proposed materials and methods of application will produce a painted surface which complies with the specified requirements;
2. Painting trials shall be carried out at the place where painting to the permanent work will be carried out and using the employees and equipment which will be used to carry out painting to the permanent work;
3. Painting trials shall be carried out on blast cleaned steel.

STW.T120.9 TRIAL RESULTS

If the painted surface produced in a painting trial does not comply with the specified requirements for the paintwork, the cause of failure shall be established by the Contractor and particulars of proposed changes shall be submitted to the CM. Proposed changes to the paint formulation, other than an adjustment in the amount of thinners, shall be carried out at the paint manufacturer's work before the final painting trial and before the first batch of paint is delivered.

STW.T130.9 COMMENCEMENT OF PAINTING

Painting shall not commence until the painted surface produced in painting trial complies with the specified requirement for paintwork.

STW.T140.9 CHANGES TO MATERIALS AND METHODS OF APPLICATION

Unless permitted by the CM, the materials and methods of application used in a painting trial which complies with the specified requirements shall not be changed.

TESTING GENERALLY

STW.T210.9 TESTING CONSULTANT

Tests which are stated in this Specification to be carried out by an Approved testing consultant shall be carried out by a testing consultant employed by the Contractor and approved by the CM.

OFF-SITE TESTING

STW.T310.9 GENERAL

The test shall be carried out by the manufacturer at the manufacturer's works on samples selected by the manufacturer.

STW.T320.9 STRUCTURAL STEEL

Tests shall be carried out on structural steel in accordance with BS 5400:Part, 6:1980, Clauses 5.2.1, 5.2.2 and 5.3.

STW.T330.9 BOLTS, NUTS AND WASHERS

Carry out tests on bolts, nuts and washers in accordance with BS 3692:1967, BS 4190:2001, BS 4395:Part 1:1969, BS 4395:Part 2:1969, BS 4395:Part 3:1973 or BS 4933:1973 as appropriate. Carry out the tests on full size bolts. The rates of sampling and testing shall be in accordance with BS 4395:Part 1:1969.

TESTING STEELWORK GENERALLY

STW.T410.9 STEELWORK BATCHES

1. A batch of steelwork is the amount of steelwork stated in the Contract and which is completed or delivered to the Site at any one time;
2. Submit to the CM a list of the parts included in each batch at least 7 days before testing starts.

STW.T420.9 SAMPLING

1. Samples to be tested shall be selected by the CM if testing is to be carried out in Hong Kong and shall be selected by the Approved testing consultant if testing is not to be carried out in Hong Kong;
2. Samples shall be selected from positions which in the opinion of the CM or Approved testing consultant are representative of the batch as a whole;
3. The CM shall inform the Contractor of the samples selected for testing at least 3 days before testing starts.

STW.T430.9 TEST PROCEDURES

1. The relevant tests stated in STW.T520 to STW.T910 shall be carried out on each batch of steelwork;

2. Inform the CM at least 7 days before tests in Hong Kong are carried out.

STW.T440.9 TEST REPORTS

1. Records of tests on steelwork carried out by the Contractor or the Approved testing consultant shall be kept by the Contractor and a report shall be submitted to the CM at least 7 days before Approval of the batch of steelwork tested is required. The report shall contain the following details:
   a. Procedure tested and exact test location in the steelwork;
   b. Results of tests compared to the required values, with any non-complying results highlighted;
   c. Any tearing, cracking or other defects;
   d. Conclusion as to the overall acceptability of the parts of steelwork examined by the Approved testing consultant.
2. Report shall be certified by the Contractor's authorised representative or by the Approved testing consultant who carried out the test.

STW.T450.9 NON-COMPLIANCE OF STEELWORK

1. If the result of any test on steelwork stated in STW.T520 to STW.T910 does not comply with the specified requirements for the test, the test shall be carried out on additional samples from the batch. The number of additional tests shall be twice the number of original tests;
2. The batch shall be considered as not complying with the specified requirements for the test if the result of any additional test does not comply with the specified requirements for the test;
3. If the result of every additional test complies with the specified requirements for the test, only those parts the samples from which have failed in the original test shall be considered as not complying with the specified requirements of the test.

TESTING STEEL

STW.T510.9 SAMPLING

Provide samples of steel from each batch of steel within 3 days after delivery of the batch to the fabricator's work or to the Site. The rate of sampling and the position and direction of the samples shall be in accordance with BS 4360:1986.

STW.T520.9 TENSILE AND IMPACT TESTING

The tensile test and the impact test shall be carried out by Employer’s Specialist Contractor on each sample of steel. The method of testing shall be in accordance with BS 4360:1986.

STW.T530.9 QUALITY GRADING

Quality grading of structural steel shall be carried out by Employer’s Specialist Contractor on steel which has not been tested for quality grades by the manufacturer. Quality grading shall be carried out in accordance with BS 5400:Part 6:1980, Clause 3.1.4 or BS 5950:Part 2:1992, Clause 2.1.6 as appropriate.

TESTING WELDING CONSUMABLES

STW.T550.9 BATCH OF WELDING CONSUMABLES

In this Specification, a batch of welding consumables is the quantity of welding consumables of the same type and size, which may include one or multiple standard lot(s) as defined in the manufacturer's quality assurance programme, delivered to the Site, or the off-site fabrication yard as one consignment that is covered by the manufacturer's certificate(s) and under one delivery order, and shall not exceed five tonnes and twenty tonnes respectively.

STW.T560.9 TESTING OF WELDING CONSUMABLES

For each batch of welding consumables used for temporary or permanent structural steelworks on Site of steel grade as stated in STW.M110 and shown in the working drawings, prepare 2 test specimens for each standard lot and carry out the chemical analysis in accordance with BS EN ISO 2560:2009 or BS EN ISO 14341:2011 or BS EN ISO 14171:2010 or BS EN ISO 17632:2015 as appropriate, except for the standard lot(s) where complying chemical analysis results have been attained from the first chemical analysis under which circumstance no further chemical analysis is required for the same standard lot(s) in subsequent batches of welding consumables. The chemical analysis shall be carried out by an Approved laboratory, accredited either by the Hong Kong Accreditation Service (HKAS) under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or an equivalent organization which has signed a mutual recognition agreement with HKAS and is employed and paid for directly by the Contractor. Allow sufficient time for testing of welding consumables in the programme.

STW.T570.9 ACCEPTANCE CRITERIA - WELDING CONSUMABLES

A standard lot in a batch of welding consumables is deemed to comply with the requirements of the Specification if the test results meet the requirements of BS EN ISO 2560:2009 or BS EN ISO 14341:2011 or BS EN ISO 14171:2010 or BS EN ISO 17632:2015 as appropriate. If the test results of the first chemical analysis of a standard lot complied with the requirements of the Specification, further chemical analysis on the same standard lot in all subsequent batches of welding consumables delivered to the same Site or the same off-site fabrication yard is not required.

STW.T580.9 FAILURE OF TESTS

Non-compliance:

If any test specimen of the welding consumables does not comply with BS EN ISO 2560:2009 or BS EN ISO 14341:2011 or BS EN ISO 14171:2010 or BS EN ISO 17632:2015, the Contractor may choose to carry out further test(s) and take further test samples from the same lot of welding consumables at the Contractor's expense or remove the whole lot of the particular batch from Site and / or the fabrication yard for off-site fabrication if appropriate. If further test(s) is chosen, the number of further test(s) is to be calculated by the application of the formula given below and no extension of time will be allowed for the said further test(s). Bear the cost of such further test(s).

$$\text{number of further test(s)} = \left(n^2 - 2n + 3\right)$$

where n = total number of unsuccessful inspection(s) / test(s) progressively until all inspection(s) / test(s) is / are successful.

Typical example of calculating the number of further inspections / tests is given in Appendix I to this Worksection, for illustration purposes only.

Acceptance criteria and further actions arising from the further test(s) shall be in accordance with STW.T570.

For a standard lot with any non-compliant chemical analysis results, chemical analysis shall be carried out for the standard lot of welding consumables, as defined in the manufacturer's quality assurance programme, subsequently delivered to the same Site or the same off-site fabrication yard regardless of the results of the further test(s).

STW.T590.9 STANDARD FOR REJECTION

If the result of any test or any further test does not comply with the specified requirements in the Specification for any particular property, the standard lot in a batch of welding consumables is deemed failing to comply with the specified requirements for that property. Then:

1. The non-compliant standard lot in a batch of welding consumables shall be removed from the Site;
2. The non-compliant standard lot in a batch of welding consumables shall be removed from the off-site fabrication yard if appropriate.

TESTING WELDS

STW.T610.9 GENERAL

1. Examination and testing of welds shall be carried out after post-weld heat treatment and before the application of corrosion protective coatings. De-burring, dressing, grinding, machining and peening shall be carried out after the visual inspection for cracks, surface pores and joints fit-up and before other inspections and tests are carried out;
2. Testing shall be carried out by the Approved testing consultant except as stated in STW.T640.

STW.T620.9 DESTRUCTIVE TESTING

Destructive testing of welds for steelwork complying with BS 5400:Part 6:1980 shall be carried out in accordance with BS 5400:Part 6:1980, Clauses 5.5.1.1., 5.5.1.2 and 5.5.1.3.

STW.T630.9 NON-DESTRUCTIVE TESTING

Inspect welds for structural steel and steel castings visually in accordance with BS 5289:1976. Carry out non-destructive testing on a proportion of welds after visual inspection. The compliance criteria and the proportion of welds to be tested are denoted by quality categories as stated in BS 5135:1984, Table 18 for butt welds and in BS 5135:1984, Table 19 for fillet welds. The quality categories of welds shall be as stated in the following table:

Quality categories of welds				
	Steelwork complying with BS 5400:Part 6:1980		Steelwork complying with BS 5950:Part 2:1992	
	Butt welds	Fillet welds	Butt welds	Fillet welds
Welds stated in the Contract for 100% non-destructive testing	A	A	A	A

Welds stated in Table 18.2	D	D	D	D
Other welds	B	B	C	C

1. Carry out non-destructive testing of butt welds by ultrasonic examination in accordance with BS 3923:Part 1:1986 or BS 3923:Part 2:1972 or by radiographic examination in accordance with BS 2600:Part 1:1983, BS 2600:Part 2:1973 or BS 2910:1986. Carry out non-destructive testing of fillet welds by either the liquid penetrant method in accordance with BS 6443:1984 or the magnetic particle flaw detection method in accordance BS 6072:1981. The particular standard or part of standard to be used shall be appropriate for the joint geometry, material and production requirements and shall be as agreed by the CM. Dress welds to facilitate ultrasonic examinations;
2. If the parent metal adjacent to the length of weld subject to non-destructive testing has been tested for laminations in accordance with BS 5996:1980, the same areas on the parent metal shall be tested by ultrasonic examination in accordance with BS 3923:Part 1:1986 or BS 3923:Part 2:1972 as appropriate when non-destructive testing is carried out on that length of weld;
3. Inspect welds for steelwork which has been fabricated and tested by non-destructive testing at the fabricator's works visually for cracks when the steelwork is delivered to the Site. Examine 5% of the welds, other than welds stated in the Table in STW.M760, for cracks by the magnetic particle flaw detection method in accordance with BS 6072:1981.

STW.T640.9 INSPECTION OF WELDS

Inspection of welds will be carried out by the CM for welds stated in the table in STW.M760.

TESTING STUD SHEAR CONNECTORS AND RIVETS

STW.T710.9 GENERAL

Testing shall be carried out by the Contractor in the presence of the CM.

STW.T720.9 WELDED STUD SHEAR CONNECTORS

Tests shall be carried out on 5% of welded stud shear connectors in accordance with BS 5400:Part 6:1980, Clause 5.5.4.

STW.T730.9 RIVETS

Tests shall be carried out on 5% of driven rivets in accordance with BS 5400:Part 6:1980, Clause 5.8.

TESTING FABRICATION TOLERANCES

STW.T810.9 GENERAL

Testing shall be carried out by the Contractor in the presence of the CM.

STW.T820.9 PROCEDURE

Rolled and built-up sections of steelwork complying with BS 5400:Part 6:1980 shall be tested to determine compliance with fabrication tolerances in accordance with BS 5400:Part 6:1980, Clauses 5.6.1 to 5.6.6.

TESTING REPAIRS

STW.T910.9 GENERAL

Defects which have been repaired and adjoining areas which in the opinion of the CM may have been affected by the repair shall be retested as Instructed by the CM.

APPENDIX STW/I

STW.APPEND1.9 CALCULATION OF NUMBER OF FURTHER INSPECTIONS / TESTS

Typical Examples for Illustrative Purposes Only

1. Chemical analysis shows 2 samples failing to meet the requirements in the Specification.

2. The Contractor can either remove the standard lot of the particular batch of welding consumables from the Site and / or the fabrication yard for off-site fabrication or at his own expense, carry out further test(s) in accordance with the formula of:

   $\left(n^2 - 2n + 3\right)$ = 2^2 - 2 x 2 + 3

   = 3 further tests

3. If one of the above 3 further tests fails, the Contractor may order further tests to be carried out at the Contractor's own expense by re-applying the formula and taking into account the total number of failed samples. Altogether and based on the formula, the number of total retesting required:

   = 3^2 - 2 x 3 + 3

   = 6

   As 3 tests have already been carried out by the Contractor, the Contractor shall carry out:

   6 - 3 = 3 further tests

4. If the next 3 further tests show further failed samples, the formula will be re-applied as before until all the tests results are satisfactory.

WRS WATER RETAINING STRUCTURES

WRS WATER RETAINING STRUCTURES 2

MATERIALS 2

GENERAL 2

WRS.M010.9 APPLICATION OF OTHER WORK SECTIONS 2

WRS.M020.9 DEFINITION OF WATER RETAINING STRUCTURE 2

SLIDING LAYER 2

WRS.M110.9 GENERAL 2

WRS.M120.9 SUBMISSIONS 2

WRS.M130.9 SAMPLES 2

MATERIALS PROVIDED BY THE WATER SUPPLIES DEPARTMENT 3

WRS.M210.9 WATER AND STERILIZING CHEMICALS 3

WORKMANSHIP 4

GENERAL 4

WRS.W010.9 SUBMISSIONS 4

WRS.W020.9 STORING SLIDING LAYERS 4

WRS.W030.9 PROTECTION OF DRAINAGE SYSTEM 4

CONSTRUCTION 4

WRS.W110.9 LAYING SLIDING LAYERS 4

WRS.W120.9 FLOOR SLABS 5

WRS.W130.9 WALLS 5

WRS.W140.9 ROOF SLABS 5

WRS.W150.9 BUILT-IN PIPES 5

WRS.W160.9 PROTECTION PRIOR TO THE DEPOSITION OF FILL 5

DEPOSITION OF FILL MATERIAL 5

WRS.W210.9 GENERAL 5

WRS.W220.9 TIMING 6

CLEANING AND STERILIZATION 6

WRS.W310.9 CLEANING 6

WRS.W320.9 STERILIZATION 6

TESTING 7

DRAINAGE SYSTEMS 7

WRS.T010.9 TEST METHODS 7

WRS.T020.9 COMPLIANCE CRITERIA 7

WRS.T030.9 NON-COMPLIANCE 7

WATERTIGHTNESS OF ROOFS 7

WRS.T110.9 TEST METHODS 7

WRS.T120.9 COMPLIANCE CRITERIA 7

WRS.T130.9 NON-COMPLIANCE 8

WATERTIGHTNESS OF STRUCTURES 8

WRS.T210.9 GENERAL 8

WRS.T220.9 LOAN OF EQUIPMENT 8

WRS.T230.9 TEST METHOD 8

WRS.T240.9 DRAINING AFTER TEST 9

WRS.T250.9 COMPLIANCE CRITERIA 9

WRS.T260.9 NON-COMPLIANCE 9

WATER STERILITY 9

WRS.T310.9 SAMPLING 9

WRS.T320.9 TEST 9

WRS.T330.9 COMPLIANCE CRITERIA 9

WRS WATER RETAINING STRUCTURES

MATERIALS

GENERAL

WRS.M010.9 APPLICATION OF OTHER WORK SECTIONS

The following works and materials shall comply with the Worksections stated, unless otherwise stated in this Worksection:

1. Earthworks shall comply with Worksection EAR;
2. Formwork and finishes to concrete shall comply with Worksection FOR;
3. Steel reinforcement shall comply with Worksection CON3;
4. Concrete shall comply with Worksection CON1;
5. Joints in concrete shall comply with Worksection CON1;
6. Drainage systems shall comply with Worksection DRA2.

WRS.M020.9 DEFINITION OF WATER RETAINING STRUCTURE

Water retaining structure is a structure, or part of a structure, including walls, floors, roofs, columns and footings, which is stated in the Contract to be constructed for storing, conveying or excluding water, sewage or other aqueous liquids.

SLIDING LAYER

WRS.M110.9 GENERAL

Sliding layers below floor slabs of water retaining structures shall be a proprietary type of polythene sheeting approved by the CM. Polythene sheeting shall be impermeable and shall have a nominal thickness of 1.1 mm.

WRS.M120.9 SUBMISSIONS

Particulars of the source and type of proposed sliding layers for water retaining structures shall be submitted to the CM for approval at least 14 days before the first delivery of the sliding layer to the Site.

WRS.M130.9 SAMPLES

Samples of the proposed sliding layers for water retaining structures shall be submitted to the CM at the same time as the particulars of the sliding layer are submitted.

MATERIALS PROVIDED BY THE WATER SUPPLIES DEPARTMENT

WRS.M210.9 WATER AND STERILIZING CHEMICALS

Water and sterilizing chemicals for cleaning, sterilizing and testing water retaining structures as stated in WRS.W320 and WRS.T240 will be provided by the Water Supplies Department for one set of tests only for those parts of the Works as stated in the Project Specific Specification. The water and sterilizing chemicals, if to be so provided, shall be obtained from the locations stated in the Contract or from other locations agreed by the CM and shall be mixed by the Contractor.

WORKMANSHIP

GENERAL

WRS.W010.9 SUBMISSIONS

The following particulars shall be submitted to the CM at least 28 days before the relevant work starts:

1. Sequence and method of concreting bays in floor slabs, walls and roof slabs and in columns and footings;
2. Details of alternative locations of construction joints if required;
3. Details of type and size of waterstops at construction joints and box-outs;
4. Sequence and method of testing roofs for watertightness;
5. Details of method of testing water retaining structures for watertightness including:
    a. Arrangement of pumps and equipment;
    b. Source of water;
    c. Equipment for measuring fall in water level;
    d. Device for dampening the oscillatory motion of the water surface;
    e. Filling rate;
    f. Method of correction for evaporation and rainfall.

WRS.W020.9 STORING SLIDING LAYERS

Sliding layers for water retaining structures shall be stored in accordance with the manufacturer's recommendations in a dry weatherproof store.

WRS.W030.9 PROTECTION OF DRAINAGE SYSTEM

Measures shall be taken to prevent concrete and deleterious material from being deposited in drainage systems under floors and on roofs of water retaining structures. After construction and before testing, the drainage system shall be thoroughly cleaned by rodding and flushing to remove any deleterious material which may impede the flow of water into or through the drainage system. The lines and levels of drainage systems shall be within 20 mm of the specified horizontal alignment and within 10 mm of the specified vertical alignment.

CONSTRUCTION

WRS.W110.9 LAYING SLIDING LAYERS

Polyethylene sheeting in sliding layers below floor slabs of water retaining structures shall be laid flat without creases. Laps shall be at least 225 mm and there shall be no gaps at the edges of the bays.

WRS.W120.9 FLOOR SLABS

If reinforcement is continuous across the joint between bays in the floor slab of water retaining structures, the bays shall be concreted contiguously, in sequence, with a minimum period of 48 hours between completion of concreting one bay and commencement of concreting the adjacent bay.

WRS.W130.9 WALLS

1. If reinforcement is continuous across the joint between bays in the wall of water retaining structures, the bays shall be concreted contiguously, in sequence, with a minimum period of 72 hours between the completion of concreting the lift in one bay and commencement of concreting the adjacent lift in the adjacent bay;
2. Unless otherwise permitted by the CM, the first lift in each bay in the walls of water retaining structures shall be concreted within seven days after completion of concreting the adjacent base of the wall. Individual lifts shall be concreted in one continuous operation without cold joints, whether or not the full height of the wall is concreted in one lift. If the full height of the wall is not placed in one lift, succeeding lifts shall be concreted within seven days from concreting of the adjacent lift unless otherwise permitted by the CM.

WRS.W140.9 ROOF SLABS

If reinforcement is continuous across the joint between bays in the roof slab of water retaining structures, the bays shall be concreted contiguously, in sequence, with a minimum period of 48 hours between completion of concreting one bay and commencement of concreting the adjacent bay.

WRS.W150.9 BUILT-IN PIPES

Puddle flanges on built-in pipes in water retaining structures shall be located centrally within the formwork. Waterstops shall be fixed around the perimeter of box-outs to the built-in pipes.

WRS.W160.9 PROTECTION PRIOR TO THE DEPOSITION OF FILL

1. Immediately after the roof slab of water retaining structures has been tested, the slab shall be protected with damp sacks or by other methods agreed by the CM from exposure to conditions which may affect the slab. The protection shall be continued until the roof drainage system has been constructed or the fill material has been deposited and compacted;
2. Materials shall not be stockpiled on roof slabs of water retaining structures. Constructional Plant or other vehicles shall not stand or run on floor slabs or roof slabs of water retaining structures unless permitted by the CM.

DEPOSITION OF FILL MATERIAL

WRS.W210.9 GENERAL

Fill material shall be spread out evenly and shall not be stockpiled on roofs to water retaining structures. Weed killer or other chemicals shall not be applied to fill material on the roofs of water retaining structures for potable or fresh water.

WRS.W220.9 TIMING

1. Fill material shall not be deposited behind sections of walls of water retaining structures until at least seven days after completion of concreting to the section of wall;
2. Deposition of fill material on or adjacent to water retaining structures shall be carried out after the watertightness test on the structure has been completed, unless otherwise permitted by the CM.

CLEANING AND STERILIZATION

WRS.W310.9 CLEANING

Immediately before water retaining structures are tested for watertightness, all dust, debris, unused materials and equipment shall be removed from the structure and the interior of the structure shall be washed and brushed down with water.

WRS.W320.9 STERILIZATION

Water for washing water retaining structures for potable or fresh water shall be fresh, potable water incorporating a mixture of sterilizing chemicals added before the structure is washed at a concentration instructed by the CM. The structure shall be maintained in a clean condition after cleaning.

TESTING

DRAINAGE SYSTEMS

WRS.T010.9 TEST METHODS

Drainage systems under floors and on roofs of water retaining structures shall be tested in accordance with the following requirements:

1. Water shall be poured at different locations agreed by the CM along the drainage system and the flow of water observed at junction pits, outfalls and other discharge points;
2. A mandrel shall be pulled through each completed section of pipeline of 300 mm diameter or less. The mandrel shall be 750 mm long and 12 mm less in diameter than the nominal diameter of the pipe.

WRS.T020.9 COMPLIANCE CRITERIA

The results of tests on drainage systems for water retaining structures shall comply with the following requirements:

1. The water shall in the opinion of the CM be freely discharged by the drainage system;
2. The bore, linearity and jointing of pipes shall comply with the specified requirements.

WRS.T030.9 NON-COMPLIANCE

If the result of any test on the drainage system for water retaining structures does not comply with the specified requirements for the test, the Contractor shall investigate the reason. Remedial or replacement work approved by the CM shall be carried out and the drainage system shall be retested.

WATERTIGHTNESS OF ROOFS

WRS.T110.9 TEST METHODS

1. The roofs of water retaining structures shall be tested for watertightness over the complete area of the roof, including perimeter joints. Roofs shall not be tested in sections unless permitted by the CM;
2. Water shall be ponded on the roof for a period of three days and topped up to maintain a depth of at least 75 mm. The test shall be carried out before fill material is deposited or drainage systems are constructed on the roof.

WRS.T120.9 COMPLIANCE CRITERIA

There shall be no leaks or damp patches visible on the soffits of roofs of water retaining structures during or at the end of the test for watertightness.

WRS.T130.9 NON-COMPLIANCE

If the result of any test for watertightness of the roof of a water retaining structure does not comply with the specified requirements for the test, the Contractor shall investigate the reason. Remedial or replacement work approved by the CM shall be carried out and the roof shall be retested.

WATERTIGHTNESS OF STRUCTURES

WRS.T210.9 GENERAL

Each compartment of structures which incorporate division walls shall be tested separately with adjoining compartments empty. The complete structure shall also be tested.

WRS.T220.9 LOAN OF EQUIPMENT

The equipment for recording water levels in tests on water retaining structures as stated in WRS.T230 will be loaned by the Water Supplies Department only for those parts of the Works as stated in the Project Specific Specification.

WRS.T230.9 TEST METHOD

1. The structure shall be filled with water at an approximately uniform rate not exceeding 2 m depth in 24 hours to the levels stated in the following table:

Tests on water retaining structures		
Type of structure	Part of structure tested	Test water level
Water retaining structures other than for sewage	Structure with division wall - each compartment of structure	100 mm below top of division wall
	Structure with division wall - complete structure	Top water level of structure
	Structure without division wall	
Water retaining structures for sewage	Structure with division wall - each compartment of structure	Top water level of structure
	Structure with division wall - complete structure	
	Structure without division wall	

2. The water used for testing water retaining structures for potable or fresh water shall be fresh potable water. The permission of the CM shall be obtained before filling starts. The structure or each compartment of the structure being tested shall be kept full for 7 days before testing to allow for absorption;

3. After the period for absorption, the water shall be topped up to the specified level and the test shall begin. During testing, the oscillatory motion of the water surface shall be dampened. The test period shall be 7 days;

4. The equipment for recording water levels shall be installed in a temporary enclosure of minimum dimensions 2 m x 2 m x 2.5 m high with a lockable door. The enclosure shall be located over stilling wells, manhole openings or other points of recording water levels. The temporary enclosure shall be removed on completion of the test. The equipment shall be calibrated before testing starts and at regular intervals agreed by the CM and shall be readable and accurate to 0.5 mm;

5. The fall in water level of water retaining structures shall be measured at hourly intervals between 8 am and 5 pm each day. The total fall shall be measured at the end of the test period.

WRS.T240.9 DRAINING AFTER TEST

1. Except as stated in sub-clause (2), structures shall be emptied after completion of testing and maintained in a clean dry condition. The water shall be removed at an approximately uniform rate not exceeding 2 m depth in 24 hours. The permission of the CM shall be obtained before emptying starts;
2. Unless otherwise instructed by the CM, the water used for the final tests on water retaining structures for potable or fresh water shall be retained in the structure and shall not be wasted or contaminated.

WRS.T250.9 COMPLIANCE CRITERIA

The results of tests for watertightness of water retaining structures shall comply with the following requirements:

1. The total fall in water level at the end of the test period, after adjustment for evaporation and rainfall, shall not exceed 1/500 times the maximum specified depth of water in the test or 10 mm, whichever is less;
2. There shall be no leaks or damp patches visible on the surface of the structure, including any division walls, during or at the end of the test.

WRS.T260.9 NON-COMPLIANCE

If the result of any test for watertightness of a water retaining structure does not comply with the specified requirements for the test, the Contractor shall investigate the reason. Remedial or replacement work approved by the CM shall be carried out and the structure shall be retested.

WATER STERILITY

WRS.T310.9 SAMPLING

After the test for watertightness of a water retaining structure for potable or fresh water has been completed, samples of the water in the structure shall be taken by the CM. The number of samples and location of sampling shall be as instructed by the CM.

WRS.T320.9 TEST

Each sample of water shall be tested to determine the bacteriological content.

WRS.T330.9 COMPLIANCE CRITERIA

The results of tests for bacteriological content of the water shall demonstrate that in the opinion of the CM the structure has been adequately sterilized.

WSP WATER SUPPLY PIPEWORK

WSP WATER SUPPLY PIPEWORK 5

MATERIALS 5

GENERAL 5

WSP.M010.9 APPLICATION OF OTHER WORKSECTIONS 5
WSP.M020.9 DEFINITIONS 5
WSP.M030.9 MATERIALS GENERALLY 5

PIPES AND FITTINGS 5

WSP.M110.A STEEL PIPES AND FITTINGS 5
WSP.M120.9 DUCTILE IRON (DI) PIPES AND FITTINGS 7
WSP.M130.9 UPVC PIPES AND FITTINGS 7
WSP.M140.9 GREY IRON PIPES AND FITTINGS 7
WSP.M150.9 FLANGES 7

ANCILLARY MATERIALS 8

WSP.M210.9 BOLTS AND NUTS 8
WSP.M220.9 ELASTOMERIC JOINT RINGS 8
WSP.M230.A ANTICORROSION TAPE 8
WSP.M240.9 BITUMINOUS COATINGS 9
WSP.M250.9 WHITEWASH 9
WSP.M260.9 ZINC-BASED PAINT 9
WSP.M270.9 JOINT FILLER 9
WSP.M280.9 COMPRESSIBLE PADDING 9
WSP.M290.9 POLYETHYLENE SHEETING 9
WSP.M300.9 EXTENSION KEYS 9

MATERIALS PROVIDED BY THE AUTHORITY OR WATER SUPPLIES DEPARTMENT 10

WSP.M410.9 PIPES, FITTINGS AND VALVES ETC 10
WSP.M420.9 WATER AND CHEMICALS 10
WSP.M430.9 PROCUREMENT 10

INSPECTION AND SUBMISSIONS 10

WSP.M510.9 INSPECTION OF MANUFACTURE AND TESTING 10
WSP.M520.9 PIPES JOINTS AND FITTINGS 11

WORKMANSHIP 12

GENERAL 12

WSP.W010.9 ACCESS TO PIPELINES 12
WSP.W020.9 SETTING OUT OF PIPELINES 12
WSP.W030.9 CONNECTION TO EXISTING WATER MAINS 12

TRANSPORT HANDLING AND STORAGE 13

WSP.W110.9 PIPES, JOINTS AND FITTINGS GENERALLY 13
WSP.W120.9 HANDLING PIPES AND FITTINGS 13
WSP.W130.9 STORING PIPES 13
WSP.W140.9 TRANSPORTING THIN WALLED PIPES 14
WSP.W150.9 HANDLING AND STORING THIN WALLED PIPES 14
WSP.W160.9 STORING VALVES 14

LAYING AND BEDDING PIPES 14

WSP.W210.9 LAYING PIPES GENERALLY 14
WSP.W220.9 LAYING STEEL PIPES 15
WSP.W230.9 LAYING FLEXIBLY JOINTED PIPES 15
WSP.W240.9 INSTALLING VALVES 15
WSP.W250.9 BEDDING PIPES 15

CUTTING AND DRILLING PIPES 15
WSP.W310.9 CUTTING 15
WSP.W320.9 DRILLING 16
JOINTING PIPES 16
WSP.W410.9 GENERAL 16
WSP.W420.9 PIPES WITH PUSH-IN JOINTS 16
WSP.W430.9 DI PIPES WITH MECHANICAL JOINTS 17
WSP.W440.9 WELDING JOINTS IN STEEL PIPES 17
WSP.W450.9 SUBMISSIONS FOR WELDING 17
WSP.W460.9 STEEL PIPES WITH SPIGOT AND SOCKET JOINTS 17
WSP.W470.9 STEEL PIPES WITH WELDED STEEL COLLAR JOINTS 18
WSP.W480.9 STEEL PIPES WITH COUPLINGS AND FLANGE ADAPTERS 18
WSP.W490.9 UPVC PIPES WITH SOLVENT WELDED JOINTS UPVC 18
WSP.W500.9 GREY IRON PIPE JOINTS 18
WSP.W510.9 MAKING FLANGED JOINTS 19
JOINT PROTECTION 20
WSP.W610.9 PROTECTION TO STEEL FLANGED JOINTS, SLIP-ON COUPLINGS AND FLANGE ADAPTERS 20
REPAIRS TO JOINTS, COATINGS AND LININGS 21
WSP.W710.9 GENERAL 21
WSP.W720.9 INTERNAL REPAIRS TO BITUMEN COATED STEEL PIPES 21
WSP.W730.9 EXTERNAL REPAIRS TO BITUMEN COATED STEEL PIPES 21
WSP.W740.9 INTERNAL REPAIRS TO STEEL PIPES WITH CONCRETE OR CEMENT MORTAR LINING 21
WSP.W750.9 REPAIRS TO DUCTILE IRON PIPES WITH BITUMEN COATINGS 22
WSP.W760.9 INTERNAL REPAIRS TO DUCTILE IRON PIPES WITH CEMENT MORTAR LINING 22
WSP.W770.9 REPAIRS TO GREY IRON PIPES 22
THRUST AND ANCHOR BLOCKS 22
WSP.W810.9 CASTING 22
WSP.W820.9 APPLICATION OF INTERNAL PRESSURE 22
BEDDING, HAUNCHING AND SURROUNDING OF PIPELINES 23
WSP.W910.9 SUPPORT 23
WSP.W920.9 FLEXIBLE JOINTS 23
WSP.W930.9 CONCRETING 23
TOLERANCES 23
WSP.W1010.9 GENERAL 23
CLEANING AND STERILIZATION 23
WSP.W1110.9 TIMING 23
WSP.W1120.9 PROCEDURE 23
CONNECTION OF UNDERGROUND WATER SUPPLY MAINS 24
WSP.W1210.9 PROCEDURE 24
WSP.W1220.9 INSPECTION OF CONNECTION 24
WSP.W1230.9 RECORD DRAWINGS 24
WSP.W1240.9 UNDERGROUND SUPPLY PIPELINE IDENTIFICATION SCHEDULE 24
WORKS OUTSIDE SITE BOUNDARY 25
WSP.W1310.9 APPROVED CONTRACTOR FOR PUBLIC WORKS 25
WSP.W1320.9 CONNECTION BY WATER SUPPLIES DEPARTMENT 25
WSP.W1330.9 NOTIFY WATER SUPPLIES DEPARTMENT TO INSPECT 25
TESTING 26
TRIALS 26
WSP.T010.9 WELDING TRIALS 26

WSP.T020.9 PIPE JOINTING TRIALS 26
WSP.T030.9 TRIALS FOR DRILLING AND TAPPING 26
TESTING JOINTS IN STEEL PIPES 26
WSP.T110.9 METHOD OF TEST 26
WSP.T120.9 COMPLIANCE CRITERIA 27
WSP.T130.9 NON-COMPLIANCE 27
PRESSURE TESTING PIPELINES 27
WSP.T210.9 SUBMISSIONS BEFORE TESTING 27
WSP.T220.9 TESTING IN SECTIONS 27
WSP.T230.9 TEST PRESSURES 27
WSP.T240.9 TESTING BEFORE BACKFILLING 27
WSP.T250.9 SIMULTANEOUS TESTING 28
WSP.T260.9 TEST EQUIPMENT 28
WSP.T270.9 PROCEDURE 28
WSP.T280.9 CALCULATION 29
WSP.T290.9 REPORTING RESULTS 29
WSP.T300.9 MAINTENANCE OF HEAD 29
WSP.T310.9 COMPLIANCE CRITERIA 29
WSP.T320.9 NON-COMPLIANCE 29
TESTING WATER STERILIZATION 30
WSP.T410.9 GENERAL 30
TESTING TURBIDITY 30
WSP.T510.9 FACILITIES FOR TESTING 30
WSP.T520.9 TESTING PRIOR TO CONNECTION OF SUPPLY MAINS 30
WSP.T530.9 PROCEDURE 30
APPENDIX WSP/I PROTECTION TO STEEL PIPES, FITTINGS AND SPECIALS USING EPOXY SYSTEM – OTHER REQUIREMENTS 31
GENERAL 31
WSP.A1.010.9 GENERAL REQUIREMENTS 31
GENERAL PROTECTION COATING REQUIREMENTS 32
WSP.A1.110.9 GENERAL 32
WSP.A1.120.9 PLANNING AND DOCUMENTATION 32
WSP.A1.130.9 AMBIENT CONDITIONS 32
WSP.A1.140.9 COATING MATERIALS 32
WSP.A1.150.9 STEEL MATERIALS 32
WSP.A1.160.9 REQUIREMENTS OF COATING, PERSONNEL AND PROCEDURES 32
HEALTH, SAFETY AND ENVIRONMENTAL CONCERNS 33
WSP.A1.210.9 REQUIREMENTS 33
SURFACE PREPARATION OF THE SUBSTRATE 33
WSP.A1.310.9 PRE-BLASTING PREPARATION 33
WSP.A1.320.9 BLAST CLEANING 33
WSP.A1.330.9 FINAL SURFACE CONDITION 33
PAINT APPLICATION 34
WSP.A1.410.9 GENERAL 34
WSP.A1.420.9 APPLICATION EQUIPMENT 34
WSP.A1.430.9 APPLICATION 34
WSP.A1.440.9 REPAIR 34
QUALIFICATION OF PERSONNEL, SUPPLIER AND PRODUCT 35
WSP.A1.510.9 OPERATORS 35
WSP.A1.520.9 SUPPLIER 35
WSP.A1.530.9 COATING MATERIAL 35
WSP.A1.540.9 PAINT WORKING SPECIFICATION 35

COATING SYSTEM 35
WSP.A1.610.9 COATING SYSTEM REQUIREMENTS 35
INSPECTION AND TESTING 37
WSP.A1.710.9 TESTING AND INSPECTION 37

WSP WATER SUPPLY PIPEWORK

MATERIALS

GENERAL

WSP.M010.9 APPLICATION OF OTHER WORKSECTIONS

The works and materials specified in this Worksection shall comply with the following Worksections, unless otherwise stated:

1. Drainage works shall comply with Worksection DRA2;
2. Earthworks shall comply with Worksection EAR1;
3. Formwork and finishes to concrete shall comply with Worksection FOR;
4. Concrete shall comply with Worksection CON1.

WSP.M020.9 DEFINITIONS

1. Fitting: a component fitted to a pipe for jointing or connecting or for changing the direction or bore of a pipe;
2. Flexible joint: a connection between pipes and fittings which provides angular deflection or axial movement or a combination of both in service without impairing the efficiency of the connection;
3. Mechanical joint: a flexible joint in which an elastomeric joint ring is located in the socket and the joint sealed by applying pressure to the joint ring by means of a gland bolted to the socket;
4. Nominal size: a numerical designation of size which is common to all components in a pipework system. The nominal size is stated as a convenient round number in millimetres and is related to, but not normally the same as, the actual internal diameter of the pipework; dn designates the nominal size of tees and tapers which are less than DN;
5. Push-in joint: a flexible joint in which an elastomeric ring is located in the socket and the joint is effected by entering the spigot through the joint ring in the socket;
6. Special fitting: a fitting which is made from a manipulated or fabricated pipe;
7. Thin walled pipe: a pipe, including pipes of DN 1200 or greater, which has a ratio of nominal size to wall thickness, excluding linings and coatings, exceeding 125.

WSP.M030.9 MATERIALS GENERALLY

Materials for water supply pipeworks for potable water shall be non-toxic, shall not promote microbial growth and shall not impart a taste, odour, cloudiness or discolouration to the water after disinfection and washing out of the pipelines as WSP.W1110 and WSP.W1120.

PIPES AND FITTINGS

WSP.M110.A STEEL PIPES AND FITTINGS

1. Steel pipes and fittings shall comply with the following:

a. Steel pipes, fittings and specials shall conform to the requirements of BS EN 10224 and BS EN 10220 where appropriate unless otherwise specified;

b. Steel pipes, joints and specials for water and sewage: BS EN 10224 and BS EN 10220;

c. Dimensions and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes: BS EN 10220;

d. Steel pipes and tubes for pressure purposes: carbon steel with specified room temperature properties: BS EN 10217 and BS EN 10216.

2. Steel pipes and fittings shall be seamless or manufactured by the electric-resistance welded and induction-welded process or by the submerged-arc welded process or otherwise as approved by the CM. The steel grade shall be at least L275;

3. Steel pipes, fittings and specials (including all flanges and blank flanges) shall be coated or lined internally and externally as stated in the following table:

Protection to steel pipes and fittings	
Protection	Description
External	A Fusion Bonded Epoxy system, complying with latest revision of ANSI/AWWA C213, manufactured under a quality system certified to ISO 9001, and factory applied by an applicator approved by the manufacturer, to a minimum dry film thickness of 400 microns. OR A chemically-cured Liquid Epoxy system, complying with the latest revision of ANSI/AWWA C210 manufactured under a quality system certified to ISO 9001, and factory applied by an applicator approved by the manufacturer, to a minimum dry film thickness of 400 microns.
	AND For pipes to be installed outdoor under direct sunlight, a topcoat of aliphatic polyurethane at 50 microns shall be applied for extra protection.
Internal	A Fusion Bonded Epoxy system, complying with latest revision of ANSI/AWWA C213, manufactured under a quality system certified to ISO 9001, and factory applied by an applicator approved by the manufacturer, to a minimum dry film thickness of 400 microns. OR A chemically-cured Liquid Epoxy system, complying with the latest revision of ANSI/AWWA C210 manufactured under a quality system certified to ISO 9001, and factory applied by an applicator approved by the manufacturer, to a minimum dry film thickness of 750 microns.

Other requirements of using epoxy system shall be in accordance with Appendix WSP/I.

4. Tees and gusseted bends shall conform to the requirements of BS EN 10224 and the details shown in Drawing No. WSD 1.21 of the standard drawing of Water Supplies Department;

5. Tolerance for pipe thickness shall comply with Clause 7.7 of BS EN 10224:2002. No negative tolerance is allowed.

WSP.M120.9 DUCTILE IRON (DI) PIPES AND FITTINGS

1. DI pipes and fittings shall comply with BS 4772:1988. Pipes and fittings other than collars, caps and blank flanges shall be lined internally with cement mortar in accordance with BS 4772:1988, Clause 3.2. Linings shall be made with sulphate-resisting Portland cement complying with BS 4027:1980;
2. Pipes shall be externally coated with metallic zinc in accordance with BS 4772:1988, Clause 3.1. Fittings shall be externally coated with zinc rich paint in accordance with BS 4772:1988, Clause 3.1.5(b). After zinc coating pipes and fittings shall be externally coated with a finishing coat of one of the following materials as stated in BS 4772:1988, Clause 3.3:
    a. Bitumen based hot applied coating material complying with Clause WSP.M240 and BS 4147:1980: Type I, Grade C; or
    b. Bitumen based cold applied coating material complying with Clause WSP.M240 and BS 3416:1991: Type II.

WSP.M130.9 UPVC PIPES AND FITTINGS

UPVC pipes and fittings shall be class D and shall comply with the following:

1. UPVC pipe for cold water services: BS 3505:1986;
2. Joints and fittings for use with UPVC pressure pipes:
    a. Injection moulded UPVC fittings for solvent welding for use with pressure pipes, including potable water supply: BS 4346:Part 1:1969;
    b. Mechanical joints and fittings principally of UPVC: BS 4346:Part 2:1970;
    c. Solvent cement: BS 4346:Part 3:1982.

WSP.M140.9 GREY IRON PIPES AND FITTINGS

GI pipes and fittings shall comply with the following:

1. Steel tubes and tubulars suitable for screwing to BS 21:1985 pipe threads: BS 1387:1985, medium grade;
2. Pipe threads for tubes and fittings where pressure tight joints are made on the threads: BS 21:1985;
3. Wrought iron steel pipe fittings (screwed BSP thread): BS 1740:Part 1:1971.

WSP.M150.9 FLANGES

1. Steel flanges shall comply with BS 4504:Section 3.1:1989, and shall be either steel plate for welding type or steel plate blank flange type. The dimensions and drilling of flanges shall comply with BS 4504:Section 3.1:1989, Table 11, as appropriate regardless of the nominal pressure rating;
2. Steel ring flanges shall be machined in the bore to a diameter of 4 mm ±1 mm larger than the outside diameter of the pipe to which the flange is to be welded;
3. Steel puddle flanges shall be separated into 180° segments;
4. DI flanges shall be cast-on or welded on standard flanges complying with BS 4772:1988.

ANCILLARY MATERIALS

WSP.M210.9 BOLTS AND NUTS

1. Bolts and nuts for flanged joints shall comply with BS 4504:1989: Section 3.1, Section 6;
2. Bolts and nuts shall be compatible with the type of joint and, unless otherwise approved by the CM, shall be obtained from the same manufacturer as the joint;
3. Bolts shall be sufficiently long and shall be suitably threaded for jointing the relevant flanges.

WSP.M220.9 ELASTOMERIC JOINT RINGS

Elastomeric joint rings shall comply with BS EN 681-1:1996, Type WA. Elastomeric joint rings for DI pipes and fittings shall comply with BS 4772:1988, Clause 2.3.4. The dimensions of rings for use with flanged joints shall comply with BS 4865:Part 1:1989. The rings shall be compatible with the type of joint and, unless otherwise approved by the CM, shall be obtained from the same manufacturer as the joint.

WSP.M230.A ANTICORROSION TAPE

1. Anticorrosion tape shall be a proprietary type approved by the CM. The tape shall either be a petrolatum tape with fabric reinforcement or a bituminous tape with PVC backing. Petrolatum tape shall be used for valves, flanged joints, slip-on type couplings and flange adapters of all sizes. Bituminous tape shall be used in buried or non-exposed condition for welded joints of steel pipe, repair of steel pipe sheathing and other applications as specified on the Drawings;
2. Anticorrosion tapes shall have a high resistance to catholic disbondment, acids and alkalis. Colour of bituminous tape shall be black. Anticorrosion tapes shall have the minimum properties stated in the following table:

Properties of anticorrosion tape			
Properties		Petrolatum Tape	Bituminous Tape
Thickness of PVC backing (mm)		-	0.75
Total thickness (mm)		1.1	1.65
Mass (kg/m²)		1.4	2.0
Tensile strength (N/mm)		4	10
Adhesion strength (180° peel) (N/mm)	Self	N/A	2.5
	Steel	N/A	2.5
Tacky adhesion strength to JIS Z 1902 (N/mm)	Self	0.5	N/A
	Steel	0.5	N/A
Dielectric strength (2 layers) (kV)		15	30
Elongation (at break) (%)		-	260
Temporary range (°C)	Wrapping	-5 to +55	+5 to +50
	In service	-20 to +70	-20 to +75

3. Primer and mastic filler for use with anticorrosion tape shall be compatible with the tape and shall be a type recommended by the manufacturer of the tape and approved by the CM. Notwithstanding clause WSP.M410 (6), primer and mastic filler for use with anticorrosion tape shall be supplied by the Contractor;

4. Bituminous tapes shall be stored in a cool dry place away from the sun's rays. No dirt or grits shall be allowed to stick on the edge of the tape before applying the tape for pipe protection.

WSP.M240.9 BITUMINOUS COATINGS

1. Bituminous coatings shall comply with the following:
   a. Bitumen based hot applied coating material for protecting iron and steel including suitable primers where required: BS 4147:1980, Type I, Grade C;
   b. Black bitumen coating solutions for cold application: BS 3416:1991, Type II.
2. Bituminous coatings used for repairing joints and coatings shall be compatible with the adjacent coating;
3. Bituminous coatings shall be made from petroleum or asphaltic bitumen.

WSP.M250.9 WHITEWASH

Whitewash shall comply with AWWA C 203:1986.

WSP.M260.9 ZINC-BASED PAINT

1. Zinc-based paint shall be a proprietary type approved by the CM;
2. Primers for zinc-based paint shall comply with BS 4652:1971;
3. Rust inhibitor shall be a chemical agent which is capable of converting rust into iron phosphate.

WSP.M270.9 JOINT FILLER

Joint filler for joints in concrete bed, haunch and surround shall be a proprietary type approved by the CM and shall be a firm, compressible, single thickness, non-rotting filler. The thickness of the filler shall be as stated in the following table:

Joint filler for concrete bed, haunch and surround	
Nominal diameter of pipe	Thickness of joint filler (mm)
Less than 450 mm	18
450 mm – 1200 mm	36
Exceeding 1200 mm	54

WSP.M280.9 COMPRESSIBLE PADDING

Compressible padding between pipes and supports shall be bitumen damp-proof sheeting complying with BS 743:1970.

WSP.M290.9 POLYETHYLENE SHEETING

Polyethylene sheeting shall be impermeable and shall have a nominal thickness of 0.125 mm.

WSP.M300.9 EXTENSION KEYS

Extension keys, clamps and its associated bolts, nuts and washers for valves shall be Grade 1.4401 stainless steel complying with BS EN 10084:2008, BS EN 10085:2001, BS EN 10087:1999, BS EN 10095:1999, BS EN 10250-4:2000 and PD 970:2005.

MATERIALS PROVIDED BY THE AUTHORITY OR WATER SUPPLIES DEPARTMENT

WSP.M410.9 PIPES, FITTINGS AND VALVES ETC

The following materials for water supply pipeworks will be provided by the Water Supplies Department or the Authority only for those parts of the Works stated in the Contract and shall be used in the permanent works:

1. Full, half and quarter length pipes with plain, flanged and spigot and socket ends;
2. Ring flanges, puddle flanges, slip-on type couplings, flange adaptors, collars, expansion joints, detachable joints, elastomeric joint rings, nuts and bolts;
3. Blank flanges and caps other than those required for pressure tests;
4. Bends, tees and tapers;
5. Steel pipes for the fabrication of gusseted steel bends and tees;
6. Primer, bitumen based composition and woven glass cloth for repairs to joints in steel pipes with bitumen coating provided by the Water Supplies Department or the Authority other than materials for protection of steel flanged joints, slip-on type couplings and flange adaptors;
7. Gate valves, air relief valves, butterfly valves and non-return valves, including all winding gear, operating motors and control equipment.

WSP.M420.9 WATER AND CHEMICALS

Water and sterilizing chemicals for cleaning, sterilizing and testing pipelines as stated in WSP.W1110, WSP.W1120 and WSP.T220 to WSP.T250 will be provided by the Water Supplies Department for one set of tests only for those parts of the Works stated in the Contract. The water and sterilizing chemicals shall be obtained from the locations agreed by the CM and shall be mixed by the Contractor.

WSP.M430.9 PROCUREMENT

The materials shall be obtained from the locations and at the times stated in the Project Specific Specification.

INSPECTION AND SUBMISSIONS

WSP.M510.9 INSPECTION OF MANUFACTURE AND TESTING

1. The manufacture and testing of pipes, joints, fittings and valves for water supply pipeworks other than materials provided by the Water Supplies Department or the Authority shall be inspected by an independent inspection authority approved by the CM;
2. The inspections shall be carried out at the manufacturer's works or at other locations stated in the Project Specific Specification or Instructed by the CM;
3. Particulars of the proposed independent inspection authority for pipes, joints, fittings and valves for water supply pipeworks, including name and address, previous experience, and names of inspectors, shall be submitted to the CM at least 28 days before manufacture of the materials starts.

WSP.M520.9 PIPES JOINTS AND FITTINGS

1. The following particulars of the proposed pipes, joints and fittings for water supply pipeworks shall be submitted to the CM;
   a. Manufacturer's literature, including details of:
      i. Manufacturing process;
      ii. Pressure and temperature ratings;
      iii. Permissible values of straight draws and angular deflection of flexible joints;
      iv. Recommendations for handling, storage, laying, jointing and repair;
      v. Drilling and tapping equipment for connections to pipes.
   b. A certificate for each material showing the manufacturer's name, the date and place of manufacture and showing that the material complies with the requirements stated in the Contract and including results of tests required in accordance with the relevant British Standard;
   c. Three copies of drawings showing details of the pipes, joints and fittings, including the materials used and the mass of each item;
   d. A certificate of inspection of the manufacture and testing signed by the Approved independent inspection authority.
2. The particulars, including certificates other than certificates of inspection, shall be submitted to the CM at least 14 days before the first delivery of the material to the Site.

WORKMANSHIP

GENERAL

WSP.W010.9 ACCESS TO PIPELINES

1. Rubber wheeled trolleys shall be provided to obtain access inside pipelines exceeding DN 500 for water supply pipeworks in order to joint pipes, repair joints, coatings and linings and inspect the pipeline. Persons entering pipelines shall wear clean soft-soled footwear;
2. Mechanical fans shall be provided to ensure that an adequate air supply is available to those entering pipelines for inspection. Engine driven fans shall be fitted with a flexible exhaust or other methods of keeping exhaust fumes clear of the fresh air intake.

WSP.W020.9 SETTING OUT OF PIPELINES

1. The alignments of pipelines shown on the Drawings are indicative only and shall be set out in lengths in accordance with the following sub-clauses for determination of the exact alignment on Site by the CM;
2. At least three weeks before commencing trench excavation of a section of pipeline, set out on Site such section of pipeline and proceed to conduct underground utilities survey in accordance with PRE.C9.1630 to PRE.C9.1650. Upon completion of the said survey and at least two weeks before commencing trench excavation, prepare and submit proposal of inspection pits excavation in relation to such pipeline to the CM for agreement. Complete excavation of the inspection pits as agreed by the CM and allow at least one week for CM's inspection before commencing trench excavation;
3. The CM may order excavation of inspection pits after the initial setting out of the alignment of pipeline or after completion of the excavation of inspection pits proposed by the Contractor at locations that may deviate from the proposed indicative alignment for determination of the final alignment. If found necessary, adjust the indicative alignment of the pipeline to suit the topography and obstructions encountered;
4. The method of setting out shall be a centre line peg with suitable offset at every change of horizontal alignment and a sight rail mounted on two posts at 30 m maximum or at every change in vertical alignment or such other appropriate methods as proposed by the Contractor and agreed by the CM;
5. Following the setting out and adjustments, if any, the existing ground levels shall be recorded and agreed with CM;
6. Submit as-built drawings within 14 days after the trench excavated for a section of the pipeline is backfilled.

WSP.W030.9 CONNECTION TO EXISTING WATER MAINS

1. Where connections to existing water mains are specified in the Contract, whether to be done by others or by the Contractor, the Contractor shall excavate inspection pits to determine the locations and levels of the existing water mains as directed by the CM. The CM may adjust the lines and levels of the proposed water mains to suit the lines and levels of the existing water mains;

2. Where connections to the existing water mains are specified in the Contract to be done by others, the Contractor shall lay the proposed water mains up to approximately 2 m from the existing water mains or as directed by the CM on Site.

TRANSPORT HANDLING AND STORAGE

WSP.W110.9 PIPES, JOINTS AND FITTINGS GENERALLY

1. Pipes, joints and fittings for water supply pipeworks shall be transported, handled and stored in accordance with the manufacturer's recommendations and in a manner which will not result in damage or deformation to the pipes, joints and fittings or in contamination of the pipes, joints and fittings;
2. Pipes, joints and fittings shall be protected from damage and damaged pipes, joints and fittings shall not be used in the permanent work unless approved by the CM. Pipes, joints and fittings shall be securely packed and supported to prevent movement when being transported;
3. UPVC pipes, joints and fittings shall be protected from exposure to conditions which may affect the material;
4. Bolts and nuts shall be packed in sealed metal containers;
5. Elastomeric joint rings shall be packed in bags and lubricant for joints shall be stored in sealed containers marked to identify the contents. The rings and lubricants shall be protected from exposure to conditions which may affect the material;
6. Boxed or crated materials or those in sealed containers shall remain in their original boxes, crates or containers.

WSP.W120.9 HANDLING PIPES AND FITTINGS

1. Pipes and fittings other than thin walled pipes shall be handled by manual methods or by using lifting appliances or chains, wire rope or canvas slings of a type recommended by the pipe manufacturer and agreed by the CM. Hooks shall not be used;
2. Slings shall be placed around the pipes and fittings and padding shall be provided at points of contact between pipes and fittings and metal lifting appliances or slings. Pipes and fittings shall not be handled by means of metal slings passed through the pipes;
3. Pipes and fittings shall not be subjected to rough handling, shock loading or dropping and shall not be rolled down ramps unless permitted by the CM; if permitted, the ramps shall be padded.

WSP.W130.9 STORING PIPES

1. Pipes other than thin walled pipes shall be stored horizontally at least 75 mm above the ground on wedged timber bearers. The bottom layers and the outer pipes in each layer shall be securely wedged to prevent sideways movement;
2. Socket and spigot pipes shall be stored with the sockets alternating and in such a manner that loads are not applied to the sockets;
3. The height of stacks of pipes other than thin walled pipes shall not exceed 2 metres unless recommended by the manufacturer and permitted by the CM;
4. Pipes shall not be strung out along the route of the pipeline unless permitted by the CM.

WSP.W140.9 TRANSPORTING THIN WALLED PIPES

When being transported, thin walled pipes shall be supported on three rubber covered saddles shaped such that the pipes are supported over at least one-quarter of the circumference. The pipes shall be securely fixed in position at each saddle by straps tightened by turnbuckles. One saddle shall be placed at the mid-point length of the pipe and the other two saddles shall be placed at distances of one-fifth of the length of the pipe from each end of the pipe.

WSP.W150.9 HANDLING AND STORING THIN WALLED PIPES

1. When being handled and stored, thin walled pipes shall be protected from deformation by means of at least two screw jack cruciform struts with rubber padded ends shaped to fit the circumference of the pipes. The struts shall be fitted inside the pipes; any temporary struts fixed by the manufacturer shall be left in position until the cruciform struts have been fixed;
2. Thin walled pipes shall be handled by using two reinforced canvas slings at least 300 mm wide. The slings shall be suspended from a lifting beam and shall be placed at a distance of one-fifth of the length of the pipe from each end of the pipe;
3. Thin walled pipes shall not be rolled;
4. Thin walled pipes shall be stored on timber bearers padded with hessian or straw to provide continuous support over at least one-third of the circumference of the pipe. The pipes shall be securely fixed in position with wedges placed at a distance of one-fifth of the length of the pipe from each end of the pipe;
5. Thin walled pipes shall not be stacked on top of each other.

WSP.W160.9 STORING VALVES

Valves, including power operated valves and associated electrical and control equipment, shall be stored in accordance with the manufacturer's recommendations in a weatherproof store.

LAYING AND BEDDING PIPES

WSP.W210.9 LAYING PIPES GENERALLY

1. The CM shall be allowed to inspect trenches, bedding, pipes, joints, fittings and valves before pipelaying for water supply pipeworks starts. The Contractor shall inform the CM 24 hours, or such shorter period agreed by the CM, before pipelaying starts in any part of the permanent work;
2. The permission of the CM shall be obtained before pipelaying starts in any of the permanent work;
3. The Contractor shall inspect pipes, joints, fittings and valves, including internal and external coatings, immediately before and after pipelaying; valves shall be inspected to ensure that they are in working order and are capable of being fully opened and closed. Deleterious material shall be removed and damage shall be repaired immediately before and after pipelaying; potable water shall be used for washing;
4. The inside of pipelines shall be kept clean and free from water, dirt, stones, debris and deleterious material. Except when pipes are being jointed, the open ends of pipelines shall be sealed with a wooden plug or stopper or by other methods agreed by the CM;
5. Measures shall be taken to prevent flotation of pipes;

6. Pipelaying shall follow closely on excavation of the trench. Lengths of trench which in the opinion of the CM are excessive shall not be left open;
7. Unless otherwise permitted by the CM, pipelines with a gradient steeper than 1 in 20 shall be laid in an uphill direction with sockets facing uphill;
8. Pipes shall be laid in such a manner that water will not pond in locations with zero and shallow gradients and such that the line and level of pipes will comply with the specified tolerances.

WSP.W220.9 LAYING STEEL PIPES

Steel pipes with welded joints for water supply pipeworks shall be spot welded to the adjacent pipe to which they will be jointed immediately after laying. Steel pipes manufactured with longitudinal or spiral welds shall be aligned in such a manner that the welds are staggered from pipe to pipe by at least 15° of arc.

WSP.W230.9 LAYING FLEXIBLY JOINTED PIPES

The degree of the curve of pipes for water supply pipeworks with flexible joints which are to be laid to a curve shall be equally distributed over all joints within the curved section. The deflection at a completed joint shall not exceed 3° or three-quarters of the maximum deflection recommended by the manufacturer whichever is less.

WSP.W240.9 INSTALLING VALVES

1. Operating gear and associated fittings shall be installed and fixed at the same time as valves for water supply pipeworks are installed. After installation, valves shall be cleaned inside and outside and left in a closed position;
2. Extension keys and clamps shall be fixed to valves in valve chambers if the vertical distance between the top of the valve spindle and the finished ground level exceeds 600 mm. The length of extension keys shall be such that the top of the extension key is not more than 300 mm below the finished ground level.

WSP.W250.9 BEDDING PIPES

1. Surfaces on which pipes for water supply pipeworks will be laid shall be cleaned and objects which may damage the pipes shall be removed before pipes are laid;
2. The bottom of trenches on which pipes will be laid directly shall be shaped to support the pipes uniformly along the length of the barrel. Holes shall be dug to prevent pipes resting on the sockets and to allow the pipes to be jointed.

CUTTING AND DRILLING PIPES

WSP.W310.9 CUTTING

1. Pipes for water supply pipeworks shall be cut and the ends shall be prepared in accordance with the manufacturer's recommendations. Purpose made equipment recommended by the manufacturer and agreed by the CM shall be used for cutting the pipes;
2. Cut ends of pipes shall be square and even, without damage to the pipe or coating. Cut ends, including cut ends of the piece not immediately required, shall be trimmed and chamfered to suit the type of joint and in such a manner that elastomeric joint rings will not be damaged by the cut end;
3. Pipes requiring to be cut to form closing lengths shall not be cut until adjacent pipes have been laid and jointed and the length to be cut can be accurately measured;

4. The permission of the CM shall be obtained before pipes provided by the Water Supplies Department or the Authority are cut. Only those pipes which in the opinion of the CM are suitable for cutting on Site shall be cut. All off-cuts shall be used for the permanent work unless in the opinion of the CM this is not practicable.

WSP.W320.9 DRILLING

1. Pipes for water supply pipeworks shall be drilled for small diameter connections using purpose made drilling and tapping equipment;
2. The threads of screw joints shall be painted before assembly with two coats of bituminous paint and shall be wrapped with three turns of spun yarn or other material approved by the CM.

JOINTING PIPES

WSP.W410.9 GENERAL

1. Pipes for water supply pipeworks shall be jointed in accordance with the manufacturer's recommendations and using jointing equipment and jointing materials recommended by the manufacturer and agreed by the CM;
2. The Contractor shall inspect pipes, joints, fittings and valves, including internal and external coatings, immediately before and after jointing. Deleterious material shall be removed and damage shall be repaired immediately before and after jointing. Potable water shall be used for washing. Surfaces which are to be jointed and jointing materials shall be cleaned immediately before jointing;
3. All joints in pipelines shall be watertight;
4. The widths of gaps at joints shall be in accordance with manufacturer's recommendations and shall be achieved by marking the outside of the pipe, by using metal feelers or by other methods agreed by the CM. The position of elastomeric joint rings shall be checked by using metal feelers after jointing;
5. Gaps at joints in pipes shall be protected after jointing by methods agreed by the CM to prevent dirt, stones or other material entering the joint;
6. Bolt holes in flanged joints and joints incorporating bolted components shall be correctly orientated before the bolts are tightened. The correct size of bolts and nuts shall be used. Bolt threads shall be lubricated and bolts shall be tightened using the correct size of spanner. Bolts shall be tightened in diametrically opposite pairs working around the bolt circle until all bolts are tightened to the torque recommended by the manufacturer;
7. Bolt holes in flanged joints shall be orientated symmetrically about the vertical diameter with no bolt holes on the vertical diameter. Elastomeric joint rings shall be the correct size and shall not protrude into the bore of the pipe. The rings may be temporarily fixed to the face of the flange using a minimum amount of adhesive of a type recommended by the manufacturer. Jointing compound or paste shall not be used.

WSP.W420.9 PIPES WITH PUSH-IN JOINTS

Pipes with push-in joints for water supply pipeworks shall be jointed by smearing the spigot end of the pipe with lubricant and placing the elastomeric ring joint in position inside the groove of the socket end of the laid pipe. The spigot end of the pipe shall be placed in the socket end of the laid pipe and pushed home.

WSP.W430.9 DI PIPES WITH MECHANICAL JOINTS

1. The elastomeric joint ring and the ends of the pipe shall be smeared with lubricant over a distance recommended by the manufacturer;
2. The gland and the elastomeric joint ring shall be placed in position on the spigot end of the pipe;
3. The spigot end of the pipe shall be placed in the socket end of the laid pipe before the bolts are tightened.

WSP.W440.9 WELDING JOINTS IN STEEL PIPES

1. Welding of joints in steel pipes for water supply pipeworks shall be carried out by the metal-arc process in accordance with BS 2633:1987 and BS 4515:1984;
2. Butt welding shall not be used for jointing plain ended pipes other than for gusseted bends unless approved by the CM. If Approved, the ends of the pipes shall be prepared in accordance with BS 534:1990 and BS 2633:1987 and welding shall be carried out in accordance with BS 4515:1984;
3. Records of welding operations shall be kept by the Contractor on the Site and shall be available for inspection by the CM at all times. Records should contain the following details:
    a. Date;
    b. Names of welders;
    c. Location of welding operation;
    d. Electrodes used in making each weld.

WSP.W450.9 SUBMISSIONS FOR WELDING

The following particulars shall be submitted to the CM at least 14 days before welding starts:

1. Details of welders, including names, copies of Hong Kong Identity Cards and details of previous experience;
2. Details of format of records;
3. Details of welding procedures, including welding plant, method of welding, materials, manufacturer and size of electrodes, number of runs and current strength;
4. Procedures for nitrogen gas tests on joints;
5. Valid certificate of competency in accordance with BS 2633:1987, Clause 11 for each welder, issued by an Authority approved by the CM.

WSP.W460.9 STEEL PIPES WITH SPIGOT AND SOCKET JOINTS

1. Pipes not exceeding DN 700 shall be welded externally. Pipes exceeding DN 700 shall be welded internally and shall then be welded externally with a sealing weld;
2. Loose scale, slag, rust, paint and other deleterious material shall be removed from parts of pipes to be welded by wire brushing or by other methods agreed by the CM. The parts shall be kept clean and dry before welding;
3. A double-run convex fillet weld shall be used for pipes not exceeding DN 900 and a triple-run convex fillet weld shall be used for pipes exceeding DN 900. The leg length of the fillet as deposited shall be at least the same as the full thickness of the pipe wall. The actual throat depth shall not be less than seven-tenths, and shall not exceed nine-tenths, of the minimum leg length as deposited;

4. Deposition of the weld metal shall be carried out in such a manner that all welds have adequate root fusion and are of good, clean metal, free from cracks, gas holes, slag intrusion and other impurities. The surface of the weld shall have an even contour with a regular finish and shall indicate proper fusion with the parent metal. Slag shall be removed from each weld by light hammering with a chipping hammer and by wire brushing;
5. Welds which contain cracks or other cavities or defects or in which the weld metal overlaps on to the parent metal without proper fusion shall be cut out and the joints shall be rewelded.

WSP.W470.9 STEEL PIPES WITH WELDED STEEL COLLAR JOINTS

Steel pipes with welded steel collar joints for water supply pipeworks shall be jointed by leaving a gap not exceeding 75 mm between the ends of the pipes to be jointed. A split steel collar shall be placed centrally around the ends of the pipes; the collar shall be at least the same thickness as the pipe wall and shall be approximately 300 mm long. The end of each pipe shall be fillet welded to the collar as stated in WSP.W460.

WSP.W480.9 STEEL PIPES WITH COUPLINGS AND FLANGE ADAPTERS

Steel pipes with slip-on type couplings and flange adapters for water supply pipeworks shall be jointed as follows:

1. Protective wrappings shall be removed from the ends of plain ended pipes to be jointed and shall be replaced by:
   a. Bitumen coating as WSP.M240 and BS 534:1990:Clause 25.1; or
   b. Epoxy or plastics based coating of a proprietary type approved by the CM.
2. The pipe shall be finished to an even, smooth surface free from distortion to allow the components of the coupling or flange adapter to be correctly positioned and jointed;
3. The coupling or flange adapter shall be placed in position on the plain end before the bolts are tightened.

WSP.W490.9 UPVC PIPES WITH SOLVENT WELDED JOINTS UPVC

Pipes with solvent welded joints for water supply pipeworks shall be jointed by applying solvent cement to the pipes to be jointed and pushing the pipes home. Excess solvent shall not be applied and surplus solvent shall be removed after jointing. Solvent welded pipes jointed outside the trench shall not be placed in the trench until the solvent setting period recommended by the manufacturer has elapsed.

WSP.W500.9 GREY IRON PIPE JOINTS

GI pipes for water supply pipeworks shall be screw jointed using a threaded coupler. The surface of the pipe and coupler shall be cleaned and the threads shall be painted with two coats of bituminous paint. The pipe thread shall be wrapped with three turns of spun yarn or other material approved by the CM and the joint tightened using purpose made tools. Coal tar compounds or lead-based paint shall not be used. Locking nuts to branch connections shall be tightened. Branch connections shall not protrude inside the pipe.

WSP.W510.9 MAKING FLANGED JOINTS

1. Further to WSP.W410, pipes and/or fittings to be jointed together shall be independently supported and properly aligned. After placing the gasket in position, the bolts shall be tightened in a sequence in accordance with the manufacturer's recommendations to avoid overstressing of the flange. If it is necessary to dismantle the flanged joint, the bolts shall be loosened in the reverse sequence to that used for tightening. The bolt tightening sequence shall be approved by the CM before making flanged joints;
2. When flanges other than polyethylene flanges are tightened, the bolts shall be tightened with a torque not exceeding the corresponding value specified in Table A or B below as appropriate. If the joint is not sealed after applying the specified torque, then the bolts shall be tightened with the torque increased by 10%. This procedure will be repeated until the joint is sealed. A final tightening shall then be applied with a further 10% increase in torque;
3. When polyethylene flanges are tightened, the bolt torque shall be in accordance with the manufacturer's recommendations or in the absence of such manufacturer's recommendations to the limits as shown in Table C below.

Table A

PN 10 Flanged Joints

APPROXIMATE BOLT TORQUES

Using rubber, cork, or

paper millboard gaskets (3 mm thick only)

Nominal Size DN (mm)	Approximate Bolt Torque (Nm)		
	To seal at 5 bar	To seal at 10 bar	To seal at 16 bar
80	55	55	55
100	55	60	65
150	90	90	95
200	95	105	110
250	90	95	105
300	95	105	115
350	90	100	110
400	125	135	150
450	120	130	145
500	125	135	155
600	160	180	220

Table B

PN 16 Flanged Joints

APPROXIMATE BOLT TORQUES

Using rubber, cork, or

paper millboard gaskets (3 mm thick only)

Nominal Size DN (mm)	Approximate Bolt Torque (Nm)				
	To seal at 5 bar	To seal at 10 bar	To seal at 16 bar	To seal at 20 bar	To seal at 25 bar
80	55	55	55	60	60
100	55	60	65	65	65
150	90	90	95	100	110
200	85	90	90	95	105
250	115	125	130	140	145
300	120	130	145	150	170
350	115	130	140	150	160
400	145	160	175	190	215
450	140	155	170	185	210
500	170	190	215	235	275
600	215	245	290	340	405

Table C

Polyethylene Flanged Joints

TYPICAL BOLT TORQUES

Nominal PE Size (mm)	Equivalent Size of Metal Flange (mm)	No. of Bolts	Torque Required (Nm)
63	50	4	35
90	80	8	35
125	100	8	35
180	150	8	60
250	250	12	100

JOINT PROTECTION

WSP.W610.9 PROTECTION TO STEEL FLANGED JOINTS, SLIP-ON COUPLINGS AND FLANGE ADAPTERS

1. Steel flanged joints, slip-on type couplings and flange adapters in steel pipes for water supply pipeworks shall be protected after jointing is complete;
2. The joint, including bolts and nuts, shall be cleaned to remove all moisture, dirt, oil, grease and deleterious material. Bolts and nuts shall be painted with two coats of bituminous paint and the joint shall be coated with primer. Mastic filler shall be applied in such a manner that all depressions, corners and voids between the bolts and nuts are filled and a smooth surface is available on which to apply the anticorrosion tape;
3. At least two layers of anticorrosion tape shall be applied to all parts of the joint and to the adjacent pipe for at least 200 mm beyond each end of the joint. The tape shall be applied in accordance with the manufacturer's recommendations and shall be wrapped spirally around the joint and pipe with at least 55% overlap per spiral;
4. The tape shall be moulded manually after application to take up the contours of the parts being protected.

REPAIRS TO JOINTS, COATINGS AND LININGS

WSP.W710.9 GENERAL

1. Unless otherwise approved by the CM, repairs to joints, coatings and linings shall be carried out using materials of the same type and grade as in the pipe, joint or fitting;
2. External repairs shall be completed before internal repairs are carried out;
3. Internal repairs and adjacent areas shall be washed with potable water after the repair is complete.

WSP.W720.9 INTERNAL REPAIRS TO BITUMEN COATED STEEL PIPES

1. Dirt, mill scale, rust and other deleterious material shall be removed from the areas to be repaired by wire brushing to leave dry, clean, bright material. All damaged material shall be removed and the area shall be cleaned and dried;
2. Primer shall be applied to the metal surface by brushing, avoiding bare spots, floods and sags;
3. The area surrounding the area to be repaired shall be gently heated with a blow lamp or hot iron until the adjacent coating is molten;
4. Bitumen shall be heated to 200°C and shall be stirred from time to time to prevent overheating. The bitumen shall be worked into the area to be repaired with a heated trowel to the same thickness as the adjacent coating. The bitumen shall be finished to a smooth uniform surface.

WSP.W730.9 EXTERNAL REPAIRS TO BITUMEN COATED STEEL PIPES

External repairs to joints other than flanged joints, slip-on type couplings and flange adapters of steel pipes with bitumen coatings shall be carried out as stated in WSP.W720, except:

1. External repairs shall not start until any specified electrical continuity has been provided and any individual test to each joint has been carried out;
2. A purpose made moulding box shall be cleaned and coated internally with whitewash. After the whitewash has dried, the box shall be fitted centrally around the joint and bolted together. Gaps between the pipe and the box shall be sealed with yarn or other material agreed by the CM to prevent leakage;
3. The heated bitumen shall be poured into the box in one operation. After the bitumen has solidified, the box shall be removed, cleaned and stored for re-use;
4. The affected area of bitumen coating shall be painted with whitewash after cooling;
5. External repairs of coatings to steel pipes with bitumen coatings shall be carried out as WSP.W720 except that the heated bitumen together with woven glass cloth shall be worked into the area to be repaired. The affected area of bitumen coating shall be painted with whitewash after cooling.

WSP.W740.9 INTERNAL REPAIRS TO STEEL PIPES WITH CONCRETE OR CEMENT MORTAR LINING

1. The area to be repaired shall be cut back to leave clean, bright metal. The area surrounding the area to be repaired shall be wetted;

2. The concrete or cement mortar shall be worked into the area to be repaired and compacted to the same thickness as the adjacent lining; the concrete or cement mortar shall be finished to a smooth uniform surface. The compressive strength and density of the compacted concrete or cement mortar shall be in accordance with BS 534:1990, Clause 29.5. The repaired area shall be cured by using curing compound as Worksection CON1;
3. Samples of the concrete or cement mortar shall be provided and test cubes shall be made and tested as Worksection CON1.

WSP.W750.9 REPAIRS TO DUCTILE IRON PIPES WITH BITUMEN COATINGS

Internal and external repairs to joints and coatings of DI pipes with bitumen coatings shall be carried out using bituminous paint. The area to be repaired shall be cleaned to bare metal and dried. The area to be repaired shall be painted with bituminous paint to the same thickness as the adjacent coating. The paint shall be finished to a smooth uniform surface.

WSP.W760.9 INTERNAL REPAIRS TO DUCTILE IRON PIPES WITH CEMENT MORTAR LINING

1. The area to be repaired shall be cut back to leave clean, bright metal. The area surrounding the area to be repaired shall be wetted;
2. The cement mortar shall be worked into the area to be repaired and compacted to the same thickness as the adjacent lining; the cement mortar shall be finished to a smooth uniform surface. The repaired area shall be cured with curing compound as stated in Worksection CON1;
3. The inside of pipe sockets and the faces of flanges shall be kept free from cement mortar.

WSP.W770.9 REPAIRS TO GREY IRON PIPES

Internal and external repairs to joints and coatings of GI pipes shall be carried out using zinc-based paint. The area to be repaired shall be cleaned to bare metal and dried. The area to be repaired shall be painted with a rust inhibitor, primer and two coats of zinc-based paint.

THRUST AND ANCHOR BLOCKS

WSP.W810.9 CASTING

The bearing face, and other faces stated in the Contract, of concrete thrust and anchor blocks for water supply pipeworks shall be cast directly against undisturbed ground. The faces of excavations shall be trimmed to remove loose material before concreting. Excess excavation and working space shall be filled with concrete of the same Grade as the block.

WSP.W820.9 APPLICATION OF INTERNAL PRESSURE

Internal pressure shall not be applied to the pipeline until thrust and anchor blocks have developed the specified grade strength.

BEDDING, HAUNCHING AND SURROUNDING OF PIPELINES

WSP.W910.9 SUPPORT

Pipes shall be supported at the required level by Grade 20 precast concrete wedges, blocks or cradles or by other methods agreed by the CM. One support shall be placed adjacent to each end of the pipe and the spacing between supports shall not exceed 3 m. Compressible sheeting shall be placed between the pipes and supports.

WSP.W920.9 FLEXIBLE JOINTS

Flexible joints shall be formed in concrete bed, haunch and surround at flexible joints in pipelines. Joint filler shall be placed next to the flexible joint in the pipeline and shall extend for the complete thickness of the bed, haunch and surround.

WSP.W930.9 CONCRETING

1. Polyethylene sheeting shall be placed on the trench bottom before concreting;
2. Concrete shall be placed evenly over the complete width of the bed and over the complete length of the pipe being concreted up to a level of 25 mm below the underside of the pipe. Concrete shall then be placed on one side of the pipe only and worked under the pipe until the concrete spreads under the pipe. Concrete shall then be placed equally on both sides of the pipe to the specified level.

TOLERANCES

WSP.W1010.9 GENERAL

Refer to Appendix H 'Schedule of Tolerance' to this Specification.

CLEANING AND STERILIZATION

WSP.W1110.9 TIMING

1. Unless otherwise permitted by the CM, pipelines shall be cleaned and sterilized not more than 7 days before the pipeline is handed over;
2. Cleaning and flushing shall be carried out after:
    a. The complete pipeline, or parts of the pipeline permitted by the CM, have been tested;
    b. Temporary Works required for testing have been removed;
    c. Parts of the pipeline removed for testing have been reconnected.

WSP.W1120.9 PROCEDURE

1. Fresh water and potable water pipelines for water supply pipeworks shall be cleaned and flushed through with potable water;
2. The pipeline shall be completely filled with water that has been dosed with a homogeneous solution of sterilizing chemicals such that the final concentration of free chlorine in the water is at least 30 ppm. The water shall be left in the pipeline for at least 24 hours;

3. After the 24 hour period, the pipeline shall be drained down and the sterilizing water shall be flushed out using potable water until the concentration of the remaining chlorine is less than 1 ppm.

CONNECTION OF UNDERGROUND WATER SUPPLY MAINS

WSP.W1210.9 PROCEDURE

Connect to supply mains as follows:

1. Submit proposed re-arrangement or tee-off (if any) to CM for approval at least 24 hours prior to execution;
2. Identify existing live fresh, flush, and fire service supply mains by:
   a. Inspect as-built record drawings;
   b. Verify by valve operation. Close all the valves of the pipes and turn on valve of each pipe one by one to identify the type of each water pipes;
   c. Paint underground pipeworks of fresh, flushing and fire service supply mains at both sides of isolating gate valves in colours as stated in WSP.W1240.
3. Test turbidity to confirm salt water mains in accordance with WSP.T530;
4. Provide temporary cover and lockable device for isolating valve pits;
5. Submit findings of the identification for inspection and confirmation by Management Division;
6. Submit to Management Division Form DCMP-F741 together with Form H for making connections to existing in service supply mains within Housing Department estates;
7. Upon receipt of Part B of Form DCMP-F741, proceed with connection works;
8. Upon connection to supply mains, complete Part C of Form DCMP-F741 and submit to Management Division together with a copy of Certificate regarding Water Supply Connection issued by Water Authority for record;
9. Remove temporary cover of the isolating valve pits after completion of the connection of supply mains;
10. Submit record drawings to Management Division within 14 days of connection irrespective of whether or not changes have been made to the Contract Drawings.

WSP.W1220.9 INSPECTION OF CONNECTION

Check all connected pipeworks to supply mains by valve operation. Close all the valves of the pipes and turn on valves of each pipe one by one to identify the type of each water pipe.

WSP.W1230.9 RECORD DRAWINGS

Submit record drawings to CM within 14 days of underground water supply connection irrespective of whether or not changes have been made to the Contract Drawings.

WSP.W1240.9 UNDERGROUND SUPPLY PIPELINE IDENTIFICATION SCHEDULE

Paint underground pipeworks of fresh, flushing, and fire service supply mains at both sides of isolating gate valves in the colours shown in the following table, complete with the identification colour code indication:

Underground Supply Pipe Identification - Colour Reference to BS 4800:1989			
Service Type	Colour Code Indication Approx. 50 mm each ring		No. of Colour Rings Around Pipe
Fresh Water Main	Blue	18 E 53	3
Flushing Water Main	Green	12 D 45	2
Fire Service Water Main	Safety Red	04 E 53	1

WORKS OUTSIDE SITE BOUNDARY

WSP.W1310.9 APPROVED CONTRACTOR FOR PUBLIC WORKS

Carry out all work in laying and extending the fresh, flushing and fire services water mains from an location at the site boundary to the street mains by a contractor, sub-contractor or licensed plumber approved by Water Supplies Department or other duly constituted authority.

WSP.W1320.9 CONNECTION BY WATER SUPPLIES DEPARTMENT

Cap end of mains to prepare for connection to street mains by Water Supplies Department.

WSP.W1330.9 NOTIFY WATER SUPPLIES DEPARTMENT TO INSPECT

Notify Water Supplies Department to inspect completed pipework and valve pit before backfilling.

TESTING

TRIALS

WSP.T010.9 WELDING TRIALS

1. Unless otherwise permitted by the CM, trials shall be carried out to demonstrate the competency of each proposed welder who will be employed to weld joints in steel pipes for water supply pipeworks;
2. Trials shall be carried out at least 7 days before welding starts;
3. The Contractor shall inform the CM 24 hours, or such shorter period agreed by the CM, before carrying out welding trials;
4. The trials shall be carried out using the welding procedures submitted to the CM;
5. Trials shall be carried out under similar conditions as those which will be encountered on the Site. Each trial shall consist of fillet welding two steel plates using at least two electrodes to complete one run of weld. The thickness of the steel plates shall be the same as the thickness of the steel pipe which will be welded;
6. A 150 mm length of the plate which contains what in the opinion of the CM is the worst welding shall be cut from the steel plates and broken in a vice;
7. The CM shall determine the competency or otherwise of each welder on the basis of the results of the welding trials.

WSP.T020.9 PIPE JOINTING TRIALS

1. Trials shall be carried out to demonstrate that the pipes, joints and fittings for water supply pipeworks fit correctly;
2. The trials shall be carried out at least 6 weeks, or such shorter period agreed by the CM, before the materials are to be incorporated in the permanent work;
3. The Contractor shall inform the CM 24 hours, or such shorter period agreed by the CM, before carrying out the trials;
4. The Contractor shall immediately inform the CM of any pipes, joints or fittings which do not fit correctly. Modifications shall be made to pipes, joints or fittings which do not fit correctly or replacements shall be provided as instructed by the CM.

WSP.T030.9 TRIALS FOR DRILLING AND TAPPING

1. Trials shall be carried out to demonstrate that the proposed equipment and methods of drilling and tapping pipes for water supply pipeworks will produce connections which comply with the specified requirements;
2. The trials shall be carried out at least 14 days before drilling and tapping starts;
3. The Contractor shall inform the CM 24 hours, or such shorter period agreed by the CM, before carrying out trials.

TESTING JOINTS IN STEEL PIPES

WSP.T110.9 METHOD OF TEST

1. Spigot and socket joints in steel pipes exceeding DN 700 for water supply pipeworks shall be tested after welding by the nitrogen gas test;

2. A tapped hole of approximately 6 mm diameter shall be made in the socket end of each pipe to be tested and a non-return valve shall be fixed in the hole. The nitrogen gas test shall be carried out by pumping nitrogen to a pressure of 400 kPa into the annular space between the spigot and socket. The pump shall be disconnected and the pressure shall be recorded for 30 minutes.

WSP.T120.9 COMPLIANCE CRITERIA

There shall be no drop in pressure in the joint during the 30 minute period of the nitrogen gas test.

WSP.T130.9 NON-COMPLIANCE

If the result of any nitrogen gas test does not comply with the specified requirement for the test, the weld at the joint shall be cut out and the joint shall be rewelded and tested.

PRESSURE TESTING PIPELINES

WSP.T210.9 SUBMISSIONS BEFORE TESTING

The following particulars shall be submitted to the CM at least 14 days before the test starts:

1. Test equipment and method of setting up the equipment;
2. Calibration certificates for pressure gauges;
3. Procedure for carrying out the test;
4. Programme for testing.

WSP.T220.9 TESTING IN SECTIONS

1. The pipelines shall be tested in sections as stated in the Contract unless otherwise permitted by the CM;
2. If testing in sections other than those stated is permitted, the section to be tested shall be as long as practicable provided that the specified test pressure will not be exceeded;
3. Final tests on complete pipelines which have been tested in sections shall not be carried out.

WSP.T230.9 TEST PRESSURES

The test pressure shall be:

1. 1.5 times the maximum working pressure if the maximum working pressure does not exceed 1.5 MPa;
2. 1.3 times the maximum working pressure if the maximum working pressure exceeds 1.5 MPa.

WSP.T240.9 TESTING BEFORE BACKFILLING

1. Unless otherwise permitted by the CM, pressure tests shall not be carried out until the fill material has been deposited and compacted over the complete length of the pipeline to be tested;
2. If permitted, sufficient fill material shall be deposited to restrain the pipeline in position during the test.

WSP.T250.9 SIMULTANEOUS TESTING

Tests shall not be carried out simultaneously on pipelines in the same trench.

WSP.T260.9 TEST EQUIPMENT

The following equipment is required:

1. Blank flanges or caps;
2. Struts and wedges;
3. Temporary concrete blocks or other anchors;
4. Force pump and pump feed tank;
5. Pressure gauge, readable and accurate to 0.01 m head;
6. Continuous pressure recorder and purpose made charts, which will be loaned by the Authority or the Water Supplies Department only for those parts of the Works stated in the Contract.

WSP.T270.9 PROCEDURE

The procedure shall be as follows:

1. Pipes and valves shall be checked for cleanliness and the operation of valves shall be checked;
2. Blank flanges or caps shall be fixed to the ends of the pipeline, or section of the pipeline, to be tested. Tests shall not be made against valve gates;
3. The blank flanges and caps shall be secured with struts and wedges against temporary concrete blocks or other anchors. The blocks and anchors shall be completed and shall have hardened sufficiently before testing starts;
4. Thrust and anchor blocks, pipe straps and other devices required to prevent movement of pipes and fittings shall be completed before testing starts;
5. The pipelines shall be filled with water and all air shall be removed;
6. Unless otherwise permitted by the CM, the pipeline shall remain filled for 3 days before testing starts to allow absorption to take place and to achieve conditions which are as stable as practicable;
7. The pressure in the pipeline shall be increased slowly to the specified test pressure by pumping water into the pipeline using a force pump;
8. The pressure in the pipeline shall be maintained within +0% and -5% of the specified test pressure for a test period of at least 2 hours;
9. At the beginning and end of the test period and at 30 minute intervals during the test period, readings shall be taken from the pressure gauge and the pressures (p) shall be recorded. The pressure shall be adjusted to the specified test pressure each time a reading is taken;
10. The pressure shall be adjusted to within the specified tolerances for the test pressure at any time during the test period when the pressure falls outside the specified tolerances;
11. The pressure shall be monitored during the test by means of a continuous pressure recorder with purpose made charts;
12. The leakage of water from the pipeline shall be measured as the amount of water required to maintain the specified test pressure in the pipeline. The amount of water shall be determined from the fall in level of water in the pump feed tank.

WSP.T280.9 CALCULATION

1. The average test pressure (P) shall be calculated as the average of the pressures (p) recorded during the test;
2. The permitted leakage of water from the pipeline during the pressure test shall be calculated from the equation:

$$permitted\ leakage = 0.02 \times d \times l \times \frac{t}{24} \times \frac{P}{10} litres$$

where:

d is the nominal diameter of the pipe (mm);

l is the length of pipeline tested (km);

t is the test period (hr);

P is the average test pressure (m).

WSP.T290.9 REPORTING RESULTS

The following shall be reported:

1. The internal diameter of pipe to the nearest 1 mm;
2. The length of pipeline tested to the nearest 1 m;
3. The test period to the nearest 0.01 hr;
4. The pressures recorded during the test to the nearest 0.01 m;
5. The average test pressure to the nearest 0.01 m;
6. The leakage and permitted leakage of water to the nearest 0.1 litre;
7. Details of any discernible leakage of water from the pipeline during the test;
8. Charts obtained from the continuous pressure recorder;
9. That the test method used was in accordance with this Specification.

WSP.T300.9 MAINTENANCE OF HEAD

Unless otherwise permitted by the CM, the pipeline shall be left charged with water at a head of at least 15 m after testing and until the pipeline has been sterilized or handed over to the Authority.

WSP.T310.9 COMPLIANCE CRITERIA

The results of tests on pressure pipelines for water supply pipeworks shall comply with the following requirements:

1. The leakage of water from the pipeline determined by the pressure test shall not exceed the permitted leakage calculated in accordance with WSP.T280;
2. There shall be no discernible leakage of water from the pipeline or from any joint during the pressure test.

WSP.T320.9 NON-COMPLIANCE

If the result of any test on pressure pipelines for water supply pipeworks does not comply with the specified requirements for the test, the Contractor shall investigate the reason. Remedial or replacement work approved by the CM shall be carried out and the pipeline shall be retested.

TESTING WATER STERILIZATION

WSP.T410.9 GENERAL

1. After the pressure test on fresh water and potable water pipelines for water supply pipelines has been completed, samples of the water in the pipeline will be taken by the CM. The number of samples and locations of sampling shall be as instructed by the CM. Testing shall be carried out as stated in WRS.T320 and WRS.T330 for water sterilization of water retaining structures;
2. The colour, odour, appearance, turbidity, conductivity and pH value of the water samples shall be of a quality comparable with that drawn from the supply point and acceptable for potable water.

TESTING TURBIDITY

WSP.T510.9 FACILITIES FOR TESTING

Provide clean water and apparatus for testing. Ensure reagents or other chemicals where used, are of current stock.

WSP.T520.9 TESTING PRIOR TO CONNECTION OF SUPPLY MAINS

Test fresh, flush, and fire service supply mains prior to connection works as required by WSP.W1210.

WSP.T530.9 PROCEDURE

Test for development of white turbidity to identify salt water mains to satisfaction of CM, as follows:

1. Collect two 10 ml samples in clean McCartney bottles from the supply mains under investigation;
2. Add two drops of barium chloride solution to one sample;
3. Shake to mix contents and wait for approximately 3 minutes for turbidity to develop;
4. Compare with the other sample for increase in white turbidity (which would indicate the presence of salt water);
5. In doubtful cases, seek record drawings as well as laboratory services for confirmation.

APPENDIX WSP/I PROTECTION TO STEEL PIPES, FITTINGS AND SPECIALS USING EPOXY SYSTEM – OTHER REQUIREMENTS

GENERAL

WSP.A1.010.9 GENERAL REQUIREMENTS

1. Pipes, fittings and specials shall be protected both internally and externally and shall be suitable for use in and transport through the tropics;
2. The Contractor shall provide full documentation from the pipe manufacturer and/or protection supplier detailing the guaranteed service life of the proposed materials;
3. The Contractor shall provide certification pursuant to Clause 4.2.2 of AWWA C210-1997 where epoxy system is applied;
4. For pipes with outside diameter less than 1016 mm, internal protection with sulphate resistant cement mortar lining in accordance with the requirement of BS EN 10298:2005 will also be considered by the CM;
5. Slip-on type couplings and flanges adaptors (including nuts and bolts) shall be protected with Rilsan Nylon 11 or a fusion bonded epoxy coating (as described in the table in WSP.M110) and shall not require bituminous paint;
6. Expansion joints shall be protected in accordance with sub-clauses (1) and (2) above, except stainless steel slides surfaces that require no coating;
7. All bolts and nuts shall be hot dip galvanized or be coated with an epoxy-based or plastic-based corrosion-protection coating;
8. For pipes, fittings and specials to be jointed together by welding, internal and external protections shall be stopped at distance from the ends as follows:
   a. Butt welded joints – 75 mm from the ends of pipes to be welded;
   b. Sleeve welded joints – for sleeve and spigot sleeve, length plus 75 mm.

   In all cases, priming shall be up to the ends of the pipes.
9. For pipes, fittings and specials not to be jointed by welding, the external protection shall be stopped at a distance sufficient to permit assembly of the joint and internal protection shall be up to the pipe end;
10. On-site completion or repair of protection lining shall be carried out in strict compliance with the manufacturer's recommendation. Except for epoxy or plastic based protection coatings, materials for completing and repairing the external and internal protections on Site shall be approved by the CM. One set of the maintenance guideline/manual on repair of epoxy coatings shall be submitted to the CM.

GENERAL PROTECTION COATING REQUIREMENTS

WSP.A1.110.9 GENERAL

Selection of coating systems and application procedures shall be made with due consideration to environmental conditions during fabrication, installation and service of the installation. All coating application procedures shall be carried out in accordance with ANSI/AWWA C210-97.

WSP.A1.120.9 PLANNING AND DOCUMENTATION

1. All painting activities shall be fully incorporated into and regarded as an integral part of the fabrication plan;
2. Procedures pertaining to overall management, painting facilities, painting equipment, painting application, quality assurance, quality checks, repair and maintenance etc. shall be established and documented in detail and submitted for the approval of the CM before commencement of the actual painting work.

WSP.A1.130.9 AMBIENT CONDITIONS

1. No final blast cleaning or coating application shall be done if the relative humidity is more than 85%, and if the steel temperature is less than 3°C above dew point in the ambient. No coating shall be applied or cured at ambient temperatures below 10°C;
2. The coating specification and/or product data sheets shall specify the maximum and minimum application and curing temperatures and other relevant requisites regarding application and curing conditions for each product in any coating system.

WSP.A1.140.9 COATING MATERIALS

The coating materials shall be suitable for the intended use and shall meet the following requirements:

1. In compliance with health, safety and environment protection requirements;
2. Suitable for raw water, salt water, fresh water and treated effluent;
3. For fresh water main coating, the material shall be suitable for drinking water uses.

WSP.A1.150.9 STEEL MATERIALS

Before abrasive blast cleaning, the steel used for fabrication shall as a minimum requirement conform to Rust Grade B as described in BS EN ISO 8501-1:2001. Any primer applied by the steel manufacturer shall be regarded as temporary corrosion protection and shall be removed in appropriate manner before application of the coating systems herein.

WSP.A1.160.9 REQUIREMENTS OF COATING, PERSONNEL AND PROCEDURES

Requirements as described in WSP.A1.510 to WSP.A1.540 of this Appendix shall be complied with and documented. Any equivalent product or alternative to the coating system specified in WSP.A1.610 proposed by the Contractor shall be approved by the CM before commencement of any coating work.

HEALTH, SAFETY AND ENVIRONMENTAL CONCERNS

WSP.A1.210.9 REQUIREMENTS

The following information/documentation shall be properly filed and made available for inspection upon demand:

1. Product Data Sheet of the coating material;
2. Material Safety Data Sheet of the coating material;
3. Volatile Organic Compound content (g/l) of the coating material;
4. Special handling precautions, personal protection and disposal instructions.

SURFACE PREPARATION OF THE SUBSTRATE

WSP.A1.310.9 PRE-BLASTING PREPARATION

1. Sharp edges, blurs, welding seams shall be rounded or smoothened by mechanical grinding before blast cleaning;
2. Hard surface lavers resulting from flame cutting shall be removed by mechanical grinding before blast cleaning;
3. Welding slag shall be removed by mechanical chipping and/or grinding. Blow-holes and welding imperfections shall be repaired by spot welding or removed by mechanical grinding. All welds shall be inspected and if necessary repaired before final blast cleaning of the area;
4. Any major surface defects, particularly surface laminations or scabs detrimental to the protective coating system shall be removed by suitable dressing. Where such defects have been revealed during blast cleaning, and dressing has been performed, the dressed area shall be re-blasted to the specified standard;
5. The surface of the substrate shall be free from any foreign matter such as weld flux, residue, dirt, oil, grease, salt, etc. before blast cleaning;
6. Any oil and grease contamination shall be cleaned by use of a new rag soaked with a suitable solvent.

WSP.A1.320.9 BLAST CLEANING

1. Blasting abrasives shall be dry, clean and free from contaminants that will be detrimental to the performance of the coating. It shall be in compliance with requirements as specified in BS EN ISO 11124;
2. Size and shape of abrasive particles for blast cleaning shall be such that the prepared surface profile (anchor pattern profile) is in accordance with the requirements for the applicable coating system. The surface profile will be graded in accordance with BS EN ISO 8503;
3. The cleanliness of the blast-cleaned surface shall be as referred to for each coating system i.e. Sa 2.5 or Sa 3 in accordance with BS EN ISO 8501-1:2001.

WSP.A1.330.9 FINAL SURFACE CONDITION

1. The substrate surface, after abrasive blast cleaning and before coating, shall be clean, dry, free from oil/grease and have the specified roughness and cleanliness ready for the first coat to be applied;

2. Dust, residual blast abrasives etc. shall be removed from the surface after blasting such that the surface cleanliness complies with Rating 2 of BS EN ISO 8502-3:2000;
3. The maximum content of soluble impurities on the blasted surface as sampled in accordance with BS EN ISO 8502-6:2000 shall not exceed a conductivity corresponding to a NaCl content of 100 mg/M². Equivalent methods may be used.

PAINT APPLICATION

WSP.A1.410.9 GENERAL

1. Product data sheet for each and every product used in a coating system shall be filed and made available for reference;
2. The following information for each product used in the coating system shall be clearly specified:
   a. Surface treatment requirements;
   b. Wet film thickness/dry firm thickness (max, min. and specified);
   c. Maximum and minimum recoating intervals at 10°C gradient from 40°C down to -5°C;
   d. Information on type of thinner to be used, thinning ratios;
   e. Mixing, handling and application requirements/recommendations.

WSP.A1.420.9 APPLICATION EQUIPMENT

1. Roller shall not be used for paint application;
2. When paints are applied by brush, the brush used shall be of a style and quality acceptable to the coating manufacturer. Brush application shall be done so that a smooth coat in accordance with the specified thickness is obtained;
3. Airless spray equipment is recommended to achieve uniform coating with good penetration. Coating supplier's recommendation for pressure settings, nozzle sizes and fan angles shall be followed.

WSP.A1.430.9 APPLICATION

1. Before application of each coat, a stripe coat shall be applied by brush to all welds, corners, behind angles, sharp edges of beams and areas not fully reachable by spray, etc. in order to obtain the specified film thickness in these areas;
2. Edges of existing coating shall be feathered before over-coating and overlapping;
3. Each coat shall be applied uniformly over the entire surface. Skips, runs, sags and drips shall be avoided. Each coat shall be free from pinholes, blisters and holidays;
4. Contamination of painted surface between coats shall be avoided. Any contamination shall be removed as per ANSI/AWWA C210 requirements.

WSP.A1.440.9 REPAIR

All repairs of coating shall be conducted in accordance with the original surface preparation requirements for the substrate and coating application requirements. The Contractor shall submit a method statement for repair of any damage caused to the epoxy coating for the approval of the CM.

QUALIFICATION OF PERSONNEL, SUPPLIER AND PRODUCT

WSP.A1.510.9 OPERATORS

1. Operators for blast cleaning, paint application etc. shall be properly trained and approved by the CM with knowledge in areas concerning operational technique, equipment use, product handling, industrial safety, personal health and use of protection equipment, etc.;
2. The personnel involved in carrying out quality inspection or verification such as QC/QA staff shall be qualified in accordance with industrial standard. A relevant qualification in this regard is acceptable if the person has attained the status of Certified Painting Inspector by FROSIO or NACE Painting Inspector - Level 3 or equivalent.

WSP.A1.520.9 SUPPLIER

1. The supplier of coating material shall be evaluated and approved by the CM;
2. The supplier shall demonstrate that it has the resources technically and financially to fulfill its commitments with supply to the Contract. In this regard, Manufacturer's research and development ability to support product advancement, production capacity, quality assurance system, supply logistics, and on-site technical after-sale support shall be evaluated.

WSP.A1.530.9 COATING MATERIAL

1. The coating material used for internal lining shall be tested and pass the requirements of BS 6920. A certification issued by Water Research Centre of the UK approving such coating for contact with potable water suitable for human consumption or its equivalent shall be provided;
2. Coatings used for both internal and external lining shall be demonstrated to have suitable mechanical properties and anti-corrosion properties for the long-term protection of the substrate. In this regard, the following properties may be used as selection criteria:
    a. Minimum adhesion strength in accordance with ASTM D4541 shall be equal to 19 MPa or in accordance with BS EN ISO 4624:2003 shall be equal to 12 MPa;
    b. Minimum impact test in accordance with ASTM D2794 shall be 0.136 kg-m;
    c. Minimum abrasion resistance in accordance with ASTM D4060 (Taber Abraser Wheel CS-17) shall be 200 mg/1000 rotations, load 1000 grams.

WSP.A1.540.9 PAINT WORKING SPECIFICATION

The supplier of coating material shall provide a working specification sheet giving a summary of the work procedures. This working specification shall be properly filed and made available for reference from time to time to ensure that correct procedures are followed.

COATING SYSTEM

WSP.A1.610.9 COATING SYSTEM REQUIREMENTS

Coating system for carbon steel pipe shall be in accordance with the coating system as in Table A, B or C as below appropriate:

Table A

System 1 for carbon steel pipe – internal lining

SYSTEM 1 For carbon steel pipe – internal lining	Coating Material and Surface Protection Requirements	Minimum Dry Film Thickness (DFT) (Microns)
Surface Preparation	Abrasive blast to Min. Sa2.5 (BS EN ISO 8501) Roughness to medium grade (BS EN ISO 8503) or 10Na according to Rugotest No.3	-
Primer Coat	Solvent free two-component, high build polyamine cured epoxy	250
Intermediate Coat	Solvent free two-component, high build polyamine cured epoxy	250
Final Coat	Solvent free two-component, high build polyamine cured epoxy	250
Total Dry Film Thickness		750

Table B

System 2 for carbon steel pipe – external lining pipe shielded from direct sunlight (buried underground)

SYSTEM 2 For carbon steel pipe – external lining pipe shielded from direct sunlight (buried underground)	Coating Material and Surface Protection Requirements	Minimum Dry Film Thickness (DFT) (Microns)
Surface Preparation	Abrasive blast to Min. Sa2.5 (BS EN ISO 8501) Roughness to medium grade (BS EN ISO 8503) or 10Na according to Rugotest No.3	-
Primer Coat	Solvent free two-component, high build polyamine cured epoxy	200
Final Coat	Solvent free two-component, high build polyamine cured epoxy	200
Total Dry Film Thickness		400
NOTES: For pipe to be installed outdoor under direct sunlight, a topcoat of aliphatic polyurethane at 50 microns is required for extra protection.		

Table C

System 3 for carbon steel pipe – temporary protection after blasting (approx. 15cm)

SYSTEM 3 For carbon steel pipe end – temporary protection after blasting (approx. 15 cm)	Coating Material and Surface Protection Requirements	Minimum Dry Film Thickness (DFT) (Microns)
Surface Preparation	Abrasive blast to Min. Sa2.5 (BS EN ISO 8501) Roughness to medium grade (BS EN ISO 8503) or 10Na according to Rugotest No.3	-
Blast Primer	2-component amine adduct cured epoxy primer	50
Total Dry Film Thickness		50

INSPECTION AND TESTING

WSP.A1.710.9 TESTING AND INSPECTION

1. Testing and inspection shall be carried out in accordance with the following table throughout the application process to ensure overall specification is met:

Testing and Inspection				
Test Type	Method	Frequency	Acceptance criteria	Action to take in case of failure
Environmental Conditions	Ambient and steel temperature. Relative humidity Dew point	Before start of each shift + twice per shift evenly timed	a. Relative Humidity below 85% b. Steel surface temp. 3°C above dew point	No blasting or coating
Visual examination	Visual for sharp edges. Welding spatter slivers rust grades etc.	100% of all surface	No defect. Ref. Specified requirement	Defects to be repaired
Cleanliness	BS EN ISO 8501-1:2001	100% visual of all surface	Min Sa2.5	Re-blasting
De-dust condition	BS EN ISO 8502-3:2000	Spot check	Dust condition Max. quantity and size rating 2	Re-cleaning and retesting until acceptable
Water soluble salts on steel surface	BS EN ISO 8502-6:2000	Spot check	Max. conductivity corresponding to 100 mg/m² NaCl	Re-cleaning and retesting until acceptable
Surface profile of the blast cleaned surface	BS EN ISO 8503	Spot check	Profile grade "Medium"	Re-blasting

Visual Examination of Coating defects	Visual to determine: 1.Contamination 2. Solvent retention 3. Pinholes 4. Sagging 5. Surface defects	100% of surface for each coat	1. No contamination 2. No solvent trap 3. No pinholes 4. No sagging 5. Smooth and good cosmetic appearance	Repair of defect
Film thickness	SSPC-PA 2 Calibration on smooth surface	SSPC-PA2	SSPC-PA2 Apply DS/R 454-80:20 rule	Repair additional coats or re-coating as appropriate
Adhesion	ASTM D 3359	Spot check	Above level 3	Coating to be rejected
NOTES: All readings should refer to coating system specification.				

2. All epoxy and plastic bond coating shall be tested in accordance with BS 6920 and Water Industry Specification (WIS) No. 4-52-01 of UK.

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GIN GROUND INVESTIGATION, INSTRUMENTATION AND SOIL TESTING

GIN GROUND INVESTIGATION, INSTRUMENTATION AND SOIL TESTING 5

MATERIALS 5

GENERAL 5

GIN.M010.9 SUBMISSION OF DETAILS REGARDING GEOTECHNICAL INSTRUMENTATION 5

GIN.M020.9 SUBMISSION OF DETAILS REGARDING GROUND INVESTIGATION 5

GIN.M050.9 FENCING 5

INSTRUMENTS AND EQUIPMENT 6

GIN.M110.9 GEOTECHNICAL INSTRUMENTATION - GENERAL REQUIREMENTS 6

GIN.M120.9 STANDPIPE PIEZOMETERS 6

WORKMANSHIP 7

GENERAL 7

GIN.W010.A METHODOLOGY 7

GIN.W020.9 DEFINITIONS 7

GIN.W030.9 PROCEDURE 10

GIN.W035.9 FENCING 10

GIN.W040.A SUBMISSION OF RECORDS AND REPORTS - GENERAL REQUIREMENTS 10

GIN.W050.9 GEOTECHNICAL INSTRUMENTATION - GENERAL REQUIREMENTS 12

GIN.W060.9 LOCATION AND ARRANGEMENT OF GEOTECHNICAL INSTRUMENTATION 12

GIN.W070.9 INSTALLATION OF INSTRUMENTS 13

GIN.W080.9 ATTACHMENT OF TUBES AND CABLES TO INSTRUMENTS 13

GIN.W090.9 MAINTENANCE OF GEOTECHNICAL INSTRUMENTATION 13

GIN.W100.9 RECORDS OF GEOTECHNICAL INSTRUMENTATION 13

GIN.W110.9 MONITORING AND RECORDING INSTRUMENT READINGS - GENERAL REQUIREMENTS 14

GIN.W120.9 CALIBRATION OF MEASURING INSTRUMENTS 14

GIN.W130.9 DEPTHS OF EXPLORATION 14

GIN.W140.9 USE OF CASING 15

GIN.W150.9 REMOVAL OF CASING 15

GIN.W160.9 SITE LOG BOOK 15

GIN.W170.9 DISPLAY OF REMOVED MATERIAL 15

GIN.W180.9 MARKING HOLES 15

GIN.W190.9 ACCESS SCAFFOLDING 15

GIN.W200.9 WORKING OVER WATER 16

GIN.W210.9 WATER LEVELS 17

GIN.W220.9 WATER LEVEL MEASUREMENT 17

SAMPLING 18

GIN.W310.9 GENERAL 18

GIN.W320.9 EQUIPMENT USED FOR SAMPLING 18

GIN.W330.9 SAMPLE NUMBERING 18

GIN.W340.9 LABELLING OF SAMPLES 18

GIN.W350.9 SMALL DISTURBED SAMPLES FROM DRILLHOLES 19

GIN.W360.9 SMALL DISTURBED SAMPLES FROM TRIAL PITS, TRIAL TRENCHES OR SLOPE STRIPPINGS 19

GIN.W370.9 BLOCK SAMPLES 19

GIN.W380.9 LARGE DISTURBED SAMPLES FROM TRIAL PITS, TRIAL TRENCHES OR SLOPE STRIPPINGS 20
GIN.W390.9 UNDISTURBED SAMPLES FROM TRIAL PITS OR TRIAL TRENCHES 20
GIN.W400.9 OPEN DRIVE UNDISTURBED SAMPLERS 20
GIN.W402.9 GROUNDWATER SAMPLES FROM LAND CONTAMINATION INVESTIGATIONS 21
GIN.W405.9 SOIL SAMPLES FROM LAND CONTAMINATION INVESTIGATIONS 21
GIN.W406.A SAFETY MEASURES FOR LAND CONTAMINATION INVESTIGATIONS 22
GIN.W410.9 CLEANING HOLE BEFORE SAMPLING 23
GIN.W420.9 OPEN DRIVE SAMPLING IN BOREHOLES AND DRILLHOLES 23
GIN.W430.9 OPEN DRIVE UNDISTURBED SAMPLING IN AUGER HOLES 24
GIN.W440.9 OPEN DRIVE SAMPLING IN TRIAL PITS AND TRIAL TRENCHES 24
GIN.W450.9 WITHDRAWING THE SAMPLER 24
GIN.W460.9 SEALING OF COMMON GROUND TUBE SAMPLES 24
GIN.W470.9 GROUND WATER SAMPLES 25
GIN.W480.9 LINER SAMPLES FROM STANDARD PENETRATION TESTS 25
GIN.W490.9 PISTON SAMPLING 25
GIN.W500.9 RETRACTABLE TRIPLE TUBE CORE SAMPLER 26
GIN.W510.9 VIBROCORING 27
GIN.W520.9 FIELD MOISTURE CONTENT SAMPLES 28
GIN.W530.9 LARGE DIAMETER PISTON SAMPLING 28
GIN.W540.9 STORAGE OF LARGE DIAMETER PISTON SAMPLES 29
GIN.W560.9 CORE BOXES 29
GIN.W570.9 EXTRUSION AND HANDLING OF CORES 29
GIN.W610.9 CORE SAMPLES FOR LABORATORY TESTS 30
GIN.W620.9 DELIVERY AND STORAGE OF SAMPLES 30

INSPECTION PITS, TRIAL PITS, TRIAL TRENCHES AND SLOPE SURFACE STRIPPING 30

GIN.W710.9 INSPECTION PITS 30
GIN.W720.9 EXCAVATION OF TRIAL PITS AND TRIAL TRENCHES 31
GIN.W730.9 SIZE AND SUPPORT OF TRIAL PITS AND TRIAL TRENCHES 31
GIN.W740.9 ACCESS TO TRIAL PITS AND TRIAL TRENCHES 32
GIN.W750.9 PUBLIC SAFETY 32
GIN.W760.9 PHOTOGRAPHS OF TRIAL PITS AND TRIAL TRENCHES 32
GIN.W770.9 BACKFILLING OF INSPECTION PITS, TRIAL PITS AND TRIAL TRENCHES 32
GIN.W777.9 RECORDS OF INSPECTION PITS 33
GIN.W780.9 RECORDS OF TRIAL PITS AND TRIAL TRENCHES 33
GIN.W790.9 SLOPE SURFACE PROTECTION STRIPPING 34

DRILLING AND HAND AUGERING FOR GROUND INVESTIGATION 35

GIN.W810.9 METHOD AND PLANT TYPE 35
GIN.W820.9 SIZE OF DRILL HOLES 37
GIN.W825.9 CATEGORIES OF CORE DRILLING 37
GIN.W828.9 RECOVERY OF CORES 38
GIN.W830.9 CORING RUN LENGTH 38
GIN.W840.9 BLOCKED DRILLHOLE 38
GIN.W850.9 USE OF LUBRICANTS AND FLUSHING MEDIUMS 38
GIN.W860.9 RAPID DRILLHOLES 39
GIN.W865.9 ROTARY OPEN HOLE DRILLING 39
GIN.W870.9 INCLINATION AND BEARING MEASUREMENT OF DRILLHOLES 39
GIN.W910.9 DRILLING RECORDS 40

GIN.W920.9 BACKFILLING OF DRILLHOLES AND ROTARY OPEN HOLES 40
GIN.W930.9 BACKFILLING OF COREHOLES 41
GIN.W940.9 METHOD OF AUGERING 41
GIN.W950.9 DIAMETER OF AUGER HOLES 41

FIELD INSTALLATIONS 41
GIN.W1110.9 INSTALLATION OF STANDPIPES 41
GIN.W1130.9 INSTALLATION OF PIEZOMETERS 42
GIN.W1135.9 INSTALLATION OF BUCKETS IN STANDPIPES AND PIEZOMETERS 42
GIN.W1140.9 MONITORING STANDPIPES AND PIEZOMETERS 42
GIN.W1145.9 AUTOMATIC GROUNDWATER MONITORING DEVICE IN STANDPIPES AND PIEZOMETERS 43
GIN.W1150.9 FLUSHING OUT STANDPIPES AND PIEZOMETERS 44
GIN.W1160.9 INSTALLING INCLINOMETER ACCESS TUBES 44
GIN.W1170.9 TAKING INCLINOMETER READINGS 44
GIN.W1180.9 MONITORING MOVEMENTS OF RETAINING STRUCTURES AND CRACKS 45
GIN.W1190.9 TILTMETER SYSTEM 46
GIN.W1200.9 TELLTALES 46
GIN.W1210.9 DEMAG GAUGE 47
GIN.W1220.9 SETTLEMENT MARKERS 47
GIN.W1230.9 MAGNETIC EXTENSOMETER 47
GIN.W1240.9 PHOTOGRAPHS OF GROUND INVESTIGATION WORKS 48
GIN.W1260.9 DATA FOR SETTING OUT THE WORKS 49
GIN.W1270.9 RESULTS AND SAMPLES TO BECOME THE EMPLOYER'S PROPERTY 50
GIN.W1280.9 TOLERANCES 50

TESTING 51
FIELD TESTS 51
GIN.T010.9 RESPONSE TEST AND WATER LEVEL READINGS IN STANDPIPES AND PIEZOMETERS 51
GIN.T020.9 IMPRESSION PACKER TEST 51
GIN.T040.9 N-SCHMIDT HAMMER TEST 52
GIN.T050.9 STANDARD PENETRATION TEST 52
GIN.T060.9 PACKER (WATER ABSORPTION) TEST 54
GIN.T070.9 VANE SHEAR TEST 55
GIN.T080.9 FALLING OR RISING HEAD PERMEABILITY TEST 55
GIN.T090.9 CONSTANT HEAD PERMEABILITY TEST 56
GIN.T110.9 IN-SITU DENSITY TEST 56
GIN.T120.9 DYNAMIC PROBE TEST 56
GIN.T130.9 PUMPING TEST 58
GIN.T140.9 PRESSUREMETER TEST 59
GIN.T150.9 POINT LOAD TEST ON ROCK CORE 61
GIN.T180.9 GOODMAN JACK TEST 61
GIN.T190.9 PLATE LOAD TEST 61
GIN.T200.9 ACOUSTIC BOREHOLE TELEVIEWER SURVEY 62
GIN.T210.9 CONE PENETRATION TEST 64

LABORATORY TESTS 64
GIN.T310.9 GENERAL 64
GIN.T320.9 LABORATORY TESTING DEFINITIONS 65
GIN.T340.9 PHOTOGRAPHIC RECORD OF SAMPLES 66
GIN.T350.9 RETENTION OF SAMPLES 66
GIN.T360.9 CLASSIFICATION AND CHEMICAL TESTS 66

GIN.T365.9 TRIAXIAL TESTS ON SOIL SAMPLES 67
GIN.T367.9 TRIAXIAL TESTS ON LOOSELY COMPACTED FILL MATERIALS 67
GIN.T380.9 ONE-DIMENSIONAL CONSOLIDATION TEST 68
GIN.T390.9 SPLITTING OF UNDISTURBED SAMPLES OBTAINED FROM TRIPLE TUBE RETRACTABLE CORE BARRELS 68
GIN.T400.9 DIRECT SHEAR BOX TEST 68
GIN.T410.9 SOIL COMPACTION TEST 69
GIN.T420.9 DETERMINATION OF THE CALIFORNIA BEARING RATIO 69
GIN.T430.9 ROWE CELL TESTING OF LARGE DIAMETER PISTON SAMPLES 69
GIN.T440.9 UNIAXIAL COMPRESSIVE STRENGTH TEST 70
GIN.T450.9 ROCK JOINT SHEAR TEST 71

APPENDICES 72

APPENDIX I - AGS DIGITAL FORMAT FOR DATA OF FIELDWORK 72
GIN.APPEND1.9 APPENDIX I - AGS DIGITAL FORMAT FOR DATA OF FIELDWORK 72

APPENDIX II - AGS DIGITAL FORMAT FOR DATA OF LABORATORY TESTING 73
GIN.APPEND2.9 APPENDIX II - AGS DIGITAL FORMAT FOR DATA OF LABORATORY TESTING 73

APPENDIX III - DAILY RECORD SHEET, DRILLHOLE, TRIAL PIT, TRIAL TRENCH AND SLOPE SURFACE STRIPPING REPORT FORMATS 74
GIN.APPEND3.9 DAILY RECORD SHEET, DRILLHOLE, TRIAL PIT, TRIAL TRENCH AND SLOPE SURFACE STRIPPING REPORT FORMATS 74

APPENDIX IV - LOCKABLE SURFACE BOX FOR PIEZOMETER & STANDPIPE INSTALLATION 75
GIN.APPEND4.9 APPENDIX IV - LOCKABLE SURFACE BOX FOR PIEZOMETER & STANDPIPE INSTALLATION 75

APPENDIX V - DETAILS OF PIEZOMETER AND STANDPIPE 76
GIN.APPEND5.9 APPENDIX V - DETAILS OF PIEZOMETER AND STANDPIPE 76

APPENDIX VII - STANDPIPE/PIEZOMETER MONITORING 77
GIN.APPEND7.9 APPENDIX VII - STANDPIPE/PIEZOMETER MONITORING 77

APPENDIX X - N-SCHMIDT HAMMER TEST 78
GIN.APPEND10.9 APPENDIX X - N-SCHMIDT HAMMER TEST 78

APPENDIX XI - PUMPING TEST 79
GIN.APPEND11.9 APPENDIX XI - PUMPING TEST 79

APPENDIX XIII - REQUIREMENTS ON APPROVED SIGNATORY OF TEST CERTIFICATES AND REPORTS AND SENIOR LABORATORY TECHNICIANS FOR SOIL AND ROCK TESTING 80
GIN.APPEND13.9 APPENDIX XIII - REQUIREMENTS ON APPROVED SIGNATORY OF TEST CERTIFICATES AND REPORTS AND SENIOR LABORATORY TECHNICIANS FOR SOIL AND ROCK TESTING 80

APPENDIX XVIII - DETAILS OF SETTLEMENT MONITORING STATIONS 81
GIN.APPEND18.9 APPENDIX XVIII - DETAILS OF SETTLEMENT MONITORING STATIONS 81

APPENDIX XXI - LOCATION OF HKHA'S CORES STORES 82
GIN.APPEND21.9 APPENDIX XXI - LOCATION OF HKHA'S CORE STORES 82

APPENDIX XXII - DETAILS OF GROUND WATER SAMPLING WELL 83
GIN.APPEND22.9 APPENDIX XXII - DETAILS OF GROUNDWATER SAMPLING WELL 83

GIN GROUND INVESTIGATION, INSTRUMENTATION AND SOIL TESTING

MATERIALS

GENERAL

GIN.M010.9 SUBMISSION OF DETAILS REGARDING GEOTECHNICAL INSTRUMENTATION

1. The following particulars of the proposed geotechnical instrumentation shall be submitted to the CM:
   a. Details of instruments and any alternative instruments proposed;
   b. Manufacturer's specifications;
   c. Test and calibration certificates;
   d. Method of installation;
   e. Method of acceptance testing;
   f. Details of ancillary measuring equipment;
   g. Schedule for installing instrumentation in relation to other work;
   h. Documents showing that the instruments are capable of measuring within the ranges and accuracies stated in this Worksection and as shown on the Drawings;
   i. Name and experience of persons responsible for installation, testing and monitoring of instruments;
   j. Details of standpipe piezometer tips, including manufacturer's specification; and
   k. Details of the form of records;
2. The particulars shall be submitted for Approval at least 28 days before installation of instrumentation starts.

GIN.M020.9 SUBMISSION OF DETAILS REGARDING GROUND INVESTIGATION

1. Submit the following particulars of the proposed materials and methods for ground investigation to CM:
   a. Details of drilling and in-situ testing equipment;
   b. Details of sampling equipment; and
   c. Details of filter materials and fill materials for drilling and testing.
2. Submit the particulars for Approval at least 7 days before the relevant work starts.

GIN.M050.9 FENCING

Comply with Worksection EXT9.

INSTRUMENTS AND EQUIPMENT

GIN.M110.9 GEOTECHNICAL INSTRUMENTATION - GENERAL REQUIREMENTS

1. Instruments for geotechnical instrumentation and their accessories shall be provided complete with all appropriate tubing, connections, monitoring equipment, read-out units and any other tools necessary for the installation calibration, setting to work and maintenance of the instruments;
2. Instruments shall be manufactured by companies with proven experience and only instruments which are well proven and have been in successful use shall be used, unless otherwise agreed by the CM;
3. Installed instruments shall become the property of the Employer. Detachable tubing, connections, monitoring equipment and read-out units shall become the property of the Contractor upon the expiry of the Maintenance Period.

GIN.M120.9 STANDPIPE PIEZOMETERS

1. Unless otherwise specified, standpipe piezometer is also referred to as piezometer in this Worksection;
2. Piezometer tips for geotechnical instrumentation shall be porous ceramic or plastic material at least 200 mm long and with a bore of at least 25 mm. The permeability shall be at least 10-4 m/sec;
3. The piezometer tip shall be connected to rigid uPVC standpipes with a bore of at least 25 mm and with a wall thickness of at least 3 mm. The standpipes shall be joined together and to the piezometer tips in such a manner that the joints remain leak-proof under the anticipated head of water;
4. Submit sample of the proposed standpipe piezometers to the CM for approval at least 14 days prior to installation.

WORKMANSHIP

GENERAL

GIN.W010.A METHODOLOGY

1. Except otherwise specified or Instructed, carry out all ground investigation works in accordance with latest edition of Guide to Site Investigation (Geoguide 2)', 'Geotechnical Manual for Slopes', and 'Model Specification for Soil Testing (Geospec 3)' published by GEO, British Standard BS 1377:1990 - 'Methods of Test for Soils for Civil Engineering Purposes', together with any of its Corrigenda. Description of all samples and exposures shall generally be in accordance with latest edition of Guide to Rock and Soil Descriptions (Geoguide 3)', published by GEO;
2. The various methods of sub-surface exploration to be used during the ground investigation are defined in this Worksection;
3. Carry out each exploration method in such a way that even slight changes in the character of the strata can be detected and the soil or rock removed from any hole shall be truly representative of the subsurface;
4. The exploration techniques shall accurately reveal the location of all changes of strata and shall facilitate the taking of disturbed and undisturbed samples at any depth;
5. Chose the exploration techniques, methods and equipment in such a way that all drill casings and other ground investigation tools such as drill rods and drill bits etc. shall be retrieved from all drillholes upon completion of drilling so that they would not become underground obstructions to future developments. If any drill casings and other ground investigation tools cannot be retrieved from drillholes, inform the CM immediately and record in accordance with GIN.W040.

GIN.W020.9 DEFINITIONS

Definitions of words and terms used in this Worksection include the following:

1. On completion of the investigation, the holes may be required to give further information on site conditions by the installation of perforated standpipes, Casagrande, Cambridge type or pneumatic piezometers. With the exception of pneumatic piezometers, these installations shall be called "observation wells";
2. The word "holes" shall mean all boreholes, auger holes, drillholes, Delft sample holes, probe holes, Penetration Vane Shear Test holes and trial pits, trial trenches, slope surface strippings where the context refers to them collectively. An "uncompleted hole" means any hole in which work is being carried out, and includes any hole which has not yet been backfilled;
3. "Hole Reference Number" shall mean the unit number allocated by the CM to a hole;
4. "Final Report" shall be a report submitted to the CM after satisfactory completion of the Works specified and after CM's acceptance of the draft reports of fieldworks, field tests and / or laboratory tests;
5. "Boring" shall mean advancing a hole into the sub-surface by the cable tool method using a suitable shell, chisel or clay cutter. Boring will be used principally in conjunction with disturbed and open drive undisturbed sampling. The rig used shall be called a "boring rig" and the hole formed shall be called a "borehole";

6. "Hand augering" shall mean advancing a hole using a portable soil auger rotated by hand and will be used principally for shallow exploration in fine-grained materials. The hole formed shall be called an "auger hole";
7. "Drilling" shall mean the use of a machine-driven rig for advancing a hole in rock or soil and recovering a core with a rotary cutting tool tipped with diamonds or other hard materials. If Instructed that a core is not required the Contractor may use a rock roller or similar bit. The rig shall be called a "drilling rig", and the hole formed shall be called a "drillhole";
8. "Probing" shall mean advancing a tool of specified dimensions into the ground without the use of boring, drilling, hand augering or excavation equipment, using either static or dynamic forces and recording the resistance to penetration offered by the ground. The hole formed shall be called a "probe hole";
9. "Sample" is any quantity of material obtained from the ground for the purposes of inspection, logging or testing;
10. A "sample tube" shall mean the container into which undisturbed soil is forced during sampling and in which the soil is extracted from the ground and stored. A "sampler" shall mean the sample tube and all the accessories that are required to obtain the undisturbed sample of soil;
11. Definitions used for laboratory testing staff are given in the testing section to this Worksection;
12. "Datum station" is a mark for which horizontal or vertical values, or both, have been fixed, and which is used as a datum for monitoring or control surveys;
13. "Geotechnical instrumentation" is the installation and monitoring of instruments in the ground or structures to provide information on soil and rock parameters, and to monitor specific variations in the condition of the ground or structures for the purposes of geotechnical design, construction control and performance monitoring;
14. "Monitoring mark" is a mark, fixed or installed, on a structure to be monitored;
15. "Reference point" is a mark placed close to another important survey mark to aid recovery or replacement;
16. "Survey station" is a mark on a stone, concrete, metal or wooden block, pipe, peg or other item defining a surveyed position;
17. "Investigation station" is the area within 1 metre from the specified point or area;
18. "Common ground" is material of clay, silt, sand, gravel, cobbles and all other types of material other than rock or boulders;
19. "Boulders" are rock fragments greater than 200 mm in size;
20. "Cobbles" are rock fragments 60 mm to 200 mm in size;
21. "Gravel" is soil particles 2 mm to 60 mm in size;
22. “Sand” is soil particles 0.06mm to 2mm in size. Sand shall be natural sand or crushed natural stone;
23. "Rock" is naturally occurring material of Grades I to III as classified in Table 4 of Geoguide 3 'Guide to Rock and Soil Descriptions';
24. "Structural concrete" shall mean concrete materials of over 200 mm unbroken length measured along the centre line of the hole, either reinforced or unreinforced that are part of structural elements, such as retaining walls, foundation caps, etc.;
25. "Unformed area" shall mean an area where slopes of inclination equal to or greater than 1 vertical to 2 horizontal, over 5 m high imposed between the nearest road access to Site and the first Investigation Station or between adjacent Investigation Stations;

For the purpose of this definition the nearest road access to Site shall be that point which, in the opinion of the CM, can be reached by a vehicle carrying a drilling rig.

26. "Formed area" shall mean all areas other than those defined as "unformed areas";
27. "Notation":

Length:	mm, m, km
Mass:	g, kg, Mg
Area:	mm^2, m^2
Volume:	mm^3, m^3
Time:	s, min, year
Liquid Volume:	l
Force:	N, kN, MN
Pressure:	kN/m^2, MPa
Unit Mass:	Mg/m^3, kg/m^3
Permeability:	m/s
Consolidation:	mm^2/s, m^2/year

28. "Dimensions of Cores" are given in BS 5930:1981;
29. "Hard strata" are natural or man-made materials, which cannot be penetrated, except by the use of rotary drilling or powered breaking tools;
30. "Block sample" is an undisturbed sample recovered by in-situ hand trimming of a block of material from the surrounding soil;
31. "Bulk sample" is a sample of at least 10 kg mass, which is representative of the grading of the material at the point of sampling;
32. "Inspection pit" is a pit for locating and identifying underground utilities and structures;
33. "Jar sample" is a disturbed sample of at least 0.7 kg mass contained in a transparent airtight jar, which has a screw cap with an airtight sealing ring;
34. "Slope surface stripping" is the removal of surface protection and vegetation from existing slopes to expose underlying soil or rock for inspection;
35. "Trial pit" is a pit for inspecting and logging the ground and in which to carry out in-situ testing and sampling;
36. "Trial trench" is any excavation with dimensions larger than a trial pit on plan;
37. "U76 sample" is an undisturbed sample recovered by advancing a thin-walled tube of approximately 76 mm diameter with a cutting edge into the soil;
38. "U100 sample" is an undisturbed sample recovered by advancing a thin-walled tube of approximately 100 mm diameter with a cutting edge into the soil;
39. "Undisturbed soil sample" is a sample complying with Class 1 or Class 2 of BS 5930:1981;
40. "AGS digital format" is a data format that complies with the Association of Geotechnical and Geoenvironmental Specialists (AGS) publication "Electronic Transfer of Geotechnical and Geoenvironmental Data";
41. "Inclined hole" is any drillhole or corehole Instructed to be drilled at an angel between the horizontal and 89.5° from the horizontal;

42. "CP (Logging)" is a person who shall comply with the minimum requirements on the qualifications and experiences required for the Competent Person (Logging) set out in the CoPSS, to carry out logging of samples and preparation of borehole logs; and

43. "AS" is the Authorized Signatory of RSC(GIFW) who is responsible for the carrying out the ground investigation field works under the Contract.

GIN.W030.9 PROCEDURE

1. Information will generally be obtained by boring and drilling with continuous boring in rock, decomposed rock and other materials;

2. Where rock and decomposed rock is overlain by soft natural deposits, then information on these soft deposits shall be obtained by boring through the deposits, taking frequent undisturbed samples and making frequent insitu tests when directed by the CM;

3. When rock or decomposed rock is reached, or as directed by the CM, drilling and coring shall be used to extend any hole started by boring;

4. Fresh or slightly decomposed rock will in general be proved to a depth of 5 m by N size drilling, unless otherwise Instructed.

GIN.W035.9 FENCING

1. Erect safety fencing or temporary barriers to comply with the requirements of GCC Clause 5.12. Where Instructed, the fencing shall be erected and left in place after completion of the investigation;

2. Comply with Worksection EXT9.

GIN.W040.A SUBMISSION OF RECORDS AND REPORTS - GENERAL REQUIREMENTS

1. Unless otherwise specified, submit the following records and reports as detailed in this Worksection to the CM within the required periods as follows:

   a. 2 copies of daily records of holes, field installations and field tests within 4 working days;

   b. 2 copies of records of the coordinates and levels of holes within 2 working days of completion of the last hole excluding backfilling and reinstatement;

   c. 2 copies of preliminary records (logs) of holes, 2 sets of discs containing gINT files capable of generating the preliminary logs and associated data files of AGS within 5 working days of sinking the hole;

   d. 2 copies of draft fieldwork report including 2 sets of all photographs, 2 sets of discs containing gINT files capable of generating the preliminary logs and associated data files of AGS within 10 working days of the actual date of completion of fieldwork;

   e. 2 copies of laboratory test results within 3 working days of completion of each test;

   f. 2 copies of draft laboratory test report within 5 working days of the actual date of completion of test programme. The draft laboratory test report should contain full details of each test together with a summary sheet(s) tabulating the results of the tests undertaken on each sample;

   g. 2 copies of the draft pumping test report within 10 working days of completion of pumping test;

h. On receipt of CM's acceptance of the draft fieldwork and laboratory test reports, prepare and submit the following within 10 working days:

i. 5 fast-bound copies of the Final Report including all photographs required;

ii. 3 copies of digital image of the Final Report. Each digital image shall be stored in files on a DVD-ROM / CD-ROM and placed in a plastic protective pocket. Each DVD-ROM / CD-ROM shall be securely and clearly labelled with the date of production of the compact disc, the Contract No. and Works Order No., where applicable, the names of the Site, the name of the Employer, and the name and company chop of the Contractor. The digital image shall contain the complete contents of the report, including a scanned image of the cover page of the Report, all photos, drawings and the certificate signed by the AS as stated in sub-clause (5). The files shall be in Portable Document Format (PDF) that can be viewed and printed by the Adobe Acrobat reader. The file name shall be agreed with the CM. Separate files should be kept of borehole logs and photographs. The resolution of all colour images shall not be less than 150 dots per inch (dpi) with colour depth of 24-bit true colour. The resolution of black and white images shall not be less than 200 dpi;

iii. 2 sets of discs containing gINT files capable of generating the Final Report and associated data files of AGS format.

i. Additional copies of the Final Report including photographs ordered by the CM shall be supplied within 10 working days when Instructed.

2. The preliminary records shall give the Contractor's preliminary description and depths of all strata encountered and all the relevant information taken from the daily records including the setting out data. Obtain Approval to the form of his daily record sheets and his preliminary records before Works commence on Site;

3. The draft reports shall contain all the information required for the Final Report;

4. The Final Fieldwork Report shall be dated and certified on its cover page as being accurate, correct and complete by the AS;

5. The Final Fieldwork Reports shall contain all the information obtained from the investigation. Each Fieldwork Report shall contain the following:

a. A factual description, prepared by a CP (Logging), of the nature and methods of the ground investigation works carried out;

b. If holes have been sunk, a summary table of the depths and thicknesses of all strata (including decomposed rock and rock) encountered at each hole location and the reduced level of each stratum boundary;

c. A copy of the location plan amended as necessary to show the exact position of each completed hole;

d. A table of the as-drilled coordinates;

e. Final records of holes together with data in AGS digital format as specified in Appendix I to this Worksection or to the approval of the CM;

f. Colour photocopies of any photographs taken;

g. A certificate signed by the AS confirming the standards of ground investigation works carried out. The contents of the certificate shall be in accordance with the requirements stated in the CoPSS in respect of ground investigation report certification by the AS. The certificate shall be prepared on ICU forms provided by the CM.

6. The Final Laboratory Testing Reports shall contain the following:

   a. All the information gained from the testing programme and such introducing pages and summary sheets as are necessary together with data in AGS digital format as specified in Appendix II to this Worksection or to the approval of the CM. The summary sheets and all test certificates shall be fully typed for inclusion into each Report. Any record photographs of unsuitable samples shall immediately follow the summary sheets;

   b. A complete index of all the tests carried out and those which are HOKLAS accredited shall be clearly shown.

7. All records and reports shall be submitted on International A4 size paper unless otherwise agreed by the CM. All Final Reports shall be typed. The format and binding of the Final Reports shall be to the approval of the CM;

8. The photograph negatives or digital photograph images, together with the digital data disk in AGS digital format, shall be included in a single copy of the Final Report which shall be marked "Master Copy". For Final Laboratory Testing Reports, the original copies of all worksheets and supporting HOKLAS endorse test certificates shall be included in the Master Copy.

GIN.W050.9 GEOTECHNICAL INSTRUMENTATION - GENERAL REQUIREMENTS

1. Instruments shall be handled, stored, installed and used in accordance with the manufacturer's recommendations and in such a manner that the performance of the instruments will not be impaired;

2. Instruments shall be protected from damage and measures shall be taken to ensure that the instruments suffer the minimum practicable amount of disturbance;

3. Instruments shall be calibrated by an Approved laboratory. Instruments shall be calibrated at intervals recommended by the manufacturer and at other intervals as Instructed. Calibration certificates shall be provided to the CM within 24 hours after calibration. See also GIN.W120;

4. Installation, testing and monitoring of the instruments shall be carried out under the supervision of a suitably qualified technician. Particulars of the technician, including qualifications and experience, shall be submitted to the CM at least 7 days before commencement of work relating to geotechnical instrumentation.

GIN.W060.9 LOCATION AND ARRANGEMENT OF GEOTECHNICAL INSTRUMENTATION

Unless specified otherwise:

1. The locations and arrangement of instruments for geotechnical instrumentation shall be as stated on the Drawings or as agreed with the CM before installation;

2 The positions and alignments of instruments shall be recorded after installation and surveys shall be carried out at times and frequencies agreed by the CM to detect any displacement of the instruments;

3. At least two reference points shall be established for each survey station or monitoring mark;

4. The survey station which has the least chance of being disturbed shall be selected as datum station. The datum station shall be stainless steel and shall be protected from damage. At least three reference points shall be established for each datum station;

5. The survey network shall be related to the territorial control points provided by the CM.

GIN.W070.9 INSTALLATION OF INSTRUMENTS

1. Unless specified otherwise, inform the CM 24 hours, or such shorter period agreed by the CM, before the installation of each instrument for geotechnical instrumentation starts;
2. Instruments shall be installed, fixed and protected in a manner which will ensure that the instruments will function satisfactorily. Tests shall be carried out after installation to demonstrate that the instruments have been correctly installed and are functioning correctly. Instruments which are not correctly installed or are not functioning correctly shall be reinstalled or replaced as Instructed;
3. All installed instruments, tubes and wires shall be clearly marked with a unique and conspicuous identification number.

GIN.W080.9 ATTACHMENT OF TUBES AND CABLES TO INSTRUMENTS

Unless specified otherwise:

1. Tubes and cables attached to instruments for geotechnical instrumentation for remote reading shall be impervious to air and water, and shall have sufficient strength and stiffness to withstand the internal and external pressures. Tubes and cables shall be protected from mechanical damage and from the harmful effects of direct sunlight, heat and ultra violet radiation at all times;
2. Tubes and cables shall be free from defects and shall be marked with identification colours and numbers at 5 m intervals. The tubes and cables shall be wound onto reels in such a manner that kinks are not formed and strain is not induced. Open ends of tubes and cables shall be blocked with stop ends at all times;
3. Tubes and cables shall be buried at least 0.5 m below ground level;
4. Tubes and cables shall be laid with sufficient slack, loops and bends to allow for settlement and other ground movements. The routing of tubes and cables shall be as agreed by the CM and shall be in straight lines unless otherwise permitted by the CM. The radius of bends shall be at least 300 mm. Each tube or cable shall be laid from the measuring instrument to the terminal duct in one continuous length without joints.

GIN.W090.9 MAINTENANCE OF GEOTECHNICAL INSTRUMENTATION

1. Instruments for geotechnical instrumentation shall be maintained in good working order until the expiry of Maintenance Period. Instruments, survey marks and stations shall be protected by suitable barricades, notices, signs, marker-buoys or by other methods agreed by the CM. Construction shall be carried out in a manner which will avoid damage to the instruments;
2. Inform the CM immediately of any instruments found damaged or instruments found not to be in working order. Replacements shall be installed for read-out units which are faulty or under repair.

GIN.W100.9 RECORDS OF GEOTECHNICAL INSTRUMENTATION

Unless otherwise specified:

1. Keep on the Site records of activities relating to installation of geotechnical instrumentation and submit a copy to the CM within 24 hours after installation of the instrument is complete;
2. Prepare a drawing showing the locations and identification of installed instruments and submit to the CM within 24 hours after installation of the instrument is complete;

3. Prepare a drawing showing the locations and details of survey stations, monitoring marks and reference points and submit to the CM within 3 days after the survey network has been established.

GIN.W110.9 MONITORING AND RECORDING INSTRUMENT READINGS - GENERAL REQUIREMENTS

Notwithstanding specific requirements detailed in the following clauses to this Worksection:

1. Record the instrument readings and processed data for geotechnical instrumentation on agreed record sheets, and submit to the CM within 24 hours after recording. The form of record sheets shall be as agreed by the CM. Unless otherwise agreed by the CM, readings shall be taken in the presence of the CM;
2. Initial readings shall be taken immediately after the instruments have been installed and after the effects of installation have subsided. The initial readings shall be submitted to the CM and shall form the basis of comparison of subsequent readings. The instruments and the initial readings shall be replaced if the initial readings are not repeatable;
3. The frequencies for reading instruments shall be as agreed with the CM. Inform the CM immediately of sudden or significant changes in the readings;
4. All installed instruments shall be left in correctly functioning condition after final readings have been taken or at the end of the Maintenance Period. Keys for locks shall be tagged to identify the instrument number and shall be handed over to the CM.

GIN.W120.9 CALIBRATION OF MEASURING INSTRUMENTS

1. Where load, displacement, flowmeters, or other measuring instruments are used or where the nature of the instruments is such that calibration is required, then produce evidence of the calibration of all such instruments prior to commencing the works. Calibration of instruments should be carried out at the intervals shown in the table below:

Measuring Equipment	Calibration Interval
Flowmeters	6 months
Proving rings	2 years (or as agreed by the CM)
Pressure gauges	6 months
Torque Head (Vane)	Prior to each mobilisation
Load cells	1 year

2. Recalibration shall be conducted immediately if there is any suspicion of damage to measuring instruments or should the CM suspect the quality of the data produced. Copies of certified calibration charts shall be supplied to the CM within three days of a calibration test.

GIN.W130.9 DEPTHS OF EXPLORATION

1. Whilst investigation holes shall be continued to such depths as the CM may direct, provisional termination criteria will be as stated in this Worksection or the Works Order or as shown on the Drawings;
2. Excess drilling/excavation deeper than the depth specified/directed (including the tolerance given in the 'Schedule of Tolerance') will be at the Contractor's expense;

3. When required by the CM, holes shall be started at the bottom of trial pits, which have been excavated by the Contractor.

GIN.W140.9 USE OF CASING

1. Where sub-surface exploration is being carried out in any stratum, which is not sufficiently cohesive to stand firmly without a casing, or when directed by the CM, casing shall be used;
2. Ensure casings are advanced concurrently with the removal of material in such a manner that loss of ground is avoided;
3. Ensure that casings are of a suitable size and are inserted in such a manner as to render them recoverable. The CM reserves the right to direct the minimum diameter of casings where these are required to maintain the hole.

GIN.W150.9 REMOVAL OF CASING

The casing shall not be removed from any hole nor any filling introduced into a hole until permission is given by the CM. The casing shall be gradually withdrawn and, in non-cohesive material, the filling in the hole shall be kept above the bottom of the casing during withdrawal.

GIN.W160.9 SITE LOG BOOK

1. Maintain a Site Log Book in a format approved by the CM. All visitors to an investigation station, including the Contractor's staff, shall sign the Site Log Book on each visit. The Site Log Book shall also be used to record all verbal instructions at that particular investigation station and shall be countersigned by the authorized personnel making the instruction before the work is carried out;
2. Copy the Site Log Book to the CM within 3 working days of the date of completion of the fieldwork for each Works Order.

GIN.W170.9 DISPLAY OF REMOVED MATERIAL

When Instructed, display the removed material as follows:

1. All material removed from boreholes and auger holes, including small and large disturbed samples in their containers and undisturbed samples in their samplers shall be laid out in sequence on a clean corrugated metal sheet protected from the weather for examination by the CM;
2. The material shall be displayed in such a manner that, when required by the CM, further small disturbed samples can be taken unmixed with other material;
3. No material shall be removed from the display unless authorised by the CM.

GIN.W180.9 MARKING HOLES

When ordered by the CM, mark the position of holes permanently by the installation of Grade 20/20 concrete markers (300 mm x 300 mm x 300 mm) flush with ground level and the hole number indicated in red paint on the top face.

GIN.W190.9 ACCESS SCAFFOLDING

1. When Instructed, provide, maintain and subsequently remove on completion of the fieldwork access scaffolding of one of the types specified below:
    a. Scaffolding for the support and transportation of drilling rigs or other plant, equipment and personnel; and

b. Inspection scaffolding for examination of slope faces by the CM or other authorized person. The scaffolding shall be constructed of sound bamboo or other suitable materials approved by the CM.

2. The scaffolding referred to in sub-clause (1)(a) shall be of adequate size and constructed in a safe and secure manner including the provision of adequate working platforms, guardrails, barriers, toe-boards, fences, coverings on openings, gangways and runs in accordance with the Construction Sites (Safety) Regulations to ensure stability of the plant and equipment and the safety of persons working thereon and of third parties during boring, drilling, sounding and the movement of plant and equipment;

3. The inspection scaffolding referred to in sub-clause (1)(b) shall normally be a double-row scaffold having a maximum horizontal and vertical grid size of 600 mm and shall conform to the relevant safety requirements in the Code of Practice for Bamboo Scaffolding Safety and the Code of Practice for Metal Bamboo Scaffolding Safety or its latest revisions issued by Labour Department. The scaffolding structure at every grid shall be sufficiently strong for safety supporting at least a person and equipment weighting 120 kg. The scaffolding shall be constructed in such a way that makes it possible for person to climb on the outside face of the grid without having to climb across any over-hanging portion or member;

4. Provide a suitable fall-arresting system approved by the CM at every area where the slope inspection process may be involved. The fall-arresting system shall normally be vertical independent lifelines securely tied to stout steel pegs, tree trunks or other suitable anchorage (except the scaffolding members) at a horizontal interval of maximum 4 m;

5. Each lifeline shall be a fibre rope with a minimum diameter of 15.9 mm complying with the American National Standard, ANSI A10.32.2012, or other relevant international safety standards. Make available to the CM four sets of full body safety harness with suitable fall arresters for attaching to the lifelines. All the provided fall-arresting systems and equipment shall meet the relevant requirements in the Labour Department Guidance Notes on Classification and Use of Safety Belts and their Anchorage Systems published in 1998 or its latest revision. In addition, appoint a Competent Person according to the above Guidance Notes to check the provided safety equipment and anchorage system prior to their being used each time. Provide also necessary training to every concerned person to ensure the proper use of the safety equipment;

6. Where the inspection scaffolding in sub-clause (1)(b) as Instructed is a single-row scaffold, provide suitable working platform(s) for proper execution of slope inspection at area(s) considered to be necessary by the CM. The working platform(s) can be supported by double-row scaffolding, truss-out scaffolding or other suitable structural form(s) meeting the site environment. All working platforms and their supporting structures shall comply with the Code of Practice for Bamboo Scaffolding Safety and the Code of Practice for Metal Bamboo Scaffolding Safety or its latest revisions issued by Labour Department.

GIN.W200.9 WORKING OVER WATER

1. The Contractor may be required to carry out investigations over water. Over deep water a pontoon or jack up platform suited to the conditions may be required. Any pontoon shall have a minimum working area of 100 m² unless otherwise agreed by the CM;

2. The personnel for marine work shall include an experienced Marine Supervisor who will be responsible for the safe moving and movement of marine craft and equipment required for this work;

3. Where drilling over water, all depths shall be measured from the initial submerged ground level which shall be a fixed referenced datum to Principal Datum level;
4. Be responsible for making an application to the Marine Department regarding the Notice to Mariners within 2 working days following the receipt of an instruction for site investigation works over water. The processing of this application by Marine Department normally takes a minimum of 14 working days. Also be responsible for applying for any extension of the Notice to Mariners to complete the Ground Investigation ordered;
5. Be responsible for observing all applicable marine regulations and requirements of the Marine Department, especially those regarding safety;
6. Ensure that, during underwater boring and drilling operations, the craft or structure supporting the plant is adequately secured against movement from tidal, wind, current or other effects. Should the Contractor employ a tower or staging for making underwater boreholes or drillholes he shall ensure that the effects of settlement of the tower or staging are allowed for in any measurement.

GIN.W210.9 WATER LEVELS

1. Take daily readings of water levels in holes on land at the following times in all holes and observation wells and record them in the daily site records and report logs:
   a. Before work commences in the morning;
   b. Before the mid-day break;
   c. After the mid-day break;
   d. After work has finished in the evening but before water (if any) is added to stabilise the hole;
   e. When a hole has been completed;
   f. Immediately prior to backfilling a hole;

   The level of the bottom of the hole and the bottom of the casing, if any, shall be measured and recorded at the same time as each water level reading;
2. If at any time the level of the water in a hole fluctuates, keep a record for the fluctuation. If the hole "gains" or "loses" water, inform the CM immediately and record the details including the level of the bottom of the hole at that time and an estimate of the rate of gain or loss of water. Make provision for measuring artesian water levels when directed by the CM;
3. Record any addition of water to assist the advance of a borehole. In the case of drilling and wash boring, keep a careful record of the behaviour of the drill and wash water including an estimate of the percentage return. Report any extraordinary smell or colour of the water and other unusual circumstances in the daily site records.

GIN.W220.9 WATER LEVEL MEASUREMENT

Provide electrically operated dipmeters to measure all water levels. Each dipmeter shall be fitted with 60 metres of graduated tape at minimum 1 cm interval graduations.

SAMPLING

GIN.W310.9 GENERAL

1. Take both disturbed and undisturbed samples from all holes at the depths and intervals as specified or as otherwise directed by CM, provide all necessary sampling equipment, tubes and containers and carry out all handling and transportation of samples to a laboratory-testing contractor or to a storage area (both temporary and permanent) as directed by the CM;
2. Transport and deliver all samples in core boxes or in any other containers as specified.

GIN.W320.9 EQUIPMENT USED FOR SAMPLING

1. All the sampling equipment and containers shall conform to the requirements of Geoguide 2 and this Worksection;
2. Submit the specifications and examples of the equipment and containers proposed to be used to the CM for approval prior to the commencement of the Works.

GIN.W330.9 SAMPLE NUMBERING

1. Assign a reference number to each common ground sample (both disturbed and undisturbed) and groundwater samples taken, commencing with samples obtained from the inspection pit, if excavated;
2. The number shall be unique for that hole and shall be in order of depth below ground level;
3. The number shall also be shown on the records adjacent to the sample symbol.

GIN.W340.9 LABELLING OF SAMPLES

1. Mark all sample containers and tube samples clearly both on the side and the top of the sample with a permanent marker pen with the following information:
    a. Name of the Contract and Works Order number where applicable;
    b. Name or reference number of the site and area;
    c. Reference number, location and inclination of the hole;
    d. Reference number of the sample;
    e. Date of sampling;
    f. Brief description of the sample;
    g. Depth of the top and bottom of the samples below ground level.
2. Identify each core box by the following information, which shall be clearly marked on the top, both ends and beneath the core box lid using waterproof ink or paint:
    a. Name of the Contract and Works Order number where applicable;
    b. Name or reference number of the site and area;
    c. Reference number, location and inclination of the hole;
    d. Depths of material contained; and
    e. Core box number with indication on the total number of boxes for the hole.

3. Record the depths at which each core run started and finished at the ends of each core run by permanent marker pen on the edge of the box or on wooden blocks which fit between the dividing slats. If a core run is contained in two sequential core boxes, the abbreviation "cont'd" shall be used on the adjacent edges of the core boxes.

GIN.W350.9 SMALL DISTURBED SAMPLES FROM DRILLHOLES

1. For all drillholes,
   a. Take jar samples from the cutting shoes of each undisturbed sample, from any anomalous material, from each Standard Penetration Test and at other locations as Instructed;
   b. Take small disturbed samples of common ground on entering each new stratum (including decomposed rock) and every 1.0 m in between other small disturbed samples from cutting shoes or corebits. They shall be taken with a driven sample tube or other method approved by the CM. The disturbed sample shall be representative of the composition of the common ground.

GIN.W360.9 SMALL DISTURBED SAMPLES FROM TRIAL PITS, TRIAL TRENCHES OR SLOPE STRIPPINGS

1. Take small disturbed samples in all trial pits and trial trenches at the top of each common ground layer encountered and then at intervals of 0.5 m in any layer thicker than 0.5 m. Take small disturbed samples in common ground every 0.5 m along each slope surface stripping, commencing at the base;
2. The disturbed sample shall be representative of the composition of the common ground exposed;
3. Place samples of material predominantly coarser grained than sand, or when Instructed, place the samples in large polythene bags. Place other material in airtight plastic containers, of minimum 100 mm diameter, with a screw top. Take sufficient material to fill the bag or container, which shall be sealed immediately after recovery;
4. Label each sample as specified in accordance with GIN.W340 including the face number from which the sample was taken.

GIN.W370.9 BLOCK SAMPLES

1. Take block samples of common ground from the sides or bottom of trial pits or trial trenches or from slope strippings when directed by the CM. Samples shall be not less than 230 mm cube;
2. The top and four sides of the sample, but not the base, shall be excavated, trimmed, wrapped in aluminium foil and waxed. A wooden box, with two opposite sides removed, shall then be placed over the prepared sample such that a minimum annulus of 25 mm exists between the inside of the box and the sample. The top and side annuli shall then be filled using polyurethane by means of two reagents. After hardening of the polyurethane, the top of the box shall be attached and the sample carefully broken away at its base at a depth of no less than 50 mm below the base of the sample. The sample shall then be carefully inverted and the "base" trimmed, wrapped in aluminium foil and waxed before the basal annulus is filled with polyurethane. After hardening, the base of the wooden box shall be attached. The top and bottom of the sample shall be clearly marked on the box, as shall the direction of magnetic north relative to the in situ sample.

GIN.W380.9 LARGE DISTURBED SAMPLES FROM TRIAL PITS, TRIAL TRENCHES OR SLOPE STRIPPINGS

Take large disturbed samples of at least 25 kg in trial pits, trial trenches or from slope stripping, when Instructed. Place all large disturbed samples in heavy duty polythene bags immediately after they are taken, and securely fastened. Before taking sample in slope stripping, remove a minimum of 100 mm of material, or other thickness, as Instructed.

GIN.W390.9 UNDISTURBED SAMPLES FROM TRIAL PITS OR TRIAL TRENCHES

Take open drive undisturbed samples from the sides or bottom of trial pits or trial trenches, when directed by the CM as described in this "Sampling" sub-section.

GIN.W400.9 OPEN DRIVE UNDISTURBED SAMPLERS

1. Take open drive undisturbed samples in trial pits, trial trenches, drillholes and as directed by the CM;

2.

   a. Undisturbed samples shall be taken in an Approved 101 mm (±1 mm) (for U100), 77 mm (±1 mm) (for U76) and 41 mm (±1 mm) (for U40) internal diameter open drive sample tubes made from thin walled seamless stainless steel or galvanised mild steel not less than 450 mm (for U100), 350 mm (for U76) and 200 mm (for U40) in length fitted with a cutting shoe tapered at an angle not exceeding 20°;

   b. The end area ratio of the sample tube cutting shoes as defined in Figure 13 of Geoguide 2 shall not exceed 30% and inside clearance between the shoe and each tube shall not exceed 2% unless a core retainer is used, in which case the clearance shall not exceed 4%;

   c. The adaptor head at the top of the sample tubes shall be fitted with a ball valve to permit the exit of air or water during driving and to assist in retaining the sample during withdrawal and it shall have an allowance for over-driving;

   d. Each sample tube shall have the word "TOP" engraved on its exterior at one end;

   e. The internal and external diameter of the cutting shoe and of the sample tube shall be recorded.

3.

   a. The sample tube cutting shoe shall be free from rust, pitting, burring or any other defect;

   b. The use of oil inside the sampler shall not be permitted;

   c. The end of the sample tube marked "TOP" shall be driven uppermost;

   d. Care shall be taken to ensure that the sample is not compressed by over-driving;

   e. The minimum recovery shall be 80% of the sampled length;

   f. The method of driving, dimensions, construction and condition of each sample tube, cutting shoe, adaptor head and sample retainer shall be to the approval of the CM prior to sampling;

   g. All recovered samples shall be stored and transported vertically, in their correct orientation, in purpose-built racks which shall hold the tubes securely.

GIN.W402.9 GROUNDWATER SAMPLES FROM LAND CONTAMINATION INVESTIGATIONS

1. When Instructed, take one groundwater sample at each drillhole, inspection pit and trial pit where groundwater is encountered during drilling/excavation and only after required soil samples have been collected;
2. For groundwater taken from a drillhole, install a groundwater sampling well in accordance with Appendix XXII to this Worksection. The well shall be constructed using at least 50 mm, flush jointed, threaded class 18 uPVC with standard factory pre-slotted sections of 1 mm or less slot aperture (or a size equivalent to 90% retention for filter pack material) vertically separated by no more than 4 mm, with at least three cuts per perimeter:
    a. Submit a method statement to CM for approval for the installation of the groundwater sampling well prior to the commencement of the installation;
    b. After installation of the wells, measure the depth to water table at all wells at the same period of time with an interface probe in order to delineate the water table contours at the Site;
    c. Upon completion of installation of the wells, pump out approximately five well volumes to remove silt and drilling fluid residue from the wells;
    d. Allow the wells to stand for a day to permit groundwater conditions to equilibrate;
    e. Measure groundwater level and thickness of free product layer, if present, at each well before groundwater samples are taken;
    f. Purge the wells for at least three well volumes to remove fine-grained materials and to collect freshly refilled representative groundwater samples. Record the time for each groundwater purging or recharge as well as the estimated groundwater flow.
3. Where groundwater is encountered in inspection or trial pits, record groundwater level. Collect groundwater samples through pumping out all groundwater, letting groundwater to recharge and allowing the groundwater to stand for a day to permit conditions to equilibrate before sampling;
4. Where free product (discrete layer of contaminant which is not bound to soil or mixed in with groundwater) at or above groundwater is encountered, measure the thickness and depth of the free product layer using an approved interface probe and collect a sample when Instructed;
5. Collect groundwater samples using Teflon bailer and decant it into appropriate sample vials or bottles provided by other contractor in a manner that minimises agitation and volatilisation of the volatile organic compounds from the samples;
6. Comply with the requirement stated in sub-clauses (2) to (8) of GIN.W405 and GIN.W406.

GIN.W405.9 SOIL SAMPLES FROM LAND CONTAMINATION INVESTIGATIONS

1. When Instructed, take specified types of soil samples from inspection pits, trial pits or drillholes for land contamination investigations and comply with the "Guidance Notes for Investigation and Remediation of Contaminated Sites of Petrol Filling Stations, Boatyards, Car Repair/Dismantling Workshops" by Environmental Protection Department;
2. Take special precautions to prevent contamination of samples, which shall include but not be limited to the following:

a. For soil and groundwater samples taken from the inspection pits/trial pits/drillholes, decontaminate all plant and equipment used for excavation/drilling and sampling as follows:

i. Decontaminated by steam cleaning or high-pressure hot water jet;

ii. Washed by phosphate-free detergent; and

iii. Rinsed by distilled or de-ionized water.

b. Between samples, decontaminate all equipment used for sample extraction and handling in accordance with sub-clauses (a)(i), (a)(ii) and (a)(iii).

3. The sample containers shall be laboratory cleaned, sealable, watertight, made of glass or other suitable materials with aluminium or Teflon-lined lids, in order to prevent reaction between container surface and sample or adsorption of contaminants;

4. Do not allow headspace in the sample containers after collection of sample;

5. Store samples at between 0°C - 4°C but never frozen, and deliver to the laboratory as directed by the CM within 24 hours of the samples being collected. Operate a chain of custody system as part of the QA system;

6. Label the samples in accordance with GIN.W340 unless otherwise specified;

7. Water use for flushing medium shall be of potable quality and no lubricant, hydraulic fluid or other additive shall be introduced during drilling. No re-use of water shall be permitted;

8. Comply with GIN.W406 for safety measures for Land Contamination Investigations;

9. Prior to mobilization, submit for the CM's approval the proposed sampling procedures and safety measures to be taken for the Land Contamination Investigations.

GIN.W406.A SAFETY MEASURES FOR LAND CONTAMINATION INVESTIGATIONS

1. Comply with safety measures as specified in the latest edition of 'Practice Guide for Investigation and Remediation of Contaminated Land' and latest edition of 'Guidance Note for Contaminated Land Assessment and Remediation' published by Environmental Protection Department for Land Contamination Investigations;

2. Exercise extreme care when toxic gases or other hazardous materials are encountered. Report any abnormal conditions found immediately to the safety officer on site and the CM;

3. Establish and maintain a Health and Safety Plan, before commencement of the Works, which shall include but not be limited to the following:

a. Instruction of works on work procedures, safe practices, emergency duties, and applicable regulations;

b. Regularly scheduled and impromptu meetings of the workers in which the possible hazards, problems of the job, and related safe practices are emphasized and discussed;

c. Good housekeeping practices;

d. Availability of and instruction in the location, use and maintenance of personal protective equipment.

4. Maintain equipment and supplies reasonably required in an emergency, including lifesaving, evacuation, rescue and medical equipment in good working order and condition at all times. Use all reasonable means to control and prevent fires and explosions, injury to personnel and damage to equipment of property. Without limiting the foregoing:
    a. Maintain proper safety devices, barriers to minimise hazards during performance of the work;
    b. Prohibit smoking and open flames and the carrying of matches and lighters;
    c. Develop and maintain a written emergency plan applicable to the Works and Site;
    d. Maintain equipment in good operating condition and have emergency and first aid equipment ready for immediate use, where applicable;
    e. Conduct equipment tests to ensure that the equipment is properly placed and in good operating condition, and that workers are able to respond to emergency situations;
    f. Require all workers on Site at all time to wear clothing suitable for the work being carried out, weather and environmental conditions. For example, wear clean PVC/latex gloves whilst handling sampling equipment and carrying out sampling;
    g. Require the personnel to wear respirator and gloves for vapour exposure protection, if necessary. Safety helmet and protective boots should be worn.

GIN.W410.9 CLEANING HOLE BEFORE SAMPLING

Before an attempt to take an undisturbed sample from a drillhole is made, remove all loose material and material disturbed by drilling or field testing from the holes. On recommencement of work at the start of each shift during the progress of a drillhole, remove a minimum of 300 mm of material before the next undisturbed sample is taken, unless otherwise Instructed.

GIN.W420.9 OPEN DRIVE SAMPLING IN BOREHOLES AND DRILLHOLES

1. The CM may order the use of an open drive undisturbed sampler in any drillhole in common ground;
2. Drive the sampler by means of either a jarring link (i.e. drilling rods delivering the impact at the adaptor head of the sampler), a sliding hammer arrangement to the Approval of the CM or a single ram stroke;
3. Do not apply vertical pull-up action to the sampling tube during the lift-up of any hammering operation;
4. Record the total depth driven or pushed and, where relevant, the number of blows used. If driven samples are Instructed in common ground of low cohesion, such as silts and silty fine sands, provide a core retainer of suitable design to improve sample recovery. In cohesive common ground, make an initial attempt to obtain a sample without the use of a core retainer;
5. If an attempt to take a U100 or U76 sample in a drillhole recovers a length of sample less than specified, clear the material disturbed by the sampling process in the hole immediately and make another attempt from the level of the base of the failed attempt, using core retainer. Should the second attempt also prove unsuccessful, perform a Standard Penetration Test with liner sampler, and continue the required sampling sequence. If two consecutive sequences of failed sampling occur in any one drillhole, inform the CM immediately.

GIN.W430.9 OPEN DRIVE UNDISTURBED SAMPLING IN AUGER HOLES

When directed by the CM open drive undisturbed samples shall be taken in auger holes. Open drive undisturbed samplers in auger holes shall be driven by mean of a jarring link and the total number of blows used shall be recorded. The sampler shall be of an Approved design.

GIN.W440.9 OPEN DRIVE SAMPLING IN TRIAL PITS AND TRIAL TRENCHES

1. Prior to sampling in trial pits or trial trenches, clear all disturbed material in order to expose common ground in its natural condition;
2. Take samples using a sliding hammer arrangement with care to ensure that no lateral movement takes place during driving, with the use of guide frame as necessary. The proposed method of driving shall be to the approval of the CM;
3. If a driven sample recovers less than that specified, make a second attempt at a clear distance at least one tube diameter from the first attempt. If the second attempt fails, make a third and final attempt at a clear distance at least one tube diameter from any previous attempts. If the third attempt fails, inform the CM immediately.

GIN.W450.9 WITHDRAWING THE SAMPLER

1. Before withdrawal in boreholes, auger holes and drillholes, rotat the sampler through two complete revolutions to shear the soil horizontally at the bottom of the sampler;
2. If necessary, delay this operation to allow the development of sufficient adhesion inside the tube;
3. Smoothly withdraw the sampler so that disturbance to the sample is kept to a minimum;
4. In trial pits or trial trenches, remove the sampler by excavating around it;
5. Measure and record the total length of the sample. Record any soil that has fallen out of the bottom of the tube.

GIN.W460.9 SEALING OF COMMON GROUND TUBE SAMPLES

1. Once a sample tube has been detached or removed from the sampling equipment, keep the visible ends of the sample clear of any disturbed material and trim the edges at 45°;
2. After cleaning the sides of the tube above the recovered sample, coat the ends with three successive thin films of just molten microcrystalline wax. Add a metal foil disc followed by more molten wax to give a total thickness of not less than 20 mm. Solidly fill any space remaining in the ends of the sample tube with damp sawdust or other material approved by the CM and cover the ends of the sample tube with tight fitting rubber caps;
3. Handle the tubes containing samples with care to avoid any possible disturbance, store them in a cool and dry location and protect them against the sun or inclement weather whilst on Site;
4. Place the material from the cutting shoe/core bit immediately in a plastic container of minimum diameter 100 mm, with a screw top. They shall be arranged securely in the corebox in their proper sequence;
5. If any undisturbed samples are found to have been incorrectly sealed, labelled or stored, they will be regarded as disturbed samples by the CM.

GIN.W470.9 GROUND WATER SAMPLES

1. When directed by the CM, take ground water samples from trial pits, trial trenches, boreholes or drillholes;
2. If water has been used for the purpose of drilling, bale out a volume of water at least equivalent to that of the drillhole volume before sampling;
3. Each sample taken shall not be less than 2 litres and shall be placed in a sterilized airtight bottle of sufficient capacity. Bottles shall be flushed out twice with the water to be sampled before use.

GIN.W480.9 LINER SAMPLES FROM STANDARD PENETRATION TESTS

1. When Instructed, provide a liner sample in conjunction with the Standard Penetration Test;
2. The split barrel sampler shall have an enlarged internal diameter to accommodate a thin stainless steel or aluminium liner of 35 mm internal diameter which shall fit tightly inside. The internal diameter of the liner may be up to 0.2 mm larger but in no case be smaller than that of the drive shoe. The liner shall have a smooth internal surface and may comprise two separate sections of equal length. The enlarged split barrel shall not be used without a liner in place;
3. After the sampler has been withdrawn from the drillhole, treat the liner and the retained soil in the same manner as an undisturbed sample.

GIN.W490.9 PISTON SAMPLING

Take undisturbed piston samples in boreholes or drillholes when Instructed and as follows:

1. Carry out piston sampling with an Approved thin-walled stationary piston sampler;
2. The sampling tube shall be 1000 mm long, formed from stainless steel with an internal cutting edge and shall have an internal diameter of 75 mm or 100 mm (± 1 mm) as specified by the CM;
3. The piston sampler shall be capable of operating to a depth of 20 metres below ground level;
4. The sampling operation shall ensure the sampling tube is pushed into the soil at a steady rate with no lateral deflection;
5. The design and performance of the sampler shall be such that a vacuum is formed over the retained sample in the tube;
6. The area ratio of the tube, as defined in Geoguide 2, shall not exceed 10% and the cutter edge taper angle shall not exceed 15°. No inside clearance is permitted;
7. The minimum recovery shall be 90% of the sampled length. Where the sample length is less than that specified, clear the material disturbed by the sampling process in the hole and make another attempt from the level of the base of the failed attempt at no extra cost. If this second sampling attempt also fails to recover the minimum specified, continue the Instructed sampling sequence and inform the CM immediately, or as soon as possible the next working day;
8. Fabricate purpose-built sample boxes for transporting and storing all piston samples in a vertical position in the correct orientation. Each vertical box shall be used to transport a maximum of two piston samples. These boxes shall be robust, water-tight, and shall be fitted with hinged top and attaching rope stands. The inside of the box shall be provided with styrofoam padding which holds samples tightly in place.

GIN.W500.9 RETRACTABLE TRIPLE TUBE CORE SAMPLER

1. Take undisturbed samples of common ground in drillholes using a triple tube retractable core barrel (Geoguide 2) fitted with either a detachable rigid clear ABS plastic or rigid opaque PVC or Polyethylene (PE) liner;

2. The dimensions of the core barrel and liner shall be as follows:

Item			Dimension (mm)
Core Barrel	Outer Tube	OD	98.5 ± 2.0
	Inner Tube	ID	78.0 ± 1.0
		OD	85.0 - 89.0
	Cutting Shoe (LeadingEdge)	ID	72.5 ± 1.0
		OD	77.2 ± 1.0
	Drill Bit	OD	101.1 ± 2.0
Liner	ID		74.0 ± 1.0
	OD		77.0 ± 1.0
	Ovality		± 0.5
	Bow		3 per metre
	Length		1000 ± 5
	Wall Thickness		1.5 minimum

3. Use face-discharged bit formed of steel and set with tungsten carbide inserts in a saw tooth profile. The drill bit shall have groove cuts on the external sidewall to facilitate return of flushing fluid;

4. The cutting shoe shall have an area ratio of 10 to 15%. The ID of the leading edge of the cutting shoe shall be smaller than the ID of the liner tube with an inside clearance within 1.5 to 3.5%. Three lengths of cutting shoes, referred to as "long", "medium" and "short" with decreasing lengths of protrusion beyond the drill bit when mounted, shall be available. The "long" shoe with a protrusion of not more than 50 mm shall be used generally for looser or softer soils, and the "medium" or "short" shoes for denser or stiffer soils;

5. The liner shall fit tightly inside the inner tube, in both radial and longitudinal directions. Obtain the type and make of the liners to be used from a manufacturer approved by the CM. In addition, within 3 weeks of award of the Contract, submit the name(s) of the suppliers, material specification and samples of the liners proposed for use in the Contract to the CM for approval. If approved, maintain the quality of the liners throughout the duration of the Contract;

6. The barrel, drill bit and cutting shoe shall be free from significant defects and in good working condition. A sediment tube may be attached to the top of the barrel to trap the cuttings falling out of suspension from the flushing medium. A core retainer of suitable design may be used only when it is necessary to reduce the risk of sample loss;

7. Prior to lowering the barrel down the drillhole, it shall be checked to ensure that the inner barrel rotates freely, the retractor spring works and that the check valve at the top of the inner barrel is functioning properly;

8. Clean out the bottom of the drillhole properly prior to sampling to the specified sampling commencement depth within a tolerance of ±25 mm, unless otherwise agreed by the CM;

9. In order to alleviate disturbance to the soil being sampled, keep the applied flushing pressure to a minimum. An optimum combination of the applied bit pressure and rotation speed shall be used to achieve a steady penetration which shall not be too slow to avoid unnecessary disturbance induced by the flushing medium;
10. Successful sampling shall mean a minimum recovery of 80% of the sampled length when water flush is being used, and 90% of the sampled length when air-foam flush is being used. If sampling is not successful, clear the material disturbed by the sampling process in the hole immediately and make another attempt from the level of the base of the failed attempt;
11. If continuous retractable triple tube core sampling has been Instructed and the second attempt also proves unsuccessful, inform the CM immediately, or as soon as possible the next working day, and submit a proposal to improve sample recovery for CM's agreement;
12. If interval sampling has been Instructed and the second attempt also proves unsuccessful, perform a Standard Penetration Test with a liner sample and continue with the sampling sequence Instructed. If two consecutive sequences of failed undisturbed sampling occur in any one drillhole, inform the CM immediately, or as soon as possible the next working day. Continue the sampling sequence unless otherwise Instructed;
13. If the CM accepts a sample less than the successful sampling length as described in sub-clause (10), the sample shall be paid for pro-rata based on the successful length.

GIN.W510.9 VIBROCORING

1. When Instructed, obtain samples by vibrocoring;
2. The vibrocore sample shall be 75 mm (±2 mm) in diameter and shall be 6 m long. The vibrocore shall be fitted with a detachable rigid PVC tube to assist in the recovery of samples;
3. A piston shall be placed inside the PVC liner. During sampling the piston shall be held rigidly so that no vertical movement of the piston shall occur such that a vacuum is formed over the retained sample. A basket core retainer shall be fitted at the bottom of the tube to assist in the recovery of samples;
4. The vibration effort shall be supplied pneumatically or hydraulically, and the vibration energy must be adjustable to suit the ground conditions. The minimum vibration energy necessary to obtain a core should be used, to avoid undue disturbance of the sample;
5. Core recovery shall be at least 80% in any vibrocore run. If the recovery falls below this level, and if in the opinion of the CM higher recoveries should have been achieved, the CM may require another sample to be taken at the same depth at another location to be agreed by the CM;
6. Storage of vibrocore samples for trace metal contamination analysis to comply with Environment, Transport and Works Bureau Technical Circular (Works) No. 34/2002, Management of Dredged/Excavated Sediment;
7. Responsible for labelling, splitting, photographing and logging of the vibrocores. After logging, the vibrocores should be wrapped and sealed in polythene sheeting. When required by the CM, cut the vibrocores into 1 m length, seal and cap both ends, label, and store in core boxes;
8. The equipment shall be so designed that 6 m long core samples can be taken continuously from the existing ground level to the required depth and surface samples can be taken from the 0-2 m run below the existing ground level;

9. Include the logging and photographs in the report in a format to be Approved and submit them in a manner as described in GIN.W040.

GIN.W520.9 FIELD MOISTURE CONTENT SAMPLES

Field moisture content samples shall be taken on the following occasions when directed by the CM:

1. When an undisturbed sample is taken (the material for the moisture content sample shall be taken from the cutting shoe);
2. When a large disturbed sample is taken in cohesive soils (the moisture content sample shall be separated from the large disturbed sample);
3. When a Standard Penetration Test is conducted (the moisture content sample shall be taken from cohesive soil in the split spoon);
4. When a Vane Shear Test is conducted (one moisture content sample shall be taken from the soil adhering to the vane, if any, when it is extracted and another moisture content sample from the sheared soil removed from the borehole, drillhole, auger hole or trial pit when it is advanced to the level of the test);
5. When an in-situ density test is conducted;
6. At the top of any cohesive stratum;
7. At 1500 mm depth below the last moisture content sample.

GIN.W530.9 LARGE DIAMETER PISTON SAMPLING

When Instructed, take large diameter undisturbed piston samples as follows:

1. Large diameter piston sampling shall be carried out with an Approved thin-walled fixed piston sampler;
2. The piston sampler shall be capable of operating to a depth of 20 metres below ground level with no lateral movements being allowed during the actual sampling operation;
3. Where marine site investigations require large diameter piston sampling, the craft supplied must be capable of being supported rigidly from the sea-bed or a fixed platform shall be provided;
4. Prior to sampling, 200 to 300 mm of borehole advance shall be undertaken to remove disturbed ground;
5. The load required to penetrate the sampler shall be applied smoothly and evenly;
6. The minimum sample length shall be 450 mm and have a diameter of 260 mm;
7. The piston sampler shall have an Approved method of cutting the base of the sample; such a method shall include a cutting wire located in the base of the sampler;
8. Samples shall be taken with the exploratory hole filled with water unless otherwise Instructed;
9. The design and maintenance of the sampler shall be such that a vacuum is formed over the retained sample in the tube;
10. Take all necessary steps to ensure full recovery of the specimen;
11. The sampler shall be withdrawn carefully and slowly, particularly for the first metre of its withdrawal, to avoid a vacuum being formed beneath the sampler and sucking the sample from the tube.

GIN.W540.9 STORAGE OF LARGE DIAMETER PISTON SAMPLES

1. Large diameter piston samples shall be stored at all times inside a steel storage container;
2. The ends of the sample tube shall be sealed with at least 3 layers of Approved wax/petroleum jelly mixture;
3. Timber blocks shall be fitted into the sample tube to fill any voids at the top of the tube;
4. The sample tube shall be clamped into the storage container by metal plates at both ends separated from the sample tube by rubber sheeting about 4 mm thick;
5. The space between the sample tube and the inside of the storage container shall be filled with water;
6. Transportation of samples shall conform to GIN.W620.

GIN.W560.9 CORE BOXES

1. Core boxes shall be 1.05 m in length, 0.45 m in width and of sound robust timber construction, able to withstand the weight of the cores and stacking of the boxes, and be sufficiently watertight to protect the cores from rain on Site and in transit. The lid shall be fitted with metal hinges, hasp and staple and a locking device. Rope strands shall be attached to the core box for lifting. Boxes shall be made with rigid separating wooden slats. For core boxes containing rock cores only, core boxes of smaller size to be approved by the CM may be used;
2. Take appropriate preventive and protective measures to minimise the risks of manual handling operations of core boxes, which include but not be limited to the following:
    a. Provide information to the workers on the risks of manual handling operations (ie. The weight and the heaviest side of the load);
    b. Provide mechanical aids and proper personal protective equipment to the works;
    c. Arrange a team of workers to carry out the manual operations.

GIN.W570.9 EXTRUSION AND HANDLING OF CORES

1. Remove all cores from double tube core barrels using a hydraulic extruder, unless otherwise Instructed. Under no circumstances shall air pressure be used for the extrusion of cores. The extruder shall apply a continuous pressure to one end of the core whilst the barrel is in a horizontal position. Only gentle hammering with a wooden mallet on the side of the core barrel to free wedged pieces shall be permitted;
2. Extrude carefully cores from single and double tube core barrels onto split plastic piping of similar diameter to the core such that the core fits tightly into the pipe and is not free to rotate. When Instructed, or the recovered core is heavily jointed or fragmented and is likely to be disturbed during transportation, it shall also be wrapped in self-clinging transparent film, or similar Approved;
3. Wrap cores from split inner tube triple tube core barrels in self-clinging transparent film and then aluminium foil and carefully transferred into split plastic piping of the same internal diameter as the split inner tubes;
4. As the core is extruded, arrange it in core boxes in a proper sequence starting with the shallowest core on the left side nearest the hinge and then working along the slat and subsequently outwards towards the hasp (i.e. from left to right with the box lid on the far side of the box as the core is placed). Position and secure slats to restrain the core from movement;

5. Pack fractured rock securely. At no time should any core be loose in the box. Show core losses in individual core runs by wooden blocks or polystyrene of a square cross section to fill the core box, and of a length equal to the core lost.

GIN.W610.9 CORE SAMPLES FOR LABORATORY TESTS

Cores recovered from drillholes will be taken for use as samples for laboratory testing when directed by the CM. The samples shall be cut from the core as it is extruded from the core barrel or when directed by the CM and a spacer bearing the sample number and depth of the top and bottom of the sample placed in the core box.

GIN.W620.9 DELIVERY AND STORAGE OF SAMPLES

1. Deliver all samples, including cores, obtained from the Site to the designated HKHA core stores, stores within the Site or any other core stores as directed by the CM within 3 working days after the completion of the field works, unless otherwise Instructed. The locations of the HKHA's core stores are shown in Appendix XXI to this Worksection;
2. Deliver all samples, including cores in their appropriate containers in such a manner as to prevent disturbance of the samples or cores by sudden movement, continuous or intermittent vibration, sudden temperature changes of any other reason. When necessary, provide purpose-built containers to protect sample tubes and jars when they are being delivered;
3. Whilst in the possession of the Contractor, store the samples in a cool and dry location protected against the sun, inclement weather, theft and vandalism to the satisfaction of the CM. Store block samples in their correct orientation. Store and transport in a vertical or horizontal direction for all samples recovered from vertical/sub-vertical or horizontal/sub-horizontal drillholes respectively in their correct orientation, and in purpose-built racks which shall hold the samples securely. Stack the core boxes by investigation station and box order;
4. Deliver samples to the laboratory specified by the CM within 3 working days of receipt of an instruction. Raise with the CM any discrepancies between the laboratory testing schedule attached to the instruction and the samples, such as incorrect sample depths or reference numbers, prior to delivery. Obtain a signed delivery docket to record the delivery and check off all the samples with a representative from the laboratory.

INSPECTION PITS, TRIAL PITS, TRIAL TRENCHES AND SLOPE SURFACE STRIPPING

GIN.W710.9 INSPECTION PITS

1. Start all land boreholes and drillholes by means of a hand excavated inspection pit, not less than 0.25 m² on plan and not less than 2 m deep, unless otherwise Instructed;
2. Assist excavation with hand operated power tools where hard strata cannot be broken out without the use of such tools;
3. Do not commence boring or drilling until the presence or otherwise of all services/utilities have been established;
4. Measure the positions, depths and dimensions of all services/utilities encountered and record them as part of the report;
5. Take small disturbed samples every 0.5 m in all common ground layer encountered in the inspection pits for logging purposes, commencing at ground level or below any concrete or road surfacing layers;

6. Where the holes are located near underground electricity cables, comply with the "Code of Practice on Working near Electricity Supply Lines" issued by Electrical and Mechanical Services Department.

GIN.W720.9 EXCAVATION OF TRIAL PITS AND TRIAL TRENCHES

1. Excavate trial pits and trial trenches by manual methods to the termination requirements or depths Instructed. Do not use powered tools unless otherwise agreed by the CM;
2. Remove the excavated material from the site and import the same or similar material for subsequent backfilling. For excavations on sloping ground, protect the material in such a manner that it does not fall or wash downhill or in any way enter surface water drainage system. Protect all excavated material from the weather. Also take all necessary measures to prevent the ingress of surface water into the excavations;
3. Before commencing any excavation, carry out three dynamic probing tests in a triangular pattern not more than 800 mm apart around the centre of each proposed trial pit unless otherwise Instructed. In trial trenches, carry out one dynamic probing test for each 1.0 m^2 of plan area of the excavation, equally spaced, unless otherwise Instructed. Terminate all probes at the initial Instructed depth of the trial pit or trial trench. On sloping ground, terminate each individual dynamic probing test at the Instructed base of the trial pit or trial trench. Make a second attempt for each test if refusal is met before the Instructed termination depth, at a distance of not less than 150 mm from the original position;
4. Submit to the CM the preliminary results of the dynamic probing tests carried out prior to excavation with the relevant daily site records for each trial pit or trial trench excavated. Include the dynamic probing test results in the Final Fieldwork Report and provide them in AGS digital format; and
5. Inform the CM immediately when each trial pit or trial trench has been completed, or if hard strata are encountered. Carry out logging or photography of each trial pit or trial trench after the termination of each excavation has been Approved.

GIN.W730.9 SIZE AND SUPPORT OF TRIAL PITS AND TRIAL TRENCHES

1. Trial pits shall have nominal plan dimensions of 1.5 m x 1.5 m to their full depth of excavation, unless otherwise Instructed or due to restricted space at the pit location or where prevented by the presence of hard strata. Where trial pits are excavated on sloping ground, the base of each pit shall be horizontal and any Instructed termination depth shall be taken as the depth of excavation at the mid-point of the base to original ground level;
2. Provide or carry out benching, shoring and access ladders such that personnel can safely inspect the sides and base of the pit or trench or carry out in-situ tests and take undisturbed samples;
3. Trial pit or trench sides shall be vertical and shored in such a manner that the natural ground shall be clearly visible throughout the height of each face;
4. Adequately support the sides of all excavation exceeding 1.2 m deep at all times to comply with the Construction Site (Safety) Regulations by using a method approved by the CM to ensure the safeguarding of life and property;
5. This clause shall in no way relieve the Contractor of his obligations or responsibilities under the Conditions of Contract.

GIN.W740.9 ACCESS TO TRIAL PITS AND TRIAL TRENCHES

1. Provide such ladders and platforms as may be necessary such that personnel can safely inspect the sides and base of the pit/trench, take photographs and carry out in-situ tests and take undisturbed samples as necessary in the trial pits or trial trenches;
2. Provide such pumps as may be necessary to maintain the excavation free from water and such ventilation and lighting as may be needed to ensure the safety of people working in the pit/trench. The base of each excavation shall be clearly visible during logging and taking of photographs.

GIN.W750.9 PUBLIC SAFETY

At all times when a trial pit or trial trench is left unattended, provide a strong wooden cover securely battened down and appropriate fencing to prevent persons and animals from falling into the excavation.

GIN.W760.9 PHOTOGRAPHS OF TRIAL PITS AND TRIAL TRENCHES

1. Within 2 working days of the date of Approval of any trial pit or trial trench, take photograph of trial pit or trial trench using a reference board with maximum dimensions of 300 mm (width) by 450 mm (length). Each face and the base shall be photographed;
2. Each photograph shall cover a length of the excavated face of between 1.5 m and 2.0 m in both vertical and horizontal directions. Where more than one photograph is required to cover the full excavated depth or length of a face, the overlap between adjacent photographs shall be between 10% and 20%;
3. Each photograph shall identify the face of the excavation and shall contain a natural scale. In the case of trial trenches, it shall also identify the location of the photograph by the metrage along the face of the excavation;
4. One colour print of minimum size 85 mm x 125 mm of each trial pit or trial trench photograph shall be supplied with the draft fieldwork report. Each copy of the Final Fieldwork Report shall contain colour photocopies of A4 mounted prints of minimum size 125 mm x 175 mm. Within 3 weeks of the award of the Contract, submit the name(s) of the suppliers and samples of the colour photocopies proposed for use in the Contract for the CM's approval. The quality of the approved colour photocopies shall be maintained throughout the duration of the Contract;
5. The method of photography shall be agreed with the CM prior to carrying out the work and shall be in accordance with GIN.W1240; and
6. Submit one copy of photographs of the trial pit or trial trench to the CM for approval before backfilling of the trial pit or trial trench.

GIN.W770.9 BACKFILLING OF INSPECTION PITS, TRIAL PITS AND TRIAL TRENCHES

1. Backfill inspection pits on completion of the drillhole. Plug at the bottom with concrete or similar material;
2. Backfill trial pits and trial trenches within 2 working days of the date of issue of an instruction from the CM. The backfilling material shall contain no material exceeding 200 mm in size, refuse, metal, rubber or synthetic material, peat, vegetation, perishable material, toxic material or material susceptible to combustion or to volume change;

3. Compact the material used to backfill inspection pits, trial pits and trial trenches until original ground level is restored. Compaction for trial pits and trial trenches shall be performed mechanically in successive layers of not more than 150 mm thick. Restore the ground surface to its condition prior to the excavation, i.e. any pitching, paving, chunam, concrete or turf shall be replaced;
4. As backfilling of each trial pit or trial trench proceeds, remove progressively timber, sheeting and other excavation supports, but the removal of such supports will not relieve the Contractor of his responsibilities for the safety and stability of the Works;
5. On completion of backfilling and prior to any reinstatement of the ground surface at the location of any trial pit or trial trench, carry out a further set of dynamic probing tests unless otherwise Instructed. Carry out three such tests in a triangular pattern not more than 0.8 m apart around the centre of each trial pit, whilst in trial trenches one such test shall be carried out for each 1 m^2 of plan area of the excavation, equally spaced. Terminate each test at the level of the excavated base of the respective trial pit or trial trench. Make a second and final attempt for each test if refusal is met before the required depth, at a distance of not less than 150 mm from the first test. Submit to the CM the results of the dynamic probing tests with the relevant daily site records for each trial pit or trial trench excavated, or to volume change. Compact the material used to backfill inspection pits, trial pits and trial trenches until original ground level is restored;
6. Compact the backfill material such that the average dynamic probing test value of the post-backfilled set of probes at any level within the excavation depth of the pit or trench excavation, shall be 80% of the average value of the pre-excavation set of probes at the same level, and no less than 10 blows/100 mm. Notwithstanding this requirement, fill and compact any subsequent depression of the ground surface occurring due to settlement;
7. For backfilling under an Excavation Permit, no broken concrete, bricks, clay, bituminous materials, materials susceptible to spontaneous combustion, perishable materials or debris shall be present in the backfill materials. The backfill materials shall not exceed 75 mm maximum particle size. The work shall comply with the requirements set out in the Conditions of Permit. The more stringent requirement shall prevail in case of any ambiguities or discrepancies between this clause and the Conditions of Permit. Satisfactory compaction of backfill shall be demonstrated by testing for relative compaction in accordance with the Worksection EAR. Relative compaction testing shall be carried out for every meter depth of backfill in each trial pit and trial trench, at locations instructed by the CM.

GIN.W777.9 RECORDS OF INSPECTION PITS

Include details of each inspection pit in the relevant daily site record and drillhole record. Submit a photograph taken vertically downwards into each inspection pit together with the daily site record for the relevant drillhole. A board showing the Contract number, Works Order number where applicable, and drillhole number, and the depth indicator used shall be clearly visible in the photograph.

GIN.W780.9 RECORDS OF TRIAL PITS AND TRIAL TRENCHES

1. Submit daily site records for trial pits or trial trenches in accordance with GIN.W040. The format of daily site records shall be to the approval of the CM. The information required on the daily site records is listed below:
    a. Site name, Contractor's name, Contract number and Works Order number where applicable, trial pit or trial trench number;
    b. Dates of excavation and weather conditions;

c. Depths and details of all sampling and field testing including total blow count for driven samples and sample recovery;

d. Any other relevant information e.g. comments on stability, maximum and average trial pit and trial trench depths and plan dimensions, water inflow, powered tools used.

2. Submit preliminary and final records for trial pits or trial trenches in accordance with GIN.W040. Present the records in the format as shown in Appendix III to this Worksection, unless otherwise agreed by the CM. The record for each trial pit or trial trench shall contain the following information:

a. Site name, Contractor's name, Contract number and Works Order number where applicable, trial pit or trial trench number;

b. The reduced level at the centre of the pit for trial pits located on level or sloping ground; the reduced levels of both ends of the longer axis for trial trenches;

c. Dates during which trial pit or trial trench was excavated;

d. Dimensions of trial pit or trial trench and its orientation;

e. The coordinates of the centre of the pit for trial pits; the coordinates of both ends of the longer axis for trial trenches;

f. Water levels with full details of fluctuation and locations of seepages. If no water is encountered, this shall be recorded;

g. A hand drawn (preliminary) and computer-generated (final) representation of the features and material types encountered in each face and the base of the trial pit or trial trench. Fill shall be shown as its constituent materials in the face sketch and its legend pattern in the legend column;

h. Details of photographs taken;

i. Stability conditions during excavation;

j. Locations and types of samples taken;

k. In-situ test types and locations;

l. The size and orientation of any services encountered;

m. A sketch showing the dimensions of any sub-surface structures, including foundations exposed in the excavations;

n. If pumping was required during excavation this shall be noted and an estimate of the rate of inflow of water made;

o. Sign of any settlement caused by excavation;

p. A "remarks" section which shall include groundwater and wall stability observations, average and maximum depths, use of shoring and details of any obstruction encountered. If the required number of dynamic probing tests was not carried out, the excavation was terminated earlier than specified, or the plan area of the excavation was reduced, these facts shall be noted with reasons.

GIN.W790.9 SLOPE SURFACE PROTECTION STRIPPING

1. Strip and dispose of surface protection, including that containing reinforcement, from slopes to expose underlying common ground or rock. The width of stripping shall be 500 mm, unless otherwise Instructed, with the axis of the strip parallel to the dip of the slope. The underlying common ground shall be excavated to a minimum depth of 100 mm and up to 300 mm as Instructed;

2. Terminate all excavation if boulders, rock or hard strata are encountered, unless otherwise Instructed. Start the stripping at the top of the slope and proceed downwards unless otherwise Instructed. Horizontal stripping may also be required;
3. When Instructed, limit stripping to specified intervals (windows) along the instructed length and provide a record for the full instructed length of the stripping to the CM;
4. Provide access for inspection by the CM;
5. Protect all exposed surfaces in such a way as to minimise the channelling of rainwater run-off. Cover up stripped areas at the end of each working day and during rainstorms to prevent the ingress of water into the slope;
6. Backfill the excavation in common ground with material approved by the CM. Reinstate stripped areas in form, colour, and conditions similar to the original conditions unless otherwise Instructed. Obtain the permission of the CM before reinstatement starts;
7. Submit preliminary and final slope stripping records in accordance with GIN.W040. Present the records in the format as shown in Appendix III to this Worksection, unless otherwise agreed by the CM. Records of the stripped areas shall contain the following:
    a. Descriptions of strata (including decomposed rock) encountered;
    b. Levels and coordinates of the top and bottom of strips, berms, benches and changes in type of slope surfacing. The survey results shall include all points on each strip where there is a change in gradient. Any other salient features shall be noted e.g. dip and dip direction of joints;
    c. The direction and bearing of the slope and the results of any in situ testing carried out;
    d. A dimensioned sketch of the strip cross-section;
    e. Photographic records as specified in GIN.W1240. The photograph of the exposed slope face shall be of such a size that it occupies the full height of an A4 size page.

DRILLING AND HAND AUGERING FOR GROUND INVESTIGATION

GIN.W810.9 METHOD AND PLANT TYPE

1. Inform the CM immediately prior to the commencement of any drilling. Unless otherwise Instructed, sink drillholes for ground investigation by rotary methods;
2. Undertake drillholes by using rigs that meet the following requirements:
    a. Drilling rigs shall be of the hydraulic feed type having the capacity to drill in the sizes and to the termination requirements or depths Instructed;

b. Drilling rigs shall be capable of providing stable drill-string rotation at speeds in the range 50-1250 rpm and have a minimum ram stroke length of 400 mm if applicable. The rigs shall be fitted with a tachometer, a hydraulic feed pressure gauge of an appropriate scale and a pressure gauge for reading water-flushing pressure. The hydraulic feed pressure readings shall be readily converted to loads transferred to the bit in pounds or kilograms according to the manufacturer's specification. In order to provide a means of measuring penetration and estimating the rate of advance, a rigid rod, clearly graduated in 10 mm increments, shall be permanently attached to, and parallel with, the hydraulic feed rams;

c. Drilling rigs shall have the company name and a unique rig number clearly and conspicuously marked; and

d. Drilling rigs shall be capable of drilling both vertical and inclined holes at any angle.

3. Undertake coreholes by using portable electric powered coring rigs that meet the following requirements. Other types of portable coring rig shall be subject to the approval of the CM:

   a. The rig can be attached securely to the structure being cored to minimise vibration;

   b. The rig shall be such that cores of H size or larger can be obtained to a depth of 6 m measured along the axis of the hole, and that either water or air-foam can be used as flushing medium;

   c. The rig shall be capable of drilling at any inclination and shall be of such type that samples of common ground can also be obtained from beyond the structure being investigated.

4. The core barrels, drill rods and drill bits of drilling equipment for ground investigation shall be of a type appropriate to the purpose of the drilling and sampling. Triple tube core barrels shall be provided with bits suitable for air-foam flush. The type and make of core barrels shall be approved by the CM;

5. The size of casings shall be appropriate to the drilling, coring, sampling, testing and other installation requirements;

6. Use only standard nominal lengths of casing and drill rods. The mixing of standard nominal imperial and metric lengths is not permitted;

7. Casings and drill rods shall be straight, in good condition, clean at the time of drilling and free from scale, dirt and other loose material;

8. All accessories and spare parts shall be as supplied or recommended by the same manufacturer unless otherwise approved by the CM. They shall be compatible with the equipment in use and with each other. Sufficient spares for core barrels, core bits, core lifters and other accessories shall be available for use on Site without causing any delay to drilling operations. The condition of the core bit in use shall be carefully monitored and if any damage occurs, such as breaking of teeth, it shall be replaced immediately;

9. Always maintain core barrels in proper working order and pay particular attention to the condition of the extrusion piston. Maintain the rubber O-rings in good condition so that no water escapes past the piston during extrusion of the cores;

10. Use sediment catcher tubes attached to the top of the core barrels if Instructed. The tube shall have the same external diameter as the core barrel, and be approximately 0.75 m long;

11. Store core barrels and drill rods on steel frame trestles;

12. Types of core barrel(s) to be used for individual drillholes will be as Instructed;
13. The methods and equipment used shall be such that:
    a. The soils encountered and the levels at which changes in ground conditions occur can be accurately identified;
    b. The specified sampling requirements can be achieved;
    c. All in-situ tests referred to in this Worksection can be undertaken and field installations incorporated at any depth in the hole;
    d. Consistency of measurement and minimal disturbance of the ground is achieved;
    e. Drilling of holes shall be executed in a sequence as indicated on the ground investigation Drawings unless otherwise Instructed.
14. Rotary drilling shall normally be carried out with diamond, tungsten carbide or combination tipped core bits which shall be suitable for the percentage core recovery and diameters required by the Contract. The type and state of the core bit, feed rates and management of the drill string shall be such that the specified minimum acceptable core recovery in any single core run can be obtained where the condition of the ground permits;
15. Common ground around the bottom of a drillhole shall not be unduly disturbed by water entering or leaving the hole, or by stress relief. The water level in a drillhole shall be kept at least 1 m to 2 m above the ambient groundwater level at all times, unless otherwise Instructed. Rapid withdrawal of rods and sampling equipment, causing rapid fluctuation in the water level inside the casing, shall be avoided;
16. Advance casings concurrently with the removal of material in such a manner that loss of ground is avoided. Set larger casings concentric with drillholes that are being reamed;
17. When Instructed, drill coreholes through retaining walls or other man-made structures by using single tube core barrels. Handle, photograph and report the core obtained as if it were rock with the exception that the submission of data in digital format is not required.

GIN.W820.9 SIZE OF DRILL HOLES

1. The size of bits, core barrels and casing shall conform to BS 4019-3:1993 or as otherwise agreed by the CM. Whenever required by the CM, drilling rigs shall be capable of drilling and recovering samples, vertically or inclined, with casing to a depth of 60 metres in S or P size, 160 metres in H size and 200 metres in N size. For purpose of pumping test, provide rigs of adequate capacity for drilling holes of minimum 250 mm diameter;
2. When Instructed, increase the size of a drillhole by reaming. The larger casing shall be set concentric with the existing hole and shall be sunk parallel with it.

GIN.W825.9 CATEGORIES OF CORE DRILLING

Three categories of core drilling shall be available:

1. Category 'A' – Water/Air-foam flush with triple tube core barrels using split inner tube (4C-MLC, HMLC or NMLC);
2. Category 'B' – Water/Air-foam flush with double tube core barrels (T2-101, TNW or products having equivalent functions or performance Approved);
3. Category 'C' – Water/Air-foam flush with single tube core barrels.

GIN.W828.9 RECOVERY OF CORES

1. Total core recovery is defined as the length of core recovered expressed as a percentage of the length of core run carried out;
2. The total core recoveries given below are the minimum which shall normally be accepted for the categories of drilling as defined in GIN.W825:

Minimum Acceptable Total Core Recovery for Category of Drilling (%)				
	Category			
	'A'	'A'	'B'	'C'
Ground Conditions	(Air-foam flush)	(Water flush)	Water/Air-foam flush)	Water/Air-foam flush)
Rock of Decomposition Grade of I to III or concrete or boulder	98	98	95	90
Common ground	80	N/A	N/A	N/A

GIN.W830.9 CORING RUN LENGTH

1. Limit coring runs to a maximum length of 1.5 m;
2. If the percentage core recovery in a core run is less than that specified, reduce the following core run by 50%, to a minimum length of 0.5 m;
3. Notwithstanding the above requirements, withdraw the core barrel and remove the core more frequently as necessary to secure the maximum possible core recovery when approved by the CM.

GIN.W840.9 BLOCKED DRILLHOLE

The core shall be removed from the drillhole immediately if blocking of the bit or grinding of the core is apparent regardless of the length of run which has been made.

GIN.W850.9 USE OF LUBRICANTS AND FLUSHING MEDIUMS

1. Do not use drilling lubricants other than clean water unless otherwise Instructed;
2. If the flushing medium is water, comply with the following:
   a. Provide a pump equipped with a gear box and capable of delivering up to 2 litres/sec;
   b. The pump shall incorporate a "surge" bottle to reduce fluctuations in water pressure and the suction hose shall be fitted with a suitable filter. It shall have a by-pass system allowing full control of water flow at all pump delivery rate;
   c. A flowmeter and a pressure gauge shall be directly fitted into the water supply line on the 'downstream' side of the by-pass valve. The flowmeter shall give an immediate visual indication of flow rate (e.g. a large rotating wheel) and be capable of measuring flow rates to the nearest 0.01 litres/sec.
3. If the flushing medium is air with foam additive, comply with the following:
   a. Provide an appropriate air-compressor and all necessary ancillary equipment to carry out drilling with air-foam flush to the CM's satisfaction;

b. The foam return shall be the consistency of thick shaving cream and the hole shall be kept full of foam at all times. The foam shall either be fully biodegradable or water soluble and arrangements shall be made for the collection and removal or dispersal of the foam returns, if required. The proposed foam additive and mixes shall be to the approval of the CM. A typical arrangement of air-foam mixing and flushing system is shown in Figure 12, Geoguide 2.

4. Flushing media shall be passed through a sedimentation basin and shall be either re-used or be discharged to surface drains or natural stream courses, except stream courses that are used as a supply of drinking water. Take measures to prevent the flushing medium from seeping through the ground. Provide excavated re-circulation pits or re-circulation tanks at the drillhole locations if the flush returns cannot be discharged safely or if Instructed. If necessary, provide temporary settling ponds or tanks to remove drilling cuttings / arisings prior to the disposal of flush returns.

GIN.W860.9 RAPID DRILLHOLES

1. The Contractor may be required to form holes up to 250 mm diameter and 60 m deep in soil or rock using rapid rotary-percussive methods with air or water as flushing medium and as follows:

   a. The OD method (Overburden Drilling): this will require the use of top-hammers to advance bit and casing tubes at the same time;

   b. If required by the CM the casing tubes, or Approved equivalent, shall be left in the drillhole to enable drilling to continue with conventional core barrels;

   c. Accurately measure and record the rate of penetration with this method of drilling. The method of measurement of penetration will be to Approval. The measurement of the rate of penetration can generally be achieved by timing, with a stop watch, the passage of a fixed point on the drillrods over a unit distance which can vary from 0.15 m to 1.0 m;

   d. The Final Report shall include a graphical record of rate of penetration against depth for each rotary percussive drillhole.

2. As far as possible consistent pressures and rotation speeds should be used with rotary percussive drilling. Changes in any drilling parameters such as bit pressure or gearing etc should all be recorded and presented with the penetration record for the drillhole;

3. This drilling technique may be required for proving bedrock, probing for boulders, forming holes rapidly for the installation of instruments or forming inclined holes for the installation of drains.

GIN.W865.9 ROTARY OPEN HOLE DRILLING

Advance a hole up to 170 mm in diameter and to a maximum depth of 40 m in common ground, rock or hard strata without the recovery of core or samples by means of a tricone roller bit, drag bit or other non-coring bit with water as the flushing medium.

GIN.W870.9 INCLINATION AND BEARING MEASUREMENT OF DRILLHOLES

1. When required by the CM, measure and report the inclination and bearing of a drillhole using a single-shot or multi-shot photographic survey tool or similar Approved instrument;

2. Report the results of each test on the daily site records and state the average inclination and bearing over the length of the drillhole on both the preliminary and final record. Submit the original film data with the daily site records.

GIN.W910.9 DRILLING RECORDS

1. The information required on the daily site record and records of a hole are listed below:
   a. Contractor's name, Contract number, Works Order number where applicable, Site name and hole number;
   b. Rig type, number, operator, hours worked and method of drilling;
   c. Dates of operation and weather conditions;
   d. Ground level of hole, the depth of each stratum from the surface and level of samples, in-situ tests and field installations;
   e. Details of all samples including blow counts of driven samples, in-situ tests and field installations and inclination / orientation of hole;
   f. Details of casing and length of casing;
   g. Water levels at start of shift, end of shift, and at times as GIN.W210;
   h. Full and continuous description of the material encountered in the hole, including the classification of each stratum by name and, when required by the CM, the characteristics of the discontinuities all according to Geoguide 3;
   i. Water return;
   j. Details of any delays, standing time;
   k. Rock Quality Designation (RQD), Fracture Index, Core Recovery and Rock Grade as defined in Figure 4 of Geoguide 3;
   l. Coordinates of hole position related to the Hong Kong Metric Grid;
   m. Legend (Drillhole Records);
   n. Any other relevant information.
2. Present the daily record sheets and record sheets of a hole in the format as shown in Appendix III to this Worksection, unless otherwise agreed by the CM.

GIN.W920.9 BACKFILLING OF DRILLHOLES AND ROTARY OPEN HOLES

1. Backfill all drillholes and rotary open holes in which no instrumentation will be installed with cement bentonite grout within one working day of the completion of the hole. The cement bentonite grout shall be a pumpable mix of cement and bentonite in the proportion of 4:1 by dry weight, or an alternative mix agreed by the CM. The water content of the grout shall be limited to that necessary for proper mixing and placement. In no case shall the water:cement ratio exceed 3. The resulting grout shall be free of lumps and foreign material;
2. When Instructed, backfill drillholes with cement grout with water/cement ratio not exceeding 0.45 from the bottom of the drillholes up to a depth specified by the CM. Backfill the remaining portion of the drillhole by cement bentonite grout as described in sub-clause (1) above after the cement grout has achieved initial set;
3. Submit a method statement to the CM for approval together with a trial showing the proposed equipment, material, mixing, handling and placement procedures including appropriate quality controls and checks to be adopted;
4. For each drillhole backfilled with grout, record the viscosity of the grout measured by Marsh Funnel and specific gravity of the grout measured by Mud Balance or any instrument of sufficient accuracy to permit measurement within ±0.01 g/cc. Keep a labelled jar sample of grout from each hole;

5. Unless otherwise Instructed, feed the grout into the bottom of the hole using a suitable pump and a tremie pipe, the end of which shall always be maintained below the grout/water interface. Remove casing in stages during grouting to ensure that the entire hole is backfilled. Check grout level at least 24 hours after initial grouting, and top up any significant drop in grout level with additional grout, or backfill with material agreed by the CM. Level and compact any subsequent depression;
6. Only if Instructed shall granular material, cement mortar or other materials be used to backfill the holes. Under no circumstances shall the Contractor use cement-bentonite balls (i.e. mixed paste) to backfill the hole;
7. Include in the daily site record a complete record of backfilling operations including the quantity of grout placed, the drop in grout level after 24 hours, the viscosity and specific gravity of the grout and any other relevant information and submit the record to the CM within 3 days of completion of backfilling;
8. For backfilling involving an Excavation Permit, the work shall comply with the requirements set out in the Conditions of the Excavation Permit. If there are any discrepancies between this clause and the Conditions of the Excavation Permit, the more stringent requirement shall prevail.

GIN.W930.9 BACKFILLING OF COREHOLES

Backfill each corehole with sand and cement mortar (1:1 ratio by weight) unless otherwise Instructed.

GIN.W940.9 METHOD OF AUGERING

1. Auger holes shall be advanced using hand-operated helical or post-hole type augers;
2. No material other than clean water shall be added to the auger holes and only when Approved;
3. Casing will not be required.

GIN.W950.9 DIAMETER OF AUGER HOLES

Post-hole auger holes shall be at least 100 mm diameter unless otherwise specified or Instructed.

FIELD INSTALLATIONS

GIN.W1110.9 INSTALLATION OF STANDPIPES

1. When Instructed, install standpipes in completed boreholes or drillholes (the holes) as indicated in Appendix V to this Worksection. Install the standpipes within 3 working days after the date of receiving the instruction;
2. The standpipes shall consist of rigid uPVC tubing to the dimensions as described in GIN.M120 for piezometer. The tube shall be capped at its lower end, and perforated/slotted in accordance with the Appendix V;
3. The upper imperforated end of the tube shall be set in concrete and fitted with an air vented uPVC cap and lockable surface box as shown in Appendix IV to this Worksection;
4. Fill the annular space between the perforated uPVC pipe and the wall of the hole with 6 mm to 10 mm size aggregates for its full length;
5. Take readings of water levels in standpipes as described in GIN.T010. Submit preliminary results within 3 working days after the date of completion of water level monitoring and tabulate and incorporate the results in the Final Fieldwork Report.

GIN.W1130.9 INSTALLATION OF PIEZOMETERS

1. When Instructed, install piezometers in completed boreholes or drillholes (the holes) as indicated in Appendix V to this Worksection. Install the piezometers within 3 working days after the date of receiving the instruction;
2. The upper end of the tube shall be set in concrete and fitted with an air vented uPVC cap and a lockable surface box as shown in Appendix IV to this Worksection;
3. Prior to installation, flush the completed hole with clean water to remove loose materials. Where the depth of the completed hole is greater than the depth at which the piezometer tip, sand filter and bottom bentonite seal are to be installed, the hole below the seal shall be grouted;
4. The grout shall consist of cement and bentonite in the proportion of 1:1 by weight or alternative mix as agreed by the CM. Bentonite shall be thoroughly mixed with water for at least 15 minutes before cement is added;
5. Place sufficient grout in the hole using a tremie pipe reaching to the bottom of the hole, such that the top of the grout shall finish 1.0 m below the base of the Instructed response zone. Bentonite pellets of between 10 mm and 15 mm in size, or other material to the approval of the CM, shall be placed in the hole and shall always be tamped with a suitable shaped tamper to form a homogeneous plug 1 m thick;
6. Extend the sand filter surround to the piezometer tip forming the response zone to at least 500 mm above and below the piezometer tip unless otherwise Instructed. The sand filter shall comprise clean sand, falling wholly between the grading limits of 200 and 1210 microns, and the volume of the sand filter placed shall be recorded on the daily site records. Alternative filter material shall be to the approval of the CM;
7. Where there is water in a hole, allow sufficient time for all the sand to settle, and measurements of the upper surface of the filter shall be taken from time to time to ensure this. Bentonite pellets, or other material to the approval of the CM, shall then be placed above the sand filter in the hole and shall always be tamped with a suitable shaped tamper to form a homogeneous impermeable plug 1 m thick. The depth of all boundaries in an installation shall always be recorded on the daily site records;
8. Backfill the hole above the compressed bentonite pellets with the cement/bentonite grout as described above to the details shown in Appendix V to this Worksection;
9. Take readings of water levels in piezometers as described in GIN.T010. Submit preliminary results within 3 working days after the date of completion of water level monitoring and tabulate and incorporate the results in the Final Fieldwork Report.

GIN.W1135.9 INSTALLATION OF BUCKETS IN STANDPIPES AND PIEZOMETERS

1. When Instructed, fabricate strings of buckets and install them in standpipes/piezometers. Install the buckets within 3 working days after the response test or within 3 working days of receiving an instruction, whichever is the later. The details of fabrication are as shown in Figure 23 of Geoguide 2;
2. Each installed bucket shall have the depth below existing ground level clearly marked at the mid point of the bucket. Include a record of all buckets including their depth and date of installation in the relevant daily site records.

GIN.W1140.9 MONITORING STANDPIPES AND PIEZOMETERS

1. When Instructed, monitor either previously installed existing standpipes/piezometers or those standpipes/piezometers installed by the Contractor in accordance with this Worksection;

2. Where standpipes/piezometers contain buckets, they shall also be monitored. Empty all buckets after monitoring. Lock surface boxes securely after monitoring;

3.

   a. Take standpipe/piezometer readings at intervals as Instructed;

   b. Reading intervals will vary depending on the time of year and the weather. Dates for readings and report submissions shall be given by the CM;

   c. Submit the reading results to the CM within 3 days of the reading date;

   d. The wet season shall be taken as being from 1st May to 31st October and intense rainfall shall be rainfall greater than 100 mm/day.

4. Submit reading results with an updated list of water level readings with record photos depicting the locations of all reading points and the readings displayed on the meter to the satisfaction of the CM and in graphical plots for each tube as per the typical layout at Appendix VII to this Worksection. The size and format of the photographs shall be agreed with the CM within 4 weeks from the notified date for commencement of the Works. Submit two copies of each to the CM within 3 days of taking the readings;

5. The graphical plots shall include rainfall information from Geotechnical Engineering Office, Civil Engineering Development Department (GEO, CEDD) rainfall station nearest to the standpipe/piezometer. Propose for Approval the rainfall station to be used. An information sheet on all GEO rain gauges is published monthly by the Geotechnical Information Unit, GEO, CEDD;

6. Holes may have more than one standpipe/piezometer tube but readings shall be taken in each tube. The measurement for standpipe/piezometer readings shall be for each tube reading.

GIN.W1145.9 AUTOMATIC GROUNDWATER MONITORING DEVICE IN STANDPIPES AND PIEZOMETERS

1. When Instructed, monitor groundwater levels in standpipes/piezometers by an automatic groundwater monitoring device. Submit details of the automatic groundwater monitoring device and report format to the CM for Approval;

2. Holes may have more than one standpipe/piezometer tubes. When Instructed, carry out automatic groundwater monitoring for the tube(s);

3. The automatic groundwater monitoring device shall comply with the following minimum requirements:

   a. Memory capacity: 24,000 measurements (non-volatile);

   b. Sampling rate: 0.5sec to 99 hours;

   c. Measurement range: 30 m H_2O with accuracy of 0.025 m H_2O and resolution of 0.01 m H_2O.

4. Download monitoring data as Instructed by the CM;

5. Submit monitoring data with an updated list of water level readings taken by dipmeter in graphical plot. Submit two copies of each and a floppy disk or CD-ROM containing the monitoring data in digital format to the CM within 3 working days of downloading the monitoring data;

6. Include graphical plots of rainfall information from Geotechnical Engineering Office, Civil Engineering Development Department (GEO, CEDD) rainfall station nearest to the standpipe/piezometer. Propose for Approval the rainfall station to be used. An information sheet on all GEO rain gauges is published monthly by the Geotechnical Information Unit, GEO, CEDD.

GIN.W1150.9 FLUSHING OUT STANDPIPES AND PIEZOMETERS

When Instructed, provide all necessary labour, plant and material to clean out blocked piezometers and standpipes by water flushing.

GIN.W1160.9 INSTALLING INCLINOMETER ACCESS TUBES

1. When Instructed, install inclinometer access tubes in existing or new drillholes for measuring ground movements in directions perpendicular to the drillhole axis;
2. All components of the inclinometer system shall be from the same manufacturer to the approval of the CM;
3.
    a. The access tube shall be of rigid PVC tubing with a bore of 50 to 70 mm. It shall be self aligning and contain 4 longitudinal keyways equally spaced around the perimeter precisely manufactured to fit the wheel dimensions of the torpedo as described in GIN.W1170 through the entire length of the tube;
    b. The access tube shall be supplied and installed in not less than 3 m lengths except for one shorter length as required to suit the total required depth;
    c. The tubes shall be joined together with Approved couplings and rivets with sealing mastic applied to each rivet head and also to the points where tubing enters a coupling;
    d. The whole joint assembly shall be wrapped in impregnated water-proofing tape and the end cap shall also be fixed and sealed in a similar manner.
4.
    a. Before the assembled access tube is lowered into a drillhole, the hole shall be pre-grouted in accordance with GIN.W930. The strength of the grout shall be comparable to that of the surrounding soil or rock;
    b. Clean water shall be added to the inside of the tubing to overcome buoyancy and the ingress of grout;
    c. When installation is finished the tubing shall be completely filled with clean water and keyways aligned to the required directions.
5. When Instructed, the upper end of the tube shall be set in concrete and fitted with lockable surface box in accordance with details as shown in Appendix IV to this Worksection.

GIN.W1170.9 TAKING INCLINOMETER READINGS

1.
    a. When Instructed, take inclinometer readings at the required frequency using an Approved biaxial torpedo. The torpedo shall be fitted with wheels and contain 2 servo-accelerometers located securely within a stainless steel water proof housing;
    b. The accelerometers shall have the sensing axes at 0° and 90°, allowing the angle of inclination of sensor and probe casing to be measured in two orthogonal directions;
    c. The sensitivity of the probe shall not be less than ±0.02 mm per 500 mm casing with a total System Accuracy of ±1.0 mm per 25 m of casing or better;
    d. The torpedo shall be able to negotiate access tube curvature of not less than 3 m radius.

2. The length of the wheel base shall be in the order of two thirds of the overall length of the probe body and the outside diameter of the torpedo (not including the wheels) shall be 25.4 mm or less. The operating range shall be 0° to 53° measured from the vertical. All electrical connections and the torpedo shall be fully waterproofed enabling the probe to operate and provide accurate and repeatable readings under water;
3. The wheels of the inclinometer probe shall be spring loaded enabling it to run precisely in the grooves of the inclinometer casing with a minimum of wobble in the 90° axis;
4. The inclinometer suspension/control cable shall be continuous with no splices or defects steel core with one piece waterproof neoprene jacket to prevent creep and slippage during use and of adequate length for all the holes on the project. It shall be limited to 10 mm diameter;
5. Reading shall be taken successively along the entire length of access tube at 500 mm intervals or shorter, and also at depths as directed by the CM. A set of readings is a down and up set for the first direction and 90° to the first direction. Another set of readings shall also be taken with the torpedo axis rotated through 180° to minimise face errors;
6.
    a. Results of all inclinometer readings shall be presented to the CM within 3 working days of completion of each monitoring and shall include a profile of all the horizontal deviations from the true vertical at each measuring point in units of mm;
    b. Four copies of monitoring reports shall be submitted to the CM within 14 days of the completion of the required monitoring. The report shall contain all the results obtained in each monitoring and where appropriate the final monitoring report may be included in the Final Report to be submitted in accordance with GIN.W040.

GIN.W1180.9 MONITORING MOVEMENTS OF RETAINING STRUCTURES AND CRACKS

1. When Instructed by the CM, provide and install tell-tales, tilt-plates, nail heads for Demag gauge measurement, or similar approved type for measuring retaining walls or crack movements in all directions;
2. Prior to the installation and monitoring, submit to the CM details of the proposed instruments to be installed, monitoring equipments to be used, installation methods and monitoring methods for Approval. The details of the proposed monitoring instruments and equipments to be used shall be submitted with manufacturer's standard specification;
3.
    a. When instructed by the CM, monitor and maintain either existing monitoring instruments or monitoring instruments installed by the Contractor and readings shall be taken at the required frequency;
    b. Results of all monitoring readings shall be presented to the CM within 3 working days of each monitoring.
4.
    a. Provide all equipment of every kind necessary for use in the execution of the monitoring works;

b. All equipment to be used shall be calibrated within the recommended calibration period and conform with the relevant manufacturer's standard specification prior to the start of each monitoring work;

c. Calibration certificates shall be supplied to the CM whenever an instrument is calibrated and the standard calibration procedure from the relevant manufacturer shall be followed and supplied together with required calibration interval and the most recent calibration carried out.

GIN.W1190.9 TILTMETER SYSTEM

1. The Tiltmeter System shall include three major components: tiltmeter sensor, mounting plate and read out unit;

2.

a. The portable tiltmeter sensor shall utilise a closed loop, force-balanced servo accelerometer specifically designed for vertical or horizontal tilt measurements;

b. The tiltmeter sensor shall have a measuring range of ±50° from vertical or horizontal, with a sensitivity of 8 arc. seconds reading + 5 arc seconds/°C or better. The sensor unit shall have a stainless steel base and accelerometer housing. To operate, the sensor shall be oriented on the pegs of the mounting plate and an angle read on the four digit indicator display;

c. The mounting plates shall be cast from specially formulated porcelain with four equally spaced pegs on 102 mm diameter circumference. The plates shall be bonded to the rock, concrete, or metal surface by an Approved epoxy resin.

3. The readout unit shall be portable, powered by a rechargeable battery capable of operating for a minimum of 16 hours at 20°C. This readout unit shall have a 20 x 20 backlit LCD screen. The readout unit shall have a temperature rating of -20°C to +50°C and shall be housed in an aluminium case with a plastic jacket. The top of the box shall be splash proof with waterproof connectors.

GIN.W1200.9 TELLTALES

1. The standard telltale shall be capable of monitoring movement across cracks in both horizontal and vertical directions. The instrument shall be manufactured using durable acrylic plastic with a linear coefficient of thermal expansion of 7.3×10^{-5} mm/°C;

2. The corner telltale shall be capable of monitoring movement across cracks in the corners in both horizontal and vertical directions. The instrument shall be manufactured using PVC rigid sheet with a linear coefficient of thermal expansion of 6.5×10^{-5} mm/°C;

3. The floor telltale shall be capable of monitoring settlement of floors relative to a wall or a column. The instrument shall be manufactured using PVC rigid sheet with a linear coefficient of thermal expansion of 6.5×10^{-5} mm/°C;

4. The displacement telltale shall be capable of monitoring movement across cracks when one surface moves out of plane with the other. The instrument shall be manufactured using PVC rigid sheet with a linear coefficient of thermal expansion of 6.5×10^{-5} mm/°C.

GIN.W1210.9 DEMAG GAUGE

1. The Demag Gauge shall consist of an Invar main beam with two conical locating points, one in a fixed position at one end, and the other, pivoting on a special knife edge. The pivoting movement shall be transmitted to a dial gauge graduated in 2 x 10^{-3} mm mounted on a table. The dial gauge shall be able to measure a maximum movement of 5 mm. The main beam shall be fixed to the pivot block with the dial table;
2. The gauge points shall be made by stainless steel discs and cemented to the structure using the setting out bar. The Demag readings are operator dependent. Ensure that the same technician always performs the gauge readings.

GIN.W1220.9 SETTLEMENT MARKERS

1. When Instructed, provide, install and monitor settlement markers at surface of existing features or at vertical face of building such as wall for settlement monitoring. Survey the settlement markers for level and position and plot on the Instrument Location Plan immediately after installation;
2. Surface Settlement Marker:
    a. The settlement marker shall be securely founded on level ground free from obstructions. Surface settlement marker shall be installed as in Appendix XVIII of this Worksection.
3. Building Settlement Marker:
    a. The settlement marker shall be installed as in Appendix XVIII of this Worksection and securely fixed to building free from obstructions.

GIN.W1230.9 MAGNETIC EXTENSOMETER

1. The magnetic extensometer shall include two major components:
    a. Magnetic target (magnet);
    b. Read switch probe.
2. For each number of magnetic extensometer ordered, it shall be equipped with a maximum 7 nos. of magnetic targets and the installation details including their depths and intervals shall be specified by the CM;
3. The magnetic targets shall be Spider Magnets comprising a PVC body with 3 Spring steel legs. The legs shall be Zinc Plate Type II coated for corrosion resistance and be attached to the body with stainless steel screws 120 degrees from one another. The legs shall be 210 mm long and require a force of at least 40N to pull the leg flush with the access tubing during tying. The magnet body shall have 6 or 12 Alnico V magnets equally spaced around its centre line;
4. The magnet shall be tied to the casing by a single wrap of 20 kg test nylon line around the top and bottom legs. The line shall be held in place by a draw pin which passes through a loop at each end of the lines. The draw pin shall be attached to a nylon cord at least 5 m longer than the installation depth. The magnet shall be held in its correct location on the access tubing by catching the top line in a tight score mark on the access tubing that will be no deeper than 0.5 mm. The magnet shall be released by withdrawing the pin from the magnet by pulling the nylon cord when it is at the required location in the borehole;

5. The Reed Switch Probe shall consist of a reel housing, the electronics and a tape with a probe at the end. The probe shall be 15 mm diameter made of stainless steel and shall house a miniature reed switch. The tape shall consist of a survey tape graduated in millimetres, coated with polyethylene, having two conductors running its length, either side of the survey tape. The reel shall be powder coated and have an epoxy painted stand. The reel shall have a light and buzzer to provide visual and audio response to magnetic fields;

6.

   a. When instructed by the CM, monitor magnetic extensometer installed and readings shall be taken at the required frequency;

   b. Results of monitoring readings shall be presented to the CM within 3 working days of each test.

7.

   a. Provide all equipment of every kind necessary for use in execution of the monitoring works;

   b. All equipment to be used shall be calibrated within the recommended calibration period and conform with the relevant manufacturer's standard specification prior to the start of each monitoring work;

   c. Calibration certificates shall be supplied to the CM whenever an instrument is calibrated and the standard calibration procedure from the relevant manufacturer shall be followed and supplied together with the required calibration interval and the most recent calibration carried out.

GIN.W1240.9 PHOTOGRAPHS OF GROUND INVESTIGATION WORKS

1. Within 3 working days of the date of completion of the hole, take photograph of the samples and/or cores contained within each core box. The photograph shall contain a reference board giving details of:

   a. Contract number and Works Order number where applicable;

   b. Project title;

   c. Hole number;

   d. Core box number (where applicable);

   e. Depth below ground level of start and finish of all material in the core box;

   f. Contractor's name;

   g. Date of taking the photograph;

   h. Standard colour chart or similar;

   i. A reference scale for the entire board length marked in 100 mm units.

2. The following criteria shall also be fulfilled:

   a. The core is evenly lit with no shadows;

   b. The core box and reference board in each photograph fill the frame;

   c. The focal plane of the camera and the plane of the core box are parallel.

3. All cores, except those susceptible to deterioration on contact with water, shall be thoroughly moistened before being photographed. Where core boxes contain disturbed samples, the lids shall be removed from the containers so that the contents are visible in the photograph. The first disturbed sample in any photographed core box shall be identified by its unique sample number and depth so that subsequent disturbed samples in that box can also be identified;

4. All photographs taken during the Contract Period shall be either on good quality colour film or in digital format as instructed by the CM. It is essential to maintain a sharp image and good colour saturation of the photographs. Colour film shall be of the same manufacture, speed and type to maintain consistent colour balance. Soft copy of digital photographs (digital photograph images) shall be the original unaltered digital images taken with a digital camera that shall conform to the JPEG Exchangeable Image File (EXIF) Version 2.2 (or later version) standard;
5. All exposed film shall be processed at a professional laboratory to ensure even results throughout the Contract. Photographs of poor quality due to uneven colour balance, poor focus, missing information or other defects shall not be accepted and the Contractor shall re-photograph the subject at his own expense;
6. One full set of colour prints of minimum size 85 mm x 125 mm shall be supplied with the draft fieldwork report. Colour photocopies of A4 mounted prints of minimum size 200 mm x 250 mm shall be supplied in each copy of the Final Fieldwork Report. Within 3 weeks of award of the Contract, the name(s) of the suppliers and samples of the colour photocopies proposed to be use in the contract shall be submitted for CM's approval. If approved, the quality of the colour photocopies shall be maintained throughout the duration of the Contract;
7. The photograph negatives, digital photograph images and all prints shall become the property of the Employer and shall not be used by the Contractor for any purpose without written consent from the CM;
8.
    a. Photographs of soil samples may be required from selected boreholes as decided by the CM. These may include piston, undisturbed samples. The samples should be split longitudinally and photographed using the procedure as for the rock core except they should not be wetted. The top and bottom of each sample should be clearly labelled;
    b. Where photographs of soil samples are required, one copy of each soil sample photograph shall be included in each of the laboratory draft report, in each of the Final Reports;
    c. Split and take photograph all triaxial test samples (refer to GIN.T340).

GIN.W1260.9 DATA FOR SETTING OUT THE WORKS

1. It is the Contractor's responsibility to locate Lands Department Bench Marks and survey control points for his use in setting out of any Works. Carry out all survey and levelling work necessary for setting out of any Works in fulfilment of his obligations for setting out of the Works under the Conditions of Contract. In all cases, levelling shall be referred to the Principal Datum of Hong Kong;
2. Setting out and levelling shall be carried out to an accuracy of ±0.1 m and ±0.01 m respectively or as otherwise directed by the CM;
3.
    a. If it is impractical to locate the Investigation Station within the area defined in GIN.W020 (17), reposition the Station with the prior approval of the CM;
    b. No drilling will be allowed to commence unless the setting out of the Investigation Station has been agreed by the CM.
4. Following completion of work at each Investigation Station, determine the coordinates of the Investigation Station to the nearest 0.1 m, and the ground level at the Investigation Station to the nearest 0.01 m. Submit this information to the CM within 3 working days of the completion of work at each Investigation Station;

5. Protect and fence adequately all survey pegs and marks erected to enable the proper execution of the Works. Submit record photos showing completion of the aforesaid protection/fencing works to the satisfaction of the CM. The size and format of the photographs shall be agreed with the CM within 4 weeks from the notified date for commencement of the Works;
6. When ordered by the CM, carry out additional setting out and levelling of Investigation Stations;
7. When ordered by the CM, carry out surveying to determine the coordinates and levels of Survey Stations set up by others.

GIN.W1270.9 RESULTS AND SAMPLES TO BECOME THE EMPLOYER'S PROPERTY

All the results of the investigation and testings shall be deemed to be the property of the Employer and shall not be divulged without CM's consent. All cores, samples and other materials recovered from the holes shall also be deemed to be the property of the Employer and the Contractor shall not dispose of any such materials and samples except as directed by the CM.

GIN.W1280.9 TOLERANCES

Refer to Appendix H "Schedule of Tolerances" to this Specification.

TESTING

FIELD TESTS

GIN.T010.9 RESPONSE TEST AND WATER LEVEL READINGS IN STANDPIPES AND PIEZOMETERS

1. Within three working days of the completion of the installation of any standpipe/piezometer, carry out a Response Test in order to prove its successful operation. When Instructed, carry out Response Test on any existing standpipe/piezometer;
2. Carry out the test as for a falling head permeability test except that it shall be terminated after 60 minutes or when the water level has retuned to its initial level, which is sooner. Before any Response Test is carried out, give the CM at least 1 working day's prior notice;
3. Submit preliminary results on a record sheet, to the approval of the CM within 1 working day of completion of each test. Include the results of all Response Tests in the fieldwork report;
4. For newly installed standpipes/piezometers:
    a. After completion of the Response Tests, read all standpipe and piezometer water levels daily whilst working on the Site until 7 days after installation of the last standpipe or piezometer;
    b. Subsequent readings on a periodic basis may also be required by the CM;
    c. Submit to the CM records of each readings which shall include hole number, site name, contract number, Works Order number where applicable, date and time of reading, reduced level of ground water surface and method of taking reading. All water levels recorded shall be presented in record charts in a tabular and graphical form as Appendix VII to this Worksection.

GIN.T020.9 IMPRESSION PACKER TEST

1. When Instructed, carry out drillhole impression packer surveys in vertical or inclined drillholes in TNW or T2-101 size, in accordance with Geoguide 2 and using equipment and methods to the approval of the CM. The impression packer equipment shall be capable of surveying a minimum 1.5 m length of drillhole for each test;
2. Carry out the survey by inserting the impression packer device into the drillhole to the depths Instructed, expanding the packers and obtaining an impression of the drillhole wall on the thermoplastic film surrounding the packers. The survey shall be referenced to a known direction by means of a downhole compass and sufficient time shall be allowed for the compass to set following the expansion of the packer. Great care shall be taken when placing the thermoplastic film onto the packers and when transferring the north point from the compass to the film;
3. If an impression packer survey is instructed over a continuous length of drillhole longer than the length of the impression packer itself, successive impression packer test sections shall overlap by a minimum of 250 mm to ensure continuity of information and cross-checking of the north direction between successive test sections;

4. Carry out measurements of the dip and dip direction of the discontinuity traces on the impression packer film. This will involve the measurement of the dip and dip direction of the joints contained in the section of core taken from the drillhole at the level of the impression packer, related to discontinuity traces on the impression packer film;
5. Present the results of the survey on a discontinuity log, in the format to be approved by the CM. Submit each set of preliminary logs to the CM with the preliminary logs of the hole and shall be presented in the Final Fieldwork Report in the same format.

GIN.T040.9 N-SCHMIDT HAMMER TEST

1. Schmidt Hammer testing using the N type Schmidt Hammer shall be carried out at the specified intervals on chunam strips. The CM may also instruct testing to be carried out at other locations;
2. The test shall be carried out on a smooth vertical soil face by trimming a patch of at least 100 mm square on the surface exposed after stripping of chunam surfacing. The test shall be conducted, with the hammer held in the horizontal direction, by striking at the vertical face of the patch;
3. Prior to each testing sequence, the hammer shall be calibrated using a calibration test anvil supplied by the manufacturer for that purpose. At each specified location, several initial "seating" blows shall be taken to ensure good contact. Ten consecutive readings shall then be recorded by striking the same spot;
4. Preliminary results shall be submitted to the CM within 2 weeks of the completion of the tests. The results shall be presented in the form specified in Appendix X to this Worksection. The results sheets shall also be included in the Final Report and the rebound values given in the slope surface stripping records to be submitted in accordance with GIN.W040.

GIN.T050.9 STANDARD PENETRATION TEST

1. The apparatus and procedure for standard penetration test (SPT) shall comply with BS EN ISO 22476-3:2005, amended by this clause as necessary. The drive hammer shall be a type incorporating an automatic trip mechanism to ensure free fall. The steel anvil of the drive assembly shall have a diameter of 145 ± 5 mm. The guide rod arrangement that permits the hammer to drop with minimal resistance shall have an outer diameter of at least 3 mm smaller than the diameter of the central hole of the hammer;
2. A cone ended adaptor with a 30° half angle shall be available to replace the open-ended driving shoe for use in gravel common ground, or if Instructed;
3. Carry out SPT below the level of the casing. The base of the drillhole shall be fully cleaned before the test starts. Jar samples shall be taken from the split-barrel shoe after each test;
4.
    a. The results shall be reported on daily site records and both preliminary and final drillhole records as the number of blows for the first 150 mm penetration (seating drive), in 75 mm increments, and subsequently the number of blows for each 75 mm penetration for 300 mm;
    b. The number of blows of the drive hammer required to achieve each 75 mm of shoe penetration until a total penetration of 450 mm has been achieved shall be recorded. The 'N' value shall be recorded as the sum of the number of blows of the driving hammer required to achieve the last 300 mm of shoe penetration:

e.g. $\frac{14, 16}{27, 29, 32, 36}$

N=124

c.

i. If the full penetration of the seating drive is not achieved after 50 blows of the drive hammer, the number of blows and the penetration achieved (in mm) shall be recorded and the test continued with the test drive from that point:

e.g.

Seating Drive	Test drive	Summary	Remarks
27, 23/35 mm	35,27,32,31	N = 125	Test drive commenced after completion of 50 blows in the seating drive.
50/20 mm	38, 100/50 mm	138/125 mm	Test drive commenced after completion of 50 blows in the seating drive; test terminated in increment 3.
50/20 mm	100/40 mm	100/40 mm	Test drive commenced after completion of 50 blows in the seating drive; test terminated in increment 2.

ii. During the test drive, if any of the first three increments of 75 mm penetration is not achieved after 100 blows of the drive hammer, or where total number of blows excluding the seating drive, reaching 200, the number of blows and the penetration achieved (in mm) shall be recorded and the test shall be terminated:

e.g.

Seating Drive	Test drive	Summary	Remarks
17, 25	38, 100/50 mm	138/125 mm	Test terminated in increment 4.
17, 25	25, 30, 100/50 mm	155/200 mm	Test terminated in increment 5.
17, 25	65, 90, 45/30 mm	200/180 mm	Test terminated in increment 5.
17, 25	35, 60, 60, 45/30 mm	200/255 mm	Test terminated in increment 6.
17, 25	25, 30, 35, 110/70	200/295 mm	Test terminated in increment 6.

5. The water level in the hole at the time of test shall be recorded and reported. When testing below the groundwater table particular care shall be taken to maintain water level in the drillhole at or above the ambient groundwater level;
6. When Instructed, provide liner samples in conjunction with the Standard Penetration Test as described in GIN.W480;
7. If liner samples have not been instructed, place the sample recovered from the split spoon immediately in a plastic container of minimum diameter of 100 mm, with a screw top. It shall then be arranged securely in the core box with the core, in proper sequence.

GIN.T060.9 PACKER (WATER ABSORPTION) TEST

1. When Instructed, carry out single or double Packer Tests in vertical or inclined drillholes in TNW and T2-101 size. Testing shall follow the method described in Geoguide 2. The general arrangement of the tests shall be as shown in Figure 31 of Geoguide 2;
2. At the commencement of the Contract, and at other times if Instructed, carry out calibration of the equipment for friction head loss by connecting the pressure gauges, flow meter and supply pipe headworks, three or four different lengths of drill rod and the packer with its tailpipe to the water supply. Pump water through the system and record flow rates for several values of back pressure. Establish and submit to the CM a graphical relationship of flow against pressure loss for the number of drill rods used and include it in the Final Fieldwork Report if packer tests are carried out;
3. Carry out a single packer test by expanding a hydraulic or pneumatic packer in the drillhole (not in the casing) to create a seal at the top of the test section. All rods and couplings must be watertight and the threads of drilling rods supplying the water to the test section shall be wrapped with thread sealing tape. The length of test section required shall be Instructed. Fill the drillhole below the packer with water and keep it full at the specified water pressure for 15 minutes immediately before the test commences. The flow meter used shall be capable of measuring flow quantities to the nearest 0.1 litre. Monitor the water levels in the drillhole above the packer at regular intervals during the test, by means of a suitable dipmeter, to check whether leakage is occurring around the packer;
4. The acceptance of water by the test section shall then be measured and recorded at successive pressures as Instructed, the maximum of which will not exceed 75% of the effective overburden pressure at the mid-depth of the test section. A calibrated pressure gauge capable of measuring the required pressure to the following accuracies shall be used:
    a. 0 - 100 kPa Maximum Value (accurate to ± 5 kPa);
    b. 0 - 200 kPa Maximum Value (accurate to ± 10 kPa);
    c. 0 - 500 kPa Maximum Value (accurate to ± 20 kPa); and
    d. 0 - 1000 kPa Maximum Value (accurate to ± 20 kPa).
5. At each pressure, the flow of water into the drillhole shall be measured over three periods, each of 5 minutes duration. If the first two readings do not differ by more than 10%, the third reading is not required. A complete test shall comprise measurement of the flow through the full cycle of pressures and any calibration tests required by the CM;
6. Packer tests using single or double packers may also be required after the drillhole has been completed. The double packer test shall be performed as for a single packer test, except that the water pressure shall be applied to a specified length of drillhole isolated between two packers;

7. Submit preliminary results on the record sheets to the approval of the CM with the corresponding preliminary logs of the hole.

GIN.T070.9 VANE SHEAR TEST

1. When Instructed, carry out the vane shear tests as specified in BS 1377-9:1990 (Test 4.4) unless amended by this clause as necessary;
2. Vanes capable of measuring shear strengths up to approximately 75 kPa shall be available. The area ratio of each vane blade shall be less than 12%. The torque measuring instrument shall be calibrated by a method approved by the CM and a copy of the most recent certified calibration chart shall be submitted with each set of vane test results and be included in the Final Fieldwork Report;
3. The vane shall be advanced to the test depth and the torque applicator assembly shall be carefully connected. After a pause of 5 minutes, the vane shall be rotated at a constant rate of between 0.1 and 0.2 degrees/sec. Readings shall be taken at intervals of each 5° rotation. The maximum torque required to rotate the vane shall be recorded. The vane shall then be rotated rapidly through 12 revolutions without taking any readings. After a further pause of 5 minutes, the test procedure shall then be repeated in order to obtain the remoulded (disturbed) undrained shear strength;
4. Submit preliminary results in a format agreed by the CM with the corresponding preliminary logs of the hole;
5. Submit final results of undrained shear strength, corrected using the torque head calibration curve with the Final Fieldwork Report in a format agreed by the CM. For tests on common ground, report the residual value of undrained shear strength.

GIN.T080.9 FALLING OR RISING HEAD PERMEABILITY TEST

1. When Instructed, carry out falling or rising head permeability tests in a hole. Flush the hole prior to carrying out the test. The installation shown in Figure 27 of Geoguide 2 shall be used unless otherwise Instructed. The graded filter material and sand shall be to the approval of the CM and shall be placed in the hole by tremie pipe. The groundwater level shall be allowed to equalise in the completed installation for at lease one hour before test commences;
2. The method of flushing of the bottom of the hole for field permeability tests shall be as follows:
    a. Clean water shall be introduced to the cased hole through a 38 mm diameter pipe fed from a storage tank. The feed pipe shall contain a perforated section 480 mm in length consisting of 20 rings of holes at 25 mm centres, each containing 4 holes of 6 mm diameter. The end of the perforated section of pipe shall be capped. The complete perforated section shall be positioned such that it is just below the existing ground water level in the hole;
    b. The flushing water shall be withdrawn from the casing through a 38 mm diameter pipe positioned with its open end between 150 mm and 200 mm above the base of the borehole. The discharge shall be by means of a pump of sufficient capacity to extract the flushing water from the base of the borehole. Control of the flow of clean water and discharge water shall be by means of valves positioned on the inflow pipe and the discharge pipe.
3. For a falling head permeability test, raise the water level in the piezometer by adding clean water by a minimum of 3 m, or the maximum practical. Then allow the water level to equalize with the groundwater level. Measure water levels in the piezometer by means of a suitable dipmeter at the following elapsed times in minutes from the start of the test:

0, 0.25, 0.5, 0.75, 1, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 45, 60, 90, 120, 150, 180

Terminate the test at 180 minutes, or earlier if:

a. The water level has returned to its initial level; or

b. A head ratio (the ratio of water head at any time during the test to the initial head at the commencement of test) of 0.3 is achieved; or

c. Instructed by the CM.

4. For a rising head permeability, lower the water level in the piezometer by pumping by a minimum of 3 m, or the maximum practical. Then allow the water level to equalize with the groundwater level. Measure water levels in the piezometer following the same procedure as for a falling head permeability test;
5. Repeat both types of permeability test once to demonstrate that consistent results have been obtained. If the results differ by more than 20% Then repeat the test again;
6. Submit preliminary results of a falling or rising head permeability test on a record sheet to the approval of the CM, together with the corresponding preliminary logs of the hole.

GIN.T090.9 CONSTANT HEAD PERMEABILITY TEST

1. The procedure used for the constant head permeability test for flushing the hole, setting up the installation and allowing the ambient groundwater level to equalise shall be the same as for a falling or rising head permeability test;
2. Feed clean water into the piezometer at a constant rate until a constant water level is established or until the water level is 0.3 m below the top of the piezometer tube. Record the constant rate of inflow to maintain a constant head. Use a flow meter capable of measuring flows down to 0.1 litre;
3. Record cumulative inflow readings, once the constant head has been achieved, in the following sequence:

   a. 4 readings at 15 second intervals;

   b. 9 readings at 1 minute intervals;

   c. 4 readings at 5 minute intervals;

   d. Readings at 10-minute intervals until the inflow values do not differ by more than10% in any 10 minute interval.

4. Submit preliminary results on the record sheet, to the approval of the CM, with the corresponding preliminary logs of the hole.

GIN.T110.9 IN-SITU DENSITY TEST

1. Carry out in-situ density tests in trial pits and trial trenches in accordance with Test Method 11.1 or 11.2 of Geospec 3;
2. Submit preliminary results using a HOKLAS approval worksheet along with the preliminary logs of the trial pit or trial trench in which the test was performed;
3. The Final Field Work Report shall contain the results presented on a HOKLAS endorsed report.

GIN.T120.9 DYNAMIC PROBE TEST

1. The equipment of dynamic probe test shall be generally as shown in Figure 36 of Geoguide 2 and amplified below:

a. The mass of the hammer shall be 10.0 kg (±0.1 kg). The ratio of the length to the diameter of the hammer shall be between 1 and 2. The hammer shall be provided with an axial hole with a diameter which is 2-3 mm larger than the diameter of the guide rod;

b. The anvil shall be rigidly fixed to the extension rods. The mass of the anvil shall be between 1.5 kg and 1.8 kg and the diameter between 60 mm and 70 mm. The combined mass of the anvil, guide rod and upper anvil shall not exceed 5.0 kg;

c. The hammer shall fall freely and not be connected to any object which may influence the acceleration or deceleration of the hammer. The hammer shall be stationary in its upper position prior to release. The fall shall be 300 mm (±5 mm);

d. The diameter of the rods shall be between 11 mm and 13 mm and the length 1000 mm (±10 mm). The rods shall be straight and shall be connected so as to bear against each other over their full area by means of external couplers of maximum diameter 20 mm;

e. The diameter of the point shall be 25 mm (±0.2 mm). The cylindrical portion of the point shall have a length of 25 mm (±1 mm). The point shall have a conical tip with an apex angle of 45º (±2º).

2. Carry out the dynamic probe test as follows:

a. The lower end of the probe shall be rested against the ground at the test location, with the first extension rod and guide rod in a vertical position;

b. The hammer shall be raised to bear against the upper anvil, and shall be allowed to fall freely. It shall not be connected to objects which may influence its acceleration and deceleration, and shall be stationary when released in the upper position. The fall shall be 300 mm ± 5 mm;

c. The hammer shall be used to drive the probe into the ground, with a rate of driving between 20 and 60 blows per minute;

d. Additional extension rods shall be added as necessary. The rods shall be rotated clockwise one full turn each time a rod is added to ensure that screw joints are tight. The blow count for every 100 mm of penetration shall be recorded, or at refusal the penetration distance for 50 blows of the hammer. Interruptions exceeding 5 minutes shall be recorded;

e. If any obstruction to the probe is encountered which cannot be penetrated over 100 mm by 100 blows of the driving hammer, then that probe shall be considered to have reached refusal and the test shall be terminated.

3. Submit test results on a record sheet to the approval of the CM, which shall contain the following details:

a. Blow count for every 100 mm penetration or at refusal the penetration distance for 50 blows of the hammer;

b. Interruptions exceeding 5 minutes;

c. Dynamic probe record (Figure 37 of Geoguide 2);

d. Confirmation that the test was carried out in accordance with this Specification.

4. If refusal is met at a depth of less than 3 m, then carry out a second test at a distance of between 0.3 m and 0.6 m from the first test;

5. Seal all probe holes on completion with cement grout consisting of cement and water in the proportions 0.4:1 by mass, for at least the top 600 mm;

6. For dynamic probing tests that are not related to trial pit or trial trench excavations, submit preliminary results within 3 working days of the date of completion of all dynamic probing testing Instructed.

GIN.T130.9 PUMPING TEST

1. When Instructed, carry out pumping tests in new or existing holes;
2. The tests consist of pumping water from a hole and observing the effect on the water table by measuring water levels in the hole being pumped and in adjacent piezometers and/or observation wells;
3. These tests shall be performed in accordance with the principles and methods outlined in BS 5930:1981: Section 5, or in accordance with BS ISO 14686:2003 if Instructed to determine the hydraulic properties of the aquifer(s) and/or effect of pumping on neighbouring area;
4. All equipment necessary to undertake the tests shall be provided including temporary electricity supply, pumps, instruments, materials, labour and haulage;
5.
    a. Unless otherwise specified, commence the pumping tests in the morning about 8 am on an agreed day;
    b. When Instructed, take water samples in accordance with GIN.W470 or otherwise as directed by the CM for laboratory tests. Complete all preparation works one day before the test;
    c. The pump used for the test shall be capable of pumping 1.5 times the maximum anticipated flow rate or flow-rate directed by the CM and shall have a discharge line connected to an efficient existing drainage system so that ponding and recharge into the ground does not occur;
    d. Measure the pumping rate and pumped water quantities using an Approved flowmeter and check them using an orifice, or similar weir.
6.
    a. Prior to pump testing, clean and flush the hole, and measure the depth of the hole accurately;
    b. When directed by the CM and unless otherwise specified, place a temporary perforated PVC lining and filter pack in the hole and withdraw the driving casing carefully. Develop the hole by using Approved methods such as jetting, surging and over pumping;
    c. Install the pump and pump the hole in accordance with the following test procedures unless otherwise Instructed:
        i. A Step Drawdown Test shall be performed at the following pumping rates:

            Stage 1: 0.25 x flow rate specified;

            Stage 2: 0.50 x flow rate specified;

            Stage 3: 0.75 x flow rate specified;

            Stage 4: 1.00 x flow rate specified;

            Stage 5: 1.25 x flow rate specified;

            Stage 6: Recovery.

Each stage shall have a minimum of 2 hours duration. Pumping shall be carried out at a constant rate for each stage. The test shall be continuous, commencing with the lowest pumping rate. Under no circumstances shall the pumping rate be increased above the rate for the next stage. Water level readings shall be taken in the hole and in the adjacent piezometers and/or observation wells every 15 seconds up to 2 minutes; every 30 seconds between 2 and 5 minutes; every 1 minute between 5 and 15 minutes; every 5 minutes between 15 and 120 minutes. After Stage 5 the pump shall be turned off and water levels monitored for a minimum of 2 hours, but in any event until the water level measured is substantially the same as the standing water level measured at test commencement;

ii. A Constant Rate Pumping Test shall be performed at the flow rate specified for a continuous period of 48 hours. Water level readings shall be taken in the hole and in the adjacent piezometers and/or observation wells every 15 seconds up to 2 minutes; every 30 seconds between 2 and 5 minutes; every 1 minute between 5 and 15 minutes; every 5 minutes between 5 and 120 minutes and subsequently at 30 minutes intervals. Pumping rate shall remain constant and be adjusted as necessary by reference to the flowmeter or orifice weir manometer. The test shall be continuous. In the event of any breakdown the test shall be repeated, with that portion of the test already performed at the Contractor's expense. After 48 hours or such period as the CM determines the pump shall be turned off and the water level monitored until the water level measured is substantially the same as the standing water level at test commencement.

7. Record, plot and calculate the pump test results on the standard sheets shown in Appendix XI to this Worksection or to follow the proforma/graphs shown in BS ISO 14686:2003 if Instructed;

8. Submit a report on the testing to the CM in accordance with GIN.W040. The report shall include a plan showing the general arrangement of the pumping test (the locations of the holes where pumping tests have been performed and piezometers and/or observation wells where water levels have been recorded, a geological log for the hole; records of the pumping tests performed; a drawing (A4 size) showing details of the hole lining; filter pack and pump level; the pump details (which shall include the pump dimensions, construction and characteristics), water level monitoring records of all relevant piezometers and/or observation wells and the results of any water laboratory tests which may have been undertaken.

GIN.T140.9 PRESSUREMETER TEST

1.

a. When Instructed, carry out Pressuremeter Test using a Menard pressuremeter type GB or GC of NX size at locations shown on the Drawings, as detailed in this Worksection or as directed by the CM;

b. The equipment shall have a pressure range and membrane strengths suitable for testing the materials at the test location. For this purpose a pressure range of up to 10,000 kPa shall be available for tests in Grades III to V decomposed rock and up to 4,000 kPa for tests in Grade VI decomposed rock or in other soils. Grades of decomposition shall be as defined in the Geoguide 3.

2.

a. The probe shall comprise essentially a 74 mm diameter measuring cell between two guard cells. The measuring cell shall be pressurised by water and the guard cells by gas;

b. The control unit shall comprise essentially a cylindrical reservoir with a graduated transparent tube called the volumeter which is connected to the measuring cell of the probe;

c. The volumeter shall be capable of being pressurised, the pressures being read on Bourdon type gauges of suitable sensitivity;

d. Coaxial tubing shall connect the probe to the control unit. The length of tubing shall be the minimum necessary to allow the deepest test to be carried out;

e. The equipment shall at all times be protected from direct sunlight. If type GC equipment is used then a separate gauge shall be used to read guard cell pressures.

3. The equipment shall be checked and calibrated when a new probe is used, a probe has been refurbished, any water circuit has been subjected to a vacuum or sudden pressure release or when 10 tests have been completed since the previous calibrations and checks. The checks and calibrations shall include the following:

   a. Integrity and de-aired state of the water circuits and water;

   b. Volume calibration of the measuring cell;

   c. Pressure calibration of the line and volumeter;

   d. Initial volume of the probe;

   e. Pressure calibration of the probe, line and volumeter.

4. Install the probe in a NX size investigation hole. Lower the probe into the hole and apply the first pressure increment within 15 minutes of removal of the core barrel from the test level;

5. Select pressure increments so that the limit pressure is achieved in 7 to 14 increments. Keep the pressure constant for the duration of each increment and take volumeter readings at 15 sec., 30 sec., 1 min., 1.5 min. and 2 min. after the application of the pressure. Take further readings if significant volume change takes place after 2 minutes;

6. Carry out cycles of unloading and reloading as directed by the CM. Consult the CM before any termination of the test;

7. Subject to Approval, the test shall be considered complete when the total volume of water in the volumeter has been injected into the measuring cell or when the pressure capacity of the apparatus is reached or when the limit pressure is reached whichever is the least;

8. Present the results of Pressuremeter Tests in the form of a net volume versus net pressure diagram with pressure indicated on the abscissa and volume on the ordinate. Plot creep volume (volume at 120 sec. minus volume at 30 sec.) for each increment;

9. Report all details of the test including the following:

   a. Site;

   b. Contract number and Works Order number where applicable;

   c. Hole number;

   d. Date of test;

   e. Number of test;

   f. Pressuremeter type and dimensions;

   g. Probe number;

   h. Name of technician;

i. Reduced level and coordinates of hole;

j. Depth below ground level and reduced level of centre of measuring cell;

k. Depth below ground level and reduced level of water / bentonite in the hole;

l. Height of centre of volumeter above ground level at the hole and reduced level;

m. Depth below ground level and reduced level of bottom of the hole;

n. Details of all relevant calibrations;

o. Reason for terminating test;

p. Weather.

10. Report the results including the Limit Pressure, Pressuremeter Modulus, Secant Shear Modulus (initial and for each cycle) and Secant Deformation Modulus (initial and for each cycle) within 7 days of the test being carried out;

11. Carry out Pressuremeter testing using an Approved pressuremeter probe of AX size having a pressure range up to 10,000 kPa at locations shown on the Drawings or as directed by the CM. The procedure for carrying out the tests will be as for the NX size or as directed by the CM and the control unit shall be located at ground level with the probe installed in a hole formed with a hand-held percussive drill of suitable diameter.

GIN.T150.9 POINT LOAD TEST ON ROCK CORE

1. Carry out Point Load Test in accordance with the 'Suggested Method for Determining the Point Load Strength' International Journal of Rock Mechanics, Mining Science and Geomechanics, 1985, Volume 22, No. 2, Pages 51-60;

2.

a. The point load testing machine shall be an Approved type;

b. Make available at least two spare sets of conical testing platens. Platens that are dented or chipped shall be immediately replaced;

c. Tests shall be carried out under air-dry or saturated conditions and to axial or diametrical orientation as directed by the CM.

3. If tests are ordered at regular intervals along the whole length of core obtained from a hole, transport the testing equipment to the Site if required by the CM so that the testing may be undertaken as cores are extracted from the drillhole(s). Reporting shall be in a form to be agreed using a correlation coefficient as agreed by the CM.

GIN.T180.9 GOODMAN JACK TEST

Goodman Jack Tests shall be carried out as directed by the CM to determine the rock mass modulus. The tests shall be carried out according to ASTM D4971-16. The tests shall be carried out by an operator fully conversant with the equipment and the method of test. Submit the results in a format to be approved by the CM within 7 days of the test being carried out.

GIN.T190.9 PLATE LOAD TEST

1. Carry out Plate Load Test at shallow pits or trenches or at other locations when Instructed. The plate load test shall be carried out in accordance with BS 1377-9:1990 (Test 4.1) by a HOKLAS accredited laboratory, except where noted hereunder;

2. The dimensions of the loading plate shall not be less than 300 mm, square or circular as Instructed. The loading plate shall be sufficiently rigid to prevent any distortion or bending at all stage of the loading test. The alignment and direction of the applied load including the load cells and jack shall remain vertical and concentric with the loading plate;
3. Apply the loading by a reaction system provided by means of kentledge system to the approval of the CM. The kentledge shall be capable of providing a reaction force not less than 3 times the test load (W_t) as Instructed by the CM;
4. Measure displacement of the loading plate by four dial gauges located at orthogonal positions. Use a reference beam to aid the measurement of the displacement. The reference beam shall be supported by two rigid foundations positioned outside the influence zones of the loaded area or kentledge reaction area. The dial gauges shall be of sufficient travel to measure the displacement of the plate and to an accuracy of 0.01 mm;
5. The maximum test load adopted shall not be less than $3W_t$, so that the significant stress on soil and settlement can be obtained. W_t is the test load and shall be obtained in accordance with Code of Practice for Foundations or its latest version issued by the Buildings Department;
6. An initial load not exceeding 25% of the initial overburden pressure may be applied to the test plate to reduce the bedding error before conducting the plate load test. Apply the test load in increments of 0.5 W_t up to W_t, release and reapply the test load in increments of 0.5 W_t up to 2 W_t, then release and reapply in increments of 0.5 W_t up to 3 W_t;
7. Maintain the test load at each incremental stage for a period of 10 minutes or longer until the rate of settlement is less than 0.05 mm in 10 minutes;
8. Maintain the maximum test load for at least 72 hours before removal;
9. Report all details of the test including:
    a. Reduced level at the test location and coordinates;
    b. Description of soil stratum where plate load test is conducted;
    c. Details of all calibration and correlation charts;
    d. Description of the method of reaction system used for the application of required loads, including any drawings to assist the presentation of the set-up;
    e. Results and interpretation of the tests in determining the soil modules of the underlying soil;
    f. Temperature and weather at the time of plate loading test;
    g. Date of test.

GIN.T200.9 ACOUSTIC BOREHOLE TELEVIEWER SURVEY

1. The output from the Acoustic Borehole Televiewer shall be such that the following information is provided:
    a. The location of discontinuities in the rock mass relative to ground level;
    b. The width, dip, and dip direction of detected discontinuities.
2. For the calculation of discontinuity dips, use the measured drillhole diameter. Provide the obtained information in graphical, tabulated, text, and digital format, as appropriate;
3. Graphical output shall include:
    a. A legible and orientated travel time log;

b. A legible and orientated amplitude log;

c. An orientated, digitised interpretation in the form of a diagrammatic internal view of the drillhole wall, showing the locations and shapes of discontinuities;

d. A dip/dip direction "tadpole" graphic; and

e. An indicator of the drillhole's deviation from vertical showing both amount and direction of deviation.

4. Adjust the depth scale of the logs to ensure the depth of the discontinuities represented on the log correlate to their corresponding depth in the rock cores or as agreed by the CM;

5. State clearly in the logs that all directions are relative to magnetic north. The declination of magnetic north from Hong Kong Metric Grid System north shall be recorded within the header information for each log. Final copies of these logs shall show the travel time and amplitude plots in colour. Logs shall have a vertical scale of not less than 1/10 unless otherwise Instructed. Provide the discontinuity data for each drillhole surveyed in tabular format and as a contoured stereographic plot, in the form of a lower hemisphere projection on an equal area stereonet;

6. Provide the following data in tabular format:

   a. Depth relative to ground level to the first appearance of each discontinuity;

   b. Depth relative to ground level to the last appearance of each discontinuity;

   c. The drillhole diameter at the mid-depth of each discontinuity;

   d. The calculated dip of each discontinuity feature to within one degree. (Horizontal is 00 degrees, vertical is 90 degrees). Dip is to be reported as a two-digit figure. The value of dip shall be corrected for the angle of the drillhole;

   e. The measured direction of dip relative to magnetic north. Direction is to be reported as a three-digit figure. Any deviation of the direction from vertical shall be taken into account when measuring dip direction;

   f. The deviation of the drillhole from vertical at the mean depth of the discontinuity reported to the nearest 0.1 degrees; and

   g. The direction of deviation of the drillhole at the mean depth of the discontinuity reported to at least the nearest 0.5 degrees relative to magnetic north.

7. The declination of magnetic north from Hong Kong Metric Grid System north shall be clearly stated in a footnote to the tabulated data;

8. Make an assessment of the distribution of material decomposition grades, according to Geoguide 3, based on the Acoustic Borehole Televiewer data as far as possible and include it in the Final Report. The assessment shall be carried out by a qualified geologist/geophysicist with experience in the interpretation of Acoustic Borehole Televiewer data;

9. A graphical differentiation shall be made between tight and open discontinuities and shading shall be used between discontinuity walls to illustrate aperture distances;

10. The tabulated data specified above shall also be supplied in digital form as a comma separated value text file. The file name shall be agreed with the CM. The file shall also contain a header line giving the Contract No., the Works Order number where applicable, the project title, the drillhole identification number, and the date of surveying. Each item in the header line is to be separated by a comma and shall not include commas;

11. Submit the results obtained under this clause in a format to be Approved within 7 days of the survey being carried out.

GIN.T210.9 CONE PENETRATION TEST

1. When Instructed, use an electrical cone capable of measuring the resistance, sleeve friction and pore pressure simultaneously. The cone shall be advanced hydraulically at a steady penetration rate of 20 mm/sec. Records at 20 mm interval of slide friction, tip resistance, and pore water pressure shall be obtained. Carry out the cone penetration test using equipment and methods in accordance with the recommendations of CIRIA Ground Engineering Report: In-situ Testing, Cone Penetration Testing, methods and interpretation by A.C. Meigh (1987);
2. For each test, provide the following information to the approval of the CM:
   a. Plot of cone point resistance, q_c versus depth;
   b. Plot of local sleeve friction f_s versus depth;
   c. Plot of pore pressure (u) versus depth;
   d. Plot of friction ratio, R_f versus depth;
   e. Plot of pore pressure ratio, (u/q_c);
   f. Plot of effective cone point resistance $(q_c - u)$;
   g. Plot of corrected total cone resistance $q_t = q_c + (1 - \beta) \times u$ versus depth where β is the cone correction factor;
   h. Plot net cone resistance $q_{net} = q_t$ – total overburden pressure versus depth;
   i. Plot normalised dissipated record versus time;
   j. Soil profile adjacent to CPT plots;
   k. Copies of all detailed test data including tapes/diskettes on which the data may be stored. All results shall be presented in SI units.
3. All tests and calibration data shall be made available to the CM within 3 days of the completion of the test;
4. The test could be terminated in cases when:
   a. 80% of the cone tip capacity, i.e. tip resistance or local friction are exceeded; or
   b. The pore pressure reaches or exceeds the nominal capacity, i.e. 20 bars or 2000 kPa; or
   c. The total thrust applied is less than the full reaction weight of the seabed frame, i.e. reaching the limitation of the penetrometer/rod string capacity.

LABORATORY TESTS

GIN.T310.9 GENERAL

1. All laboratory testings shall be carried out by an Approved commercial testing laboratory on the Development Bureau's List of Approved Suppliers of Material and Specialist Contractors for Public Works in Soil and Rock Testing. The testing work to be carried out comprises generally of testing of soil, rock and groundwater samples. The testing may be of any of the following types:
   a. Determination of Moisture Content;
   b. Determination of Atterberg Limits;
   c. Determination of Particle Density;
   d. Determination of Particle Size Distribution;

e. Determination of Amount of Chemical Substances and Electro-chemical Properties;

f. Determination of Dry Density/Moisture Content Relationship;

g. Determination of In-situ Bulk Density, In-situ Dry Density and Relative Compaction;

h. Determination of the California Bearing Ratio;

i. Determination of Compressibility Characteristics of Soils;

j. Determination of Shear Strength of Soils using Triaxial Apparatus;

k. Determination of Shear Strength of Soils using Shear Box Apparatus;

l. Direct shear strength tests including tests carried out on rock joints;

m. Any other soil and rock tests as directed by the CM.

2. Carry out all laboratory tests for soils in accordance with the recommended testing methods and procedures stated in 'Geospec 3: Model Specification for Soil Testing', GEO, unless otherwise specified;

3. Provide HOKLAS endorsed test reports for those soil tests that carried out in accordance with the recommended testing methods and procedures stated in 'Geospec 3: Model Specification for Soil Testing', GEO;

4. For those soil and rock tests where HOKLAS endorsed test reports are not available, submit the following to the CM for approval at least two months prior to testing:

   a. Copies of the full test procedures manuals (with equipment details, sample preparation and testing procedures, and recording and reporting specific to the laboratory) to be adopted for each test;

   b. Copies of calibration certificates for major equipment and measuring instruments to be used;

   c. A sample of the work sheets and of the test report;

   d. The name, qualifications and experience in testing of the person who will be supervising the tests full time at the laboratory and certifying the reliability and completeness of the test reports;

   e. Such tests shall be carried out to the test methods and test conditions specified by the CM, under a quality system up to HOKLAS standards. In particular, approved Signatories of Test Certificates and Reports and Senior Laboratory Technicians shall have qualifications and experience as specified in Appendix XIII to this Worksection. Evidence of training provided to personnel shall be available. Calibration shall have traceability to national standards of measurement. The CM may require an audit to be carried out on the testing laboratory at any time by Public Works Laboratories or by a third party. No claims for extension of time or additional payment will be considered by the CM for any action required by the laboratory to correct non-compliance identified in the audit.

5. The CM shall have the right of access to the Contractor's laboratory at all times when testing is being carried out in connection with this Contract;

6. While laboratory testing is in progress, inform the CM without delay of any unusual occurrences during any of the tests ordered, and of any test that is running to excessive time.

GIN.T320.9 LABORATORY TESTING DEFINITIONS

For laboratory testing the following definitions will apply:

1. Laboratory Engineer - a graduate engineer with a minimum of 5 years experience with at least 2 of which have been gained in soil testing in a laboratory, or a Chartered Engineer with a minimum of 2 years experience in soil testing and fully familiar with the soil testing procedures to be used in the Contract;
2. Senior Technician - a person with at least 10 years experience gained in a soil testing laboratory and fully familiar with all soil testing procedures to be used in the Contract;
3. Technician - any of the Contractor's personnel capable and qualified to set up and conduct tests in the laboratory;
4. Laboratory Assistant - any of the Contractor's personnel requiring direct supervision from an engineer, senior technician or technician.

GIN.T340.9 PHOTOGRAPHIC RECORD OF SAMPLES

1. A colour photographic record shall be taken for each triaxial test specimen, splitting of undisturbed sample, uniaxial rock compression test specimen and rock joint shear test specimen as described in GIN.W1240;
2. Immediately after testing, split soil cylindrical specimen longitudinally or otherwise as directed by the CM;
3. Place a reference label, scale and a suitable colour comparator along with the split specimen in the camera's field of view and a photograph taken at a scale agreed with the CM.

GIN.T350.9 RETENTION OF SAMPLES

1. When laboratory tests are carried out on only part of a soil sample, the remainder of the soil in the sampler or container shall be resealed with wax as soon as possible and retained;
2. All soil on which laboratory tests have been carried out, including that wasted during the preparation of test specimens, shall be retained in airtight containers until the presentation of the Final Report;
3. On submission of the Final Report and with the CM's acceptance, samples and specimens may be dumped. In no circumstances are samples and specimens allowed to be dumped without the Approval.

GIN.T360.9 CLASSIFICATION AND CHEMICAL TESTS

1. For all classification and chemical tests, adopt the following tests:
   a. Test procedures as specified in 'Geospec 3: Model Specification for Soil Testing', GEO:

Classification and Chemical Tests	Test Method as specified in 'Geospec 3: Model Specification for Soil Testing', GEO
i. Determination of moisture content	5.1, 5.2 or 5.3
ii. Determination of Atterberg Limits	6.1 or 6.2
iii. Determination of particle density	7.1 or 7.2
iv. Determination of particle size distribution	8.1, 8.2, 8.3, 8.4, 8.5, 8.6 or 8.7
v. Determination of organic matter content	9.1

vi. Determination of total sulphate content of soils and sulphate content of groundwater	9.3
vii. Determination of water-soluble chloride content	9.4
viii. Determination of the pH value	9.5

b. Test procedures as specified in BS:

Classification and Chemical Tests	BS
i. Determination of carbonate content of soils	The method as stated in BS 1377-3:1990, Test 6
ii. Determination of resistivity of soils	The method as stated in BS 1377-3:1990, Test 10.4

2. The particular test method to be employed will be given by the CM.

GIN.T365.9 TRIAXIAL TESTS ON SOIL SAMPLES

1. Carry out the test for determination of shear strength of soils using Triaxial Apparatus (also known as Triaxial Tests) in accordance with Test Method 15.1 or 15.2 or 15.3 of 'Geospec 3: Model Specification for Soil Testing', GEO. The particular test method to be employed will be given by the CM;
2. Triaxial testing shall be either single stage or multistage as Instructed. The size of the specimens to be tested shall generally be either 76 mm or 100 mm nominal diameter;
3. Remoulded triaxial specimens not greater than 100 mm diameter may be required. The specimen shall be prepared in accordance with Clause 13.2 of 'Geospec 3: Model Specification for Soil Testing', GEO;
4. Triaxial specimens not greater than 100 mm diameter may be required from a block sample. These shall be prepared by trimming using a soil lathe, in accordance with the method described in Clause 13.3 of 'Geospec 3: Model Specification for Soil Testing', GEO.

GIN.T367.9 TRIAXIAL TESTS ON LOOSELY COMPACTED FILL MATERIALS

Follow Test Method 15.2 of 'Geospec 3: Model Specification for Soil Testing', GEO (Geospec 3) with modifications on the following stages:

1. Sample preparation
   a. Follow Clause 13.2 of Geospec 3 if the initial target density is dense enough to enable a uniform triaxial specimen to be prepared. (Note 1 of Clause 13.2.2.9 of Geospec 3 recommends the use of static compaction);
   b. Where static compaction is not applicable in preparing a very loose and uniform specimen, slight tamping using a purposely-made apparatus shall be used;
   c. The initial target dry density and moisture content shall be specified by the CM. When the initial moisture content (m.c.) is not specified, the use of a m.c. value close to its optimum m.c. shall be acceptable;
   d. The CM may specify a series of initial relative compaction for the triaxial specimens instead of the initial target dry densities as mentioned in sub-clause (c).
2. Saturation
   a. Before applying back pressure, follow the following steps:

i. Disconnect the tubes at pore pressure and back pressure lines;

ii. Set the pressure of the CO_2 coming out from the cylinder at about 20 kPa;

iii. With the pore pressure and back pressure valves closed, plug in the tube with CO_2 to the pore pressure line;

iv. Immediately open the pore pressure and back pressure valves at the same time;

v. Check the CO_2 pressure via the pore pressure transducer. Adjust the CO_2 cylinder pressure at around 20 kPa;

vi. Allow the CO_2 to percolate through the soil specimen for about 5-10 minutes;

vii. Plug out the CO_2 tube and plug in back the tubes for pore pressure and back pressure. Take care to avoid trapping air bubbles in the tubes; and

viii. Continue with the procedures as set out in clause 15.2.6.2 of Geospec 3.

b. Use more stringent criterion for saturation. To enable correction for volume change during saturation be estimated, a full saturation or nearly full saturation of the specimen is required. The pore pressure coefficient B shall be $\geqq 0.97$ and the back pressure $\geqq$ 200 kPa before proceeding to the consolidation;

c. Follow the recommendation of Geospec 3 if the change in volume during saturation is significant. An estimate of the volume change is required.

3. Shearing

a. Terminate the test only at an axial strain of at least 20%.

4. Unload the specimen and dismantle the test

a. During unloading and dismantling, care must be exercised to minimize the loss of moisture and soil grains from the specimen.

GIN.T380.9 ONE-DIMENSIONAL CONSOLIDATION TEST

Carry out one-dimensional consolidation tests in accordance with Test Method 14.1 of 'Geospec 3: Model Specification for Soil Testing', GEO.

GIN.T390.9 SPLITTING OF UNDISTURBED SAMPLES OBTAINED FROM TRIPLE TUBE RETRACTABLE CORE BARRELS

1. For inspection purposes, tubes containing undisturbed samples obtained from triple tube retractable core barrel may be required to be split longitudinally on Site or in the laboratory for their full length by use of a rotary saw or other suitable means. Saw runs will in general be two in number and diametrically opposite. The tube material will be plastic;

2. Log the split undisturbed samples graphically with detailed description in accordance with Geoguide 3. Include the logs and photographs of the split undisturbed samples in both the Final Fieldworks Report and Laboratory Tests Report.

GIN.T400.9 DIRECT SHEAR BOX TEST

Carry out the test for determination of shear strength of soils using Shear Box Apparatus (also known as Direct Shear Box Tests) in accordance with Test Method 16.1 of 'Geospec 3: Model Specification for Soil Testing', GEO. The particular test method (Method A or Method B) to be employed will be given by the CM.

GIN.T410.9 SOIL COMPACTION TEST

Carry out the test for determination of dry density/moisture content relationship (also known as Soil Compaction Tests) in accordance with Test Method 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7 or 10.8 of 'Geospec 3: Model Specification for Soil Testing', GEO. The particular method to be employed will be given by the CM. Separate specimens shall be required for each moisture content/dry density determination.

GIN.T420.9 DETERMINATION OF THE CALIFORNIA BEARING RATIO

Carry out the test for determination of California Bearing Ratio in accordance with Test Method 12.1 of 'Geospec 3: Model Specification for Soil Testing', GEO.

GIN.T430.9 ROWE CELL TESTING OF LARGE DIAMETER PISTON SAMPLES

1. Rowe Cell (also known as hydraulic cell) consolidation tests may be required on soil samples with diameters ranging from 75 to 254 mm. Testing may be of "free strain" or "equal strain" type and be carried out under one of the following drainage conditions:
    a. Vertical drainage to the top surface only, with measurement of pore pressure at the centre of the base;
    b. Vertical drainage to both top and bottom surfaces;
    c. Radial drainage outwards to the periphery only, with measurement of pore pressure at the center of the base;
    d. Radial drainage inwards to a central drain with measurement of pore pressure at one or more points off center.
2. Carry out Rowe cell consolidation tests in accordance with BS 1377-6:1990 (incorporating Amendment No. 1) with the following modification:
    a. Carry out all tests in an area free from significant vibrations and other mechanical disturbance. The temperature variation during any test shall not exceed 8ºC, and the temperature at any time during a test shall be between 15ºC and 28ºC. The apparatus shall be sited away from the effects of local sources of heat, direct sunlight and draught;
    b. Carry out a pre-test assessment of the soil sample before the test. If necessary, inform and request the CM to examine and assess the sample condition and its suitability for test;
    c. The permeability of the porous discs shall be at least one order of magnitude greater than the estimated permeability of the soil specimen. Check the permeability of the porous discs before they are first used and subsequently at a frequency of at least once every year to ensure that they meet the above criterion;
    d. In addition to the calibration of the apparatus as described in Clauses 3.2.5 and 3.2.6 of BS 1377-6:1990, calibration of rim drain shall also be carried out for tests under outward radial drainage condition;
    e. At each stage of loading, plot the compression gauge readings against both logarithm of time and square-root of time and maintain the pressure until such time that the end of primary consolidation is reached. The end of primary consolidation shall be determined using both the log time and the square-root time plots, whichever gives a longer primary consolidation period. When the end of primary consolidation can be identified on only the log time or the square-root time plots, that shall be taken as the end of primary consolidation;

f. Determination of the initial moisture content of the soil sample in clause 3.5.8.1.2 of BS 1377-6:1990 shall be in accordance with Test Method 5.1 or 5.3 of 'Geospec 3: Model Specification for Soil Testing', GEO as Instructed. Drying of the specimen as required in Clause 3.5.6.4 of BS 1377-6:1990 shall be at a temperature which is the same as that adopted in the test method specified for the determination of initial moisture content of the soil specimen;

g. Temperature correction described in Clause 3.5.8.5.5 of BS 1377-6:1990 shall not be carried out;

h. The coefficient of consolidation (cv) shall be calculated using both the log of time plot and the square-root time plot, where possible;

i. Upon completion of the test, break up the specimen for inspection (if necessary, soak the dried soil specimen in water until it is sufficiently soft for breaking up into individual particles). If there are particles of size large than one-fifth of the height of the consolidation ring, determine and record the percentage by weight and the size distribution of these particles within the specimen. Determine the percentage by weight and size distribution of large particles using BS sieves or other equivalent standard sieves;

j. The reporting to test results shall include all information as required in Clause 3.5.9 of BS 1377-6:1990 except that:

   i. A basic description of the specimen shall be carried out;

   ii. The initial void ratio and degree of saturation of the sample shall be reported;

   iii. Plot of percentage vertical compression and void ratio (which correspond to the end of primary consolidation as defined in sub-clause (2)(e) against the logarithm of applied pressure for the complete load-unload cycle shall be provided;

   iv. Plots of compression against time (both log time and square-root time), for each load increment, shall be included;

   v. The daily maximum and minimum temperatures recorded in the vicinity of the test apparatus over the whole period of test shall be reported; and

   vi. The percentage by mass and size distribution of particles larger than that acceptable, if found within the test specimen, shall be reported.

k. For "free strain" tests under outward radial drainage condition, t0.465 plots instead of square root time plots shall be used as referred in sub-clauses (2)(e) and (2)(j)(iv).

3. Report the results on the forms shown in Appendix A of BS 1377-6:1990. Alternative record sheets shall be to the approval of the CM.

GIN.T440.9 UNIAXIAL COMPRESSIVE STRENGTH TEST

1. When Instructed, determine the uniaxial compressive strength (UCS) in accordance with ASTM D7012-07 on intact rock core specimens;

2. At the discretion of the CM, determine also the elastic moduli of the intact rock in accordance with ASTM D7012-07;

3. Report the test results on forms to the approval of the CM.

GIN.T450.9 ROCK JOINT SHEAR TEST

Carry out rock joint shear test in accordance with ASTM D5607-16 and with the following modifications:

1. Unless otherwise Instructed, carry out multi-stage testing;
2. Carry out the following in rock joint shear tests and report on the forms to the approval of the CM:
    a. Determine and record the dimensions of the top and bottom shear surfaces;
    b. Estimate the actual area of contact between the top and bottom surfaces. Calculate the areas of regular shapes. Determine the areas of irregular shapes by tracing the shape onto a tracing paper and measuring the area with a planimeter;
    c. Record the roughness profile, before and after shear, with the aid of the profilometer. Also make a description of the rock joint surfaces with regard to colour, tightness and nature of infilling materials;
    d. Take photographs of top and bottom joint surfaces, before and after shear, in accordance with the requirements of GIN.T340;
    e. Soak the specimen in water for 48 hours before testing unless otherwise Instructed;
    f. Record the horizontal displacements, vertical displacements, shear loads and normal loads during the tests;
    g. Make the following corrections in calculating the stresses:
        i. Hydraulic ram springs - where hydraulic rams have been used, apply a correction to gauge readings to take into account the resistance provided by the ram return springs;
        ii. Cross-sectional areas - take into account the reduction in cross-sectional area during the shearing process;
        iii. Take into account contributions to normal load such as self-weight of loading system, weight of upper box and sample and cementing material.
3. The variations to the above procedures for testing tight joints shall be Approved.

APPENDICES

APPENDIX I - AGS DIGITAL FORMAT FOR DATA OF FIELDWORK

GIN.APPEND1.9 APPENDIX I - AGS DIGITAL FORMAT FOR DATA OF FIELDWORK

Refer to Project Specific Specification.

APPENDIX II - AGS DIGITAL FORMAT FOR DATA OF LABORATORY TESTING

GIN.APPEND2.9 APPENDIX II - AGS DIGITAL FORMAT FOR DATA OF LABORATORY TESTING

Refer to Project Specific Specification.

APPENDIX III - DAILY RECORD SHEET, DRILLHOLE, TRIAL PIT, TRIAL TRENCH AND SLOPE SURFACE STRIPPING REPORT FORMATS

GIN.APPEND3.9 DAILY RECORD SHEET, DRILLHOLE, TRIAL PIT, TRIAL TRENCH AND SLOPE SURFACE STRIPPING REPORT FORMATS

Refer to Project Specific Specification.

APPENDIX IV - LOCKABLE SURFACE BOX FOR PIEZOMETER & STANDPIPE INSTALLATION

GIN.APPEND4.9 APPENDIX IV - LOCKABLE SURFACE BOX FOR PIEZOMETER & STANDPIPE INSTALLATION

Refer to Project Specific Specification.

APPENDIX V - DETAILS OF PIEZOMETER AND STANDPIPE

GIN.APPEND5.9 APPENDIX V - DETAILS OF PIEZOMETER AND STANDPIPE

Refer to Project Specific Specification.

APPENDIX VII - STANDPIPE/PIEZOMETER MONITORING

GIN.APPEND7.9 APPENDIX VII - STANDPIPE/PIEZOMETER MONITORING

Refer to Project Specific Specification.

APPENDIX X - N-SCHMIDT HAMMER TEST

GIN.APPEND10.9 APPENDIX X - N-SCHMIDT HAMMER TEST

Refer to Project Specific Specification.

APPENDIX XI - PUMPING TEST

GIN.APPEND11.9 APPENDIX XI - PUMPING TEST

Refer to Project Specific Specification.

APPENDIX XIII - REQUIREMENTS ON APPROVED SIGNATORY OF TEST CERTIFICATES AND REPORTS AND SENIOR LABORATORY TECHNICIANS FOR SOIL AND ROCK TESTING

GIN.APPEND13.9 APPENDIX XIII - REQUIREMENTS ON APPROVED SIGNATORY OF TEST CERTIFICATES AND REPORTS AND SENIOR LABORATORY TECHNICIANS FOR SOIL AND ROCK TESTING

Refer to Project Specific Specification.

APPENDIX XVIII - DETAILS OF SETTLEMENT MONITORING STATIONS

GIN.APPEND18.9 APPENDIX XVIII - DETAILS OF SETTLEMENT MONITORING STATIONS

Refer to Project Specific Specification.

APPENDIX XXI - LOCATION OF HKHA'S CORES STORES

GIN.APPEND21.9 APPENDIX XXI - LOCATION OF HKHA'S CORE STORES

Refer to Project Specific Specification.

APPENDIX XXII - DETAILS OF GROUND WATER SAMPLING WELL

GIN.APPEND22.9 APPENDIX XXII - DETAILS OF GROUNDWATER SAMPLING WELL

Refer to Project Specific Specification.

GRO GROUTING FOR GEOTECHNICAL WORKS

GRO GROUTING FOR GEOTECHNICAL WORKS 2

MATERIALS 2

GENERAL 2

GRO.M010.9 DEFINITIONS 2

GROUT FOR GEOTECHNICAL WORKS 2

GRO.M110.9 GROUT 2

GRO.M120.9 STANDPIPES FOR GROUTING 3

WORKMANSHIP 4

SUBMISSIONS, RECORDS AND MONITORING 4

GRO.W010.9 PARTICULARS OF GROUTING FOR GEOTECHNICAL WORKS 4

GRO.W020.9 RECORDS OF GROUTING FOR GEOTECHNICAL WORKS 4

GRO.W030.9 MONITORING OF GROUTING OPERATIONS 5

DRILLING FOR GROUTING FOR GEOTECHNICAL WORKS 5

GRO.W110.9 DRILLING 5

GRO.W120.9 INSTALLATION OF STANDPIPES AND CAPPING PIPES 6

GROUTING FOR GEOTECHNICAL WORKS 6

GRO.W130.9 GROUTING EQUIPMENT 6

GRO.W140.9 MIXING GROUT 7

GRO.W150.9 PRESSURE GROUTING 7

GRO.W160.9 LOSS OR LEAKAGE OF GROUT 7

GRO.W170.9 MAKING GOOD HOLES 7

TESTING 9

GENERAL 9

GRO.T010.9 TRIALS FOR GROUTING 9

GRO.T020.9 BATCH OF GROUT 9

GRO.T030.9 LABORATORY 9

TESTING FOR BLEEDING OF GROUT 9

GRO.T110.9 TEST FOR BLEEDING OF GROUT 9

TESTING FLOW CONE EFFLUX TIME OF GROUT 10

GRO.T210.9 TEST FOR FLOW CONE EFFLUX TIME OF GROUT 10

TESTING CRUSHING STRENGTH OF GROUT 10

GRO.T310.9 TEST FOR CRUSHING STRENGTH OF GROUT 10

PACKER TESTS ON DRILLHOLES FOR GROUTING AND GROUTED DRILLHOLES. 11

GRO.T410.9 TESTING 11

GRO.T420.9 COMPLIANCE CRITERIA 12

GRO.T430.9 NON-COMPLIANCE OF DRILLHOLES 12

GRO.T440.9 NON-COMPLIANCE OF GROUTED AND REGROUTED DRILLHOLES 12

GRO GROUTING FOR GEOTECHNICAL WORKS

MATERIALS

GENERAL

GRO.M010.9 DEFINITIONS

In this Specification:

1. "Ground", for the purpose of grouting for geotechnical works, is fill material, soil and rock and the interfaces between fill material, soil and rock and any structures;
2. "Grout", for the purpose of grouting for geotechnical works, is cement grout, cement-sand grout, cement-bentonite grout and Approved proprietary grout;
3. “Sand” shall be natural sand or crushed natural stone;
4. "Grouting", for the purpose of grouting for geotechnical works, is the mixing and injection of grout through predrilled or preformed holes;
5. "Grouting stage", for the purpose of grouting for geotechnical works, is the discrete length of drillhole into which grout is to be injected in a continuous operation;
6. "Lugeon" is a water loss of 1 litre per minute per metre length of hole tested at an effective pressure of 1 MPa.

GROUT FOR GEOTECHNICAL WORKS

GRO.M110.9 GROUT

1. Materials for grout shall comply with Worksection CON1 except as stated in this Worksection;
2. Cement grout for geotechnical works shall consist of Portland Cement (PC), Pulverised Fuel Ash (PFA), sand and water. Admixtures shall not be used unless permitted by the CM. The use of PFA in cement grout shall follow the same requirements of PFA in concrete as specified in Worksection CON1;
3. Sand for grout shall be clean dry sand complying with BS 1200:1976 and shall have a particle size distribution such that 100 % passes a 2 mm BS test sieve and not more than 30 % passes a 0.2 mm BS test sieve;
4. Water for grout shall be clean fresh water having a temperature not exceeding 30°C or less than 5°C;
5. Cement grout shall have a minimum crushing strength of 30 MPa at 28 days;
6. The amount of bleeding of grout shall not exceed 0.5 % by volume 3 hours after mixing or 1.0 % maximum when measured at 23 ± 1.7°C in a covered glass or metal cylinder of 100 mm internal diameter and with a grout depth of approximately 100 mm. In addition, the water shall be reabsorbed by the grout within 24 hours;
7. The flow cone efflux time of grout shall not be less than 15 seconds.

GRO.M120.9 STANDPIPES FOR GROUTING

1. Unless otherwise Approved, standpipes for grouting shall be standard black metal pipe complying with BS 1387:1985 (1990). Unless otherwise permitted by the CM, non-metallic grout pipe may be used for grouting rock dowels, rock bolts and soil nails. Where metallic standpipes are used for grouting rock dowels, rock bolts and soil nails, they shall be extracted from drillholes as grouting proceeds;
2. Submit to the CM for approval of the proposed standpipes for grouting the following particulars at least 14 days prior to installation:
    a. Sample of the proposed standpipes for grouting;
    b. Certificate(s) from the manufacturer confirming compliance of the materials with the requirements of this Specification or as shown on Drawings.

WORKMANSHIP

SUBMISSIONS, RECORDS AND MONITORING

GRO.W010.9 PARTICULARS OF GROUTING FOR GEOTECHNICAL WORKS

The following particulars of the proposed materials and methods of construction for grouting for geotechnical works shall be submitted for Approval at least 28 days before grouting starts:

1. Details of drilling, grouting and testing equipment;
2. Details of grout mix, including admixtures;
3. Methods of storing, mixing and injecting grout;
4. Methods of drilling, cleaning, capping and sealing grout holes;
5. Methods of grouting, including grouting stages, order of working and re-grouting methods;
6. Methods of controlling surface water, groundwater, grout leakage and ground movement, including methods of containing overflow grout, grout spill, monitoring and instrumentation; and
7. Safety and hazard risk control measures, including bursting of high pressure grout pipes.

GRO.W020.9 RECORDS OF GROUTING FOR GEOTECHNICAL WORKS

1. Keep records of grouting for geotechnical works on the Site. The records shall be available for inspection by the CM at all times. Records shall include the following details:
    a. Hole location and reference number;
    b. Depth of hole;
    c. Type of grout and grout mix proportions;
    d. Volume of grout injected;
    e. Grouting pressures; and
    f. Times and details of any interruptions, leakages and equipment malfunctions.
2. Submit a record of grouting for each hole to the CM within 24 hours after completion of grouting of the hole. The record shall contain the following details:
    a. Hole location and reference number;
    b. Grouting stage numbers and lengths;
    c. Collar level and hole inclination;
    d. Details of grout injections including the information stated in sub-clause (1); and
    e. Details of the grouting procedure, including any stoppages, leaks to other holes, surface leaks and ground movement.
3. Submit a record of the testing for each hole, including test results, to the CM within 24 hours after completion of testing of a hole. Records of Packer tests shall contain the following details:
    a. Hole location and reference number;

b. Depth of packer in the hole;

c. Date and time of test;

d. Type of gauge or meter and identifying reference number;

e. Test readings for each 5 minutes period;

f. Calculated test results in Lugeons; and

g. Details of any equipment malfunctions, sudden water losses or blockages, surface leakage or other variations in test procedure.

4. Submit a report of grouting for each part of the Works as shown on the Drawings, including record drawings and logs of holes, to the CM within 7 days after completion and testing of grouting for that part of the Works. The form of records, logs and record drawings shall be as agreed by the CM.

GRO.W030.9 MONITORING OF GROUTING OPERATIONS

1. Where as shown on the Drawings or directed by the CM, install instrumentation to monitor heave, bulging, settlement, lateral movement, deformation or fracturing of the ground or structures due to grouting operations. Keep records of monitoring on the Site and submit a copy of the records to the CM at frequencies as shown on the Drawings or as agreed by the CM;
2. Check the accuracy of the instruments before grouting starts and at regular intervals agreed by the CM.

DRILLING FOR GROUTING FOR GEOTECHNICAL WORKS

GRO.W110.9 DRILLING

1. Drill holes in rock for grouting for geotechnical works using rotary or percussion type drills. The tolerances for the holes shall be as stated in Worksection GIN except that for drillholes of soil nails which shall be as stated in Worksection SLO. Do not use grease and other lubricants in the flushing medium or on the rods, except around the threads at the ends of the rods. Do not use drilling methods which result in drill cuttings causing blockages such that grouting cannot be performed satisfactorily;
2. The set-up for drilling plant and ancillary equipment shall be in such a manner that water, dust, fumes and noise generated in the course of drilling and grouting operation shall be sufficiently diverted, controlled, suppressed and muffled. The flushing medium for drilling shall be clean water or air accompanied by the operation of an effective dust extraction and filtering device as agreed by the CM;
3. The minimum size of hole for grouting in rock shall be 40 mm;
4. Drill holes in soil for grouting for geotechnical works by a method which is suitable to the ground conditions and which is Approved;
5. The location of all underground obstructions and utilities shall be determined by the Contractor before drilling starts and the drilling pattern shall take account of the location of obstructions and utilities;
6. Casings required to prevent the collapse of grout holes shall be as stated in Worksection GIN. Remove casings immediately before or simultaneously with the grouting or sleeve grouting operation in such a manner that the grout hole will not collapse and the injection of grout will not be hindered;

7. Flush clean grout holes with water or compressed air introduced at the bottom of the hole after drilling is complete. Protect the holes with capping pipes or standpipes to prevent subsequent collapse or clogging after flushing;
8. Re-flush grout holes, which have been drilled more than one day before grouting of the hole starts, with water or compressed air immediately before grouting is commenced and remove excess flushing water by air jet. Holes drilled in soft ground or in ground other than rock and in which sleeve grouts are proposed as part of the grouting operation shall be sleeve grouted as soon as practicable after drilling.

GRO.W120.9 INSTALLATION OF STANDPIPES AND CAPPING PIPES

1. Unless otherwise permitted by the CM, cap grout holes after drilling and before grouting. Capping shall be by a suitably sealed grout connection, standpipe, packer or other methods agreed by the CM. The cap shall seal the hole to prevent contamination or clogging of the hole until grouting operations start;
2. Install standpipes, if required, in holes after drilling. The pipe shall be sealed into the hole using cement grout consisting of PC and water in the proportions 1:1 by volume.

GROUTING FOR GEOTECHNICAL WORKS

GRO.W130.9 GROUTING EQUIPMENT

1. Grouting equipment for geotechnical works shall be a type, quantity and size suitable for the grouting required. The equipment shall be kept clean and in good working order;
2. Standby grouting equipment shall be available at all times and shall be capable of being brought into operation immediately in the event of breakdowns during grouting operations;
3. Grouts mixers shall be high-speed colloidal mixers having a rotor speed of the least 1000 r/min and capable of producing a colloidal grout mix. Mixers shall be fitted with a water-volume measuring device for batching purposes;
4. Holding tanks shall be fitted with an agitator to provide continuous agitation of the grout at 100 r/min. The tank shall be fitted with a dipstick to allow continuous measurement of the volume of grout in the tank. A 2.36 mm removable screen shall be provided between the tank and the pump or grout lines;
5. Grout pumps shall be a positive displacement type. Pumps shall be fitted with bypass valves to allow a standby pump to be brought into operation;
6. Working pressure gauges shall be accurate to within 3 % and shall be calibrated against a test gauge before grouting starts and at weekly intervals. A test gauge with accompanying calibration certificates shall be kept on the Site for the purpose of calibrating working gauges. Working gauges shall be numbered and a record shall be kept of gauge number, shift worked, calibration dates and repairs undertaken. Keep records on the Site and make the records available for inspection by the CM at all times;
7. Packers shall be such that they seal holes in rock at the specified level and shall be capable of withstanding the maximum grout or water pressure to be used at the level without leakage. Packers may be of the mechanical or inflatable rubber type. A sufficient number of packers of a size to suit the holes shall be available on the Site.

GRO.W140.9 MIXING GROUT

1. Grout for geotechnical works shall be mixed by volume or batched by mass as agreed by the CM. The mix proportions may be adjusted if Approved depending on the results of the trial grouting, water tests in the hole or the results of previously grouted holes;
2. Mix grout by adding approximately two-thirds of the cement to the water, adding any admixture and adding the remaining one-third of cement. Other mixing procedures shall not be used unless permitted by the CM;
3. The time for which grout shall be mixed in high-speed mixers shall be suitable for the type of mixer used. Grout shall be continuously agitated in a holding tank after mixing and shall be screened before being circulated in the grout lines. Mixed grout shall be continuously circulated in such a manner that grout which is not taken in a hole can be returned to the holding tank;
4. Grout to which a retarding agent has not been added, and which is not used within 30 minutes after mixing, shall not be used for grouting.

GRO.W150.9 PRESSURE GROUTING

1. Grout holes in rock in grouting stages not exceeding 3 m. Grouting may be carried out in either an upstage or a downstage sequence;
2. Grout ground other than rock in such a manner that grout can be injected at various points along the grout hole in a multi-stage operation. The grouting method shall employ perforated pipes with rubber sleeve valves unless otherwise permitted by the CM;
3. Grouting pressures shall initially be 100 kPa per 4-metre depth of hole and shall not exceed the overburden pressure unless permitted by the CM;
4. Grout holes in a continuous operation at the grouting stages and pressures as stated in the Drawings. Unless otherwise permitted by the CM, carry out grouting by injecting the grout under pressure into each grouting stage of the hole until the grouting stage refuses to take further grout;
5. If in the opinion of the CM grouting of any hole or grouting stages has not been completed due to excessive grout-takes, low pressures, excessive leakage or other causes, the hole shall be redrilled or flushed out with water and re-injected with grout.

GRO.W160.9 LOSS OR LEAKAGE OF GROUT

1. If during the grouting of any hole, grout is found to flow from adjacent grout holes in quantities, which in the opinion of the CM are sufficient to interfere seriously with the grouting operation or to cause appreciable loss of grout, the holes shall be temporarily capped. If in the opinion of the CM capping is not essential, ungrouted holes shall be left open to allow air and water to escape;
2. If during the grouting of any hole grout is found to flow from joints in the geological formation at the Site or any other location, the leaks shall be plugged or caulked in a manner agreed by the CM;
3. If during the grouting of any hole the grout-take increases suddenly by a significant amount, inform the CM immediately.

GRO.W170.9 MAKING GOOD HOLES

1. Make good grout holes through concrete using concrete agreed by the CM. The concrete shall be firmly compacted and shall be finished to match the adjacent surface;

2. Top up uncapped holes in rock after grouting using cement grout consisting of PC and water in the proportion 1:1 by volume, or 1:3 cement sand mortar.

TESTING

GENERAL

GRO.T010.9 TRIALS FOR GROUTING

Unless otherwise permitted by the CM, carry out a grouting trial. The extent and depth of holes for grouting trials and the tests to be carried out shall be as stated in the Drawings.

GRO.T020.9 BATCH OF GROUT

1. For GRO.T110 and GRO.T210, a batch of grout for geotechnical works is any quantity of grout used for grouting geotechnical works in one continuous operation in one day;
2. For GRO.T310, a batch of grout for geotechnical works is the quantity of grout as stipulated in Clause 1.2 of CS1:2010.

GRO.T030.9 LABORATORY

Unless otherwise Approved, carry out tests by employing a laboratory that complies with the requirements stated in the Preliminaries Worksection.

TESTING FOR BLEEDING OF GROUT

GRO.T110.9 TEST FOR BLEEDING OF GROUT

1. Testing arrangements:
    a. Carry out tests by employing a laboratory that complies with the requirements stated in the Preliminaries Worksection.
2. Testing samples:
    a. Provide one sample of grout from each batch of grout for geotechnical works to determine the amount of bleeding of the grout;
    b. Provide samples not more than 30 minutes after the grout has been mixed and protect samples from moisture content changes before the tests for determining the amount of bleeding are carried out.
3. Testing methods:
    a. Divide each sample of grout into three specimens. Test each specimen to determine the amount of bleeding;
    b. Test each specimen for bleeding in accordance with ASTM C940-98a;
    c. Complete the bleeding tests immediately prior to each application in a day or as directed by the CM.
4. Non-compliance:
    a. If the result of any test does not comply with the specified requirements for amount of bleeding of grout for geotechnical works:
        i. Submit particulars of proposed changes to the materials, grout mix or methods of production to the CM for approval;
        ii. Carry out further grouting trials unless otherwise permitted by the CM.

TESTING FLOW CONE EFFLUX TIME OF GROUT

GRO.T210.9 TEST FOR FLOW CONE EFFLUX TIME OF GROUT

1. Testing arrangements:
    a. Carry out tests by employing a laboratory that complies with the requirements stated in the Preliminaries Worksection.
2. Testing samples:
    a. Provide one sample of grout from each batch of grout for geotechnical works to determine the flow cone efflux time of the grout.
3. Testing methods:
    a. Test each sample to determine the flow cone efflux time in accordance with ASTM C939- / C939M-16a.
4. Non-compliance:
    a. If the result of any test does not comply with the specified requirements for flow cone efflux time:
        i. Submit particulars of proposed changes to the materials, grout mix or methods of production to the CM for approval;
        ii. Carry out further grouting trials unless otherwise permitted by the CM.

TESTING CRUSHING STRENGTH OF GROUT

GRO.T310.9 TEST FOR CRUSHING STRENGTH OF GROUT

1. Testing arrangements:
    a. Carry out tests by employing a laboratory that complies with the requirements stated in the Preliminaries Worksection.
2. Testing samples:
    a. Provide one sample of grout for geotechnical works from every 10 m^3 or 10 batches, whichever is the smaller volume, for geotechnical works to determine the crushing strength of the grout. Provide at least one sample from the grout produced on any one day;
    b. Provide samples not more than one hour after the grout has been mixed and protect samples from moisture content changes before test cubes are made.
3. Testing methods:
    a. Make three 100 mm test cubes from each sample of grout taken, mark the test cubes with suffix A1, A2 and B;
    b. Make, cure and test all test cubes for crushing strength at 28 days in accordance with CS1:2010.
4. Acceptance Criteria:
    a. The crushing strength for all individual test cubes with suffix A1, A2 and B shall have the minimum specified crushing strength; and
    b. The test results of the average crushing strength of test cubes with suffix A1 and A2 shall comply with the acceptance criteria set below:

i. The average strength determined from any group of four consecutive test results shall exceed the specified grout strength by 5 MPa. Where there are only two or three test results available, those results shall be treated as if they were four consecutive test results;

ii. If the difference between the crushing strengths of the test cubes with suffix A1 and A2 exceeds 15% but does not exceed 20% of the test result:

- Do not use the test result for that sample to assess compliance as set out in sub-clause (b) (i) above; and
- Review the sampling and testing procedures and propose for improvement.

iii. If the difference between the crushing strengths of the test cubes with suffix A1 and A2 exceeds 20% of the test result:

- Discard the test result for that sample; and
- Propose investigation for Approval to establish if the grout represented by the sample is acceptable or not.

c. If the test result does not comply with the specified requirements for crushing strength of grout:

i. Submit particulars of proposed changes to the materials, grout mix or methods of production to the CM for approval;

ii. Make further trial mixes and carry out further grouting trials unless otherwise permitted by the CM.

5. Reporting:

Option 1

a. Submit test report for test cubes with suffix A1, A2 and B with a statement signed by SQCC confirming that the material complied with sub-clause 4(a) above;

b. Submit a separate test report for test cubes with suffix A1 and A2 with a statement signed by SQCC confirming that the material complied with sub-clause 4(b) above, together with a statistical analysis according to the acceptance criteria given in Building (Construction) Regulation 59 have been complied with;

Option 2

a. Submit test report for test cubes with suffix A1, A2 and B with a statement signed by QCE confirming that the material complied with sub-clause 4(a) above;

b. Submit a separate test report for test cubes with suffix A1 and A2 with a statement signed by QCE confirming that the material complied with sub-clause 4(b) above, together with a statistical analysis according to the acceptance criteria given in Building (Construction) Regulation 59 have been complied with;

c. All reports must be submitted within 7 days after testing.

PACKER TESTS ON DRILLHOLES FOR GROUTING AND GROUTED DRILLHOLES

GRO.T410.9 TESTING

1. The water loss from drillholes for grouting and from grouted and re-grouted drillholes shall be determined by the Packer test;

2. The number of drillholes for grouting to be tested to determine the water loss shall be as Instructed;
3. Unless otherwise Instructed, test every grouted drillhole and every re-grouted drillhole to determine the water loss;
4. Carry out Packer tests in accordance with BS EN ISO 22282-3:2012 and the following sub-clauses (5) to (8);
5. Tests shall be carried out using clean water, in grouting stages not exceeding 3 m in length. Determine the rate of flow of water in the test to an accuracy of 10 % for flows exceeding 1 L/min;
6. The test pressure shall be equal to the overburden pressure and shall not exceed the specified maximum grouting pressure for the grouting stage being tested;
7. Carry out the test between a packer and the base of the hole for grouting stages at the base of a hole and between two packers in other cases;
8. Carry out the test by pumping water at the specified pressure into the grouting stage being tested and measuring with a volume meter the water loss over three consecutive 10 minutes periods. The results shall be calculated in Lugeons for each 10 minutes period.

GRO.T420.9 COMPLIANCE CRITERIA

The water loss determined by the Packer test in the grouted hole shall not exceed 5 Lugeons when measured over a 10 minute period.

GRO.T430.9 NON-COMPLIANCE OF DRILLHOLES

If the result of any Packer test on drillholes for grouting does not comply with the specified requirements for the test, the drillhole shall be grouted, re-drilled and retested. Grouting, re-drilling and retesting shall continue until the result of the Packer test complies with the specified requirements for the test.

GRO.T440.9 NON-COMPLIANCE OF GROUTED AND REGROUTED DRILLHOLES

If the result of any Packer test on grouted drillholes or regrouted drillholes does not comply with the specified requirements for the test, the grout shall be removed and the drillhole shall be regrouted and retested. Removal of grout, regrouting and retesting shall continue until the result of the Packer test complies with the specified requirements for the test.

GWD GROUND WATER DRAINAGE AND CONTROL

GWD GROUND WATER DRAINAGE AND CONTROL 3

MATERIALS 3

GENERAL 3

GWD.M010.9 DEFINITIONS 3

SUBMISSIONS 3

GWD.M110.9 PARTICULARS OF GRANULAR FILTERS 3
GWD.M120.9 PARTICULARS OF GEOTEXTILE FILTER 4
GWD.M130.9 PARTICULARS OF TRENCH DRAINS 4
GWD.M140.9 PARTICULARS OF RAKING DRAINS 4
GWD.M150.9 PARTICULARS OF RELIEF DRAINS 5
GWD.M160.9 PARTICULARS OF CAISSON DRAINS 5
GWD.M170.9 PARTICULARS OF PREFABRICATED BAND DRAINS 5
GWD.M180.9 PARTICULARS OF FILTER PIPES 5
GWD.M190.9 PARTICULARS OF GROUNDWATER CONTROL, DRAWDOWN AND MONITORING 6
GWD.M200.9 SAMPLES OF MATERIALS 6

FILTER AND DRAINAGE MATERIALS 6

GWD.M310.9 GRANULAR FILTER MATERIAL 6
GWD.M320.9 GEOTEXTILE FILTER 6
GWD.M330.9 FILTER PIPES 6
GWD.M340.9 RAKING DRAINS 7
GWD.M345.9 RELIEF DRAINS 8
GWD.M350.9 PREFABRICATED BAND DRAINS 8
GWD.M360.9 FILL MATERIAL FOR TRENCH DRAINS 8
GWD.M370.9 CAISSON LINERS 8

WORKMANSHIP 9

DELIVERY, HANDLING AND STORAGE 9

GWD.W010.9 GRANULAR FILTER MATERIAL 9
GWD.W020.9 GEOTEXTILE FILTER 9
GWD.W030.9 FILTER PIPES 9
GWD.W040.9 PREFABRICATED BAND DRAINS 9

GRANULAR FILTERS 9

GWD.W110.9 MIXING 9
GWD.W120.9 DEPOSITION AND COMPACTION 9

GEOTEXTILE FILTER 10

GWD.W210.9 EXPOSURE AND DAMAGE REPAIR 10
GWD.W220.9 LAYING 10
GWD.W230.9 PROTECTION 10
GWD.W240.9 RECORDS 10

RAKING DRAINS 10

GWD.W310.9 INSTALLATION 10
GWD.W320.9 DRILLING 11
GWD.W330.9 RECORDS 11

TRENCH DRAINS 11

GWD.W410.9 EXCAVATION 11
GWD.W420.9 GEOTEXTILE FILTER SURROUND 12
GWD.W430.9 BED FOR TRENCH DRAINS 12
GWD.W440.9 DEPOSITION AND COMPACTION OF FILL MATERIAL 12

RELIEF DRAINS 12

GWD.W510.9 TRIALS 12

GWD.W520.9 FIXING 12
CAISSON DRAINS 12
GWD.W610.9 CONSTRUCTION 12
GWD.W620.9 DISCHARGE OF WATER 13
GWD.W630.9 RECORDS 13
PREFABRICATED BAND DRAINS 13
GWD.W710.9 INSTALLATION 13
GROUNDWATER CONTROL AND DRAWDOWN 14
GWD.W810.9 DRAWDOWN OF GROUNDWATER TABLE 14
GWD.W820.9 DEWATERING 14
GWD.W830.9 GROUNDWATER RECHARGE 14
GWD.W840.9 MONITORING 14
GWD.W850.9 RECORDS 15
GWD.W860.9 TOLERANCES 15
TESTING 16
GRANULAR FILTER MATERIAL 16
GWD.T010.9 GRANULAR FILTER MATERIAL 16
FILL MATERIAL FOR TRENCH DRAINS 16
GWD.T110.9 FILL MATERIAL FOR TRENCH DRAINS 16

GWD GROUND WATER DRAINAGE AND CONTROL

MATERIALS

GENERAL

GWD.M010.9 DEFINITIONS

In this Specification:

1. "Caisson drain" is an excavated vertical shaft, with or without raking drains, to provide drainage by intercepting and lowering the groundwater level in the vicinity;
2. "Geotextile filter" is a permeable sheet of synthetic material used like a granular filter for filtration and in-plane drainage;
3. "Filter pipe" is a perforated or non-perforated pipe used for draining groundwater;
4. "Granular filter" is a graded sand or gravel placed against a soil to prevent the migration of fine particles out of the soil caused by water flow, and graded such that free discharge of water flowing into the filter is allowed. Sand shall be natural sand or crushed natural stone;
5. "Prefabricated band drain" is a synthetic drain which, when installed in a soil strata, acts as a drainage medium for dissipation of pore water pressure;
6. "Raking drain" is a drillhole, with or without perforated filter pipes and geotextile filter sheath, installed generally at an upward inclination for groundwater lowering by gravity flow;
7. "Relief drain" is a synthetic drain installed on slope surfaces or in excavations to divert water seepage before applying sprayed concrete, masonry dentition or other construction;
8. "Trench drain" is a trench wholly or partly filled with granular material or clean crushed rock, with or without filter pipes and geotextile filter.

SUBMISSIONS

GWD.M110.9 PARTICULARS OF GRANULAR FILTERS

Submit to the CM for approval the following particulars of the proposed materials and methods of construction for granular filters at least 14 days before deposition of granular filter material starts:

1. Whether granular filter material is to be supplied ready mixed or is to be mixed on the Site;
2. Source of supply, including name of supplier of ready mixed material;
3. Quantity of each constituent if the material is to be mixed on the Site;
4. Construction plant and methods of mixing for material mixed on the Site;
5. Method of storage and location of storage areas on the Site;
6. Methods of deposition and compaction of material;

7. Test report(s) for the granular filters showing compliance of the materials with the requirements of this Specification or as shown on the Drawings;
8. Results of three tests for particle size distribution of the fill material against which the granular filter is to be placed;
9. Details of filter design including calculations and grading envelopes.

GWD.M120.9 PARTICULARS OF GEOTEXTILE FILTER

1. Submit to the CM for approval the following particulars, including certificates, of the proposed materials and methods of construction of geotextile filter at least 28 days before the first delivery of the geotextile filter to the Site:
   a. Manufacturer's name and source of supply;
   b. Details of geotextile filter including manufacturer's literature;
   c. A certificate for the geotextile filter showing the manufacturer's name, the date and place of manufacture and showing that the geotextile filter complies with the requirements, including results of tests, stated in this Specification or shown on the Drawings;
   d. Calculations showing that the geotextile filter complies with the filtration characteristics stated in this Specification or shown on the Drawings;
   e. Details of previous uses of the geotextile filter;
   f. Details of quantities to be supplied in each delivery;
   g. Method of storage;
   h. Methods of cutting and jointing geotextile filter;
   i. Method of repairing small batches; and
   j. Methods of laying and holding in position.
2. Submit certificates for each batch of geotextile filter delivered to the Site.

GWD.M130.9 PARTICULARS OF TRENCH DRAINS

Submit to the CM for approval the following particulars of the proposed materials and methods of construction for trench drains at least 14 days before installation of trench drains starts:

1. Source of supply, including name of supplier of the fill material for trench drains;
2. Test report(s) for the fill material for trench drains showing compliance of the materials with the requirements of this Specification or as shown on the Drawings;
3. Method of excavation of trench and installation of geotextile filter;
4. Details of granular fill material as stated in GWD.M360;
5. Details of geotextile filter as stated in GWD.M120.

GWD.M140.9 PARTICULARS OF RAKING DRAINS

Submit to the CM for approval the following particulars of the proposed materials and methods of construction for raking drains at least 14 days before installation of raking drains starts:

1. Certificate(s) from the manufacturer and the associated test report(s) for the raking drains showing compliance of the materials with the requirements of this Specification or as shown on the Drawings;
2. Method of connecting adjacent sections of pipes;

3. Proportions of sealant mix;
4. Details of geotextile filter sheath.

GWD.M150.9 PARTICULARS OF RELIEF DRAINS

Submit to the CM for approval the following particulars of the proposed materials and methods of construction for relief drains at least 14 days before fixing of relief drains starts:

1. Details of relief drains and outlets; and
2. Method of fixing relief drains to the slope face.

GWD.M160.9 PARTICULARS OF CAISSON DRAINS

Submit to the CM for approval the following particulars of the proposed materials and methods of construction for caisson drains at least 14 days before construction of caisson drains starts:

1. Methods of excavation and installation and removal of caisson liners;
2. Method of compaction of fill material;
3. Details of granular filter material as stated in GWD.M110; and
4. Details of geotextile filter as stated in GWD.M120.

GWD.M170.9 PARTICULARS OF PREFABRICATED BAND DRAINS

Submit to the CM for approval the following particulars of the proposed materials and methods of construction for prefabricated band drains at least 28 days before installation of prefabricated band drains starts:

1. Details of type of drain, including manufacturer's literature;
2. A certificate showing the manufacturer's name, the date and place of manufacture and showing that the drains comply with the requirements stated in this Specification or shown on the Drawings;
3. Details of previous installations by the Contractor using similar drains;
4. Method of installation; and
5. Details of installation mandrel, drain anchor, method of penetration and method of recording depth of installation.

GWD.M180.9 PARTICULARS OF FILTER PIPES

Submit to the CM for approval the following particulars of the proposed materials and methods of construction for filter pipes at least 28 days before installation of the filter pipes starts:

1. Details of type of pipes, including manufacturer's literature;
2. A certificate showing the manufacturer's name, the date and place of manufacture and showing that the pipes comply with the requirements stated in this Specification or shown on the Drawings;
3. Details of previous installations by the Contractor using similar pipes; and
4. Method of installation.

GWD.M190.9 PARTICULARS OF GROUNDWATER CONTROL, DRAWDOWN AND MONITORING

Submit to the CM for information the following particulars of the proposed materials and methods of construction for groundwater control, drawdown and monitoring at least 14 days before the relevant work starts:

1. Constructional plant and materials for dewatering;
2. Timing and sequence of dewatering operations;
3. Details of silt traps;
4. Methods of monitoring flow rates and volumes of silt, including monitoring intervals; and
5. Methods and locations for discharging groundwater.

GWD.M200.9 SAMPLES OF MATERIALS

Submit samples of the following proposed materials to the CM for approval of the source and type of each material at the same time as particulars of the material are submitted:

1. Granular filter material;
2. Geotextile filter and two pieces of geotextile filter joined in accordance with the manufacturer's recommendations for each type of joint;
3. Relief drains;
4. Filter pipes;
5. Raking drains;
6. Prefabricated band drains.

FILTER AND DRAINAGE MATERIALS

GWD.M310.9 GRANULAR FILTER MATERIAL

Granular filter material for granular filter, trench drains and caisson drains shall consist of durable, inert, natural material free from clay, organic material and other impurities. Granular filter material shall have the particle size distribution stated in this Specification or shown on the Drawings.

GWD.M320.9 GEOTEXTILE FILTER

Geotextile filter shall be an Approved proprietary type and shall have the properties stated in this Specification or as shown on the Drawings.

GWD.M330.9 FILTER PIPES

1. Filter pipes shall comply with the following:
    a. Precast concrete pipes to BS 5911-1:2002+A2:2010 and BS EN 1916:2002;
    b. Vitrified clay pipes to BS EN 295:2013;
    c. DI pipes to BS EN 545:2006;
    d. Steel pipes to BS EN 10224:2002;
    e. Porous concrete pipes to BS 5911-114:1992;
    f. Perforated concrete pipes to BS 5911-1:2002+A2:2010 and BS EN 1916:2002;

g. Pitch fibre pipes to BS 2760:1973;

h. uPVC pipes to BS EN 1401-1:2009 (Fittings also refer to BS 4660:2000 and BS EN 13598-1:2010) or BS 3506:1969;

i. Corrugated polyethylene tubing to AASHTO M252-18.

2. Class O uPVC pipes shall not be used;

3. The perforations in perforated pipes shall be cleanly cut and shall be uniformly spaced along the length and circumference of the pipe;

4. uPVC plastic pipes shall be jointed by couplers.

GWD.M340.9 RAKING DRAINS

1. Type 0 raking drains shall be unlined raking drains. Drain holes shall be at least 40 mm diameter;

2. Type 1 raking drains shall be single pipe raking drains consisting of a single perforated pipe with a non-perforated invert;

3. Type 2 raking drains shall be single pipe raking drains consisting of a single perforated pipe with a non-perforated invert and enclosed within a geotextile filter sheath;

4. Type 3 raking drains shall be double pipe raking drains consisting of an outer permanent pipe and an inner removable pipe enclosed within a geotextile filter sheath. The outer and inner pipes shall be perforated pipes with a non-perforated invert;

5. Pipes for raking drains shall be perforated pipes with non-perforated invert as Approved. The portion of openings in the perforated pipe shall cover between approximately 50 % and 70 % of the circumference of the pipe. The percentage of opening areas to overall surface area of the pipe shall neither be less than 14 % for 40 mm diameter pipe nor less than 8 % for 65 mm or above diameter pipe. The pipe material shall have the following physical properties or having equivalent functions:

   a. Material: non-metallic;

   b. Minimum tensile strength: 21,300 kN/m²;

   c. Minimum compressive strength: 22,000 kN/m²;

   d. Minimum flexural strength: 6,800 kN/m².

6. Couplers for filter pipes shall also have non-perforated invert and shall be of similar strength and durability of the pipe materials. The lapped length of coupler and each end of the filter pipes shall be at least 100 mm. The elongation at the pipe connection shall be less than 5 mm under a 45 kg pulling force;

7. Geotextile filter sheaths for raking drains shall be formed of non-woven geotextile filter robust enough to prevent tearing and shall have the following physical properties or materials having equivalent functions or performance as Approved:

   a. Material: non-metallic;

   b. Minimum tensile strength: 17 kN/m;

   c. Apparent opening size: 140 μm;

   d. Coefficient of permeability under 2 kN/m²: 5 x 10-3 m/s;

   e. Flow rate at 100 mm head under 2 kN/m²: 195 L/m²s.

8. Tying wires for jointing pipes and stitching filter sheath shall be non-metallic wires of minimum breaking load 400 N or equivalent as Approved.

GWD.M345.9 RELIEF DRAINS

Relief drains shall be drain mats with multi-layer porous fabric wrapped in filter fabric and covered with an impermeable fabric or products having equivalent function or performance as Approved. PVC flanges for connecting relief drains to outlet pipes shall be directed by the CM.

GWD.M350.9 PREFABRICATED BAND DRAINS

1. Prefabricated band drains shall consist of a core and a filter. The drains may be manufactured as a single unit or the filter may be wrapped around the core, and overlapped and sealed to contain the core. The drains shall be made from chemically treated paper, polyethylene, polyester, polyolefine or other synthetic material or combination of such materials;
2. Prefabricated band drains shall be provided with an outer casing or mandrel of rhomboidal or rectangular cross section for use during installation. The drains shall also be provided with an anchor to ensure embedment of the drain during extraction of the mandrel;
3. The strength of the materials in prefabricated band drains shall be such that the drains will withstand all forces resulting from handling and installation;
4. The filter jacket for prefabricated band drains shall be a type which:
    a. Has been previously proved effective under similar soil and pressure conditions;
    b. Is in all cases able to prevent excessive migration of soil particles into the core; and
    c. Has a permeability not less than that of the surrounding soil.
5. Prefabricated band drains shall be able to conform to soil deformation without buckling or crimping of the core.

GWD.M360.9 FILL MATERIAL FOR TRENCH DRAINS

1. Fill material to be used with geotextile filter in trench drains shall be clean crushed rock. Type A and Type B fill material shall have the particle size distributions stated in the following table:

Particle size distribution of fill material for trench drains							
Type of fill material	Percentage by mass passing BS test sieve						
	63 mm	37.5 mm	20 mm	10 mm	3.35 mm	600 μm	63 μm
Type A	-	100	-	45-100	25-80	8-25	0-5
Type B	100	85-100	0-20	0-5	-	-	-

2. Fill material passing a 425 μm BS test sieve shall be non-plastic;
3. The D15 particle size of Type A fill material for use with perforated pipes shall be at least 15 % larger than twice the maximum dimension of the perforations, where D15 is the equivalent sieve size in millimetres, interpolated from the particle size distribution curve, through which 15 % of the fill material would pass.

GWD.M370.9 CAISSON LINERS

Caisson liners shall be concrete tapered rings at least 100 mm thick and not exceeding 1 m deep. The liners shall be constructed with well-compacted concrete of Grade 20/20 or greater.

WORKMANSHIP

DELIVERY, HANDLING AND STORAGE

GWD.W010.9 GRANULAR FILTER MATERIAL

1. Granular filter material shall not be handled or stored in a manner which will result in mixing of the different types and sizes or in segregation, contamination, deterioration or erosion of the material;
2. Place stockpiles of granular filter material on well-drained, prepared areas and shall be separated by dividing walls of sufficient height to keep the different materials separate.

GWD.W020.9 GEOTEXTILE FILTER

1. Deliver geotextile filter in secure wrappings to ensure that the geotextile filter is dry and protected from damage, contamination and exposure to conditions that may adversely affect it;
2. Store geotextile filter on a level surface and shall be kept in a secure and dry condition, which will not result in damage to the fabric or in contamination of the fabric.

GWD.W030.9 FILTER PIPES

Store coils of plastic tubing for filter pipes flat.

GWD.W040.9 PREFABRICATED BAND DRAINS

1. Prefabricated band drains shall be supplied in rolls, securely packed in lightproof wrappings;
2. Store prefabricated band drains in a clean, dry environment.

GRANULAR FILTERS

GWD.W110.9 MIXING

Mix granular filter material thoroughly by the method approved by the CM. Material that has been stockpiled shall be remixed before deposition.

GWD.W120.9 DEPOSITION AND COMPACTION

1. Deposit and compact granular filter material as stated in Worksection EAR1;
2. Deposit granular filter material in a manner which will not result in segregation or contamination of the material;
3. Deposit granular filter material in such a manner that a continuous free draining zone is formed. Clean and scarify the surface of each layer before the next layer is deposited unless otherwise permitted by the CM.

GEOTEXTILE FILTER

GWD.W210.9 EXPOSURE AND DAMAGE REPAIR

1. The total period for which geotextile filter is exposed to daylight or other sources of ultra-violet radiation during handling, delivery, storage and installation shall not exceed 7 days;
2. Do not use geotextile filter that has been damaged or exposed to daylight or other sources of ultra-violet radiation for longer than the period stated in sub-clause (1) above in the permanent work unless permitted by the CM;
3. Repair geotextile filter that has been torn or damaged during installation by using a patch of the same material extending at least 300 mm beyond the edge of the damaged area. Do not carry out repairs on geotextile filter that has been damaged during storage prior to installation.

GWD.W220.9 LAYING

1. Install geotextile filter in such a manner that the individual yarns, webs or layers of the fabric retain their intended orientation and relative positions with respect to each another;
2. Install, cut and joint geotextile in accordance with the manufacturer's recommendations;
3. Laps in sheets of fabric reinforcement, which are not stated in the Drawings to be jointed, shall be at least 300 mm.

GWD.W230.9 PROTECTION

Do not operate construction plant and other vehicles on installed geotextile filter unless in the opinion of the CM that the installed geotextile filter is adequately protected by a cover of fill material or other means agreed by the CM.

GWD.W240.9 RECORDS

Keep records of installation of geotextile filter on the Site and submit a copy of the records to the CM each day. Records shall contain the following details:

1. Identification of structures and sections of work where geotextile filter is installed;
2. Type of geotextile filter, including identification of batch;
3. Date of first exposure of geotextile filter to ultra-violet radiation before installation;
4. Type of joint, amount of overlap, method of holding in place and any repairs to geotextile filter carried out during installation;
5. Date of installation of geotextile filter; and
6. Date of final covering of geotextile filter.

RAKING DRAINS

GWD.W310.9 INSTALLATION

1. The length of raking drains assembled before installation shall not exceed 12.5 m. Connections between adjacent pipes shall be secured in such a manner that the cumulative longitudinal extension of a 12.5 m assembled length of pipe does not exceed 5 mm when pulled by hand;

2. Pipes for Type 2 and Type 3 raking drains are to be wrapped in geotextile filter sheath in the following manner prior to installation in order to ensure that the overlap and stitching shall be at the non-perforated invert of the pipe:
    a. The pipe shall be placed onto and along the centre of a strip of geotextile filter with the non-perforated invert at top;
    b. The strip of geotextile filter shall be of sufficient width to allow an overlap of at least 50 mm, and shall be drawn around the pipe and stitched together tightly with non-metallic wires;
    c. The stitching shall be tied off onto the pipe and the fabric at every 300 mm to prevent dislocation during installation;
    d. The filter sheath shall be marked to ensure that the non-perforated invert is correctly positioned during installation.
3. During delivery and installation of raking drains, take care to ensure that the pipe and geotextile filter sheath are not damaged. Submit the method of installation of raking drains to the CM for approval prior to installation;
4. Before installation of drain pipes, check the drillholes for cleanliness. Whenever any obstruction is encountered inside a drillhole during pipe insertion, withdraw the pipe and clear the obstruction before re-insertion. No jacking or hammering of pipes shall be carried out during the whole process of pipe insertion.

GWD.W320.9 DRILLING

1. Do not use drilling lubricants other than clean air or fresh water for drilling holes for raking drains. Use casings to prevent collapse of the hole and to permit unobstructed insertion of the pipes and geotextile filter sheath;
2. Position the drillhole entry point within the tolerance specified. Deviation in alignment and from straight shall not exceed the tolerance specified. Maintain a positive gradient throughout the complete length of the hole. Measure the inclination of holes by a method agreed by the CM;
3. Drilling and sampling for undisturbed soil samples and rock cores instructed by the CM to be recovered from drillholes shall be as stated in Worksection GIN;
4. Drillholes shall be temporarily plugged or otherwise protected to prevent entry of deleterious material after drilling.

GWD.W330.9 RECORDS

Keep records of drillholes for raking drains on the Site and submit a drillhole log for each drillhole to the CM before installation of the raking drain starts. The borehole log shall contain the following details:

1. Drain reference number;
2. Location, inclination, bearings, diameter and length of hole;
3. Details of drilling progress;
4. Details of water seepage related to drilling progress; and
5. Details of samples taken.

TRENCH DRAINS

GWD.W410.9 EXCAVATION

The width of trench drains:

1. Shall be at least 450 mm;
2. With filter pipes not exceeding 150 mm diameter shall be at least four times the nominal diameter of the pipe;
3. For pipes exceeding 150 mm diameter shall be at least the same as the external diameter of the pipe plus 450 mm.

GWD.W420.9 GEOTEXTILE FILTER SURROUND

Install geotextile filter surround for trench drains as stated in GWD.W220.

GWD.W430.9 BED FOR TRENCH DRAINS

1. Concrete bed for filter pipes in trench drains shall be at least 75 mm thick and shall be Grade 20/20 concrete;
2. Granular bed for filter pipes for trench drains shall have a thickness at least the same as the diameter of the pipe or 150 mm, whichever is greater.

GWD.W440.9 DEPOSITION AND COMPACTION OF FILL MATERIAL

1. Deposit the material for granular bed for trench drains in the trench in layers not exceeding 150 mm thick and for the complete width of the trench. Compact each layer with six passes of a plate vibrator or by other methods agreed by the CM;
2. Deposit and compact fill materials around filter pipes in trench drains as stated in Worksection EAR1. Obtain the permission of the CM before depositing fill material around filter pipes.

RELIEF DRAINS

GWD.W510.9 TRIALS

Construct a trial length of relief drains of at least 2 m.

GWD.W520.9 FIXING

Fix relief drains in position before surface protection or remedial measures are applied. Carry out the fixing in a manner that will not affect the serviceability of the relief drains or outlets. Discharge water collected in relief drains to outlets agreed by the CM.

CAISSON DRAINS

GWD.W610.9 CONSTRUCTION

1. Carry out excavation for caisson drains by manual methods in stages not exceeding 1.0 m depth unless otherwise permitted by the CM. Dewater excavation below the groundwater level so that work may be carried out, as near as may be practicable in the circumstances, in dry conditions. Carry out the dewatering as stated in GWD.W810 and GWD.W820;
2. Unless otherwise permitted by the CM, support the caisson drain shaft at all times during construction using concrete liners. Fill voids between liners and excavated faces with no fines concrete. Install caisson liners for each 1.0 m stage on the same day as that stage is excavated;
3. Remove softened and loose material from the base of the caisson drain immediately before depositing granular filter material in the caisson drain;

4. Remove part or all of the concrete liner adjacent to the granular filter layer before depositing the granular filter material or fill material. Remove debris arising from the concrete liner from the caisson drain;
5. Deposit granular filter material in layers not exceeding 500 mm and compact the granular filter material by methods approved by the CM.

GWD.W620.9 DISCHARGE OF WATER

Discharge water collected in caisson drains to the outlets stated in this Specification or shown on the Drawings.

GWD.W630.9 RECORDS

1. Keep records of caisson drains on the Site and submit a copy of the records to the CM within 14 days after completion of construction of caisson drains. The records shall contain the following details:
   a. Record of work carried out each day; and
   b. Drawings showing the exact locations of caisson drains and the final depths relative to Principal Datum.
2. Keep detailed face logs of caisson drains on the Site and make available for inspection by the CM at all times. The logs shall contain the following information and the format shall be as shown in Figure 10 of 'GEOGUIDE 2: Guide to Site Investigation', GEO:
   a. Details of depths and rate of groundwater seepage;
   b. Details of water levels, including dates and details of fluctuation; and
   c. Four colour prints and one negative for each of the photographs or composite photographs taken during excavation. Each excavation stage shall be photographed using a reference board with maximum dimensions of 300 mm (width) by 450 mm (length). The photographs shall cover all the excavated faces before the placing of caisson liners. Where more than one photograph is required to cover the full excavated depth or length of a face, the overlap between adjacent photographs shall be between 10 % and 20 %. Each photograph shall identify the face of the excavation and shall contain a natural scale and a colour comparison chart placed alongside the excavated face. The minimum size of colour prints shall be 125 mm x 175 mm.

PREFABRICATED BAND DRAINS

GWD.W710.9 INSTALLATION

1. The installed location of prefabricated band drains shall be within 300 mm of the specified location in plan on the ground surface and the drain shall be within 2 % of the installed length to the vertical;
2. Install each prefabricated band drain in one continuous length without joints;
3. The depth of penetration of prefabricated band drains shall be as stated in this Specification or shown on the Drawings. Modify the depth as instructed by the CM during installation based on the resistance of the soil to penetration. Notify the CM immediately of any sudden change in the penetration resistance to the mandrel.

GROUNDWATER CONTROL AND DRAWDOWN

GWD.W810.9 DRAWDOWN OF GROUNDWATER TABLE

Do not draw down the groundwater table to more than 2 m below the earthwork final surface as defined in Worksection EAR1 for excavation.

GWD.W820.9 DEWATERING

1. Carry out dewatering in such a manner that no loss of fines from the ground occurs;
2. Silt traps shall be provided and shall be regularly maintained. All dewatering pumps shall discharge into silt traps;
3. Do not discharge pumped groundwater onto roads, footpaths, kerb channels or adjacent land. Make all arrangements with and obtain the necessary approvals from the relevant authorities for discharging water to drainage systems, watercourses or the sea. Do not start dewatering until the arrangements for disposal of the water have been approved by relevant authorities and implemented. Water entering the Site shall not be discharged into the same silt traps as are used for dewatering;
4. The total capacity of pumps available on the Site for dewatering shall be at least equal to twice the rate of flow measured through the silt traps at any time when the groundwater table is maintained at maximum drawdown;
5. Half of the total pump capacity shall be equipped with a secondary motive power source in addition to the primary motive power. The secondary motive power source shall commence operation automatically in the event of failure of the primary motive power source or an effective alarm system shall be set up which will warn of failure of the primary motive power source. The maximum allowable delay between failure of the primary motive power source and full operation of the secondary motive power source shall not exceed 15 minutes;
6. A full-time attendant shall be available on the Site at all times to execute the changeover if manual operation of equipment is required to bring the secondary motive power into operation;
7. The operation of the changeover of motive power equipment shall be demonstrated to the satisfaction of the CM before the relevant work starts unless otherwise permitted by the CM.

GWD.W830.9 GROUNDWATER RECHARGE

1. If groundwater recharge is to be carried out to maintain the specified groundwater levels at any location, the groundwater recharge system shall have the means to regulate and measure the rate of recharge and to provide an adequate continuous supply of water for recharge. Only clean water shall be used;
2. The capacity of pumps and the power sources which are to be used for groundwater recharge shall be as stated in GWD.W820 (4) except that the rate of flow shall refer to the maximum rate of groundwater recharge required;
3. The groundwater table at any location shall not be raised above the background groundwater table measured before the relevant work starts.

GWD.W840.9 MONITORING

1. Monitor groundwater levels at locations stated in this Specification or shown on the Drawings or as instructed by the CM at all times when groundwater control and drawdown is carried out. Make arrangements for installing instruments and taking measurements both inside and outside the Site;

2. The survey marks for monitoring shall be located in position and level to the Hong Kong standard survey grid and to Principal Datum to within 10 mm in every direction;
3. Monitoring stations and monitoring shall be as stated in Worksection GIN;
4. Groundwater levels shall be measured to an accuracy of 20 mm. Settlements shall be measured to an accuracy of 3 mm;
5. Notify the CM immediately if any incremental settlement reading exceeds 5 mm or if the accumulated settlement exceeds the maximum allowable settlement stated in this Specification or shown on the Drawings.

GWD.W850.9 RECORDS

Keep records of monitoring of settlement, groundwater control and drawdown on the Site and submit a copy of the records to the CM within 24 hours of taking readings.

GWD.W860.9 TOLERANCES

Refer to Appendix H "Schedule of Tolerances" to this Specification.

TESTING

GRANULAR FILTER MATERIAL

GWD.T010.9 GRANULAR FILTER MATERIAL

1. Testing arrangements:
    a. Carry out tests by employing a laboratory that complies with the requirements stated in the Preliminaries Worksection.
2. Testing samples:
    a. A batch of granular filter material is any quantity of granular filter material of the same type and grading delivered to the Site at any one time;
    b. Provide one sample of granular filter material from each 500 m^3 or part thereof of the material delivered to the Site;
    c. Unless otherwise permitted by the CM, provide one sample of granular filter material from each 500 m^3 or part thereof of granular filter material that has been deposited and compacted;
    d. The size of each sample taken as stated in sub-clause (2)(b) above shall be 10 kg. The method of sampling shall be in accordance with CS3:2013;
    e. Samples taken as stated in sub-clause (2)(c) above, shall consist of material excavated from the compacted layer to form a flat bottomed, steep sided hole of approximately 0.13 m^2 to the complete depth of the compacted layer. A template shall be used to fix the edges of the hole if necessary. The sides and bottom of the hole shall be at least 50 mm from other types of fill material.
3. Testing methods:
    a. Test each sample of granular filter material to determine the particle size distribution in accordance with Test Method 8.2 of Geospec 3: Model Specification for Soil Testing, GEO.
4. Non-compliance:
    a. If the result of any test for particle size distribution on a sample of granular filter material taken as stated in sub-clause (2)(b) does not comply with the specified requirements for particle size distribution, provide additional samples from the same batch and carry out additional tests for particle size distribution;
    b. If the result of any test for particle size distribution on a sample of granular filter material taken as stated in sub-clause (2)(c) does not comply with the specified requirements for particle size distribution, provide additional samples from the same batch and carry out additional tests for particle size distribution;
    c. The batch shall be considered as not complying with the specified requirements for particle size distribution if the result of any additional test as stated in sub-clauses (4)(a) or (4)(b) above for particle size distribution does not comply with the specified requirements for particle size distribution.

FILL MATERIAL FOR TRENCH DRAINS

GWD.T110.9 FILL MATERIAL FOR TRENCH DRAINS

1. Testing arrangements:

a. Carry out tests by employing a laboratory that complies with the requirements stated in the Preliminaries Worksection.

2. Testing samples:

   a. A batch of fill material for trench drains is any quantity of fill material for trench drains of the same type delivered to the Site at any one time;

   b. Unless otherwise permitted by the CM, provide one sample of fill material for trench drains from each batch of fill material for trench drains delivered to the Site;

   c. The size of each sample taken as stated in sub-clause (2)(b) above shall be 10 kg. The method of sampling shall be in accordance with CS3:2013.

3. Testing methods:

   a. Test each sample of fill material for trench drains to determine the particle size distribution in accordance with Test Method 8.2 of Geospec 3: Model Specification for Soil Testing, GEO;

   b. Test fill material passing a 425 μm BS test sieve to determine the plasticity index in accordance with Test Method 6.1 of Geospec 3: Model Specification for Soil Testing, GEO.

SLO SLOPE TREATMENT WORKS

SLO SLOPE TREATMENT WORKS 5

MATERIALS 5

GENERAL INFILLING, BEDDING AND SURFACING MATERIALS ETC 5

SLO.M010.9 CEMENT MORTAR 5
SLO.M020.9 ROCK FOR MASONRY INFILLING 5
SLO.M030.9 SOIL-CEMENT 5
SLO.M040.9 GROUT FOR GEOTECHNICAL WORKS 5
SLO.M070.9 WEEPHOLES 5

SPRAYED CONCRETE MATERIALS 6

SLO.M110.9 CONCRETE 6
SLO.M120.9 AGGREGATE 6
SLO.M130.9 REINFORCEMENT 6
SLO.M140.9 COLOURING 6

PROTECTIVE SCREEN FOR SLOPE WORKS 6

SLO.M210.9 PROTECTIVE MESH AND FIXINGS 6

ROCK BOLTS AND GROUT 7

SLO.M310.9 ROCK BOLTS 7
SLO.M320.9 GROUT FOR ROCK BOLTS 7

ROCK DOWELS 7

SLO.M410.9 ROCK DOWELS 7
SLO.M420.9 GROUT FOR ROCK DOWELS 7

SOIL NAILS 8

SLO.M510.9 GENERAL 8
SLO.M520.9 SOIL NAILS 8
SLO.M525.A SOIL NAILS WITH DOUBLE-CORROSION PROTECTION 9
SLO.M526.9 GROUT FOR SOIL NAILS 10
SLO.M527.9 SOIL-NAIL HEAD 10
SLO.M540.9 NON-BIODEGRADABLE MATS FOR EROSION CONTROL 10
SLO.M550.9 BIODEGRADABLE MATS FOR EROSION CONTROL 10
SLO.M560.9 WIRE MESH FOR EROSION CONTROL 10

BUTTRESSES 11

SLO.M610.9 CONCRETE 11
SLO.M620.9 REINFORCEMENT 11
SLO.M630.9 DRAINS 11

ROCK JOINT RELIEF DRAINS 11

SLO.M710.9 DRAINS 11

BOULDER BARRIER MATERIAL 11

SLO.M810.9 GABION 11
SLO.M815.9 FABRICATED SOIL 11

SUBMISSIONS 12

SLO.M910.9 PARTICULARS OF ACCESS 12
SLO.M920.9 PARTICULARS OF SPRAYED CONCRETE 12
SLO.M930.9 PARTICULARS OF ROCK BOLTS 12
SLO.M950.9 PARTICULARS OF SOIL NAILS 13
SLO.M955.9 PARTICULARS OF MATS FOR EROSION CONTROL 14
SLO.M957.9 PARTICULARS OF WIRE MESH FOR EROSION CONTROL 14
SLO.M960.9 DETAILS OF ROCK ANCHORS 14
SLO.M970.9 PARTICULARS OF GABIONS 15
SLO.M980.9 METHOD STATEMENT FOR REMOVAL OF UNSTABLE BOULDERS 15

WORKMANSHIP **16**

GENERAL REQUIREMENTS AND PRELIMINARY WORK **16**

SLO.W010.9 SCOPE OF WORK 16
SLO.W020.9 ACCESS TO SLOPES 16
SLO.W030.9 PROTECTION FENCES AND BARRIERS 17
SLO.W040.9 PREPARATION FOR SLOPE TREATMENT WORKS 17

BOULDER STABILISATION, REMOVAL AND CONSTRUCTION OF BOULDER BARRIERS **17**

SLO.W110.9 GENERAL 17
SLO.W120.9 REMOVAL OF BOULDERS 18
SLO.W130.9 CONSTRUCTION OF BOULDER BARRIERS 18

ROCK SLOPE TREATMENT WORKS **19**

SLO.W210.9 SCALING AND TRIMMING OF ROCK SLOPES 19
SLO.W220.9 ROCK SPLITTING 19
SLO.W230.9 SEALING AND INFILLING OF ROCK JOINTS 19
SLO.W240.9 CONCRETE BUTTRESSES 19
SLO.W250.9 CONSTRUCTION OF REINFORCED CONCRETE PADS 20
SLO.W260.9 DRAINAGE HOLES IN BUTTRESSES AND PADS 20

SOIL-CEMENT FILL **20**

SLO.W310.9 MIXING SOIL-CEMENT 20
SLO.W320.A DEPOSITION AND COMPACTION OF SOIL-CEMENT FILL 20

SPRAYED CONCRETE **21**

SLO.W410.9 RECORD 21
SLO.W420.9 MIX DESIGN AND PROCESS 21
SLO.W430.9 TRIAL PANEL 21
SLO.W440.9 PREPARATION OF SLOPE SURFACES 21
SLO.W450.9 FIXING REINFORCEMENT 21
SLO.W455.9 WEEPHOLES, STUD DRAINS AND JOINTS IN SPRAYED CONCRETE 22
SLO.W460.9 EQUIPMENT FOR SPRAYING CONCRETE 22
SLO.W470.9 SPRAYING CONCRETE 22
SLO.W490.9 CURING SPRAYED CONCRETE 23
SLO.W500.9 INSPECTION OF SPRAYED CONCRETE 23
SLO.W510.9 RECORDS OF SPRAYED CONCRETE 23

PROTECTIVE MESH FOR SLOPES **23**

SLO.W750.9 FIXING PROTECTIVE MESH 23

INSTALLATION OF ROCK BOLTS **24**

SLO.W810.9 GENERAL 24
SLO.W820.9 STORAGE AND PROTECTION OF ROCK BOLTS 24
SLO.W830.9 DRILLING AND PREPARING ROCK BOLT HOLES 24
SLO.W840.9 FIXING ROCK BOLTS 24
SLO.W850.9 GROUTING ROCK BOLTS 25
SLO.W860.9 PROVING ROCK BOLTS 25
SLO.W870.9 RECORDS OF ROCK BOLTS 25

INSTALLATION OF ROCK DOWELS **26**

SLO.W910.9 GENERAL 26
SLO.W920.9 STORAGE AND PROTECTION OF DOWELS 26
SLO.W930.9 DRILLING AND PREPARATION OF ROCK DOWEL HOLES 26
SLO.W940.9 FIXING ROCK DOWELS 27
SLO.W950.9 GROUTING ROCK DOWELS 27
SLO.W960.9 RECORDS OF ROCK DOWELS 27

INSTALLATION OF ROCK ANCHORS **27**
SLO.W1010.9 DESIGN, INSTALLATION AND TESTING 27

INSTALLATION OF SOIL NAILS **27**
SLO.W1110.9 GENERAL 27
SLO.W1112.9 HANDLING OF SOIL NAIL BARS 28
SLO.W1114.9 STORAGE OF SOIL NAIL BARS 28
SLO.W1116.9 CUTTING SOIL NAIL BARS 28
SLO.W1118.9 SURFACE CONDITION OF SOIL NAIL BARS 28
SLO.W1119.9 REPAIRS TO GALVANIZED COATING 29
SLO.W1120.9 DRILLING FOR SOIL NAILS 29
SLO.W1130.9 INSTALLATION AND GROUTING FOR SOIL NAILS 30
SLO.W1140.9 SOIL-NAIL HEAD 31

MATS FOR SLOPE EROSION CONTROL **32**
SLO.W1150.9 PREPARATION OF SURFACES 32
SLO.W1160.9 LAYING AND FIXING OF MATS FOR EROSION CONTROL 32

INSTALLATION OF ROCK JOINT RELIEF DRAINS **33**
SLO.W1210.9 GENERAL 33
SLO.W1220.9 WEEPHOLES FOR ROCK JOINT RELIEF DRAINS 33
SLO.W1230.9 FIXING ROCK JOINT RELIEF DRAINS 33

APPLICATION OF NO-FINES CONCRETE **33**
SLO.W1310.9 USE AND APPLICATION 33

GROUT STRENGTHENING OF JOINTED ROCK **33**
SLO.W1410.9 TECHNIQUE AND APPLICATION 33

TREATMENT OF DECOMPOSED ZONES **35**
SLO.W1510.9 TECHNIQUE AND APPLICATION 35

REINSTATEMENT OF ROCK BERMS **36**
SLO.W1610.9 MAKING GOOD 36

EXTENSOMETERS **36**
SLO.W1710.9 PROVISION, INSTALLATION, TESTING AND RECORDING 36

TELL-TALES AND REFERENCE POINTS **36**
SLO.W1810.9 PROVISION AND INSTALLATION 36

TOLERANCES **37**
SLO.W1910.9 SOIL NAILING 37

TESTING **38**

TESTING FOR THE OPTIMUM MOISTURE CONTENT AND MAXIMUM DRY DENSITY OF SOIL-CEMENT FILL **38**
SLO.T010.9 OPTIMUM MOISTURE CONTENT AND MAXIMUM DRY DENSITY OF SOIL-CEMENT FILL 38

TESTING CONCRETE CORES FROM SPRAYED CONCRETE **38**
SLO.T110.9 TESTING CONCRETE CORES FROM SPRAYED CONCRETE 38

TESTING ROCK BOLTS **39**
SLO.T210.9 TRIALS FOR ROCK BOLTS 39
SLO.T220.9 PACKER TESTS ON DRILLHOLES FOR ROCK BOLTS 39
SLO.T230.9 TESTS ON INSTALLED ROCK BOLTS 39

TESTING SOIL NAILS **40**
SLO.T310.9 GENERAL 40
SLO.T315.9 MEASURING APPARATUS FOR PULL-OUT TEST 40
SLO.T320.9 PULL-OUT TEST FOR SOIL NAILS 40
SLO.T325.9 CREEP TEST 41
SLO.T360.9 TIME DOMAIN REFLECTOMETRY (TDR) TEST 41
SLO.T370.9 MAGNETOMETRY TEST 42

SLO.T380.9	BATCH OF SOIL NAIL BARS AND CONNECTORS	42
SLO.T390.9	SAMPLE OF SOIL NAIL BARS AND CONNECTORS	43
SLO.T400.9	TESTS FOR SOIL NAIL BARS AND CONNECTORS	43
SLO.T410.9	COMPLIANCE CRITERIA FOR SOIL NAIL BARS	44
SLO.T420.9	COMPLIANCE CRITERIA FOR CONNECTORS	44
SLO.T430.9	NON-COMPLIANCE OF SOIL NAIL BARS	44
SLO.T440.9	NON-COMPLIANCE OF GALVANIZED COATING	44
SLO.T450.9	NON-COMPLIANCE OF CONNECTORS	44

SLO SLOPE TREATMENT WORKS

MATERIALS

GENERAL INFILLING, BEDDING AND SURFACING MATERIALS ETC

SLO.M010.9 CEMENT MORTAR

1. Cement mortar for in-filling joints in rock faces, for bedding rock for masonry infilling and for surfacing slopes shall consist of Portland cement (PC) and sand in the proportions 1:3 by mass;
2. PC shall comply with BS EN197:2000;
3. Sand shall be natural sand or crushed natural stone complying with BS 1200:1976.

SLO.M020.9 ROCK FOR MASONRY INFILLING

Rock for masonry infilling shall not exceed 300 mm in size and shall be obtained from an Approved source.

SLO.M030.9 SOIL-CEMENT

1. Soil-cement shall consist of PC, sand and inorganic soil in the proportions 1:3:12 by mass unless otherwise stated. The mix proportion of soil-cement is 1:3:40 by mass when it is applied to the top layer (maximum 300 mm thick) or other areas as directed or agreed by the CM;
2. PC shall comply with BS EN197:2000;
3. Sand shall be natural sand or crushed natural stone complying with BS 1200:1976;
4. Inorganic soil shall be free from organic matter and shall contain not more than 30% of soil particles passing a 63 μm BS test sieve;
5. Submit to the CM for approval of the proposed soil-cement the following particulars at least 14 days before the first delivery of the material to the Site:
    a. Source of supply and type of the inorganic soil for the soil-cement;
    b. Test report(s) for the inorganic soil showing compliance of the materials with the requirements of this Specification or as shown on the Drawings.

SLO.M040.9 GROUT FOR GEOTECHNICAL WORKS

As Worksection GRO.

SLO.M070.9 WEEPHOLES

1. Unless otherwise as shown on the Drawings, weepholes shall be 50 mm nominal diameter uPVC pipes;
2. Submit samples of the proposed weepholes to the CM for approval at least 14 days prior to installation.

SPRAYED CONCRETE MATERIALS

SLO.M110.9 CONCRETE

As Worksection CON1.

SLO.M120.9 AGGREGATE

The nominal maximum aggregate size of aggregates for sprayed concrete shall not exceed 10 mm.

SLO.M130.9 REINFORCEMENT

Unless otherwise Approved, fabric reinforcement including A393 and A252 for sprayed concrete shall comply with Worksection CON3 except that the 50 mm x 50 mm x 2.7 mm (wire diameter) hot dip galvanized steel welded mesh shall have tensile strength not less than 275 N/mm².

SLO.M140.9 COLOURING

The pigment shall comply with ASTM C979/C979M and shall have the characterization of light fast, lime proof, weather resistance and durable like concrete. The pigment shall also comply with the requirements stipulated in FIN1.M820.

PROTECTIVE SCREEN FOR SLOPE WORKS

SLO.M210.9 PROTECTIVE MESH AND FIXINGS

1. Protective mesh for slopes shall be PVC coated galvanized steel wire woven into a double twisted hexagonal mesh. Each hexagon shall be 80 mm x 60 mm. The steel wire shall be at least 2.2 mm diameter and the PVC coating shall be at least 0.4 mm thick. PVC coating on steel wire shall comply with BS 1722-16:2009 or equivalent. The colour of PVC coating is to be approved by the CM. Wire for protective mesh shall comply with BS 1052:1980 (1999). Galvanized coating on wires shall comply with BS EN 10244-2:2006. The tolerance on the opening of mesh shall comply with BS EN 10223-3:2013;
2. Tying wire for protective mesh shall be 2.2 mm diameter PVC coated galvanized soft annealed steel wire;
3. Bolts for fastening protective mesh to rock or structure shall be galvanized mild steel hooks as shown on the Drawings;
4. Stainless steel anchor bolts and accessories for fastening protective mesh to soil nail heads shall be as shown on the Drawings;
5. Hooks, fixing pins, steel plates and washers for fixing the protective mesh to slope face shall be as shown on the Drawings and shall be galvanized to BS EN ISO 1461:2009;
6. Galvanizing shall comply with BS EN ISO 1461:2009;
7. Submit to the CM for approval of the proposed protective mesh and fixings the following particulars at least 14 days prior to installation:
    a. Samples of the proposed protective mesh and its fixings;
    b. Certificate(s) from the manufacturer and the associated test report(s) showing compliance of the materials with the requirements of this Specification or as shown on the Drawings.

ROCK BOLTS AND GROUT

SLO.M310.9 ROCK BOLTS

1. Rock bolts shall be an Approved proprietary type. Rock bolt shall comply with CS2:2012 and shall be mild steel or high yield deformed steel as shown on the Drawings. The rock bolt reinforcement shall also comply with Worksection CON3;
2. The rated working load of rock bolts shall not exceed 50 % of the ultimate tensile strength. A reduction of 4 mm in the diameter of the bolt shall be taken into account for corrosion when calculating the ultimate tensile strength;
3. Nuts for rock bolts shall be of grade 4 steel and comply with BS 4190:2001. Connectors shall comply with Worksection STW. Bearing plates shall be of grade S275JR steel plate and comply with BS EN 10025-2:2004. Holes in steel plates for rock bolt heads shall be drilled perpendicular to the face of the steel plate and the centre of the hole shall be at a position of within 2 mm from the centroid of the plate. The clearance between the steel bar and the hole of the steel plate shall not be more than 2 mm. All nuts, connectors and bearing plates shall be galvanized to BS EN ISO 1461:2009. Rock bolts shall have non-corrodible centralizers capable of ensuring an even annulus of grout as Approved. Grease shall comply with Table 1 of Geospec 1: Model Specification for Prestressed Ground Anchors, GEO;
4. Rock bolts shall be galvanized in accordance with BS EN ISO 1461:2009.

SLO.M320.9 GROUT FOR ROCK BOLTS

Grout for rock bolts shall be as stated in GRO.M010 to GRO.M110 except that the water cement ratio shall not exceed 0.45. The use of admixtures (e.g. PFA) shall be subject to Approval.

ROCK DOWELS

SLO.M410.9 ROCK DOWELS

1. Rock dowels shall consist of untensioned straight or L-shaped deformed high yield steel or mild steel bars complying with CS2:2012 and Worksection CON3 and shall be galvanized to BS EN ISO 1461:2009;
2. Rock dowels shall have non-corrodible centralizers capable of ensuring an even annulus of grout around the steel bar as Approved;
3. Submit to the CM for approval of the proposed rock dowels the following particulars at least 14 days prior to installation:
   a. Samples of the proposed rock dowels;
   b. Certificate(s) from the manufacturer and the associated test report(s) showing compliance of the materials with the requirements of this Specification or as shown on the Drawings.

SLO.M420.9 GROUT FOR ROCK DOWELS

Grout for rock dowels shall be as stated in GRO.M010 to GRO.M110 except that the water cement ratio shall not exceed 0.45. The use of admixtures (e.g. PFA) shall be subject to Approval.

SOIL NAILS

SLO.M510.9 GENERAL

A soil nail shall consist of a steel bar, cement grout, centralizers, head assembly and all other associated components as shown on the Drawings.

SLO.M520.9 SOIL NAILS

1. Soil nail bars shall be of high yield deformed bars and comply with CS2:2012 and Worksection CON3. Dimensions, mass per metre and permissible deviation of soil nail bars shall refer to Clause 1.4 of CS2:2012. Chemical composition of soil nail bars shall refer to Clause 1.5 of CS2:2012 and mechanical properties shall refer to Clause 1.6 of CS2:2012. Definition of relevant terms such as stocklist, manufacturer, etc. in the clauses in relation to soil nails shall be referred to Clause 1.2 of CS2:2012;
2. Nuts shall be of grade 4 steel and comply with BS 4190:2001;
3. Connectors shall comply with Worksection STW and shall be:
    a. A proprietary type approved by the CM;
    b. For tension joints, a cold swaged or threaded type. The connectors shall be capable of developing the full tensile strength of the parent bar and shall comprise high tensile steel studs and seamless steel tubes fitted with protective plastic caps;
    c. For compression joints, a wedge locking or bolted sleeve type.
4. Bearing plates shall be of grade S275JR steel plate and comply with BS EN 10025-2:2004;
5. Permanent casings shall comply with BS 4019-3:1993;
6. All steel components for soil nails shall be galvanized to BS EN ISO 1461:2009. Materials for repair to hot dip galvanized coating shall comply with BS EN ISO 1461:2009;
7. Soil nails shall have non-corrodible centralizers capable of ensuring an even annulus of grout around the soil nail bars. The nominal diameter of the centralizers shall not differ from the specified diameter of the drillhole by more than 10 mm;
8. Conducting wires for length checking shall be solid wires of specified diameter with insulation;
9. Wires and ties for fixing and anchoring packers, centralizers, grout pipes and conducting wires etc. shall be made of non-corrodible materials;
10. For soil nails using threaded type connectors but without galvanized coating on either the threads inside the connectors or the threads at the ends of soil nail bars, heat-shrinkable sleeve of a proprietary type as approved by the CM shall be used as an alternative to galvanization as a corrosion protection measure to the connections. Any rust on the threads of soil nail bars and connectors shall be thoroughly cleaned before being connected together;
11. Unless otherwise specified by the manufacturer and approved by the CM, the heat-shrinkable sleeve for soil nail bars connectors shall be made of a layer of radiation cross-linked polyethylene and a layer of anti-corrosion mastic sealant material. The properties of polyethylene and mastic sealant materials shall comply with the following requirements:

Property	Test Method	Unit	Acceptance
Properties of polyethylene			
Tensile strength at 23ºC (Cross head speed: 50 mm/min.)	BS EN ISO 527-1:2019	MPa	≥ 17
Ultimate elongation at 23ºC (Cross head speed: 50 mm/min.)	BS EN ISO 527-1:2019	%	≥ 350
Impact brittleness	BS ISO 974:2000	ºC	≤ -40
Water absorption at 23ºC, 24 hours	BS EN ISO 62:2008	% increase in weight	≤ 0.1
Properties of mastic sealant material			
Corrosion effect	ASTM D2671-13 (Procedure A)		No corrosion
Peel strength to steel at 23ºC (Cross head speed: 100 mm/min.)	DIN 30672	N/cm	≥ 4
Shear strength at 23ºC (Cross head speed: 50 mm/min.)	BS ISO 4587:2003	N/cm²	≥ 10
Softening point	ASTM E28	ºC	≥ 70

SLO.M525.A SOIL NAILS WITH DOUBLE-CORROSION PROTECTION

Materials for soil nails with double-corrosion protection shall comply with SLO.M520 unless otherwise specified in the following sub-clauses:

1. Corrugated sheathing for the double corrosion protection shall be a proprietary type approved by the CM and shall be made of high density thermoplastic materials which shall be homogeneous, thermally stable, chemically inert and resistant to chemical, bacterial and fungal attack. The wall thickness of the sheathing shall be at least 1.0 mm. Plastic sheathing and all associated components shall comply with the requirements as stipulated in Table 2 of latest edition of 'Model Specification for Prestressed Ground Anchors (Geospec 1)' published by GEO;

2. Finished internal and external surfaces of the sheathing shall be smooth, clean and free from flaws, pin-holes, bubbles, cracks and other defects. Sheathing and all associated components shall be used in accordance with the manufacturer's instructions;

3. Sheathing and other plastic protective components shall:

   a. Not contain any substances that will promote corrosion;

   b. Be covered to prevent exposure to ultra-violet light from direct or indirect sunlight;

   c. Be resistant to slip;

   d. Be capable of withstanding the applied handling stresses, the hydrostatic and grouting pressures.

SLO.M526.9 GROUT FOR SOIL NAILS

Grout for soil nails shall be as stated in GRO.M010 to GRO.M110 except that the water cement ratio shall not exceed 0.45. The use of admixtures (e.g. PFA) shall be subject to Approval.

SLO.M527.9 SOIL-NAIL HEAD

1. Steel reinforcement for soil-nail heads shall be of grade 500 steel and comply with CS2:2012 and Worksection CON3;
2. Concrete for soil-nail heads shall be Grade 30/20 concrete or 30 MPa sprayed concrete and comply with Worksection CON1.

SLO.M540.9 NON-BIODEGRADABLE MATS FOR EROSION CONTROL

1. Non-biodegradable mats for erosion control shall be woven and ultraviolet stabilized mats. The mats shall have the material properties as shown on the Drawings;
2. The mats must be produced by proprietary manufacturers and specifically designed for the erosion control of sloping ground;
3. The colour of the mats shall be black or dark green or other colour as directed or Approved.

SLO.M550.9 BIODEGRADABLE MATS FOR EROSION CONTROL

1. Biodegradable mats for erosion control shall be woven coir mesh mats or woven jute mats. The mats shall have the material properties as shown on the Drawings;
2. The mats must be produced by proprietary manufacturers and specifically designed for the erosion control of sloping ground.

SLO.M560.9 WIRE MESH FOR EROSION CONTROL

1. Wire mesh for erosion control shall comply with SLO.M210 (1);
2. Unless otherwise specified in the Drawings, fix the wire mesh onto the slope surface by means of anchor bolts and/or fixing pins. The fixing pins, steel plates and washers for fixing the wire mesh to slope face shall comply with SLO.M210;
3. Galvanized costing on wires shall comply with BS EN 10244-2:2009. The anchor bolts nuts and washers for fixing the wire mesh to soil nail heads shall be stainless steel complying with Worksection DRA. Submit details of anchor bolts and fixing pins to CM for approval;
4. Anchor bolts and accessories shall have the following properties:
    a. The minimum size of the anchor bolts shall be M8;
    b. The components of the anchor bolts shall include the following:
        i Hexagonal bolt or threaded rod with hexagonal nut;
        ii. Washer with minimum diameter of 20 mm.
    c. The length and diameter of the drillholes and the minimum size and embedment depth of the anchor bolts shall be as shown on the Drawings or otherwise Approved;
    d. The mean ultimate tensile resistance and mean ultimate shear resistance of the anchor bolts shall be 31 kN and 47 kN respectively in non-crack concrete with concrete strength at 30 N/mm².

BUTTRESSES

SLO.M610.9 CONCRETE

Buttresses may be either mass concrete or reinforced concrete as directed by the CM. Concrete for buttresses shall be of Grade 20/20 concrete and shall comply with Worksection CON1 unless otherwise as shown on the Drawings.

SLO.M620.9 REINFORCEMENT

As shown on the Drawings.

SLO.M630.9 DRAINS

Drainage which is required behind buttresses shall consist of relief drains connected to 50 mm diameter uPVC outlet pipes.

ROCK JOINT RELIEF DRAINS

SLO.M710.9 DRAINS

1. The drain must be produced by proprietary manufacturers and specifically designed for use as rock joint relief drain;
2. Submit sample of proposed rock joint relief drains to the CM for approval at least 14 days prior to installation.

BOULDER BARRIER MATERIAL

SLO.M810.9 GABION

The barrier shall consist of mesh gabions or equivalent. The gabion shall be a box-shaped container made of triple-twist hexagonal steel wire mesh strengthened by selvedges of heavier wire and by mesh diaphragms which divide it into 1 m compartments. The steel wire mesh for the gabion shall be 2.7 mm diameter with a plastic coating giving an outer diameter of 3.8 mm. The mesh shall conform to BS EN 10223-3:2013.

SLO.M815.9 FABRICATED SOIL

Fabricated soil shall comply with Worksection EXT12 in respect of the requirements for fabricated soil and consist of a mixture of 3 parts by volume Decomposed Granite and 1 part by volume Soil Conditioner as follows:

1. Decomposed Granite shall consist of evenly textured, granular soil taken from the top 300 mm of land previously supporting vegetation growth. It shall be free from weeds, deleterious matter and stones larger than 50 mm in any dimension;
2. Soil Conditioner shall consist of moist peat; or fully matured animal manure as supplied by Agriculture and Fisheries Department; or equal and approved by the CM. No material shall give off toxic nor obnoxious fumes;
3. Submit information on the source and type of decomposed granite to the CM for approval at least 14 days prior to application.

SUBMISSIONS

SLO.M910.9 PARTICULARS OF ACCESS

Particulars of the proposed means of access for slope treatment works, including access structures and reinstatement, shall be submitted to the CM for approval at least 14 days before the slope treatment works start.

SLO.M920.9 PARTICULARS OF SPRAYED CONCRETE

1. Submit to the CM for approval the following particulars of the proposed materials and methods of construction of sprayed concrete at least 14 days before sprayed concrete is used:
    a. Type and performance of mixing and spraying plant;
    b. Details of water sprays and associated pumps for surface spraying;
    c. Method of curing;
    d. Details of trial panels and test panels;
    e. Methods of measuring surface temperature and moisture content of the soil;
    f. Methods of achieving the specified thickness of sprayed concrete and the specified cover to reinforcement and methods of measuring the thickness and cover after spraying;
    g. Method of fixing reinforcement;
    h. Details of materials and mix design;
    i. Details of dry mix process and/or wet mix process for applying sprayed concrete;
    j. Name and details of the experience of the shotcretors;
    k. Details of working platform;
    l. Method of forming expansion joints; and
    m. Sequence of spraying on slope surfaces.
2. Keep records of sprayed concrete operations on the Site and submit to the CM daily. The records shall contain details of the quantities of all materials used at each location.

SLO.M930.9 PARTICULARS OF ROCK BOLTS

1. Submit to CM for approval on the source and type of rock bolts and a sample of a complete rock bolt at the same time when particulars of rock bolts are submitted;
2. Submit to the CM for approval the following particulars of materials and methods of construction for rock bolts at least 28 days before pull-out trials start and before any rock bolts are installed in the permanent works:
    a. Details of rock bolts, nuts, washers, bearing plates, connectors, sleeves, grease and centralizers;
    b. Methods of tensioning and grouting;
    c. Proposed working loads;
    d. Previous performance records;
    e. Details of equipment for testing rock bolts, including test and calibration certificates;

f. Details of working platform and drilling equipment, including method of drilling and size of drillholes;

g. Details of equipment for Packer tests in drillholes including test and calibration certificates;

h. Grout mix details and grouting equipment.

3. All equipment for testing rock bolts shall be tested and calibrated by laboratories approved by the CM not more than 6 months prior to the date of carrying out the tests.

SLO.M950.9 PARTICULARS OF SOIL NAILS

1. Submit to the CM for approval the following particulars of materials and methods of construction for soil nails at least 28 days before pull out tests commence and before any soil nails are installed in the permanent works:

   a. For soil nail bars, a certificate from the quality assured stocklist and a copy of the manufacturer's certificate/document of the original steel bars in accordance with Clause 4.1 of CS2:2012;

   b. Details of the proposed materials and methods of installation for soil nail bars connectors, including manufacturer's literature;

   c. Details of and assembled component samples comprising of soil nails bars, coupling sleeves, nuts, washers, plates, connectors, centralizers, grout pipes, conducting wires, corrugated sheathing, packers for isolating the bond length and plugs capable of sealing the drillholes and withstanding the pressure head maintained on the grout during grouting;

   d. Details of galvanizer, including name and location of the coating factory, to be employed for galvanizing the steel components and method of making good any damaged galvanized coating. Original certificate from the manufacturer showing the date and place of application of the coating and showing that the galvanized coatings comply with the requirements stated in the Drawings and including results of tests carried out by methods as recommended in BS EN ISO 1461:2009 for thickness of coating. A document prepared by the manufacturing factory for the galvanized soil nail bars with threads and couplers, certifying each batch of steel with certificates from quality assured stocklist, mill and hot dip galvanizer are properly stored, handled, processed and supplied to a purchaser;

   e. Details of heat-shrinkable sleeve for protecting the connections between soil nail bars if galvanized coating to either the threads inside connectors or at the ends of soil nail bars is not applied, together with details of the heat application equipment for shrinking the sleeves; risk assessment for using the heat application equipment and safety measures in connection with the use of the heat application equipment;

   f. Method of repairing damaged heat shrinkable sleeves during heat application or other installation process of soil nails;

   g. Details of corrosion protection for the threaded portion of the steel bar at soil nail head;

   h. Details of working platform;

   i. Details of temporary support to drillholes;

   j. Details of permanent casing;

   k. Method of storing materials;

   l. Method of drilling and details of drilling equipment;

m. Method of assembling soil nail bars;

n. Method of installing soil nail bars into drillholes;

o. Method of grouting and details of grouting equipment;

p. Details of equipment for measuring the volume of grout injected into each drillhole together with the accuracy and method of calibrating the equipment;

q. Details of equipment for testing soil nails, including test and calibration certificates;

r. Details of testing assembly including details of datum for deformation measurement and bearing pad;

s. Method of constructing soil nail-heads;

t. Certificate(s) from the manufacturer and the associated test report(s) of all components for soil nail showing compliance of the materials with the requirements of this Specification or as shown on the Drawings.

SLO.M955.9 PARTICULARS OF MATS FOR EROSION CONTROL

Submit to the CM for approval the following particulars of materials and methods of construction for the mats for erosion control at least 14 days prior to installation:

1. Details and samples of materials;
2. Manufacturer's literature including recommended sequence of mat installation and hydroseeding;
3. Methods of drilling holes, lapping, fixing and anchoring;
4. Method of placing and tamping soil into the mats, if required;
5. Details of equipment; and
6. Certificates from the manufacturer on the compliance of the materials with the requirements as shown on the Drawings.

SLO.M957.9 PARTICULARS OF WIRE MESH FOR EROSION CONTROL

Submit to the CM for approval the following particulars of materials of wire mesh, anchor bolts and methods of construction at least 14 days prior to installation:

1. Details and samples of wire mesh and anchor bolts;
2. Method of drilling holes for the bolts and details of drilling equipment; and
3. Certificates from the manufacturer on the compliance of the materials with the requirements as shown on the Drawings.

SLO.M960.9 DETAILS OF ROCK ANCHORS

1. When required by the CM submit, prior to the commencement of fabrication and installation, details of rock anchors which the Contractor proposes to use in the Works. The details shall include, inter alia, working drawings showing all relevant anchor dimensions, corrosion protection, head details, stages of installation, etc, together with a method statement including all relevant data on installation, grouting, stressing and monitoring procedures. All relevant test certificates and manufacturer's literature shall also be submitted. Do not commence the installation of anchors until the CM has indicated that he has no further comment on these drawings and procedures. The CM's acceptance of the proposals for anchors will be contingent upon their acceptance by the Geotechnical Engineering Office, Civil Engineering Development Department;

2. Maintain detailed comprehensive records of all activities relating to the installation of rock anchors on the Site. Such records shall be compiled on Approved record sheets. Records shall be submitted to the CM for his verification not more than 24 hours after completion of each anchor.

SLO.M970.9 PARTICULARS OF GABIONS

Submit to the CM for approval the following particulars of materials of gabions and the methods of construction at least 14 days prior to installation:

1. Details and samples of materials;
2. Manufacturer's literature including recommended sequence of gabion installation; and
3. Certificates from the manufacturer on the compliance of the materials with the requirements as shown on the Drawings.

SLO.M980.9 METHOD STATEMENT FOR REMOVAL OF UNSTABLE BOULDERS

Submit to the CM for approval a method statement for the removal of unstable boulders, including the safety precautions to be taken, before the commencement of works.

WORKMANSHIP

GENERAL REQUIREMENTS AND PRELIMINARY WORK

SLO.W010.9 SCOPE OF WORK

1. Rock stabilization works on final excavated rock slopes shall include, but shall not be limited to breaking up and removing loose or overhanging rocks, supporting loose rocks with dowels or bolts, providing masonry infill, buttresses or reinforced concrete supports, securing loose areas with sprayed concrete (reinforced with mesh or plain), infilling joints with mortar, removing soft material and backfilling with concrete and providing adequate drainage measures. Typical details of these items are shown on the Drawings;
2. The quantities of various stabilization measures given in the Bill of Quantities are all provisional. A detailed examination of the final rock slope may result in significant variation in the actual quantity of work required. The Contractor shall be deemed to have made allowance in his rates for this variation in quantities;
3. Blasting is not permitted for the works unless Approved;
4. If, in the CM's opinion, the rock stabilization works are required principally as a result of the Contractor's standard of workmanship (for example poorly aligned presplit drillholes) the Contractor shall bear the cost of such stabilization measures as are required by the CM;
5. The CM will inform the Contractor of the extent and nature of rock stabilization work required for any slope, or portion of slope, within two weeks of access being provided to that slope or portion of slope. The CM will also inform the Contractor which of these items, if any, he considers to be necessary as a result of the Contractor's standard of workmanship;
6. For rock slopes with multiple benches, rock stabilization works shall be installed progressively as the benches are excavated. Blasting of each lower bench shall not be carried out unless the upper bench has been inspected by the CM and the Instructed stabilization measures installed to the CM's satisfaction.

SLO.W020.9 ACCESS TO SLOPES

1. Means of access consisting of scaffolding constructed of sound bamboo, metal or other materials agreed by the CM shall be installed to enable the CM to examine slope treatment works. The scaffolding shall allow access to within 0.8 m of the slope face. Hand and foot holds for climbing shall be provided by bamboo or metal members at centres not exceeding 0.5 m vertically and 0.8 m horizontally;
2. Where the slope stabilization details include the removal of rock from the slope or other materials the CM may wish to carry out an additional inspection of that area of the slope from which rock or other materials have been removed. If required by the CM, re-erect or repair the access to enable such additional inspection to take place;
3. Install a system of safety ropes on the scaffolding. Safety ropes shall be 12 mm diameter and shall have a breaking force of at least 18 kN. The system of safety ropes shall consist of:
    a. Vertical ropes at not more than 3 m centres horizontally securely anchored to the crest of the slope; and

b. Horizontal ropes at not more than 3 m centres vertically.

The system of safety ropes shall be constructed in such a manner that the ropes are tied at not more than 3 m spacings in both directions to form a net.

4. Provide scaffolding for CM to carry out inspection to the slope. Do not use the scaffolding for carrying out site operations without the permission of the CM;
5. Where rock slope works are included in the Contract, allow sufficient time in the programme for the CM to inspect the rock slope, check the stability, design slope treatment works and determine the extent of works required, taking into account of any specified time stated in the Contract that the CM may require for inspection and design of slope treatment works;
6. Additional payment for repairing or re-erecting access for the purpose of inspection in accordance with sub-clause (2) shall not be made. The rate to provide and maintain access shall be deemed to include the cost of complying with this sub-clause.

SLO.W030.9 PROTECTION FENCES AND BARRIERS

1. Construct protection fences and barriers for slope treatment works as shown on the Drawings before slope treatment works start;
2. Repair damaged protection fences and barriers immediately. Obtain CM's permission before protection fences and barriers are dismantled.

SLO.W040.9 PREPARATION FOR SLOPE TREATMENT WORKS

1. Clear vegetation and remove existing impermeable surfaces and topsoil from existing soil slopes before slope treatment works start;
2. Trim and scarify surface of slopes before slope treatment works start. On completion of trimming and scarifying, remove any loose materials from the surface of slopes by means of water jet coupled with compressed air for rock slopes or other hard surfaces and by means of air jet for soil slopes, unless otherwise directed by the CM;
3. Clean rock faces and joints, and the surface and joints of retaining walls of moss, vegetation and loose material, immediately before slope treatment works start. Remove surplus water by an air jet. Divert water flowing from or across the rock face by relief drains or by other methods agreed by the CM before the application of impermeable surfaces;
4. Reinstate any slope surface that has been stripped for inspection by the CM without any further slope work to its original condition.

BOULDER STABILISATION, REMOVAL AND CONSTRUCTION OF BOULDER BARRIERS

SLO.W110.9 GENERAL

1. Where shown on the Drawings or as directed by the CM, carry out boulder stabilization/removal works. Carry out the boulder stabilization/removal works in such a manner as to prevent damage to other parts of the ground surface, slope drainage channels or pipes, road surfaces, fencing and any other temporary or permanent features;
2. Take all necessary precautions to ensure public safety within the area of boulder stabilization/removal works to prevent fires, and to avoid erosion or the slippage or wash of loose materials within, or into areas beyond, the limits of the Site;

3. On the completion of the works the area shall be left clean and tidy. Reinstate all works areas, including backfilling of any excavations, re-establishing vegetation by hydroseeding or planting, making good of any erosion and damage to roads, tracks or paths to the satisfaction of the CM.

SLO.W120.9 REMOVAL OF BOULDERS

1. Where directed by the CM, remove boulders from slopes by means of line drilling, expansive grouts, rock breakers or other methods agreed by the CM. For the purpose of this clause, a boulder to be removed from rock slopes shall qualify as "boulder" only if it exceeds 0.2 m^3 in volume before excavation and it cannot be removed without the use of powered mechanical equipment;
2. Under no circumstances will blasting be permitted. Take all materials removed off the slope and clean the slope surface. Devoid of any loose fragments;
3. Carry out such removal so as to prevent boulders, rock fragments or other materials from falling down the slope. The broken up boulders, rock fragments or other materials from boulder removal shall not be allowed to remain or be scattered on the slope. Removal shall also be carried out in such a manner as to prevent damage to other parts of the ground surface, slope drainage channels or pipes, road surfaces, fencing and any other temporary or permanent features.

SLO.W130.9 CONSTRUCTION OF BOULDER BARRIERS

1. Where shown on the Drawings or as directed by the CM, construct boulder barriers as protection against potentially hazardous boulders or rock falls. Conduct a joint initial record survey to determine the actual barrier location for agreement before construction. Details of boulder barriers shall be issued within 2 weeks after the survey. Vegetation clearance at the tentative barrier location is to be completed to the satisfaction of the CM prior to the survey;
2. Excavate the foundation for the barrier in accordance with Worksection EAR1 and to depths as directed by the CM;
3. Construct drainage pipes, headwalls, baffle blocks and watercourse paving associated with the boulder barrier in accordance with the Drawings to intercept water and to carry the water flow through the pipes under boulder barriers;
4. The barrier shall consist of mesh gabions or equivalent in accordance with SLO.M810. Join the gabions securely by looping binding wire through the mesh and twisting it together. The binding wire shall be coated with PVC. The strength of connections shall be not less than the strength of the steel wire mesh. Sprayed concrete shall be applied on the gabions surface for fire protection if required by the CM;
5. Where shown on the Drawings or as directed by the CM, place additional steel wire mesh on the face of the gabions. The wire mesh sheeting shall be fastened to the gabions by binding wire;
6. Fill the gabions to one-third height with hard durable stones of sizes between 125 mm to 200 mm. The stones shall be adequately hand-packed to ensure that it is tightly packed and has minimum voids. Horizontal bracing wires with plastic coating shall be fixed in the gabions directly above the level of the stone to keep the face of the gabion even and free from bulging. Continue filling and repeat the process until the stones reach to the top level of the gabion;

7. Where shown on the Drawings or as directed by the CM, place a layer of galvanized steel wire mesh with openings less than 1.5 mm at one-third height of the gabions. Fill and compact stones until they reach the top level of the gabion. Fill all voids within the rockfill above the mesh with fabricated soil as specified in SLO.M815. The top surface of the barrier shall be hydroseeded or planted as directed by the CM.

ROCK SLOPE TREATMENT WORKS

SLO.W210.9 SCALING AND TRIMMING OF ROCK SLOPES

1. Carry out rock scaling on areas as directed by the CM. Rock scaling shall include the removal of all loose blocks of any size using hand tools, or boulders not exceeding 0.2 m^3 in volume using powered mechanical equipment;
2. Carry out scaling and trimming of rock slopes in such a manner that soil and rock is removed from the slope face without affecting the stability and integrity of the slope;
3. Take measures to prevent uncontrolled falls of debris arising from scaling and trimming works. Carry out scaling and trimming of rock slopes using hand-held tools;
4. Remove all material excavated by scaling and trimming and loose fragments of soil and rock off the slope;
5. Clean rock faces using a water jet coupled to compressed air after scaling and trimming is complete.

SLO.W220.9 ROCK SPLITTING

Carry out rock splitting using percussive hammers, drills, hydraulic splitters, chemical expanding agents, hand-tools or other methods agreed by the CM.

SLO.W230.9 SEALING AND INFILLING OF ROCK JOINTS

Seal joints in rock faces with Grade 20/20 concrete, cement mortar or masonry as shown on the Drawings or directed by the CM. Rock for masonry infilling shall be bedded in cement mortar. Where shown on the Drawings or as Instructed, install relief drains before rock joints are sealed or infilled.

SLO.W240.9 CONCRETE BUTTRESSES

1. General requirements:
    a. Where directed by the CM, construct buttresses to support rock or rock faces at the locations and to the dimensions as directed by the CM and in accordance with the details shown on the Drawings;
    b. Construction of buttresses may incorporate some or all of the following activities and features: scaling of loose rock, trimming, installation of rock dowels, rock bolts, no-fines concrete, sandbag filters, raking drains, drainage holes and channels;
    c. At each buttress location, scale off loose blocks and trim the slope to lines and levels as directed by the CM. For buttresses located at the base of the slope, trim and excavate the bottom area to an Approved alignment;
    d. Unless otherwise specified, form all exposed concrete faces in accordance with Worksection CON1;
    e. Construct drainage behind buttresses as SLO.W260 with a gradient of at least 1 in 50. Fix the uPVC pipes securely to the formwork before concreting starts.

2. Special requirements for concrete buttressing to unstable rock:

   a. Where shown on the Drawings or directed by the CM, construct buttresses to support a boulder, groups of boulders or other rock masses;

   b. Excavate the foundation for the buttress in accordance with Worksection EAR1 to depths directed by the CM. Do not place any formwork until the CM is satisfied that a suitable founding level has been achieved;

   c. The buttress shall be anchored by 32 mm diameter rock dowels embedded 500 mm into the ground and projected at least 300 mm into the buttress, or as shown on the Drawings or as directed by the CM;

   d. Prior to concreting, scarify the rock surface thoroughly;

   e. Where shown on the Drawings or as directed by the CM, construct drains to intercept water and to carry it past the boulder, groups of boulders, rock masses or the strata influencing their stability.

SLO.W250.9 CONSTRUCTION OF REINFORCED CONCRETE PADS

Reinforced concrete pads may be used in conjunction with one or more rock bolts. Dimensions of the pads and details of the reinforcement required shall be given to the Contractor within two weeks of access being provided for the CM's examination of the rock slope. Where possible the shape of the concrete pads will be chosen so that support during construction can be provided by natural irregularities in the rock slope. Where such irregularities do not exist, the Contractor may, where Approved, install dowel bars to provide temporary support.

SLO.W260.9 DRAINAGE HOLES IN BUTTRESSES AND PADS

1. Where ordered by the CM, 50 mm diameter uPVC pipes shall be built into buttresses or reinforced concrete pads to act as drainage holes. The buried end of the pipe shall be mortared in place on a joint or fissure and the exposed end fixed firmly to the formwork before concreting commences;
2. Where directed by the CM, a pocket of coarse filter material or no-fines concrete shall be placed at the buried end of the pipe.

SOIL-CEMENT FILL

SLO.W310.9 MIXING SOIL-CEMENT

Mix soil-cement thoroughly in a concrete mixer. Small quantities of soil-cement shall not be hand mixed unless permitted by the CM. The method of mixing soil-cement shall be agreed by the CM.

SLO.W320.A DEPOSITION AND COMPACTION OF SOIL-CEMENT FILL

1. Deposit soil-cement fill in its final position and compact within 30 minutes after the cement has been added to the mix;
2. Compact soil-cement fill in accordance with Worksection EAR1 to obtain a relative compaction of at least 95% throughout.

SPRAYED CONCRETE

SLO.W410.9 RECORD

Before sprayed concrete is applied to any slope, keep records of the slope in terms of photographs/mapping, format of which shall be as agreed with the CM.

SLO.W420.9 MIX DESIGN AND PROCESS

Before sprayed concrete is used, submit the mix design to the CM for approval. Where required by the CM, construct trial panels for different types of spraying equipments or different shotcretors. Make test panels to establish the suitability of sprayed concrete mix, spraying equipment and shotcretors and test in accordance with SLO.T110.

SLO.W430.9 TRIAL PANEL

1. Construct a trial panel at least 50 mm thick and at least 3 m x 3 m in area for sprayed concrete on the surface to be treated. The average percentage rebound shall be estimated for each trial panel and shall be used in the calculations of the cement content of the applied concrete. Cores shall be taken and tested in accordance with the requirements of the testing section in this Worksection;
2. Trial panel for coloured sprayed concrete:
    a. Carry out a trial panel for coloured sprayed concrete of an area not less than 2 m x 2 m at least 2 months before any permanent coloured sprayed concrete is to be constructed;
    b. The trial panel shall be used to demonstrate the methods and the finishes of the proposed coloured spayed concrete construction;
    c. Should the panel not present the required finishes, carry out further trial panels until acceptable finishes are produced. No permanent coloured sprayed concrete construction shall be allowed until the trial panel is Approved.

SLO.W440.9 PREPARATION OF SLOPE SURFACES

1. Remove weak material along joints or seams in slope surfaces to which sprayed concrete will be applied to a depth equal to the width of the weak zone;
2. If the soil surface temperature exceeds 25°C or the moisture content is less than 10 %, water the surface to be sprayed using sprays unless otherwise Instructed. Hoses without sprays shall not be used. Spraying of water onto the slope surface shall be carried out not more than 1 hour before spraying of concrete starts;
3. Before sprayed concrete is applied, protect all tree trunks, railings, channels, utilities, pipes, structures, street furniture or other facilities adjacent to or within the sprayed concrete area from being contaminated by sprayed concrete or rebound particles with an Approved means. Clean and make good all contaminated surfaces to the satisfaction of the CM.

SLO.W450.9 FIXING REINFORCEMENT

Fix and lay fabric reinforcement for sprayed concrete securely to the slope by steel nails or rawl bolts, or as shown on the Drawings, without sharp bends or creases. The cover to the reinforcement shall be at least 20 mm and laps between adjacent sheets shall be at least 150 mm, or as shown on the Drawings. Place the fabric reinforcement centrally in the sprayed concrete. The fabric reinforcement shall be supported clear of the ground and away from any surface irregularities with adequate numbers of cover blocks.

SLO.W455.9 WEEPHOLES, STUD DRAINS AND JOINTS IN SPRAYED CONCRETE

1. Construct 50 mm diameter weepholes as follows:
   a. On slope surfaces at 1.5 m staggered centres in each direction; and
   b. On rock faces, on rock joints and at locations/spacings as directed by the CM.
2. Extend all weepholes through the full thickness of the sprayed concrete and lay with an outward inclination of 1 in 10;
3. When directed by the CM, form stub drains and rock joint relief drains as shown on the Drawings. Stub drains shall be formed with perforated uPVC pipes installed in 75 mm diameter drillholes of 500 mm minimum length. The spacing of the drains shall be as directed by the CM;
4. On soil slopes, construct expansion joints in sprayed concrete in line with the expansion joint s of adjacent channels, berm slabs and concrete structures etc, or at 15 m intervals maximum in case there is no channels, berm slabs or concrete structures;
5. Construction joints in sprayed concrete shall comply with Worksection CON1.

SLO.W460.9 EQUIPMENT FOR SPRAYING CONCRETE

1. Sprayed concrete shall be applied using the dry process in which water and admixtures shall be added at the nozzle. Alternatively, sprayed concrete shall be applied using wet process in which wet ready-mixed concrete shall be supplied at the nozzle;
2. Equipment for dry-mix process shall be capable of projecting a mixture of cement, fine and coarse aggregate and water at high velocity on to the surface of the slope to produce a dense homogeneous cover. The equipment shall be fitted with weight-batching facilities;
3. Equipment for wet-mix process shall be capable of projecting a mixture of wet ready-mixed concrete at high velocity on to the surface of the slope to produce a dense homogeneous cover;
4. Only skilled operators experienced in the use of sprayed concrete shall be employed as shotcretors. Submit the names and details of the experience of the shotcretors who will be employed on the Works for Approval at least 14 days before sprayed concrete works start.

SLO.W470.9 SPRAYING CONCRETE

1. Measure the surface temperature and moisture content of the soil and submit the results to the CM immediately before sprayed concrete is applied;
2. For dry-mix process, the aggregates and sand for sprayed concrete shall be kept dry before mixing. Sand shall be natural sand or crushed natural stone. The water shall be added at the nozzle at the instant of application. The air and water supply, the rate of application and all other factors affecting the quality of the work shall be adjusted to produce dense concrete with no sloughing. For wet-mix process, the ready-mixed concrete shall comply with Worksection CON1 unless otherwise Approved. For both the dry-mix process and wet-mix process, rebound material shall not be reused and shall be removed within 8 hours after spraying;
3. Apply sprayed concrete in layers not exceeding 50 mm thick to the total thickness as shown on the Drawings or as directed by the CM. Sprayed concrete shall be applied perpendicular to the surface to be sprayed and the nozzle shall not be positioned farther than 1.5 m from the surface during spraying. Submit details of the methodology to be used to achieve the required thickness. The maximum panel dimension shall not exceed 15 m^2;

4. Colour pigment approved by the CM shall be mixed thoroughly with the sprayed concrete mix. A layer of 25 mm thick of coloured sprayed concrete shall be applied to form the total thickness of sprayed concrete as shown on the Drawings;
5. Submit details of colour pigments including specification and colour samples and the method statement to the CM for approval prior to application. Colour to be employed shall be directed by the CM.

SLO.W490.9 CURING SPRAYED CONCRETE

Cure sprayed concrete for at least 4 days after application by one of the following:

1. Applying a liquid curing compound to the sprayed concrete surface by a low-pressure spray until a continuous visible covering is achieved. The application rate shall be applied as recommended by the manufacturer. For textured surfaces and fluted surfaces, the application rate shall be adjusted to ensure that full covering is achieved. Covering the adjoining reinforcement or formwork shall be avoided; or
2. Covering the sprayed concrete surface with hessian, sacking, canvas or other absorbent material as agreed by the CM or with a layer of fine aggregate at least 25 mm thick. The hessian, sacking, canvas, absorbent material or fine aggregates shall be kept constantly wet; or
3. Covering the sprayed concrete surface with polyethylene sheeting. Sprayed concrete surfaces which have become dry shall be thoroughly wetted before the sheeting is placed.

SLO.W500.9 INSPECTION OF SPRAYED CONCRETE

1. Completed areas of sprayed concrete shall be sounded using a wooden mallet;
2. Take cores of 75 mm diameter from the completed sprayed concrete area at the rate of 1 no. per every 150 m² of sprayed surface or part thereof at locations determined by the CM for checking the quality and thickness of the sprayed concrete as well as cover to reinforcement;
3. Whenever any defect is found or the test result of any of the concrete cores from test panels as detailed in SLO.T110 does not comply with specified requirements, carry out further investigation to locate the extent of the defect;
4. Remove and re-spray areas which in the opinion of the CM are substandard or hollow;
5. Reinstate the surface with core holes with cement mortar of colour matching the adjacent surface.

SLO.W510.9 RECORDS OF SPRAYED CONCRETE

Keep records of sprayed concrete operations on Site and submit them to CM daily. The records shall contain details of the quantities of all materials used at each location. The records could be either a hard copy or soft copy as agreed by the CM.

PROTECTIVE MESH FOR SLOPES

SLO.W750.9 FIXING PROTECTIVE MESH

1. Unless otherwise shown on the Drawings, orientate, lace, suspend down and fix protective mesh onto the slope face with dowels or steel hooks at intervals not exceeding 3 m;
2. The diameter of the drillholes for dowels or steel hooks shall be at least 20 mm larger than the diameter of the dowels or steel hooks;

3. The method of drilling and cleaning of drillholes shall be as stated in sub-clauses (1) and (2) of SLO.W830;
4. Position the last column and row of dowels or steel hooks fixing the edge and base of the protective mesh at not more than 300 mm from the respective edges/base of the mesh;
5. Laps in mesh sheets in vertical direction shall be avoided as far as possible. Where necessary, the laps shall be at least 300 mm minimum wide and lapping sheets shall be laced with 2.2 mm nominal diameter galvanized and PVC-coated binding wire at the centre of the lap in the same way as adjacent vertical sheets.

INSTALLATION OF ROCK BOLTS

SLO.W810.9 GENERAL

1. Where directed by the CM, install rock bolts to support large blocks or boulders, to reinforce masses of unstable jointed rock, or, in conjunction with reinforced concrete pads and beams, or steel support, to support zones of loose fragmented rock or rock masses resting on weak seams, as shown on the Drawings;
2. Provide and install all flat washers, tapered washers, steel bearing plates, and cement mortar patching, to ensure uniform bearing of the rock bolt on the surface of the rock, concrete pad, beam, or support, as shown on the Drawings and as directed by the CM;
3. The permission of the CM shall be obtained before installation of rock bolts starts.

SLO.W820.9 STORAGE AND PROTECTION OF ROCK BOLTS

The rock bolts shall be stored in clean dry conditions, and at the time of installation shall be undamaged, straight and free from rust, pitting, grease or other deleterious matter.

SLO.W830.9 DRILLING AND PREPARING ROCK BOLT HOLES

1. Drill holes for rock bolts at the locations as Instructed. The diameter of the hole shall be at least 20 mm larger than the diameter of the rock bolt or the outer diameter of the connectors, if used, whichever is larger. The method of drilling shall be rotary or rotary percussive with water flush or air flush accompanied by the operation of an effective dust extraction and filtering device. Holes shall be drilled to provide 50 mm cover to the end of bolts for which cement grout is used to form the bond length;
2. Flush holes for rock bolts with clean fresh water before rock bolt installation starts and until the return water runs clear. Blow out standing water from the hole using compressed air after flushing. Seal hole to prevent ingress of foreign matter;
3. Test holes for rock bolts by the Packer test as stated in SLO.T220 and submit the test results to the CM for approval before commencing the installation of the rock bolts.

SLO.W840.9 FIXING ROCK BOLTS

1. The location, direction, inclination, length and diameter of each rock bolt drillhole shall be in accordance with the Drawings or as directed by the CM;
2. Obtain CM's permission before commencing the installation of the rock bolts;

3. All rock bolts shall first be fixed centrally in the drillhole by permanent centralizers or other Approved means to prevent displacement of the bolt during injection and setting of grout. When Instructed, provide double corrosion protection of approved type to rock bolts. All bolts (other than trial bolts for load testing) shall be finally grouted within 8 hours of being tensioned to their installed working load;
4. Install rock bolts in accordance with the manufacturer's recommendations;
5. Rock bolts shall be fully grouted after stressing. Heat-shrinkage plastic sleeves approved by the CM shall be provided to the free length of rock bolts;
6. Installation of rock bolts, including grouting of the free length and installation of head protection, shall be completed as soon as practicable and not more than 14 days after completion of the drillhole;
7. Rock bolt with a grouted anchorage shall not be stressed until the grout crushing strength has attained a value of 21 MPa when tested in accordance with Worksection GRO;
8. Where as shown on the Drawings or as Instructed, cover all rock bolts determined as permanent by the CM by concrete of Grade 20/20 which shall be 250 mm square in size and of 150 mm minimum thickness. A unique identification number shall be marked on the concrete surface. Temporary rock bolts shall have their unique identification numbers marked on a concrete pad of 150 mm square in size and of 30 mm minimum thickness. Depth of marking of all rock bolts shall not be less than 5 mm.

SLO.W850.9 GROUTING ROCK BOLTS

1. Grouting for rock bolts shall be in accordance with Worksection GRO except as stated in sub-clauses (2) and (3) below;
2. Grout shall be introduced at the lower end of drillholes with downward inclinations and shall displace all air and water through the top of the drillhole;
3. Packers and return ducts which maintain a head on the grout until the grout has set shall be used for drillholes with upward inclinations or with inadequate downward inclinations. The packers and ducts shall be such that separate grouting of the anchorage zone and free-length zone of the drillhole can be carried out. The head to be maintained on the grout shall be as Approved.

SLO.W860.9 PROVING ROCK BOLTS

Each installed rock bolt shall be proved as stated in SLO.T230. Rock bolts shall be locked off at 1.1 times the working load after proving. The complete bolt head assembly shall be encased by a concrete block after locking off.

SLO.W870.9 RECORDS OF ROCK BOLTS

1. Keep records of installation of each rock bolts on the Site and submit a copy to the CM not more than 7 days after each installation operation. The records could be either a hard copy or soft copy as agreed by the CM. The hard-copy report shall use re-cycled papers and double side printed. The soft copy shall be in read-only format. Format and content of the records shall be as Approved;
2. The records shall contain the following information:
    a. Rock bolt location and identification number;
    b. Drilling details, including:
        i. Date and time drilling started and finished;
        ii. Machine and operator identification;

iii. Location, level, inclination, bearing, length and diameter of drillhole;

iv. Rate of penetration at 0.5 m intervals.

c. Water tightness of drillhole, including:

i. Date and time water test started and finished;

ii. Details of any pre-grouting and redrilling;

iii. Length of test zone;

iv. Water pressure applied;

v. Duration of test;

vi. Measured water absorption rate.

d. Details of steel bolts, including:

i. Type and diameter;

ii. Bond length;

iii. Overall length;

iv. Number and type of centralizers;

v. Stressing record and lock-off load; and

vi. Details of Manufacturer and supplier.

e. Corrosion protection details;

f. Test details and results;

g. Details of grouting, including:

i. Date and time grouting started and finished;

ii. Details of any packers used and length of grouted zones;

iii. Head maintained on grout during setting;

iv. Volume of grout accepted;

v. Identification marks of grout cubes.

INSTALLATION OF ROCK DOWELS

SLO.W910.9 GENERAL

Obtain CM's permission before commencing the installation of the rock dowels.

SLO.W920.9 STORAGE AND PROTECTION OF DOWELS

The bars shall be stored in clean dry conditions and at the time of installation shall be undamaged and free from rust, pitting, grease, or any other deleterious matter.

SLO.W930.9 DRILLING AND PREPARATION OF ROCK DOWEL HOLES

The drilling and preparation of holes for rock dowels shall be as stated in sub-clauses (1) and (2) of SLO.W830.

SLO.W940.9 FIXING ROCK DOWELS

1. The location, length, direction, inclination and diameter of each dowel shall be as directed by the CM;
2. The bar shall be fixed centrally in the drillhole by permanent centralizers or other Approved means which will prevent displacement of the bar during injection and setting of the grout.

SLO.W950.9 GROUTING ROCK DOWELS

1. Grouting for rock dowels shall be in accordance with Worksection GRO except as stated in sub-clause (2) below;
2. Rock dowels shall be grouted over the complete length of the drillhole in which the dowel is installed. Centralizers shall be fitted to rock dowels before grouting to ensure an even annulus of grout. No jacking or hammering of the dowels shall be carried out during the whole process of insertion of dowels into drillholes. Grout shall be introduced at the lower end of drillholes with downward inclinations and shall displace all air and water through the top of the drillhole.

SLO.W960.9 RECORDS OF ROCK DOWELS

Keep records of installation of each rock dowels on the Site and submit a copy to the CM not more than 7 days after each installation operation. The records could be either a hard copy or soft copy as agreed by the CM. The hard-copy report shall use re-cycled papers and double side printed. The soft copy shall be in read-only format. Format and content of the records shall be as Approved. The records shall contain details of the reference number, date of installation, location, length, inclination and level of each rock dowel installed.

INSTALLATION OF ROCK ANCHORS

SLO.W1010.9 DESIGN, INSTALLATION AND TESTING

Design, install, test and subsequently monitor rock anchors to comply with all the requirements in Geospec 1: Model Specification for Prestressed Ground Anchors, GEO.

INSTALLATION OF SOIL NAILS

SLO.W1110.9 GENERAL

1. The dimensions of soil nail heads and the orientation of soil nails shall be as shown on the Drawings or as directed by the CM;
2. The diameter of drillholes shall be the minimum diameter as specified. The grout cover to the lower end of soil nail bar shall be at least 50 mm;
3. Holes in steel plates for soil nail heads shall be drilled perpendicularly to the face of the steel plate and the centre of the hole shall be at a position of within 2 mm from the centroid of the plate. The clearance between the soil nail bar and the hole of the steel plate shall not be more than 2 mm;

4. The spacing of the centralizers and the suitability of the method of fixing the centralizers, grout pipes, conducting wires and corrugated sheathing where required shall be determined by carrying out trials on Site until no damage, deformation and displacement of the centralizers, grout pipes, conducting wires and corrugated sheathing are observed on completion of assembling all components, during inserting and withdrawing the soil nails. Once Approval is given, no change to the type, method and arrangement of fixing of the centralizers, grout pipe, conducting wires and corrugated sheathing shall be made without the prior approval of the CM;
5. For soil nails with double corrosion protection, centralizers shall be provided on the soil nail bar and the sheathing at suitable intervals to meet the following requirements:
    a. The soil nail bar shall be positioned in the sheathing so that a minimum grout cover to the bar of 10 mm is maintained;
    b. There shall be minimum clearance of 15 mm between the sheathing and the sides of the drillholes or casing.
6. For soil nails with double corrosion protection, corrugated sheathing shall be embedded at least 50 mm into soil nail head.

SLO.W1112.9 HANDLING OF SOIL NAIL BARS

1. Soil nail bars shall not be subject to rough handling, shock loading or dropping from a height;
2. Use nylon, rope or padded slings for lifting galvanized soil nail bars. Bundles shall be lifted with a strong back or with multiple supports to prevent abrasion.

SLO.W1114.9 STORAGE OF SOIL NAIL BARS

1. Store soil nail bars off a levelled, well drained and maintained hard-standing ground on level supports and in a manner, which will not result in damage or deformation to the soil nail bars, or in contamination of the soil nail bars. Submit proposal/measures to protect the soil nail bars from wetting and rusting caused by weather to the CM for approval;
2. Store soil nail bars horizontally;
3. Store different types and sizes of soil nail bars separately;
4. Do not store soil nail bars on or adjacent to concrete surfaces that form part of the permanent works;
5. Store galvanized soil nail bars on wooden or padded cribbing.

SLO.W1116.9 CUTTING SOIL NAIL BARS

1. Cut soil nail bars in accordance with BS 8666:2005 to the specified shapes and dimensions;
2. Comply with Table 5 of BS 8666:2005 for tolerances on cutting soil nail bars.

SLO.W1118.9 SURFACE CONDITION OF SOIL NAIL BARS

1. Soil nail bars shall be clean at the time of assembling and shall be free of loose mill scale, loose rust or any substance that, in the opinion of the CM, is likely to reduce the bond or affect the bars or grout chemically. Maintain the soil nail bars in this condition until insertion of soil nail bars;
2. If the surface condition of the soil nail bars deteriorates such that it does not comply with the requirements stated in sub-clause (1) of this clause, the soil nail bars shall be cleaned or dealt with by other methods agreed by the CM.

SLO.W1119.9 REPAIRS TO GALVANIZED COATING

1. If the coating to galvanized soil nail bars is damaged,

   a. At any point by an amount exceeding 25mm^2 in area or 50mm in length; or

   b. At more than three points in a 1m length by amounts each even not exceeding 25mm^2 in area or 50mm in length;

   that part of the soil nail bars shall not be used in the permanent works. If the coating to galvanized soil nail bars is damaged at more than six points in the cut length of a bar by amounts each even not exceeding 25mm^2 in area or 50mm in length, that length of bar shall not be used in the permanent works.

2. Except as stated in sub-clause (1) of this clause, all damaged areas and cut ends of galvanized soil nail bars shall be repaired by materials to be approved by the CM. Sufficient material shall be applied to provide a coating of at least the same thickness as the galvanized coating. The Contractor shall refer to Section 6.3 and Annex C of BS EN ISO 1461:2009 for information on repair of damaged areas;

3. Carry out repairs to galvanized coatings within 8 hours of cutting or identifying damage. Remove traces of rust from the surface of the soil nail bars before the repair is carried out.

SLO.W1120.9 DRILLING FOR SOIL NAILS

1. Comply with sub-clauses (4) and (5) of GRO.W110, and the following sub-clauses of this clause;

2. The set up of drilling plant and ancillary equipment shall be in such a manner that water, dust, fumes and noise generated during the drilling operation shall be sufficiently diverted, controlled, suppressed and muffled;

3. Carry out drilling for soil nails using rotary or percussive type drills with air as the flushing medium unless otherwise agreed by the CM. Provide temporary support, including but not limited to the use of temporary casing, to drillholes to prevent the collapse of drillholes until the completion of grouting. Clear drillholes of all debris and standing water immediately before installation of soil nails. Before soil nails are installed, provide the CM all necessary equipment and assistance to check the inclination, diameter, bearing, cleanliness and length of all drillholes;

4. Where as shown on the Drawings or required by the CM, submit drilling records including reference numbers of soil nails, date and time of drilling, penetration rate, description of strata of materials penetrated and any special observations during drilling such as underground voids encountered, collapse of hole, groundwater encountered, appropriate depth to groundwater and depth of zone of no air return etc. to the CM not more than 2 working days after completion of drilling in a format agreed by the CM;

5. Where as shown on the Drawings or ordered by the CM, install and leave in place with soil nails permanent steel casing of appropriate internal diameter and of 6.3 mm minimum thick. Unless otherwise specified by the CM, the bottom 2 m length of drillhole should be left unsupported by permanent casing;

6. Do not carry out drilling at a place within 10 meters radius of any freshly grouted soil nails, including soil nails for pull-out tests, grouted less than 12 hours previously.

SLO.W1130.9 INSTALLATION AND GROUTING FOR SOIL NAILS

1. Do not install soil nail bars and connectors from each batch until testing of the batch has been completed. Install and grout soil nails as soon as possible after drilling. In any case, each drillhole shall not be left unsupported for more than 3 days. Check all drillholes for cleanliness prior to installation of soil nails. Fix connectors for soil nail bars in accordance with manufacturer's recommendation and using equipment recommended by the manufacturer. Soil nail bars shall not be welded unless approved by the CM. For soil nail bars with threaded type connectors, each length of the soil nail bars shall be tightened by means of an appropriately sized wrench. During the whole process of installation, do not carry out any jacking or hammering of the soil nails. Grouting for soil nails shall comply with Worksection GRO and the following sub-clauses of this clause;

2. Calculate and record the gross volume of the drillholes, discounting the volume of all cast-in components of each of the soil nails to be grouted on the request forms for inspection of soil nail installation;

3. Terminate the grout pipe at a point within 150 mm above the lower end of the soil nail bars and no side cut hole shall be made on the grout pipe except that the cut is made within 150 mm above the lower end. Fix grout pipe onto the soil nail bars or corrugated sheathing (in case of double corrosion protection soil nails) by non-corrodible ties at spacing of not more than 2 m. Grout pipes shall not be removed from drillholes after insertion and the part protruding from drillholes after grouting shall be trimmed down to the base of soil nail head;

4. Where heat-shrinkable sleeve is used, the heat-shrinkable sleeve shall be heat-shrunk by means of an apparatus approved by the CM, and it shall be used in accordance with the manufacturer's instructions. The sleeve shall have sufficient length and shall be positioned such that a minimum 100 mm length of soil nail bars beyond the connector is protected by the sleeve after completion of heat-shrinking. No lapping of the sleeve shall be allowed. The sleeve thickness shall not be less than 1.0 mm after heat-shrinking. Finished surface of the sleeve shall be smooth, free of trapped air pockets, flaws, holes, cracks, burn marks and other defects. Any defects or damage found on the sleeve shall be made good to the satisfaction of the CM;

5. Install a pair of conducting wires in each permanent soil nail in accordance with the Drawings. For the shorter wire, the insulation of the wire at the lower end (25 mm length) shall be removed and the exposed end of the wire shall be in contact with the soil nail bars and securely tied to the soil nail bars by adhesive tape. The lower end of the longer wire shall be sealed in such a manner to achieve electrical insulation;

6. After insertion of soil nail bars into the drillhole, seal the top end of the drillhole with an appropriate plug capable of withstanding a grout pressure head, which is maintained during the first hour after completion of grouting as described in sub-clause (8) of this Clause. Install an outlet pipe extending above the slope surface through the plug to allow discharge of air, water and grout from the upper end of the drillhole during grouting. Submit details of the arrangement of outlet pipe and sealing plug for the CM's agreement and carry out a site trial to demonstrate that the set up performs satisfactorily;

7. Grout soil nails on the same day when the soil nail bars are inserted into drillholes. Soil nails which are not grouted after insertion and are left in drillhole overnight shall be withdrawn from the drillhole and the drillhole shall be checked for cleanliness and obstructions prior to re-insertion;

8. Grout soil nails over their entire length of soil nail bars in one single operation. Inject grout into drillhole through the grout pipe to the lower end of drillhole such that air and water are displaced from the drillhole as grouting proceeds. When the consistency of the grout flowing out of the outlet pipe is the same as the injecting grout, the grouting operation shall be stopped and the inlet grout pipe sealed. A pressure head of at least 300 mm of grout measured from the top of drillhole shall be maintained in the outlet pipe during the first hour after completion of grouting. Any settlement of the grout level inside the outlet pipe observed shall be replenished with fresh grout immediately;
9. The set up of grouting plant and ancillary equipment shall be in such a manner that water, spillage of grout, dust, fumes and noise generated in the course of grouting operation shall be sufficiently diverted, controlled, suppressed and muffled;
10. Record the volume of grout used for grouting each drillhole and the volume used for refilling each drillhole after grout settlement. Submit the records to the CM not more than 3 days after each grouting operation. The records shall include all details as required in GRO.W020 (1) and the following:
    a. Volume of grout spilled from the drillhole;
    b. Volume of grout added to outlet pipe after grout settlement.
11. Report to the CM any excessive grout loss immediately. If a drillhole cannot be fully filled with grout after injecting a volume of grout equal to 10 times the calculated gross volume of the drillhole, discounting the volume of all cast-in components, cease immediately the grouting operation for that drillhole unless otherwise agreed by the CM. Report the grouted length of the drillhole to the CM and submit proposals for completing the grouting for that drillhole to the CM for approval as soon as possible;
12. Unless otherwise agreed by the CM, for soil nails with double corrosion protection, grout firstly over the annular space between the wall of drillhole and corrugated sheathing in a continuous operation. Grout the annular space between corrugated sheathing and soil nail bars immediate afterwards in a continuous operation.

SLO.W1140.9 SOIL-NAIL HEAD

1. Construct soil-nail heads in accordance with the details as shown on the Drawings. Submit for the CM's agreement a method statement for the construction of soil-nail heads;
2. The threads at the top end of soil nail bars shall be thoroughly cleaned, properly treated with galvanized coating or protected with approved zinc-rich paint prior to construction of soil-nail heads;
3. Carry out concreting of soil-nail heads in a manner which ensures that the placed concrete is adequately compacted. Unless agreed otherwise by the CM, concreting of soil-nail heads using sprayed concrete shall be applied in two stages, allowing the bearing plate to be positioned firmly against the first stage concrete. The method statement as referred to in sub-clause (1) of this clause shall include proposal for the construction sequence of 2-stage sprayed concrete soil-nail heads. Conduct trial runs to demonstrate to the CM that the proposed method statement will produce satisfactory results and the rebound of sprayed concrete material is minimal;
4. Backfill any temporary excavation for constructing soil-nail heads, including overbreaks, with Grade 30/20 concrete, 30 MPa sprayed concrete or other material as agreed by the CM;

5. Where Insttructed, uncover a maximum of 3 concreted soil-nail heads from the batch of soil-nail heads constructed on any one day for examination of the quality of soil-nail heads. If defective workmanship is identified in any one of the uncovered soil-nail heads, the whole batch of soil-nail heads constructed on the same day shall be deemed to be defective. Break up all the remaining soil-nail heads constructed on the same day for the CM's examination. Re-construct and re-examine the soil-nail heads to the satisfaction of the CM.

MATS FOR SLOPE EROSION CONTROL

SLO.W1150.9 PREPARATION OF SURFACES

Clear areas to be applied with mats of all rubbish, debris and loose soils. All local irregular spots and areas shall be trimmed or filled with compacted fill material or compacted soil-cement to provide smooth surface unless otherwise Instructed. The finished slope surfaces shall be inspected by the CM prior to installation of mats.

SLO.W1160.9 LAYING AND FIXING OF MATS FOR EROSION CONTROL

Lay and fix mats for erosion control onto sloping ground in accordance with the manufacturers' recommended procedures and in compliance with the following requirements:

1. The mats except biodegradable types shall be anchored along the slope crest and each berm level with at least 200 mm length embedded into the ground or underneath the concrete berm slabs. The mats shall also be embedded at least 200 mm into any adjacent structures to be constructed. The mat shall be rolled out from top down the slope surfaces. Sufficient galvanized anchorage pins at a maximum spacing of 1 m centre to centre shall be provided to ensure the mats are in complete and total contact with the ground at every place. In areas of irregularities due to exposed rocks or existing structures, additional anchorage pins shall be provided to prevent any gap or void forming underneath the mats. Lapping between mats shall be at least 150 mm and shall be formed with the upslope mat over the downslope mat. No lapping shall be formed within 1 m of any intersection of two slope surfaces which have a sharp difference in slope gradient or strike direction;
2. The biodegradable erosion control mats shall be anchored along the crest of slope and each berm with at least 2 rows of bamboo sticks or wooden pegs at a maximum horizontal spacing of 550mm on 300mm length mat lapping. The mats shall be rolled out from top down the slope surfaces. Sufficient bamboo sticks or wooden pegs at a maximum spacing of 1m centre to centre shall be provided to ensure the mats are in complete and total contact with the ground at every place;
3. In areas of irregularities due to exposed rocks or existing structures, additional anchorage pins shall be provided to prevent any gap or void forming underneath the mats. Lapping between mats shall be at least 150 mm and shall be formed with the upslope mat over the downslope mat. No lapping shall be formed within 1 m of any intersection of two slope surfaces which have a sharp difference in slope gradient or strike direction;
4. Where recommended by the manufacturer of the mats for erosion control, on completion of laying and anchoring of the mats, place and tamp soil into the mats in accordance with the Drawings or as directed by the CM. All voids shall be completely filled to form an integral composite structure;
5. The sequence of hydroseeding and laying of mats shall be in accordance with the manufacturer's recommended sequence, or as directed by the CM. The protective material for hydroseeding shall be laid on top of the erosion mat, if specified.

INSTALLATION OF ROCK JOINT RELIEF DRAINS

SLO.W1210.9 GENERAL

Where as shown on the Drawings or directed by the CM, install rock joint relief drains on the slope surface before applying sprayed concrete, buttresses or other constructions. Install the drains along weathered seams or at joints where water seepage is evident.

SLO.W1220.9 WEEPHOLES FOR ROCK JOINT RELIEF DRAINS

Weepholes shall be provided from the relief drain through the sprayed concrete or buttresses at intervals not greater than 1200 mm in each direction, or as directed by the CM.

SLO.W1230.9 FIXING ROCK JOINT RELIEF DRAINS

1. Fix the relief drain in place immediately prior to applying sprayed concrete, buttresses or other constructions;
2. Before the first length of permanent drain is installed, fix a trial length in place to demonstrate the method of fixing for Approval;
3. No permanent relief drains shall be installed until the CM has given his Approval to the method of fixing.

APPLICATION OF NO-FINES CONCRETE

SLO.W1310.9 USE AND APPLICATION

1. Where as shown on the Drawings or directed by the CM, apply no-fines concrete as Worksection CON1 to form drainage layers between the rock slopes and the sprayed concrete, buttresses, or other structures, or on its own;
2. Where as shown on the Drawings or directed by the CM, fill rock slopes that have voids behind the trim line or undercut points, resulting from face treatment and stabilization work or scaling and trimming, with no-fines concrete as Worksection CON1.

GROUT STRENGTHENING OF JOINTED ROCK

SLO.W1410.9 TECHNIQUE AND APPLICATION

1. Cement grouting shall be carried out in holes not less than 50 mm diameter drilled at locations, spacings, depth, inclinations, and directions, all as directed by the CM and as shown on the Drawings;
2. At the collar of each grout hole, reamed out if necessary, a stand-pipe shall be cemented not less than 1000 mm into the rock, and extend not more than 500 mm out of the rock, and shall be attached to a Tee manifold to facilitate injection of grout. The bore of the standpipe shall be not less than 50 mm;
3. The manifold shall consist of inlet and outlet connections for the delivery hose from the grout pump and the return hose to the grout holding tank, respectively; a valve in the stem of Tee to control bleed off of grout from the pumping circuit into the grout hole; a valve in the branch to the delivery hose; a valve in the branch to the return hose; and a pressure gauge (0 to 250 kPa), located not more than 200 mm above the connection to the standpipe, to measure the injection pressure of the grout, all as shown on the Drawings;

4. The grout pump and delivery and return hoses shall be of sufficient capacity to allow a pressure of not less than 250 kPa to be maintained at the standpipe of the grout hole being injected;
5. The grout pump shall be of the positive displacement type and, together with its motive power, shall permit small variations (not more than 25 kPa) in output pressure to be effected over the whole range from zero pressure to maximum delivery pressure. A suitable pressure gauge shall be fitted to the delivery line;
6. Grout shall be mixed in accordance with Worksection GRO;
7. During grout injection, a manifold operator shall be in continuous attendance at the grout injection manifold and a pump operator shall be in continuous attendance at the grout pump, for the whole duration of the work. The manifold operator shall be in continuous radio or telephone communication with the pump operator during this time;
8. The injection pressure to be maintained at the manifold gauge; the water:cement ratio of the grout mix; the duration of the injection, the number of injection periods, and the sequence in which holes are to be injected or re-injected, shall be as directed by the CM one day in advance of the work for every grout hole. No grouting shall be commenced or resumed unless Instructed;
9. The manifold operator, with the aid of the pump operator, shall ensure that the specified injection pressure is maintained at all times within a tolerance of 10 kPa at the manifold gauge. He shall record the gauge pressure and the times of commencement and cessation of grout injection, against each hole number. He shall also keep a record of any grout leakage at the ground surface or other holes by means of a dimensioned sketch plan. Fair copies of these records shall be forwarded to the CM at the end of each working day;
10. If grout leakage through natural rock joints at the surface occurs during grouting of a hole, then grouting shall immediately cease and shall not be resumed until the leaking joints are caulked using oakum, lead wool, or other caulking materials, all to the satisfaction of CM, who may direct grouting to continue at other holes until caulking is completed. If grout leaks into another hole near that being grouted, the former hole shall be flushed clean of grout after grouting is completed and before the grout has set;
11. If grout leakage occurs from the collar of the hole, grouting of the hole shall cease until the leak is stopped by caulking or cementing or other methods;
12. If the manifold operator observes lift or heave of surface rock during grouting, he shall immediately close the manifold valve, and advise the CM. No further grouting shall be attempted at the general locality until Instructed;
13. The pump operator shall, for each hole grouted, dip the grout tank and record the total volume of grout injected to an accuracy of 0.02 m^3 (Note: this will not include the grout in the delivery and return pipes), the strength of the grout mix, the pressure in the delivery line, and the times of commencement and termination of pumping. Fair copies of these records shall be conveyed to the CM at the end of each working day;
14. At the commencement of grouting operations each day, and before the grout hoses are connected to the standpipe manifold at the hole, a grout tank and delivery and return hoses shall be flushed with clean water for not less than 5 minutes at a velocity sufficient to remove all dirt, cement flakes, sand and foreign matter;

15. Before grouting commences at a hole, the hole shall be cleaned out by means of a probe or lance consisting of a 25 mm bore pipe of suitable length, fitted with a cap at one end and connectors for compressed air and water at the other, and perforated by 5 mm diameter holes at 25 mm centres in staggered rows every 90° for a distance of not less than 300 mm from the cap. The lance shall be passed up and down the hole for not less than five minutes and all drill cuttings and rock particles and foreign matter shall be removed from the hole by the compressed air and water jets before grouting is attempted;
16. On connection of the grout injection manifold to the standpipe and commencement of grouting, injection pressures shall be continuously maintained within tolerance of the pressure specified by the CM for the full period of injection, except in the event of grout leakage or rock movement as noted in sub-clauses (10), (11), and (12) above;
17. On completion of grouting at a hole, and after a suitable period of time has elapsed (as specified by the CM) for the grout to achieve an initial set, all grout in the hole itself shall be flushed out using the air-water lance. The standpipe shall then be temporarily capped. If the hole is not required for further grouting, the standpipe shall, on the CM's Instructions, be cut off flush with the rock surface and the hole filled with grout;
18. No oils, water soluble oils, greases, or other lubricants, shall be used on drill rods or drill bits or in drilling water during the drilling of grout holes;
19. The CM may require tell-tales, uplift gauges, or other means of detecting rock movement, to be installed before grouting commences;
20. The CM may require additives to be used in the grout to hasten or delay setting times or to achieve other characteristics in the grout;
21. The CM may require holes that have already been grouted to be deepened by further drilling through the standpipe and additional grouting carried out;
22. The CM may require type of grout other than cement grout to be used in the grouting operations;
23. On completion of grouting of a hole, the grout injection manifold shall not be removed from the standpipe until the grout pressure on the gauge has fallen to zero. Care shall be exercised by the manifold operator when disconnecting the manifold from the standpipe and moving it to another hole not to spill grout on the ground.

TREATMENT OF DECOMPOSED ZONES

SLO.W1510.9 TECHNIQUE AND APPLICATION

1. Where directed by the CM, decomposed zones shall be stabilized and protected in accordance with the measures shown on the Drawings;
2. For steeply dipping or sub-vertical decomposed zones, the work shall consist of:
    a. Removing weak or loose material from the seam to a depth equal to 100 mm plus the width of the zone if the latter is less than or equal to 300 mm or to a depth of 400 mm otherwise;
    b. Installing a drainage layer and longitudinal continuous drain if so Instructed;
    c. Placing a Grade 20/20 mass concrete plug flush to the rock surface;
3. The CM may direct raking drains to be installed to intersect and drain the weathered zone below its outcrop;
4. For gently dipping or sub-horizontal decomposed zones, the work shall consist of:

a. Removing weak and loose material from the zone as described above;

b. Placing a drainage layer of sandbags not less than 100 mm thick and a continuous longitudinal drain next to the decomposed material;

c. Installing a reinforced concrete plug, inclined outward to its foot, and keyed and dowelled into the rock on the lower side of the seam; and

d. Installing outlet drain pipes through the concrete plug from the longitudinal drain, as directed by the CM.

REINSTATEMENT OF ROCK BERMS

SLO.W1610.9 MAKING GOOD

Where directed by the CM, make good the shoulder of rock berms by means of mass concrete (Grade 20/20) placed flush with the berm surface and rock face and securely held to the rock by means of rock dowels as shown on the Drawings.

EXTENSOMETERS

SLO.W1710.9 PROVISION, INSTALLATION, TESTING AND RECORDING

1. Where directed by the CM provide, install and test rod extensometers of an Approved proprietary type;
2. The extensometers shall have either five (5) rods and a maximum length of 25 metres, or three (3) rods and a maximum length of 15 metres;
3. The extensometers shall be installed and tested in drillholes of a suitable size according to the manufacturer's instructions and shall be completed with all necessary components such as reference heads and protective caps;
4. A dial gauge of suitable accuracy and its accessories (including calibration accessories) shall be provided by the Contractor and shall be available on the Site in a serviceable condition at all times;
5. Take readings from all installed extensometers at a frequency to be directed by the CM from time to time, and convey the recorded data to the CM within 2 days of the readings being taken.

TELL-TALES AND REFERENCE POINTS

SLO.W1810.9 PROVISION AND INSTALLATION

1. Where directed by the CM, provide and install tell-tales and reference points for the purpose of measuring rock or soil movement. The tell-tales shall consist of mortar patches or glass strips affixed to the rock, or of such other similar means as the CM may direct;
2. The reference points shall be of an Approved proprietary type consisting of demountable stainless steel eyebolts affixed to corrosion protected steel bolts grouted not less than 200 mm into rock. Provide the necessary accessories and protective caps for the reference points. Install the reference points strictly in accordance with the manufacturer's installation instructions.

TOLERANCES

SLO.W1910.9 SOIL NAILING

Refer to Appendix H "Schedule of Tolerance" to this Specification.

TESTING

TESTING FOR THE OPTIMUM MOISTURE CONTENT AND MAXIMUM DRY DENSITY OF SOIL-CEMENT FILL

SLO.T010.9 OPTIMUM MOISTURE CONTENT AND MAXIMUM DRY DENSITY OF SOIL-CEMENT FILL

The maximum dry density and optimum moisture content of soil-cement fill shall be as Worksection EAR1 except that the method of testing shall be the Vibrating Hammer Test Method in accordance with BS 1924-2:2018.

TESTING CONCRETE CORES FROM SPRAYED CONCRETE

SLO.T110.9 TESTING CONCRETE CORES FROM SPRAYED CONCRETE

1. Testing arrangements:
    a. Carry out tests by employing a laboratory that complies with the requirements stated in the Preliminaries Worksection.
2. Testing samples
    a. The strength of sprayed concrete shall be determined from the concrete cores cut from a test panel constructed at the same time as sprayed concrete is applied;
    b. Construct one test panel for each application in a day or as directed by the CM;
    c. The test panel shall be 250 mm thick and shall be at least 1000 mm x 1000 mm in size. Fix securely the mould in position at the same height and inclination as the surface being sprayed. Construct the panel by spraying concrete into the mould at the same time as the concrete to be tested is applied. Cure the test panel by the same method as the sprayed concrete;
    d. Provide three concrete cores from each test panel. Cores shall not be taken within 125 mm from the edges of the panel;
    e. Concrete cores shall be 100 mm diameter and shall be the full depth of the test panel;
    f. The method of taking concrete cores shall be in accordance with CS1:2010.
3. Testing methods
    a. Test each concrete core to determine the compressive strength and density;
    b. Prepare and test the concrete cores to determine the compressive strength in accordance with CS1:2010;
    c. Test the concrete cores to determine the density in accordance with CS1:2010;
    d. Three concrete cores shall be tested at 28 days;
    e. Interpret the results of tests for compressive strength of concrete cores in accordance with CS1:2010;
    f. Do not make adjustments to the measured strength in respect of the age of the core when tested unless permitted by the CM;

g. The minimum compressive strength of concrete cores, converted to estimate in-situ cube strength in accordance with CS1:2010 shall be the specified grade strength at 28 days.

4. Non-compliance

   a. If the result of any test does not comply with the specified requirements for compressive strength or density of concrete cores from sprayed concrete:

      i. Submit particulars of proposed changes to the materials, mix design, methods of production or methods of construction to the CM for approval;

      ii. Make further trial mixes and construct further trial panels unless otherwise permitted by the CM.

TESTING ROCK BOLTS

SLO.T210.9 TRIALS FOR ROCK BOLTS

1. The design bond length of rock bolts with bonded anchorages shall be determined for each rock type by a pull-out trial;
2. The proof load of the pull-out trial shall be twice the working load;
3. Pull-out trials shall be carried out on two bolts for each combination of rock bolt and rock type;
4. Unless otherwise permitted by the CM the bolts used in trials shall be discarded and shall not form part of the permanent works, and the hole shall be sealed by grouting.

SLO.T220.9 PACKER TESTS ON DRILLHOLES FOR ROCK BOLTS

Holes for rock bolts shall be tested by the Packer test as follows and the results of the tests shall be submitted for Approval, before installation of rock bolts starts:

1. The water loss from drillholes for rock bolts shall be determined by the Packer test. The number of drillholes to be tested shall be as Instructed;
2. The Packer test shall be carried out on the bond length of the drillhole at a test pressure of 100 kPa. The method of testing shall be as stated in Worksection GRO;
3. The water loss determined by the Packer test in the grouted hole shall not exceed 5 Lugeons when measured over a 10 minute period;
4. If the result of any Packer test on drillholes for rock bolts does not comply with the specified requirements for the test, the drillhole shall be grouted, re-drilled and retested. Grouting, re-drilling and retesting shall be continued until the result of the Packer test complies with the specified requirement for the test.

SLO.T230.9 TESTS ON INSTALLED ROCK BOLTS

1. Test each installed rock bolt to determine the loss in stress by applying a test load of 1.5 times the working load for 5 minutes;
2. The loss in stress in installed rock bolts shall not exceed 5% of the test load in 5 minutes;
3. If the result of any test for loss in stress of installed rock bolts does not comply with the specified requirements for the test, an additional test for loss of stress shall be carried out on the rock bolt;
4. If the result of any additional test for loss of stress of installed rock bolts does not comply with the specified requirements for the test, the rock bolt shall be replaced.

TESTING SOIL NAILS

SLO.T310.9 GENERAL

1. Soil nails for pull-out tests shall be installed and tested prior to the installation of permanent soil nails as directed by the CM. The number of pull-out tests shall be as shown on the Drawings or as Instructed. Soil nails subjected to pull-out tests shall not form part of the permanent works. Submit the details of the testing arrangement including the set-up and support for the testing apparatus to the CM for approval. Drilling records of holes selected for pull-out tests shall be provided to the CM within 24 hours after drilling;
2. Where Instructed, carry out non-destructive testing of soil nails by either Time Domain Reflectometry (TDR) test or magnetometer test to verify the length of the installed soil nails. The frequency of non-destructive testing shall be at least 1% of soil nails with a minimum of 2 nails per slope (including wall).

SLO.T315.9 MEASURING APPARATUS FOR PULL-OUT TEST

1. The apparatus for measuring loads and deformations shall have an accuracy of 5 kN and 0.05 mm respectively. The apparatus for measuring deformation shall be capable of measuring a displacement of up to 50 mm;
2. The apparatus shall be tested and calibrated by laboratories approved by the CM not more than 6 months prior to the date of carrying out the tests;
3. Submit the test and calibration certificates to the CM at least one week before the test.

SLO.T320.9 PULL-OUT TEST FOR SOIL NAILS

Unless otherwise directed by the CM, adopt the following procedures of the pull-out tests for soil nails:

1. The loading apparatus shall be set up in such a way that no loading, other than the pull-out load, acts on the soil nail bars at the nail head. The reaction of the pull-out load from the loading apparatus shall act on a sufficiently sized rigid bearing plate placed against a temporary cut face at normal to the alignment of the soil nail bars to ensure adequate load spreading and to avoid eccentric loading. Monitoring instruments shall be carefully positioned and independently supported to record the extension of the soil nail steel bar and any movement of the steel baring plate;
2. Grout the soil nail over the length as specified in the Drawings or as directed by the CM. The length to be grouted shall be isolated by means of a packer that can prevent grout from leaking through to the free-length section during grouting and that can ensure that the proposed bonded section is effectively grouted to the required length as shown on the Drawings. Subject to the CM's approval, alternative means to form the required bond length may be adopted by the Contractor. The entire free length of the soil nail bars shall be properly debonded or capped to ensure that the test load can be directly transferred to the bonded zone in case of grout leak through the packer. The pull-out test shall not be carried out until the grout has reached a cube strength of 21 MPa;
3. The maximum test load shall be either 90 % of the yield load of the soil nail bars of the test nail (T_p) or the ultimate soil/grout bond load (T_{ult});

4. The test nail shall be loaded in stages: from the initial load (T_a) via two intermediate test loads (T_{DL1} and T_{DL2}) to the maximum test load. T_{DL1} and T_{DL2} are the loads that result in the bonded zone tested to the design working bond strength and 2 times the working bond strength respectively. T_a shall not be greater than T_{DL1} or 5 % of T_p. All loadings including T_a, T_{DL1}, T_{DL2} and T_p shall be specified in the Drawings or as directed by the CM;
5. During the first two loading cycles, the intermediate loads, T_{DL1}, and T_{DL2}, shall be maintained for 60 minutes for deformation measurement. After the measurement has been completed, the load shall be reduced to T_a and the residual deformation shall be recorded. In the last cycle, the test load shall be increased gradually from T_a straight to maximum test load and then maintained for deformation measurement. The measurement at each of the cycles shall be taken at time intervals of 1, 3, 6, 10, 20, 30, 40, 50 and 60 minutes. The test nail is considered to be able to sustain the test load if the difference of nail movements at 6 and 60 minutes does not exceed 2 mm or 0.1 % of the grouted length of the test nail. In this case, the test shall proceed to the next loading cycle or be terminated if the test nail is subject to T_p;
6. If the nail fails to sustain the test load T_{DL1}, T_{DL2} or T_p, the test shall be terminated and the nail movement against residual load with time shall be recorded. The measurements shall be taken at time intervals of 1, 3, 6, 10 and every 10 minutes thereafter over a period for at least two hours. Where required, the measurements shall be continued and at intervals as directed by the CM;
7. Throughout the test, the soil nail movement versus the applied load shall be measured, plotted on a graph and recorded along with all other relevant information, on forms agreed by the CM or as shown on the Drawings. All the results shall be submitted to the CM within 3 days of completion of the test;
8. Where required, the whole soil nail shall be pulled out from the drillhole for the CM's inspection. Where the soil nail bar remains in-situ after the pull-out test, the bar shall be cut-off flush with the finished ground and remaining part of the drillhole grouted.

SLO.T325.9 CREEP TEST

Where Instructed, carry out a creep test as part of a pull-out test as stated in SLO.T320. During a creep test, monitor movement of the test nail at a prescribed load as detailed below:

1. The test nail shall be loaded in stages in accordance with the loading cycles specified for a pull-out test;
2. The test load in one of the loading cycles shall correspond to two times the allowable design bond strength;
3. The creep period shall start as soon as the test load of two times the allowable design bond strength is applied. The load shall be maintained for 60 minutes. During this period, readings of the nail head movement shall be taken at time intervals of 1, 2, 3, 5, 6, 10, 20, 30, 50 and 60 minutes;
4. A test nail shall be considered acceptable when:
    a. A total creep movement between the 6-minute and 60-minute readings during creep testing is less than 2 mm; and
    b. The overall trend of creep rate (i.e. creep movement/log time) is linear or decreasing throughout the creep test load hold period.

SLO.T360.9 TIME DOMAIN REFLECTOMETRY (TDR) TEST

Adopt the following procedures for the TDR test:

1. Select some nails of known length for calibration of pulse propagation velocity;
2. Remove concrete nail head to provide access to steel nail head;
3. The head of the steel soil nail shall electrically be accessible. All loose materials shall be removed from the bar head;
4. Connect the TDR instrument to the steel soil nail head and the electric wire;
5. Send a short pulse into the steel soil nail and record the time of reflection (if the wire is electrically in contact with the steel soil nail end, the return signal from the nail end should go down and vice versa);
6. Send a long pulse into the steel soil nail and record the time of reflection (if the wire is electrically in contact with the steel soil nail end, the return signal from the nail end should go down and vice versa);
7. Determine the average propagation velocity of the pulse from the results obtained in sub-clauses (5) and (6);
8. Repeat steps described in sub-clauses (4) to (7) for steel soil nail to be tested and estimate its length by using the calibrated propagation velocity;
9. Submit a test report with the test results and their interpretations to the CM within 3 days of completion of the test;
10. Re-cast the concrete nail head after the test as directed by the CM.

SLO.T370.9 MAGNETOMETRY TEST

Adopt the following procedures for the magnetometry test:

1. Drill a hole parallel and in the vicinity of the test nail. The separation between the drillhole and the test nail should be about 300 mm to 500 mm, and the length of drillhole should be longer than the anticipated length of the soil nail by at least 1 m. The size of the drillhole should be large enough to accommodate a PVC pipe of minimum 55 mm internal diameter;
2. Insert the magnetometer into the PVC pipe. Measure and record the Earth's magnetic field as the magnetometer moves along the pipe until it reaches the end of the pipe;
3. Repeat the measurement and recording process as the magnetometer moves away from the pipe end until it reaches the top of the pipe;
4. Analysing the fluctuation of the measured Earth's magnetic field to determine the locations of couplers and the end of steel soil nails;
5. Submit a test report with the test results and their interpretations to the CM within 3 days of completion of the test;
6. Grout the drillhole after the test as directed by the CM.

SLO.T380.9 BATCH OF SOIL NAIL BARS AND CONNECTORS

1. For the purpose of testing, subdivide the soil nail bars delivered to the Site into batches in accordance with Clause 1.2.1 of CS2:2012;
2. A batch of connectors is any quantity of connectors of the same type, size and grade, manufactured by the same mill, covered by the same mill and testing certificates and delivered to the Site at any one time.
3. In addition, for a batch of galvanized soil nail bars, the coating shall have been applied at the same coating factory and shall be covered by the same original test certificates with original signatures and official authorization chop.

SLO.T390.9 SAMPLE OF SOIL NAIL BARS AND CONNECTORS

1. Provide samples of soil nail bars and connectors from each batch of the materials delivered to the Site and at least 14 days before insertion of the soil nail starts. The number of samples to be provided from each batch shall be as stated in the following Table:

Description	Size of batch	No. of samples per batch
Soil nail bars	All size	1
Connectors	less than 100 no.	1
	100 – 500 no.	2
	Exceeding 500 no.	3

2. The number of specimens in each sample shall be as follows:

Category	Number of specimens
Soil nail bars	In accordance with Table 10 of CS2:2012 for Class 2 steel
Thickness of galvanized coating for soil nail bars/connectors	In accordance with Table 1 of BS EN ISO 1461:2009
Connectors for tension joint	3

3. Each specimen of bar shall be at least 1m long. Each specimen of connectors shall consist of one connector joined to two lengths of bar each at least 500mm long. The bars shall be of the same type, size and grade as the bars to which the connector will be fixed in the permanent work;

4. Each specimen of soil nail bars shall be taken from different bars in the batch. The ends of specimen shall be cut square before delivery to the laboratory.

SLO.T400.9 TESTS FOR SOIL NAIL BARS AND CONNECTORS

1. Each sample of soil nail bars shall be tested in accordance with Clause 5.1.1 of CS2:2012 except no test for bond property shall be carried out;

2. Test each specimen as required in sub-clause (2) of SLO.T390 of galvanized soil nail bars/connectors to determine the thickness of coating in accordance with BS EN ISO 1461:2009 for compliance;

3. Test each sample of connectors to determine the tensile properties in accordance with SLO.T420;

4. The number of tests on each sample shall be as stated in the following Table:

	Type and number of tests				
	Tensile properties	**Bend performance**	**Mass per metre**	**Chemical composition (product analysis)**	**Thickness and uniformity**
Soil nail bars	In accordance with Clause 5.1.1 of CS2:2012 for Class 2 Steel				-

Galvanized coating	-	-	-	-	In accordance with Table 2 of BS EN ISO 1461:2009
Connectors	3	-	-	-	-

SLO.T410.9 COMPLIANCE CRITERIA FOR SOIL NAIL BARS

1. If the results of the tests performed on the test specimens of soil nail bars meet the requirements specified in Clause 5.1.2 of CS2:2012, the batch shall be deemed to comply with the requirements.

SLO.T420.9 COMPLIANCE CRITERIA FOR CONNECTORS

1. The results of tensile properties tests on specimens of connectors shall comply with the following requirements:
   a. The tensile strength shall exceed 287.5 MPa for grade 250, 540 MPa for grade 500B and 575 MPa for grade 500C soil nail bars;
   b. When a test is made of a representative gauge length assembly comprising soil nail bars of the size, grade and profile to be used and a connector of the precise type to be used, the permanent elongation after loading to 0.6 times of the specified characteristic strength and unloading shall not exceed 0.1mm. The gauge length shall span over the connector.

SLO.T430.9 NON-COMPLIANCE OF SOIL NAIL BARS

1. If the result of any test on soil nail bars fails, the acceptance of retests shall be considered in accordance with Clause 5.1.4 of CS2:2012.

SLO.T440.9 NON-COMPLIANCE OF GALVANIZED COATING

1. If the result of any test for thickness of galvanized coating to soil nail bars or connectors does not comply with the specified requirements for the property, additional samples shall be provided from the same batch and additional tests for the property shall be carried out. The number of additional samples shall be as stated in the Table under sub-clause (1) of SLO.T390;
2. The number of specimens in each additional sample shall be as follows:
   a. Galvanized soil nail bars: 4;
   b. Galvanized connectors: 4.
3. The number of tests on each additional sample shall be four;
4. The batch shall be considered as not complying with the specified requirements for the property if the result of any additional test does not comply with the specified requirements for the property.

SLO.T450.9 NON-COMPLIANCE OF CONNECTORS

1. If the result of any test for tensile properties of connectors does not comply with the specified requirements as stated in SLO.T420, provide additional samples from the same batch and carry out additional tests as stated in SLO.T420. The number of additional samples shall be as stated in the Table under sub-clause (1) of SLO.T390;
2. The number of specimens in each additional sample shall be six;

3. The number of tests on each additional sample shall be six;
4. The batch shall be considered as not complying with the specified requirements for tensile properties if the result of any additional test does not comply with the specified requirements as stated in SLO.T420.